VAISALA

PRODUCT AND DISPLAY MANUAL

IRIS

M211319EN-D

PUBLISHED BY

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CHAPTER 1
GENERAL INFORMATION

IRIS is a powerful weather monitoring, tracking and forecasting system that runs on a variety of hardware and software platforms connected by a network.

IRIS supports several types of user, each having different privileges for viewing products or controlling IRIS features:

- **Operators** are responsible for the daily operation of IRIS. They define and schedule radar TASKS and determine how the radar data is output.
- **Observers** can define radar TASKS and output, but they are not allowed to perform any scheduling. This could interfere with the operation of the radar device.
- **System managers** are responsible for installing and maintaining the IRIS software and the platforms on which it runs. The system manager has special privileges and is responsible for granting access to the users of the system. Special training is recommended in the platform hardware and software, and also in networking.

1.1 About This Manual

This manual is organized around the IRIS menus. Each chapter indicates the types of user who can access the menu. You may want to skip the chapters for those menus that you cannot access.

All Users Chapter 2, Introduction to IRIS Products, on page 17
Introduces all users to the IRIS system, its hardware and software, and the concepts on which it is built. A more detailed introduction is in the *IRIS Radar Manual*.

Operators	Chapter 3, Configuring IRIS Products, on page 21 Chapter 4, Optional IRIS Products, on page 121 Describes how to use the Product Configuration menu to define products, which display the radar data in a variety of ways.
Operators	Chapter 5, Scheduling Products, on page 211 Describes how to schedule product generation for fully automatic or manual operation.
All Users	Chapter 6, The Quick Look Window, on page 223 Describes how to use the Quick Look Window, which provides easy access to IRIS products for forecasting and analysis applications.
All Users	Chapter 7, Requesting Product Output, on page 287 Describes how to direct products and optional overlays to a display, printer, storage medium, other computer or communications port using the Product Output menu.
Operators	Chapter 8, Performing Archive Operations, on page 299 Describes how to record products to tape or optical disk and retrieve them back to disk using the Archive menu. In addition, it describes other basic archive operations, such as mounting and dismounting, loading and initializing the tape or optical disks.
Operators	Chapter 9, Managing Ingest Files, on page 315 Describes how to use the Ingest Summary menu to keep track of ingest files stored on disk and how to convert raw ingest data into ingest files.
All Users	Chapter 10, Choosing Overlay Files, on page 321 Describes how to pick an overlay file, such as a geopolitical map or grid, to display on top of other IRIS products.
All Users	Appendix A, Basic Radar Meteorology, on page 325 Defines common terms and abbreviations used by IRIS.
Operators	Appendix B, Product Configuration Example, on page 333 Describes two comprehensive examples of IRIS configurations — one to perform general weather monitoring, the other to detect and alert users of wind shear events.
Operators	Appendix C, Radial Velocity Correction, on page 365 Describes the theory and application of radial velocity correction.

Operators	Appendix D, IRIS 3DView, on page 377 Describes how to install and use the optional 3D display features of IRIS.
Operators	Appendix E, IRIS TDWR Features, on page 403 Describes how to configure IRIS to support TDWR airport features.
Operators	Appendix F, Hydromet Raingage Correction, on page 437 Describes how to configure and use the optional Hydromet features of IRIS.

1.2 Version Information

Table 1 Manual Revisions

Manual Code	Description
M211319EN-D	This manual. Fourth version. September 2014
M211319EN-C	Previous manual. Third version. November 2013
M211319EN-B	Previous manual. Second version. March 2013
M211319EN-A	Previous manual. First version.

1.3 Related Manuals

Manual Code	Manual Name
M211315EN	IRIS and RDA Installation Manual
M211316EN	IRIS and RDA Utilities Manual
M211317EN	IRIS Radar User’s Manual
M211318EN	IRIS Programmer’s Manual
M211320EN	RCP8 User's Manual
M211321EN	RVP8 User's Manual
M211322EN	RVP900 User's Manual
M211452EN	IRIS and RDA Dual Polarization User’s Manual

You can download the latest versions of the manuals from Vaisala product website, http://www.vaisala.com. They can be read online using by Adobe® Reader®, which is installed with IRIS.

Vaisala encourages you to send your comments and/or corrections to:

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1.4 Documentation Conventions

Throughout the manual, important safety considerations are highlighted as follows:

WARNING	Warning alerts you to a serious hazard. If you do not read and follow instructions very carefully at this point, there is a risk of injury or even death.

CAUTION	Caution warns you of a potential hazard. If you do not read and follow instructions carefully at this point, the product could be damaged or important data could be lost.

NOTE	Note highlights important information on using the product.

The following conventions are used throughout this manual:

Menu–>Choice	Pull-down menu selections are shown in boldface type. The name of the menu is shown first, with an arrow pointing to the menu entry that you should choose. To pull down a menu, position the mouse cursor over the menu bar and press the left mouse button.
–>**Choice**	Pop-up menu choices are shown in boldface type, with the arrow pointing to the menu choice that you should make. Pop-up menus are position-dependent. That is, the menu that appears depends on the position of the mouse cursor over a particular field. The text tells you were to position the mouse. To pop up a menu, press the right mouse button.
"Field Value"	Quotation marks surround the value of a field, such as a status value or the name of a configuration file.

`$`	The dollar sign is used to show the operating system prompt, though it may differ from one system to the next.
`command parameter`	Command syntax is printed in bold, monospace type. User-supplied parameters are shown in italics. Enter the command exactly as it is shown and supply the appropriate parameter value.

CHAPTER 2
INTRODUCTION TO IRIS PRODUCTS

IRIS is an advanced hardware and software product for either Doppler or non-Doppler weather radar applications. IRIS was developed by SIGMET, Inc., to provide virtually all of the features required for the operation of a radar network and distribution of radar products, including local and remote radar control, signal processing, product generation and display. For a detailed system level description of how IRIS works, please review chapters 2 - 6 of the *IRIS Radar Manual*.

The Product and Display manual focuses on the following concepts:

- Configuring products (meteorological images)
- Scheduling products
- Viewing products using the Quick Look Window (QLW)
- Sending the products to different destinations (Product Output)
- Archiving products
- Managing product inventory
- IRIS Overlay configuration

In this chapter:

2.1 IRIS Product Overview

The following table provides a brief overview of the products supported in IRIS. The optional products require an additional level of licensing.

Table 2 IRIS Products

Product	Description
BASE Echo Base	Used for determining the base of echoes
BEAM Antenna Beam Pattern	A full screen cross–section format image showing range–averaged intensity in azimuth and elevation coordinates. Used for calibration and alignment purposes and for verifying antenna pattern.
CAPPI Constant Altitude PPI	A horizontal "cut" at a selected altitude used for surveillance and severe storm identification. This product is also useful for monitoring the weather at specific flight levels for air traffic applications.
FCAST Forecast	An array of direction and intensity vectors used to shift a current weather display interactively.
HMAX	Displays the height of the maximum reflectivity above each output pixel. This product requires a volume scan.
MAX Maximum Reflectivity	Shows the maximum reflectivity over each pixel as well as the East–West and North–South maximum projects in side panels.
MLHGT Melting Level Height	Displays a map of the melting layer altitudes.
PPI Plan Position Indicator	A full screen image used primarily for weather surveillance purposes.
RAIN1 Hourly Rain Accumulation	Hourly rainfall accumulation. The user can select the Z–R relationship.
RAIN–N N–Hour Rain Accumulation	Rainfall accumulation of the last *N* hours, where *N* is selected by the user.
RAW Raw Data Product	A data files that contains the raw signal processor output parameters (Z, ZT, V, W, ZDR, etc) in polar coordinates. This cannot be displayed, but it is useful for recording on tape/disk/dvd or transferring to another IRIS network computer for product generation purposes.
RTI Range Time Indicator	Displays time along the horizontal axis and the vertical axis displays range from the radar. This is most often used for manual scans when observing a fixed target.
RHI Range Height Indicator	A full screen image showing the detailed cross–sectional structure of a storm, used for identifying severe storms, hail and bright band.

Table 2 IRIS Products (Continued)

Product	Description
SRI Surface Rainfall Intensity	This product is mainly used as input for the RAIN1 product in order to obtain the best possible estimates of accumulated precipitation even at longer ranges from the radar.
STAT Radar System Status	A file containing a report indicating the state of all key components of the radar software.
TOPS Echo Tops Map	A color–coded contour map of the top of a selected dBZ level. Either Z or ZT can be used as the basis for the top measurement.
TRACK Interactive Storm Tracking & Forecasting	An overlay product created in the Quick Look Window.
VIL Vertically Integrated Liquid	A color–coded map of the estimated depth of water (in mm) contained in a selectable atmospheric layer. This is an excellent indicator of severe storms. Either Z or ZT can be used as the basis for the estimate
VVP Velocity Volume Processing	Line graphs or time vs. height cross–sections of wind speed, wind direction and divergence vs. height. The user can select the range of influence and the maximum height.
Warn Warning/Centroid	Automatic warning and centroid plotting. Automatic warnings can be set for protected areas and user–selectable warning criteria. Output is a warning message and a situation overlay showing the centroid locations of storm features, such as high VIL or reflectivity.
Wind Wind Speed and Direction	Displays wind speed and direction with either wind bards or wind strings. The user can specify the range and height of the data, and the range and azimuth spacing of the lines that are displayed.
XSECT Cross Section	A volume scan product that shows the height cross section along a user–definable line.
	OPTIONAL IRIS Products
CATCH Cross Section	Calculates the precipitation accumulation in subcatchment areas such as watershed areas. This product requires the Hydromet option.
COMP Multi–Radar Site Composite	Produces a single composite image of radar data from many different radar sites.
DWELL Composite in Time	The DWELL product is a product of a product and composites successive images of a product in time. Moving targets will show a "streak" on the display.
NDOP Multiple Doppler	Provides a mechanism for including velocity (Doppler) data from another radar site now enabling the measurement of horizontal wind in addition to vertical wind.

Table 2 IRIS Products (Continued)

Product	Description
SHEAR Wind Shear	This product detects wind shear in the atmosphere, allowing the detection of microbursts, gust fronts, mesocyclones, cold fronts, and atmospheric waves.
SLINE Shear Line	A shear line (frontal boundary), marks the transition between two air masses on the image.

CHAPTER 3

CONFIGURING IRIS PRODUCTS

This chapter describes the configuration of the IRIS meteorological products using the Product Configuration Menu. IRIS lets you create products for a wide variety of applications. These products provide information that can be used directly for weather nowcasting and forecasting.

NOTE	The Live Action feature of the Quick Look Window allows you to configure many IRIS products interactively and instantly see the results. See Live Action Tool- Product Generation and Display on page 231 for a description of Live IRIS.

IRIS products can display radar data in many ways. For example, the CAPPI product shows the distribution of a radar parameter, such as reflectivity or spectrum width, at a constant altitude. The echo tops product shows a color contour map of the height of a selected reflectivity surface. The rainfall products, RAIN1 and RAINN, show the accumulation of precipitation over selectable time periods. There is even a product — the WARN product — that looks at other IRIS products to determine if there is significant weather, such as reflectivity or wind shear greater than a threshold amount.

Every product is associated with a TASK. TASKS collect information from signal processors and store the data on disk in ingest files. TASKS are configured with the TASK Configuration menu, described in the *IRIS Radar Manual*.

To enter the Product Configuration menus:

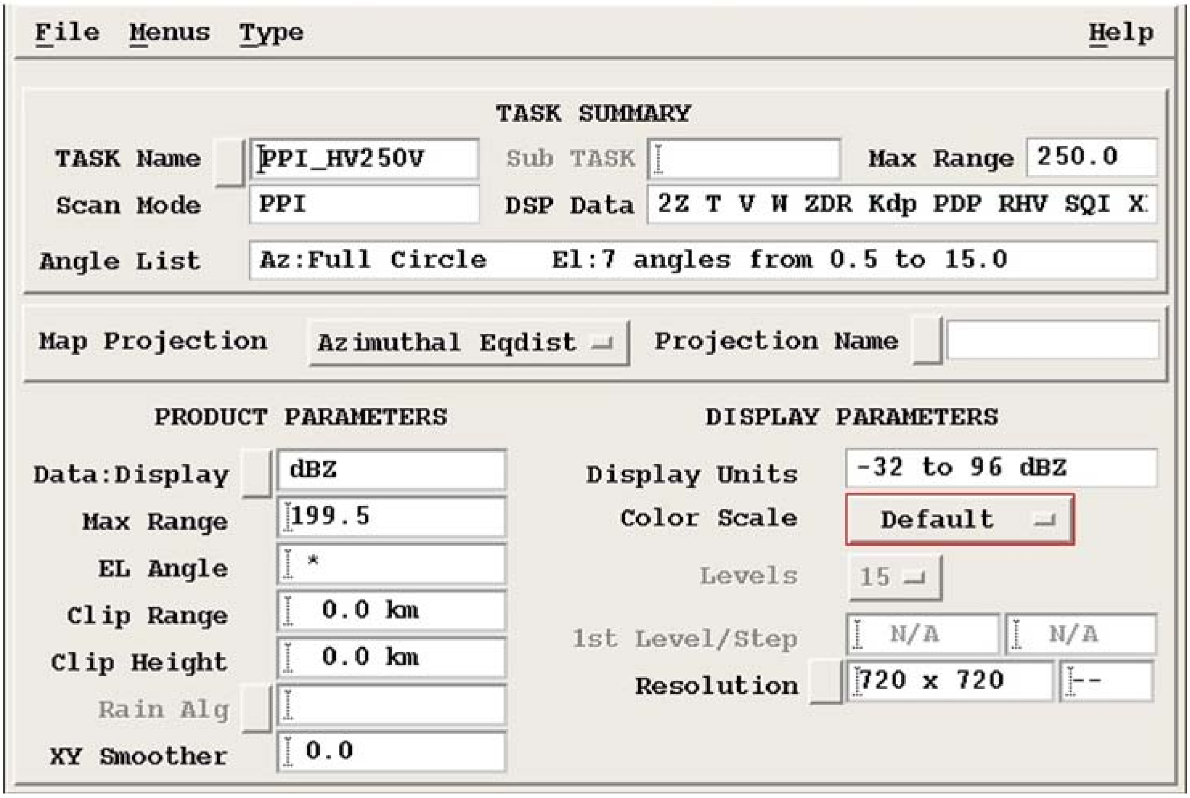
Choose **Menus**–>**Product Configuration** from the IRIS menu bar or from any of the IRIS menus.

In the following chapters:

VIL: Vertically Integrated Liquid	VIL: Vertically Integrated Liquid on page 99
VVP: Velocity Volume Processing	VVP: Velocity Volume Processing on page 102
WARN: Warning/ Centroid	WARN: Warning/Centroid Product on page 106
WIND: Wind Speed and Direction	WIND: Wind Speed and Direction on page 115
XSECT: Cross Section	XSECT: Cross Section on page 117

Appendix B, Product Configuration Example, on page 333 contains a complete set of product configuration examples to help you get your operation started.

3.1 Product Configuration Menu



Most Product Configuration menus have the same general format:

Task Summary Contains information about the TASK associated with the product.

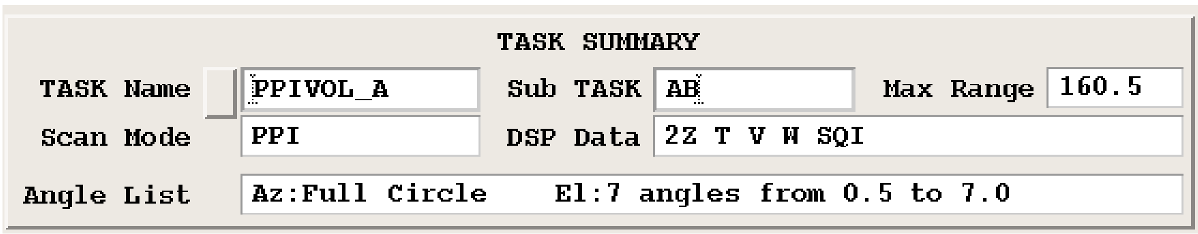
Map Projection Specify geographical map projection, if desired.

Product Parameters Determines what data and range, and other product specific options to use.

Display Parameters Pick up your default color scale, which can be overridden at display time. In case of HClass data type, choose the classification method to be projected in the product. This cannot be reversed at display time.

This section describes the information that is common to most Product Configuration menus; each product type is described in detail in its own section in this chapter.

3.1.1 Task Summary



TASK Summary information, taken from the associated TASK, shows the key TASK configuration parameters to help you make consistent products.

Every product is associated with a TASK, which provides the ingest data for the product. To associate a TASK with a product, click on the TASK Name button to pop up a list of TASKS to choose from.

If you are configuring a product to run from ingest data, enter a TASK name, including wildcard characters. The question mark (?) matches a single character; the asterisk (*) matches any string of characters.

If you wish to make volume scan product from hybrid TASKS, specify in the task name section any of the input tasks, which end with a underscore and single letter. You can then specify the Sub-Task suffix letters in the Sub Task box. You can type a "*" to indicate all subtasks. Or you can type individual letters such as "ABC", "AB", "BC", or "AC" to select which portions of the hybrid to include. You can also use the special charater "–" to indicate a range of letters, for example "A–DF" means "ABCEF". RAW products are always made from a single task. You need to make a separate RAW product for each sub task.

If you are retrieving RAW data from tape or receiving a RAW product over the network, there is no TASK configuration file on your disk. In this case, you can type the TASK name directly into the field, exactly as it appears in the Ingest Summary menu or the Tape menu.

NOTE	Important Hint: RHI scans should have the text "RHI" in the TASK name to distinguish them from PPI scans.

There are two important considerations when associating a TASK with a product — matched resolution sampling, and constructing volume scans for a product. Matched Resolution Sampling

For best results, the range bin spacing and number of bins in the TASK should match what is needed for the product. This is called a "matched resolution sample." The match does not need to be exact because IRIS uses interpolation algorithms. However, for optimized product appearance and system performance the match should be close.

For example, if you are making a low resolution product (240 × 240) to a range of 120 km, and you want a single pixel to represent 1 km of data, then the TASK should be configured with at least 120 range bins spaced 1000 m apart. Note that 170 bins can be displayed to the corners of the product. For a medium resolution product with 1 km bin spacing, the best match is for TASKS with 240 to 340 bins spaced 1 km apart. Note that IRIS can make products for any range bin spacing that can be specified in the TASK Configuration menu, e.g., 500 m or 250 m spacings can be used as well.

For best performance, match the range bin spacing, number of bins and maximum range in the TASK configuration, to the desired pixel resolution, pixel scale and maximum product range in the product configuration.

Constructing Volume Scans

Some products require volume scan TASKS — either PPI Full or PPI Sector scans taken at multiple elevation angles. Volume scan products include:

- BEAM
- CAPPI
- MAX
- TOPS
- VIL
- XSECT
- VVP
- WIND

For these products, multiple elevation angles are required in the associated TASK. In general, there is a tradeoff between the number of elevation angles, the quality of the product and the TASK scan time. More elevation angles produce higher quality products at the expense of taking more time to complete the volume scan.

A typical volume scan is shown in on page 26. In this example, the height resolution is 1 km at 60 km range, for heights less than 10 km. A one degree beam is 1 km wide at 60 km, so this scheme matches the antenna resolution. If close range work is important, one must add higher elevation angles to cover the upper regions.

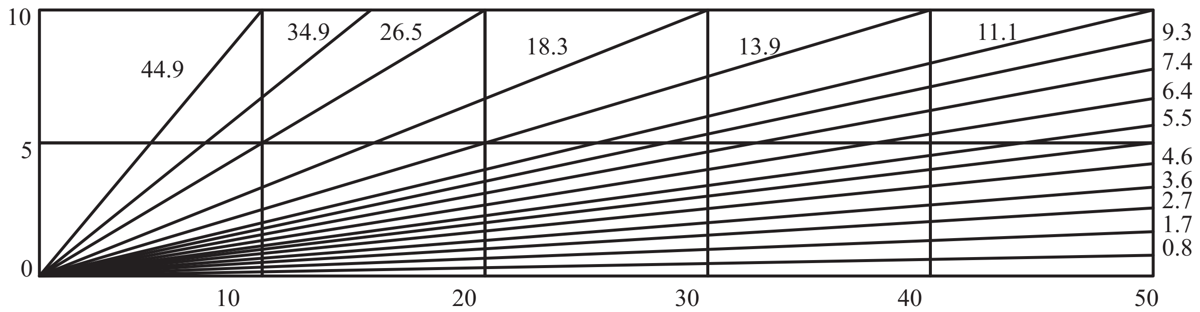


Figure 1   Example of 15-tilt Volume Scan

When constructing a volume scan TASK configuration, it is a good idea to do a drawing such as the one in the example, with a 1:1 vertical:horizontal scale so that you get a true picture of the sampling geometry.

Note that the example is corrected for earth curvature, as are all of the IRIS products. Also, because of beam widening effects, the accuracy of all products degrades with range. For example, the beam width at 120 km range is 2 km across for an antenna with a 1° beam. This is a fundamental limitation of radar sampling.

3.1.2 Map Projections

IRIS allows users to specify the type of map projection that is used for display. This is useful for combining the data from other sources or for generating displays that are not centered on the radar. Composites for example, must use a projection so that the data from several radars can be mapped to a single display. Page numbers refer to the projection equations from *Map Projections–A Working Manual, U.S. Geological Survey Professional Paper 1395*.

The choices are:

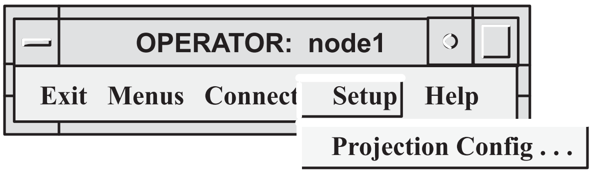
- **Azimuthal Equidistant (AED)** —choose this for a standard radar display map where azimuth lines are straight and angles are not distorted. This projection has the property that the distance in the map horizontal direction is the same as the distance in the map vertical direction. This means that lines of constant azimuth (radar rays) are straight and circles can be used to represent lines of constant range. Because of this, the AED projection is particularly convenient for radar applications. For radar applications, the radar is usually placed in the center of the map and the radar location serves as the map reference point. Note that lines of latitude and longitude are not straight in this projection. (page 191)
- **Mercator** —choose this for true Mercator projection mapping where latitude and longitude lines are straight and intersect at right angles. Additionally, a line of constant bearing from a point is straight so it is useful for navigation. Mercator has the advantage that it is very standard so that it is easier to combine data from different sources onto a Mercator projection. It has the disadvantage that at high latitudes, the horizontal and vertical scales are very different (large distortion). (page 38)
- **Polar Stereographic** —Useful near the North Pole. This is essentially the AED projection with the reference point at the North Pole. (page 154)
- **Universal Transverse Mercator (UTM)** —This is a projection just like Mercator with the axis reversed at a selectable longitude. The horizontal dimension is compressed by a factor of 0.9996. By convention the reference longitudes should be multiples of 6 degrees. Is is used by the military, and is good for regions with long North-South extent. (page 48)
- **Perspective**— This is often used for satellite images. We assume that the satellite is at geosynchronous height. (169)
- **Equidistant Cylinder** — This is used for the digital terrain maps in IRIS (e.g., inserted in the **overlay** utility). (page 90)
- **Gnomonic** — All great–circle arcs are straight lines. (page 164)
- **Gauss Conformal** — Same as Universal Transverse Mercator except omitting the 0.9996 scale factor. (page 48)
- **Lambert Conic** — Lambert Conformal Conic, scale is true along 2 standard parellels. (page 104)

Any projection can be selected in the Product Configuration Menu. Additionally the user can:

- Select the Projection Name of a preconfigured projection. The Projection Name button in the Product Configuration Menu gives a list of available projection files on the system. In this case the radar Max Range and Output Pixel Resolution are desensitized since they are defined by the projection file that is selected. Projection files are typically used when the radar is not centered in the display.
- Select <NONE> for the Projection Name in which case the radar is defaulted to be at the center of the screen. Additionally in the case of an AED projection, the radar is defined to be the map reference point. In this case, the Max Range and Resolution fields are configurable in the Product Configuration Menu.

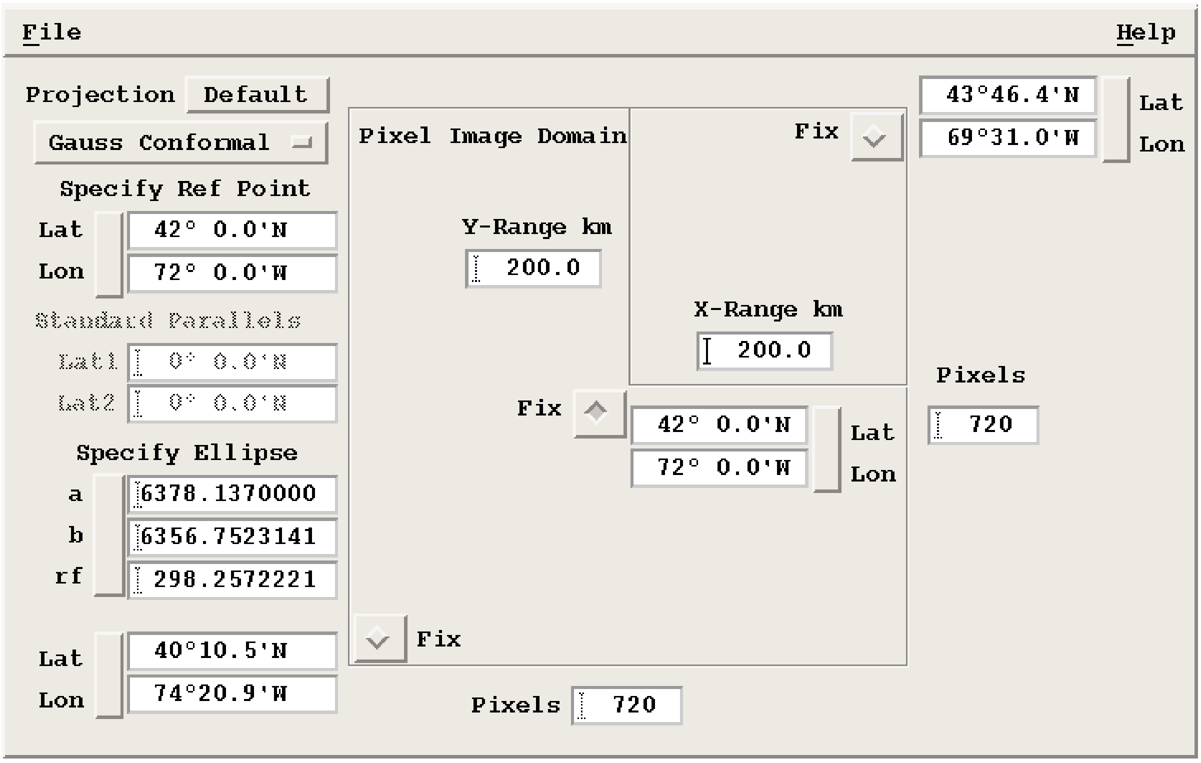
Most of the time you will not need to create or use special projection files. To configure a standard radar display centered on the radar, simply use the features that are contained in the Product Configuration Menu — Azimuthal Equidistant for the projection type and <NONE> for the Projection Name. In the event that you want the radar off-center, then you will need to configure a projection file as described below.

Starting and Using the Projection Configuration Menu



The Projection Configuration Menu is located under Setup in the IRIS Main Menu bar. Select Setup/Projection Configuration ...

The menu appears as shown below.



Define the Projection Type

First select the Projection.

NOTE	It is important to define the projection type as the first step. The list of available projection files under the File command will be given only for the selected projection type.

File

This functions identical to other IRIS menus. The **File**–>**Open** command will give a list of existing Mercator or AED files depending on which type of projection is selected. The Save as command allows you to name the projections that you create. The name of the open projection file is displayed in the menu title bar (AED_200_KM in the example).

Reference Point

For AED projections: The reference point is the location from which all azimuths display as straight lines. Usually set to the radar location.

For Mercator projections: The map cannot cross the line 180 degrees away from this longitude, so set it near your location. The latitude defines the range scale.

For Polar Stereographic: The is the longitude line which you wish to have vertical in the map. Effectively this rotates the map. Again the latitude defines the range scale.

For UTM: Only a longitude is selected. This is the center meridian of the UTM strip. By convention these are spaced every 6 degrees, starting at 3 degrees. Use a value near your longitude.

For Lambert Conic: Also define 2 standard parallels.

Fixing a Corner or Center Location

To configure a projection, you will need to know the latitude and longitude of either the NE or SW corner or the center of the display. You should push the Fix button at the location that you know and then input the lat/lon coordinates. With the Fix button pushed-in, you will be able to change other parameters of the projection geometry without loosing you coordinate information.

Specifying the Projection Coverage Area

Once you have fixed one of the corners or the center, you can now specify the region of the projection in either one of two ways:

- Specify the latitude and longitude of one of the two unfixed points.
- Specify the distance north (Y-Range) and the distance east (X-Range) from the center.

The projection menu acts as a spread sheet. Whenever you change a parameter the other parameters will adjust to reflect the change.

NOTE	The spread sheet algorithm will converge on a correct solution even for very strange projections. One example where it may not converge is for an AED projection where the Reference Point is several thousand kilometers from the center of the projection region. If you encounter a problem with the spreadsheet, check the reference point, then click the Default button to load some valid numbers.

Specifying the Pixels

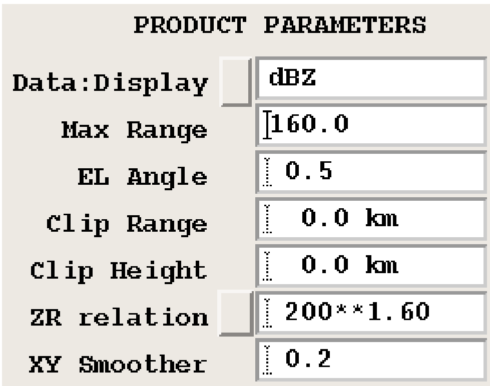
The number of pixels that are used to represent data in the projection is specified for the X- and Y-directions of the output display. If you have specified the other aspects of the projection, then simply input the correct number of X-pixels (horizontal direction). The number of Y-pixels will then adjust automatically.

If you adjust the number of Y-pixels, then other parameters of the spread sheet will change, such as the lat/lon of the unfixed points and the Y-Range.

Fine Tuning the Spread Sheet

Since all of the projection geometry parameters are linked through the spread sheet algorithm, when you change one parameter, other parameters will adjust automatically. This means that you may have to do some compromising. For example, if you want a 480 × 480 pixel Mercator display, both the X- and Y-ranges cannot in general be made equal (e.g., 100 km). In this case, the compromise might be to have an X-range of 100 km and a Y-range of 99.5 km to get a perfect 480 × 480 display. The spread sheet makes it easy to experiment with different compromises.

3.1.3 Product Parameters



Product parameters let you choose what data to take from the TASK and how to display that data.

Data : Display

The Data portion of this field specifies the data parameter from which to derive the product, such as Z, V, W, ZT, ZDR. This information comes from the TASK associated with the product. Some data parameters can be displayed in more than one way. The following display parameters are available:

Data Type	Usage
dBZ	Clutter Corrected Reflectivity
dBZt	Uncorrected Reflectivity
Rain	Rainfall Rate
Liq	Rainfall Depth
Vel	Radial Velocity

Data Type	Usage
Width	Doppler Spectrum Width
ZDR	Differential Reflectivity
Tops	Echo Top Height
VIL	Vertically Integrated Liquid
Wind	Wind Speed and Direction
Shear	Wind Shear

To select a data:display parameter, click on the Data:Display button and pop up a menu of valid choices. The list of choices varies, depending on the product type.

Product Maximum Range

NOTE If you select a custom Map Projection Name (other than <NONE> you cannot configure this field in the product output menu. This is because the maximum range is determined by the projection configuration. See Map Projections on page 26 for a discussion of projection configurations.

This is the maximum range configured for the product, which must be less than or equal to the data range. The maximum range is the range in the E-W / N-S direction centered on the radar. This means that the range to the corners of the resulting display will be greater.

ZR Relation

Unfortunately, weather radars do not measure the rainfall rate (R) directly. Instead the measure a quantity called the equivalent radar reflectivity factor (Z). In general, the larger the reflectivity factor, the larger the rainfall rate. The ZR relationship is a standard technique for estimating the rainfall rate based on the measurement of the radar reflectivity factor. The have the general coefficient exponent form of:

```
Z = 200 R 1.6 (the classic Marshall Palmer relationship)
```

There are three options associated with this field:

- **Fixed-** In this case, the user can type-in the coefficient and exponent. The default value configured in **setup** is first inserted.
- **Setup-** The coefficient and exponent values set in **setup**–>**Product**–>**Product Generation** will be grabbed when the product is run. If the setup values were changed, the new values will be used.

- **Disdrometer-** The coefficient and exponent values are derived from a special GAGE product with the assigned name "DISDROMETER". The GAGE product contains (optionally) the coefficient and exponent derived from a disdrometer which is measuring the size distributions of particles. Note that this is only available with the IRIS/Hydromet option. When the product is run, IRIS looks for the closest DISDROMETER product, first searching in time (within +- 1 hour) and then opening the file and searching in space by comparing lat/lon (within 200 km is valid). If a valid coefficient and exponent are found, then they are used in the product generation, otherwise the **setup** defaults are used.

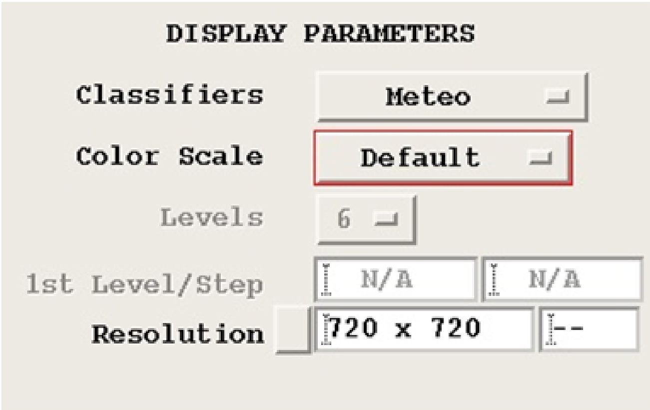
XY Smoother

The X-Y Smoother field performs image processing to average the color contours and interpolate over small gaps or missing pixels in the final Cartesian image. You can specify the length of the smoother in km. This final step can significantly improve the appearance of products for presentation. Also, smoothing can result in better data compression.

A word of caution on smoothing—it requires substantial CPU resources to perform smoothing. The internal limit on the smoother length is 60 pixels, much longer than you probably want to use. If you are going to produce many smoothed products in a regular operation, please observe the following suggestions:

- Use low resolution products together with smoothing. It is faster to make a low resolution product and smooth it than to make a medium resolution product and smooth it. In many cases, the results are nearly identical, so there is no benefit in smoothing high or medium resolution products.
- Use the minimum smoothing length to get the desired effect. That is, don't over-smooth. Larger smoothing lengths require more computation. Don't use a length that is larger than you need.

3.1.4 Display Parameters



The display parameters determine how the product appears.

Display Units

Most of the data types are numerical. The first Display Units shows the range of values and the units for the product's output values. The values that you can assign to the display units are summarized below. For example, the Echo Tops algorithm outputs values in km to the nearest 100 m spanning the range of 0 to the maximum data height defined with the **setup** utility or 25.5 km, whichever is less.

In case of the classification information (HClass), the first Classifiers field lets you to choose which classifier outcomes are projected in the product. The selector lists out those classification algorithms and their merged combinations that are available in the current IRIS release.

Display Parameter	Maximum Display Range, Display Units, or the Classifier method
dBZ	-32 to 96 dB mm^6/m^3
dBZt	-32 to 96 dB mm^2/m^3
Rain	0 to 255 mm/hr or 0 to 10.2 inches/hr
Liq	0 to 1000 mm
Vel	$-V_u$ to V_u m/s
Width	0 to V_u m/s
ZDR	-8 to +8 dB
Tops	0 to 25.5 km or height configured in Setup
VIL	0 to 65.0 mm
Wind	Configured in Setup
Shear	+- 25 m/s/km
HClass	"Meteo", "Precip", "Cell" "Meteo+Precip", "Meteo+Cell"

Color Scale, Levels, 1st Level/Step

The color scale relates numerical data values to colors. The Scale field lets you choose whether to use a uniform scale with a start value and a constant step, or a custom color scale that has been preconfigured for your system:

- Custom color scales are defined with the **color_setup** utility (see the *IRIS Utilities Manual*). Each color scale has a name that has been defined in the Color Setup Utility. Names can reflect scales that are appropriate for different seasons such as "Summer" or "Winter." If in doubt, select "Default" which is usually configured to be a reasonable scale. The number of scale steps will be filled-in automatically since this is also part of the custom color scale.
- When you choose a Uniform color scale, you pick the number of level steps (from 2 to 16). The following fields should also be set:

  The 1st Level field sets the numerical value used to label the right side of the first level in the color scale for the product. The Step field sets the spacing between the color levels. The numbers in the color legend in the product are spaced by this value.

The color scale also associates the classification data to the class descriptors (class identifiers with class legends). Sets of class legends can be customized as Classifier sets in your system (with the **HydroClass Name Editor** in the **color_setup** utility), to match with the available classifier methods.

The units you use for the 1st Level/Step depends on the display parameter, as shown in the following table:

Display Parameter	1st Level/Step Format
dBZ	+ - XX Whole dBZ
dBZt	+ - XX Whole dBZ
Rain	+XXX.X mm/hr
Liq	+XXX.X MM
Vel	+- X.X m/s
Width	+ XX.X m/s
ZDR	+- X.X dB
Tops	+ XX.X km
VIL	+ XX.X mm
Wind	NA
Shear	+- XX.X m/s/km

In all cases, you simply enter the desired value.

NOTE	Special case for the mean velocity. Selecting a level step of 0 causes the velocity to be displayed for the entire unambiguous interval between $-V_u$ to $+V_u$. Selecting an odd number of levels produces a legend with a band centered on zero velocity. Selecting an even number of velocity levels does not produce a legend with a band centered on zero velocity, but rather a color break exactly at zero velocity.

When choosing a Uniform color scale, you have some more flexibility to choose colors. The associations of the class identifiers with class legends is fixed by the color_setup.

Figure 2 on page 37 shows two examples of the display configuration parameters, one for ZT and one for velocity, and the resulting color legends that would appear with the product.

In the case of ZT, the example shows that the bottom of the scale "thresholds" such that data less than -20 dBZ are not displayed, while the top end "saturates" since the top color will include all values greater than 50 dBZ. When you select Uniform scales, the behavior (saturation vs thresholding) of the end of the scales cannot be changed. This behavior is inherited from the custom color scale named 'Default', which is configured in Color Setup.

In the velocity example, by entering 0 for level step, the display will automatically span the full Nyquist interval. Note that both ends are set to saturate for velocity.

The format of the color legends, with regard to how the numerical legend labels relate to the color band boundaries, is configured in the Color Setup utility for each parameter. This utility offers considerable flexibility for defining how the color legends are constructed for each data parameter. Refer to the *IRIS Utilities Manual* for details.

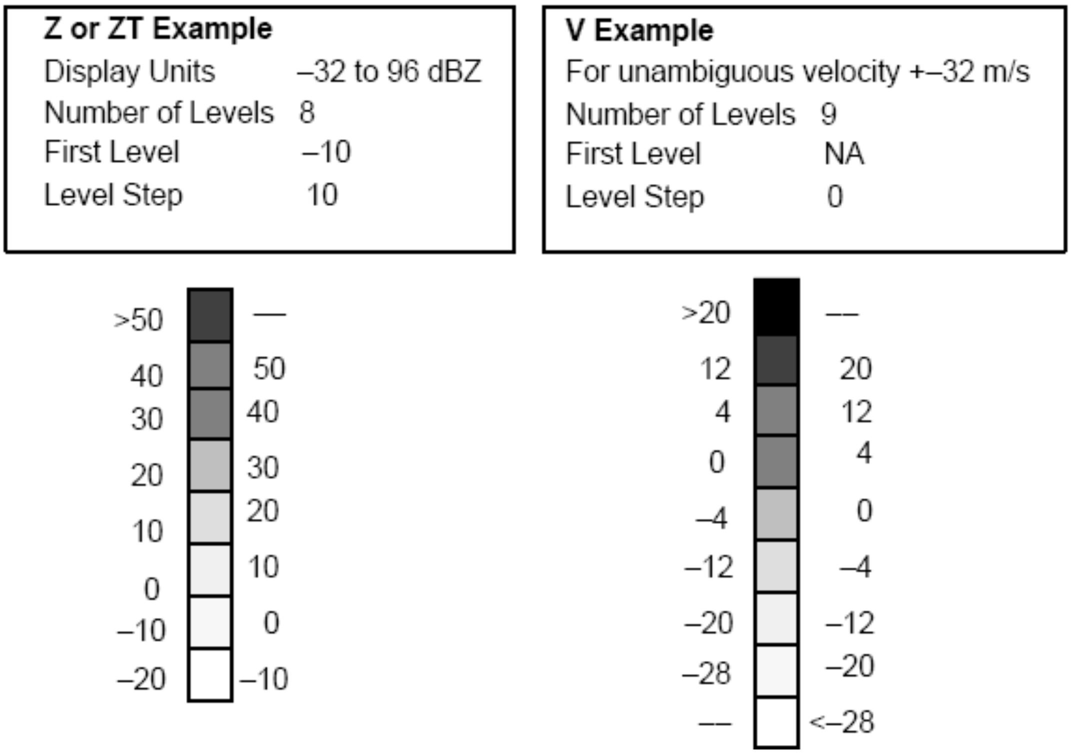


Figure 2 Color Legend Format Example

Product Picture Resolution

NOTE	If you select a custom Map Projection Name (other than <NONE> you cannot configure this field in the product output menu. This is because the resolution is determined by the projection configuration. See Map Projections on page 26 for a discussion of projection configurations.

IRIS can produce product pictures in virtually any resolution, from 16 × 16 to 3100 × 3100 pixels. IRIS products are produced specifically for the display resolution that is requested, optimizing the match between the display pixels and the actual radar data. This means that high resolution products are not merely low resolution products with replicated pixels. Likewise, low resolution products are not produced by degrading a higher resolution product. When you request a high resolution product, you get the best possible image that can be generated from the original data. If a low resolution product is requested, the product is computed efficiently by calculating the product only at the requested resolution. In addition to efficient generation, low resolution products can be transmitted over a communications link and displayed more rapidly because they contain fewer pixels.

The Resolution field in the Product Configuration menus shows the X-Y number of pixels.These can be changed by entering different numbers of pixels, or by popping up a menu of the default low, medium or high picture resolutions. The defaults are shown in Table 3 on page 38 for both PPI (square image region with legends to the right) and RHI formats (rectangular image region with legends beneath). The defaults are optimized to the resolution of the standard IRIS display devices.

Table 3 Default Picture Resolutions

Default Resolution RHI (Rectangular) Format[1]	**PPI (Square) Format[2]**			
	X-Pixels	**Y-pixels**	**X-Pixels**	**Y-Pixels**
Low	240	240	288	136
Medium	480	480	600	290
High	720	720	840	530
XHigh	940	940	1060	750

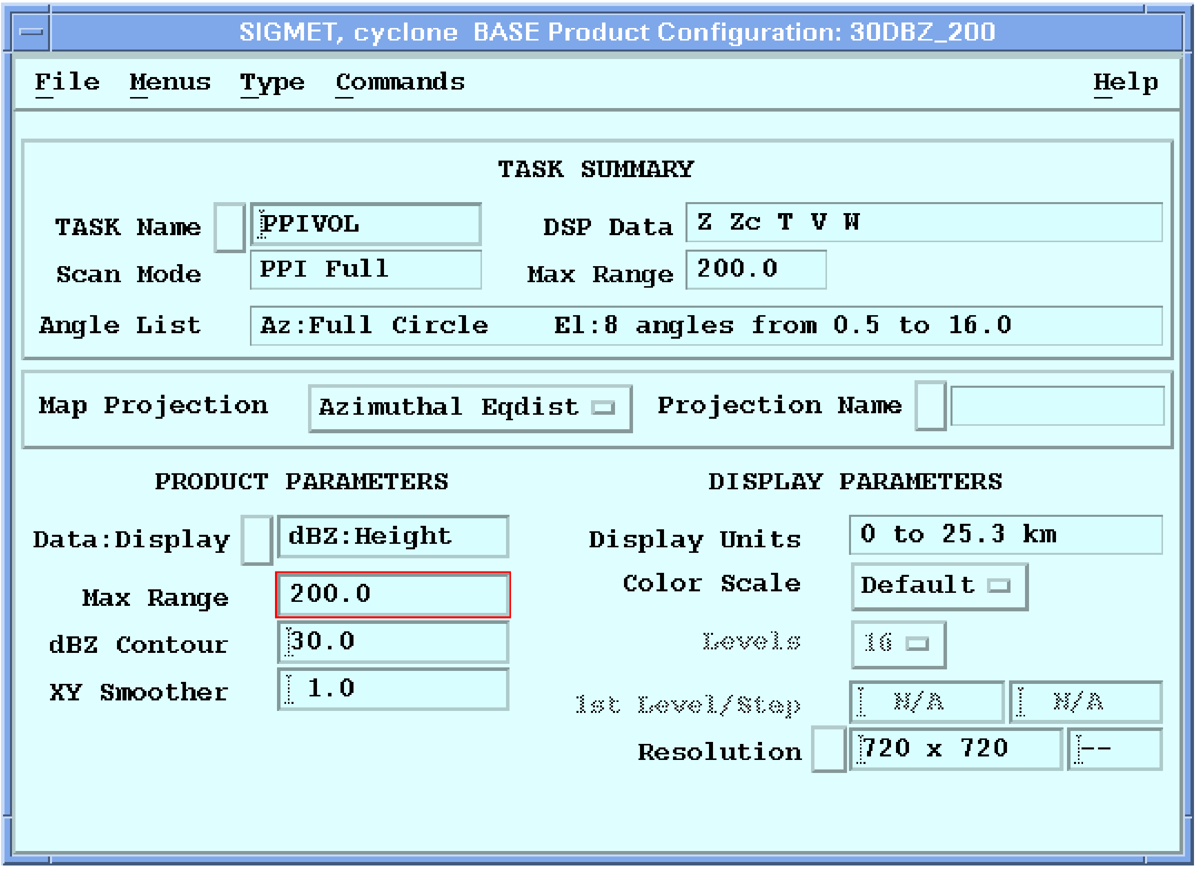
1. Rectangular image region with an optional legend beneath.
2. Square image region with an optional legend to the right.

Regardless of the product type, IRIS figures out the best way to display your product in either PPI or RHI format. If your image does not exactly match the pixel size of a target display device, IRIS adjusts it to make a best fit. For example, if you output a low resolution image to a high or medium resolution printer, IRIS doubles the pixels so that the display fills the image area. Likewise, IRIS shrinks an image if it has more pixels than can be displayed on an output display device.

If you want the impact of the large screen, but you do not want to burden IRIS with creating high resolution products, specify 360 × 360 display resolution. IRIS will double these numbers to fit exactly into the large display window. Likewise, 240 × 240 images will be tripled to fit exactly into a large display, or doubled to fit into a medium display.

For more information on data formats, refer to the *IRIS Programmer's Manual*.

3.2 BASE: Echo Base Product



This section describes the fields of the Product Configuration menu that are unique to BASE products. For general information, see these other sections of this chapter:

- Task Summary area, Task Summary on page 24.
- Product Parameters, see Product Parameters on page 31.
- Display Parameters area, Display Parameters on page 34.

The BASE product is used to detect the base of echoes. It is similar to the TOPS product which is used to detect the top of echoes. Similar to the echo TOPS, the user specifies a "dBZ Contour" for the base. For each output pixel in the product, the algorithm searches downward through successive elevation angles. A base height is determined by linear interpolation when the specified "dBZ Contour" is crossed from greater to lesser value.

The final output of the product is a color-coded map of echo base heights for the selected dBZ contour. Optional Cartesian smoothing can be applied.

Some limitations of the echo base product are described in the notes below:

NOTE	C, S and X band radars detect precipitation particles such as rain or snow. They are not sensitive to cloud particles which are much smaller (of order a factor of 1000 smaller in diameter). Thus the BASE product cannot be used to detect the cloud base height for radars transmitting in these bands. However, millimeter wavelength radars (K and W bands) can detect cloud particles.

NOTE	Because of earth curvature, ground clutter and beam blockage, radars are actually very poor at looking for features close to the surface. This means that the BASE product will not be able to detect echo bases to very low levels. When precipitation in excess of the specified dBZ contour is reaching the ground, or near to reaching the ground, the BASE product displays a special color to indicate that there is a BASE, but its height cannot be determined.

A sample BASE Product Configuration menu is shown at the beginning of this section.

To open the BASE Product Configuration menu:

Choose **Type**–>**BASE** from the menu bar.

Data : Display

The choices are:

dBT Height

dBZ Height

dBZc Height

Max Range

This is to select the maximum range for the product. Recall that earth curvature effects are greater at greater ranges. You can display a PPI at your lowest elevation angle and use the cursor tool to see what heights are possible to observe at various ranges. For example, for a 0.5 degree elevation angle at 100 km, the beam is centered at 2.3 km. Therefore it will not be possible to detect echo bases lower than this.

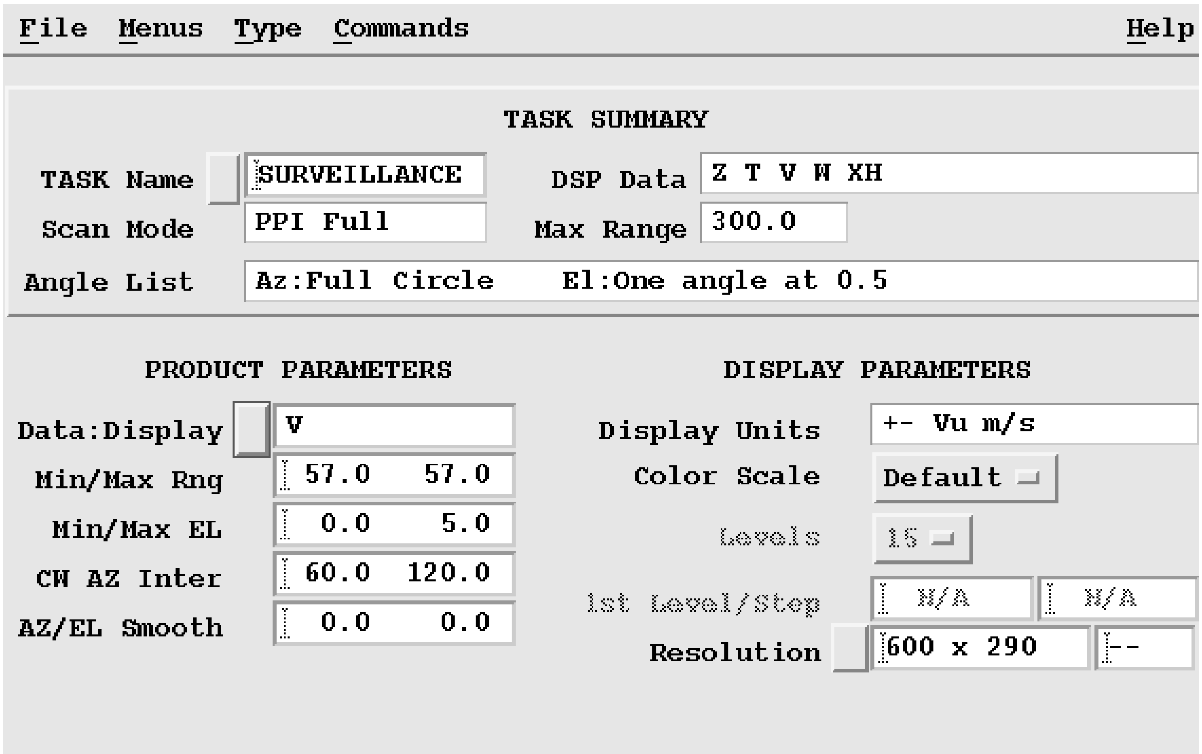
dBZ Contour

This is to select the dBZ threshold for the echo base.

AZ/EL Smoother

The smoother is applied as the final step of the product generation. Enter the values in degrees, first for the azimuth and then for the elevation direction. Typical values would be 1.0, 1.0.

3.3 BEAM: Antenna Beam Pattern Product



This section describes the fields of the Product Configuration menu that are unique to BEAM products. For general information, see these other sections of this chapter:

- Task Summary area, Task Summary on page 24.
- Product Parameters, see Product Parameters on page 31.
- Display Parameters area, Display Parameters on page 34.

The BEAM product is similar to a cross-section in that it shows a quasi-vertical slice of the atmosphere. The display coordinates are azimuth (horizontal) and elevation (vertical). It is constructed from a PPI volume scan. The product is used primarily for system testing and evaluation purposes, i.e.,

- Antenna beam pattern testing. Typically a radiator is place on a tower a few km from the radar. The radar is then scanned in sector or full PPI mode around the target using high resolution (e.g., <0.5 degree) spacing in AZ and EL. The transmitter is typically turned-off for this. The BEAM product can then be used to display the antenna response to the radiator.
- Calibrated sphere measurement. Similar to above except the radar is radiating. The sector scan is made about the calibration sphere which is typically suspended from a tethered balloon. The resulting display shows the location and returned power from the sphere. This can be used for full system calibration.

At near horizontal incidence (low elevation angles), the BEAM product is very similar to a cross-section. Since the product can be configured to average a range interval, the BEAM product can give a picture of the weather or other targets in a spherical "slab" defined as a range, azimuth and elevation interval. The cross-section on the other hand, attempts to show a planar "slice" through the weather.

A sample BEAM Product Configuration menu is shown at the beginning of this section.

To open the BEAM Product Configuration menu:

Choose **Type**–>**BEAM** from the menu bar.

Data : Display

The choices are:

Z dBZ

V V

W W

T dBZt

Min/Max Range

This is to select the range interval over which averaging will be performed. Note that the BEAM product performs averaging of dBZ or dBT values without linearizing. All distances are entered in km.

NOTE	Note that IRIS has a selectable maximum height above which data are not recorded (e.g., 20 km). Thus at far ranges, this height will be exceeded in the upper angles of a volume scan. This should be considered when selecting the Min/Max range. For example, if the height cutoff is set to 20 km, and a volume scan uses elevation angles up to 20 degrees, then the maximum range that includes all of the data will be 55 km.

Min/Max EL

This is to select the elevation window. For example, if the volume scan has elevation angles between and including 0 and 5 degrees, then enter the values 0.0 and 5.0.

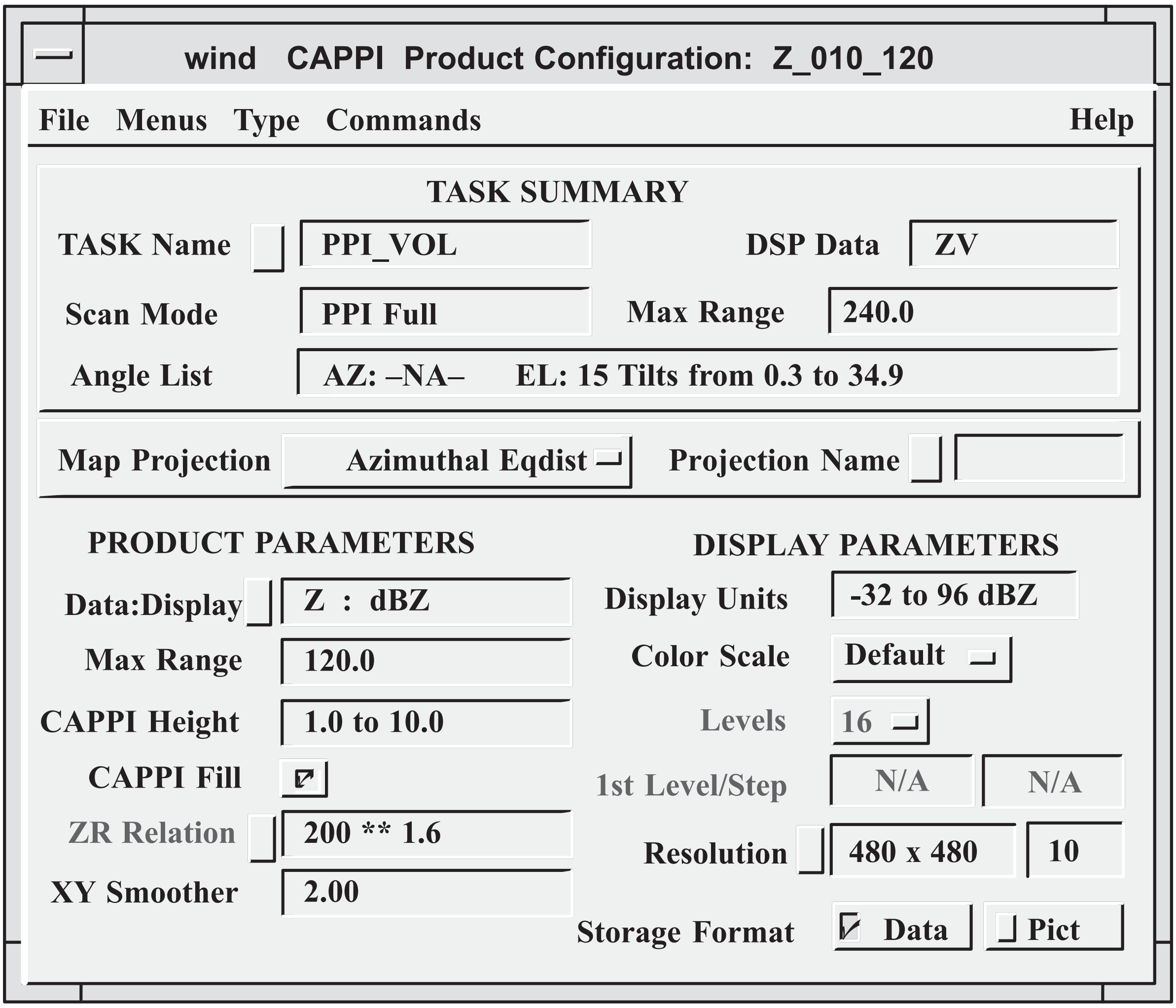
CW AZ Interval

This is to select the azimuth window. The first value will correspond to the left side of the display, while the second value will correspond to the right side of the display. From left to right on the display, the angles will be in the clockwise direction. For example, clockwise interval of 0.0 to 90.0 represents a 90 degree sector, while the interval 90.0 to 0.0 represents a 270 degree sector.

AZ/EL Smoother

The smoother is applied as the final step of the product generation. Enter the values in degrees, first for the azimuth and then for the elevation direction. Typical values would be 1.0, 1.0.

3.4 CAPPI: Constant Altitude Plan Position Indicator



This section describes the fields of the Product Configuration menu that are unique to CAPPI products. For general information, see these other sections of this chapter:

- Task Summary area, Task Summary on page 24.
- Map Projection Area, Map Projections on page 26
- Product Parameters, see Product Parameters on page 31.
- Display Parameters area, Display Parameters on page 34.

CAPPI stands for Constant Altitude PPI. A CAPPI is a horizontal cut through the atmosphere, therefore, it requires a PPI volume scan at multiple elevation angles. The number of angles and their spacing depends on the range and height of the CAPPI you want to produce. Refer to the discussion of constructing volume scans in Task Summary on page 24.

The CAPPI product also supports calculation of SHEAR data. The configuration options are the same as the SHEAR product, with choices of radial, azimuthal, and elevation shear.

To open the CAPPI Product Configuration menu:

Choose **Type**–>**CAPPI** from the menu bar.

Data : Display

Specify the data type you wish to make a CAPPI for. Essentially all IRIS data types are available. If you wish to generate rainrate, then you can select which input data type is used for the conversion. We support a Z/R relationship, as well as a KDP/R relationship.

CAPPI Height

Specify the height of the CAPPI surface in kilometers and tenths of kilometers. The IRIS CAPPI algorithm constructs CAPPIs by interpolating in height and range to the selected CAPPI surface. An intermediate product in cylindrical coordinates (CAPPI height, surface range and azimuth) is produced first, followed by the final conversion to Cartesian coordinates for the display. Enter a range of numbers for a 3-D CAPPI.

CAPPI Fill

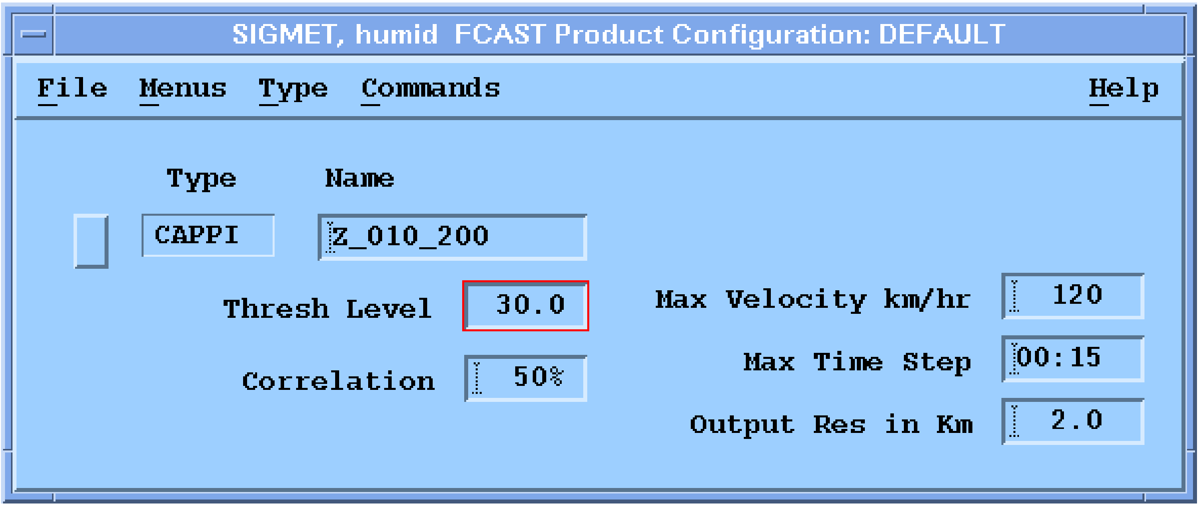
The interpolation algorithm requires that for each point in the output product image, there be an elevation angle both above and below the selected height. For example, the volume scan in the sample CAPPI Product Configuration menu cannot produce a CAPPI at 5 km height for ranges less than 5 km because there is no angle higher than 5 km in this region. Similarly, if you pick a low-level CAPPI surface, the lowest elevation angle is higher than the surface at far ranges. The resulting product display shows these unsampled areas as black.

The CAPPI Fill field uses the highest elevation angle to fill the near ranges, and the lowest elevation angle to fill the far ranges, eliminating the black areas. This approach is also called "Pseudo CAPPI." This is not recommended for 3-D CAPPIs.

3.5 FCAST: Forecast

The Forecast product is used in the Quick Look Window to project other products forward in time to see a "future" look at the weather. The product takes as input another image product and then determines an average speed and direction of echo motion. It is similar to the automatic TRACK product in that it computes the mean speed and direction by doing a cross-correlation between the current and the previous version of the product.

The product configuration menu also has many fields in common with the TRACK product described in TRACK: Track/Forecast on page 93. The menu fields are described below.



Input Product Selection

Use the **Type** button to select a product type and name. Select a product that will produce a reasonable echo motion. If you are using the product to forecast the motion of a VIL features, then you could base the forecast on a VIL product. In the example a CAPPI product of dBZ is selected.

Threshold Level

The algorithm applies a weighting function to the data based on this level. Values above this level are amplified and values below this level are suppressed by the weighting function. When you choose the level, look at a display in loop mode and get a feeling for what color boundary moves in a representative way. Usually you want to select a weak value so that you can be sure that it will always be present when there are echoes. In the example, 30 dBZ is selected.

Correlation

The correlation algorithm will return a speed, direction and a correlation value which serves as a quality indicator. The value that you enter here will be used as a threshold. If the calculated correlation value in the product is larger than the threshold that you set, a forecast product is generated.

Otherwise no forecast product is generated. The example requires a correlation of 50%. A larger value would be more restrictive. A smaller value would be more likely to pass unreliable motion estimates when the data are noisy.

Max Velocity in km/hr

It is also possible that the forecast product has a sufficiently high correlation, but makes an absurd velocity perhaps because of random noise. To prevent this, enter the maximum velocity that you would expect to see for weather echoes in your area. A value of 120 km/hr is a reasonable first guess.

Max Time Step

The Forecast product calculates the mean echo motion by doing a correlation between the current and previous image. Max Time Step is the maximum time that the Forecast product will look back to find the previous image. The example value of 15 minutes is a reasonable starting point since the average life of an individual convective cell is approximately 30 minutes.

Output Resolution

The current version of the forecast product produces a single motion vector. However, future versions will compute a field of motion vectors. In addition, users can make their own forecast product using their own algorithms. These can have a field of non-uniform motion vectors.

The Output Resolution is the resolution of the output field of vectors. The total size of the output field will match the size of the input product (in km). For example, if the input product has a 200 km range (400 km total span), and the output resolution is 5 km, then the output will be a grid of 80 × 80 motion vectors.

Display and Use in Forecasting

The display of the forecast product itself shows an array of motion vectors similar to the WIND or NDOP products. In the current version of the FCAST product, all motion vectors are the same.

The most interesting display is when the FCAST product is used to shift the display of another product. This is done using the Quick Look Window Forecast tool (see Forecast Tool on page 268). The QLW displays support additional features that are not currently supported by the Forecast product made by IRIS:

- Non-uniform motion fields will be correctly used in the forecast.

- Non-uniform intensity changes will be correctly applied.

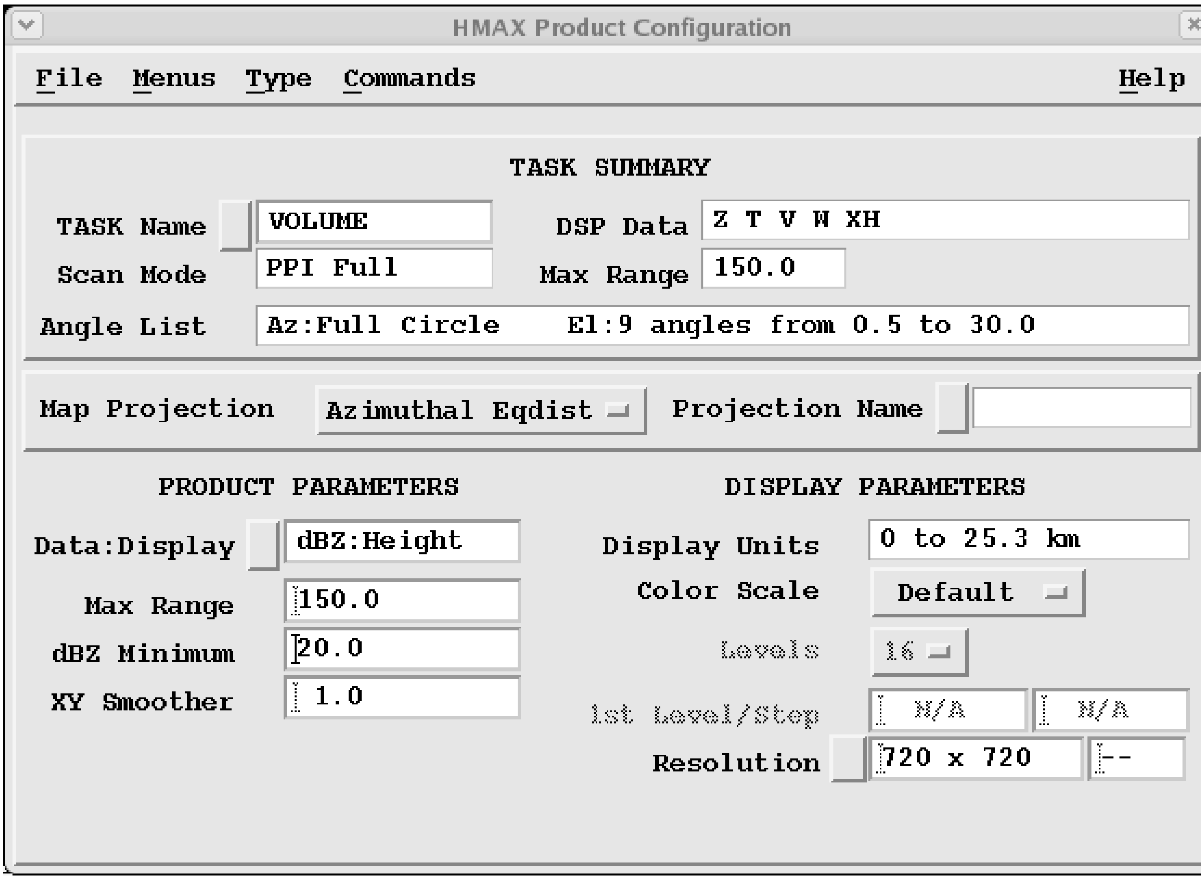
With regard to the second point, the forecast product creates a corresponding array of intensity changes. In the case of the current implementation these are all set to 1.

Forecast Algorithm in Quick Look Window

The forecast algorithm in the Quick Look Window takes as input a product and a forecast product (array of motion vectors and intensity changes). Also please see Forecast Tool on page 268. The steps involved in the forecast are as follows:

- An output array is created that has the same projection and resolution as the input product (e.g., an input CAPPI that we want to forecast).
- The forecast product motion vectors and intensity change array points are re-mapped onto the output array. This re-mapping means that the input product and the forecast product do not have to have the same projection, resolution or range.
- Usually there will be many more output array pixels than there are grid points in the forecast product. Therefore it is necessary to interpolate the spares motion vector and intensity change points to each pixel point (pixel) in the output array. The result is that each pixel of the output array now has a a motion vector and an intensity change associated with it.
- For each pixel of the output array, the motion vector is used to "look back" in time per the selected forecast time. This "backwards displacement" vector points to a pixel in the adjusted input product. The value of this pixel is then used for the output product pixel.
- The intensity changes in the output array are then applied pixel-by-pixel to adjust the data for growth and decay.

3.6 HMAX: Height of Maximum Intensity Product



This section describes the fields of the Product Configuration menu that are unique to HMAX products. For general information, see these other sections of this chapter:

- Task Summary area, Task Summary on page 24.
- Product Parameters, see Product Parameters on page 31.
- Display Parameters area, Display Parameters on page 34.

The HMAX product displays the height of the maximum reflectivity above each output pixel. It is similar in some respects to the MAX product which shows the value of the maximum reflectivity over each pixel. The HMAX algorithm requires a volume scan. It searches vertically through the elevation angles above each output pixel and determines the height of the maximum intensity.

The product can in some cases show the presence and height of the bright band. In animation, rapidly decreasing heights in convective storms may indicate the presence of a microburst. A limitation of the HMAX product is described in the note below:

NOTE	A limitation of this product is that the heights are quantized by the number of elevation angles. It is not possible to interpolate the maximum, so the height is simply the height of the elevation angle where the maximum occurs (with earth curvature correction). Using a volume scan with many elevation angles and the 2D Cartesian smoother both help to mitigate the effects of this quantization.

A sample HMAX Product Configuration menu is shown at the beginning of this section.

To open the HMAX Product Configuration menu:

Choose **Type**–>**HMAX** from the menu bar.

Data : Display

The choices are:

dBT Height

dBZ Height

dBZc Height

Max Range

This is to select the maximum range for the product

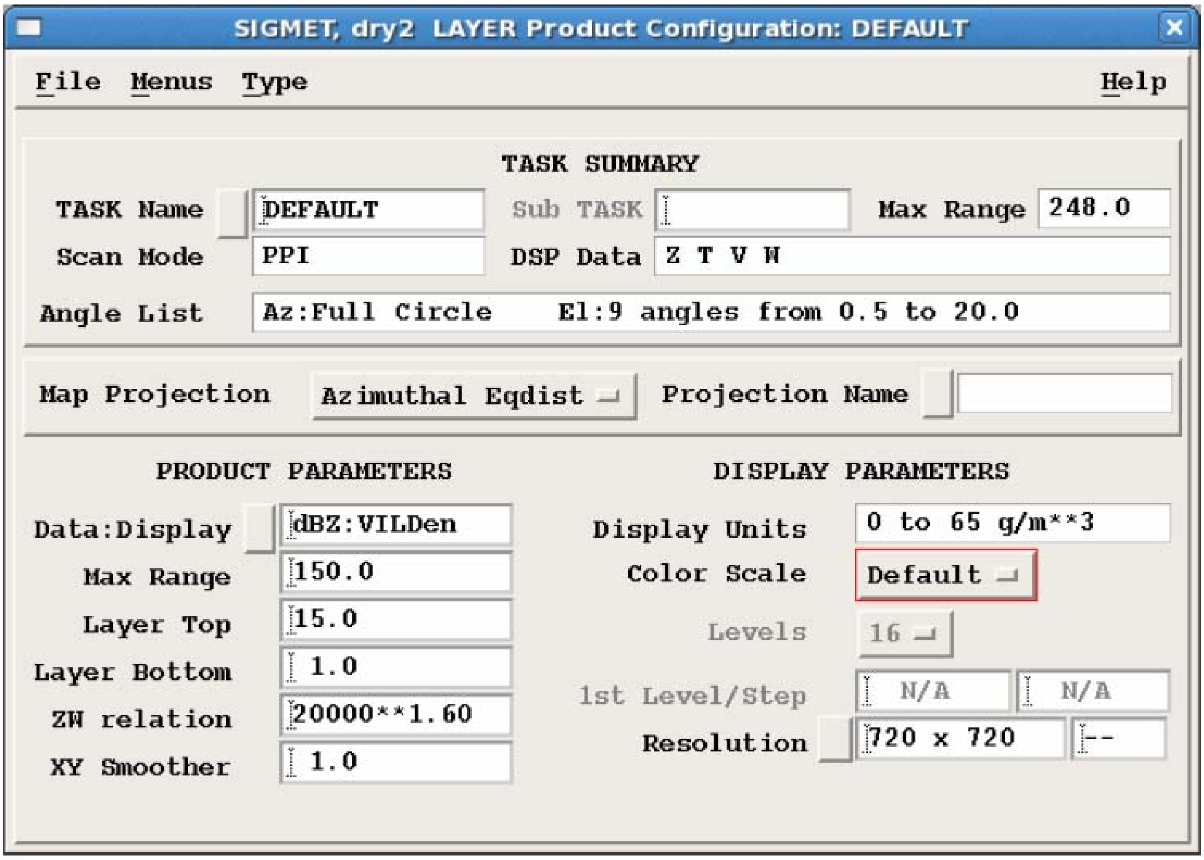
dBZ Minimum

This is to select the smallest maximum reflectivity for which to show height.

AZ/EL Smoother

The smoother is applied as the final step of the product generation. Because of the quantization of the heights by the elevation steps in the volume scan, you may want to try a longer smoother than you would typically use to help smooth over the quantization (e.g., 3.0 km).

3.7 LAYER: Layer Average



This section describes the fields of the Product Configuration menu that are unique to LAYER products. For general information, see these other sections of this chapter:

- Task Summary area, Task Summary on page 24.
- Map Projection Area, Map Projections on page 26
- Product Parameters, see Product Parameters on page 31.
- Display Parameters area, Display Parameters on page 34.

The LAYER product can compute layer averages of any polar data types in the ingest files. In addition, it can convert to liquid first, and thus compute VIL Density. When computing VIL Density, the output is in g/m**3.

The LAYER algorithm is very similar to the VIL algorithm, except that it divides by the layer thickness. It first searches out all points in the layer (accounting for earth curvature) over a given range and at a given azimuth that intercept the PPI scans of the volume scan, including one point above and below. Next, if the data is Z, it linearizes it, or if the output is VIL

Density it converts the Z values to W values (here, W refers to water content), and averages the values in the layer. Each data point is assigned a weighting corresponding to the height interval that it represents in the layer. The result is an intermediate PPI product that is transformed to Cartesian and stored. If Z is selected as the Product Data parameter, but at run time only T is available (or vice versa), the product runs with the available data parameter.

To open the LAYER Product Configuration menu:

Choose **Type–>LAYER** from the menu bar.

Data:Display

Use the **Data:Display** button to control which type of data will be computed.

dBT:VILDen Select input type to compute VIL Density data.
dBZ:VILDen
dBZc:VILDen
* Select any other data type to compute layer average

Layer Top and Layer Bottom

Select the top and bottom heights of the layer in kilometers and tenths of kilometers.

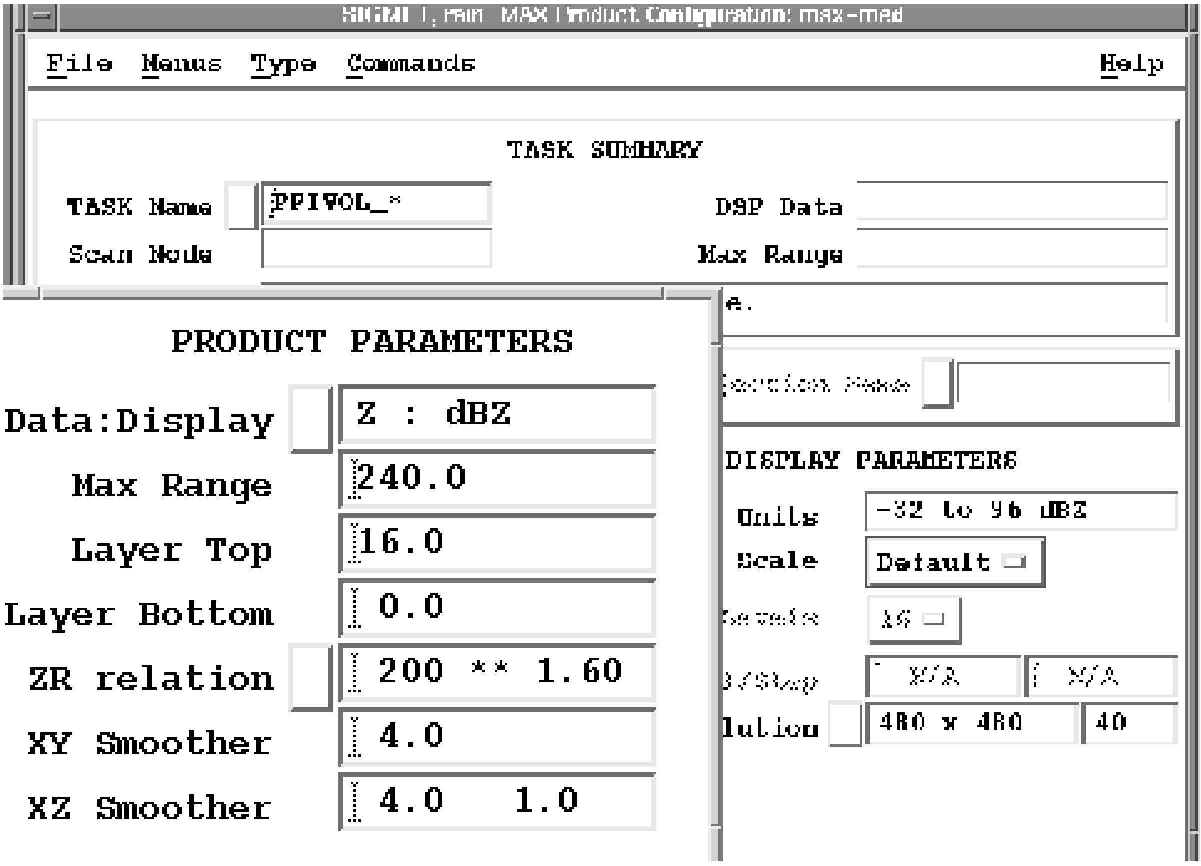
ZW Relation

Select the reflectivity-water content (Z-W) relationship. This field is desensitized if we are not computing VIL Density. A default value for rain is provided. For snow, reduce the coefficient to a smaller value, such as 2000, to account for the lower reflectivity of ice.

LAYER can function when only one angle is in the TASK, but this is not recommended for best results. If no angle in the associated TASK passes through the layer, no result can be calculated.

For a layer of 5 to 10 km, in the volume scan example in Figure 1 on page 26, layer averages cannot be calculated for ranges less than 5 km. In the resulting product display, there would be a inner circle of area-not-scanned.

3.8 MAX: Maximum Data with side panels



This section describes the fields of the Product Configuration menu that are unique to MAX products. For general information, see these other sections of this chapter:

- Task Summary area, Task Summary on page 24.
- Map Projection Area, Map Projections on page 26
- Product Parameters, see Product Parameters on page 31.
- Display Parameters area, Display Parameters on page 34.

The MAX product provides an easy-to-interpret presentation of the echo height and intensity in a single display. It is especially useful for depicting areas of severe weather. The product is based on a volume scan TASK and is calculated by first constructing a series of CAPPI's to span the selectable layer, and then determining the maxima data value for the horizontal and two vertical projections — East-West and North–South.

on page 54 shows an example of a MAX display. Note, that the radar cannot see all the way to the surface of the earth, hence the curved boundaries at the bottom of the side panels.

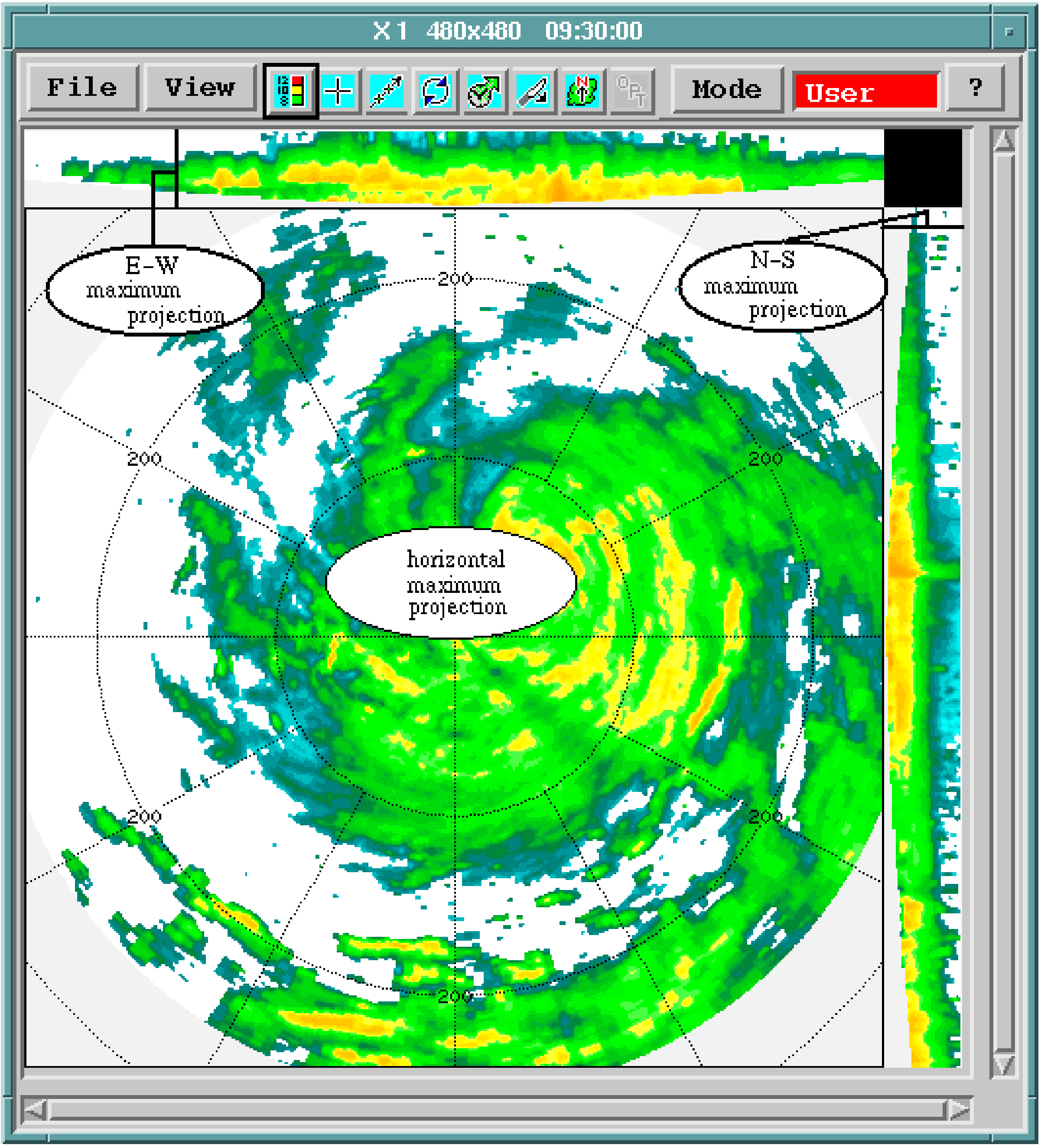


Figure 3 Example of MAX Display

The horizontal maximum projection is calculated by taking the highest data value in a user-specified layer over each pixel. The E-W maximum projection is obtained by taking the maximum reflectivity for each pixel along the corresponding N-S line. Likewise, the N-S maximum projection is obtained by taking the maximum reflectivity along E-W lines.

on page 55 shows the geometry that corresponds to the MAX Product Configuration at the beginning of this section. Before configuring a MAX product, it is a good idea to make a diagram of the layout that you want, similar to the diagram shown in on page 55. Also, compare this to the set of elevations in your task to see if you have a sensible resolution especially in the upper parts of your MAX box.

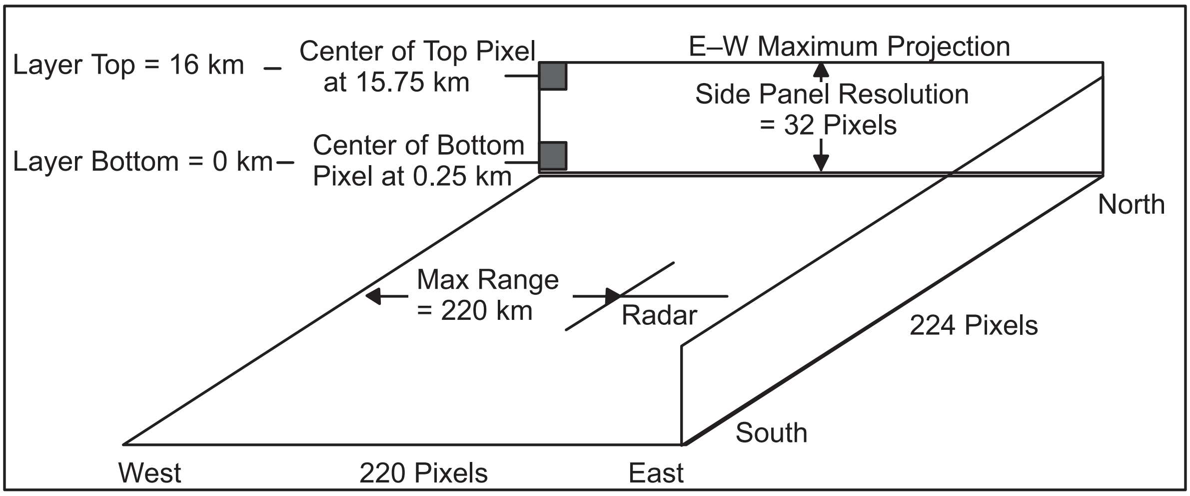


Figure 4 Example of MAX Geometry

To open the MAX Product Configuration menu:

Choose **Type**–>**MAX** from the menu bar.

Product Name and TASK Name

Select a Product Name that is mnemonic, such as Z_0_16_220 to indicate that the product covers the layer 0 to 16 km to a range of 220 km. The associated TASK Name must correspond to a volume scan TASK — at least two elevation angles are required.

Data : Display

Many types of input data can be selected, including dBT, dBZ, dBZc, V, Vc, W, ZDR, ZDRc, Kdp. And rainrate can be output for the appropriate types.

Max Range

The Max Range field corresponds to the span of the image from the radar to the edge of the picture in the East-West direction. In on page 55, the range of 220 km is covered by 120 pixels to yield 2 km per pixel resolution.

Layer Top and Layer Bottom

The Layer Top and Layer Bottom fields are selected to the nearest 100 m. In selecting the layer top value, keep in mind the maximum data height allowed for your system as configured in the **setup** utility. In the example, the layer spans 0 to 16 km. The corresponding side panel resolution is set to 32 pixels so that each pixel represents 0.5 km. The center of the bottom pixel is at 0.25 km height and the center of the top pixel is at 15.75 km height.

XY Smoother and XZ Smoother

There are two smoothers for this product. The XY Smoother is for the horizontal maximum projection, while the XZ Smoother is for the side panels. The values for the smoothers are in km. In the case of the side panel XZ Smoother, there are two values—horizontal smoothing and vertical smoothing.

Color Scale, Levels, and 1st Level/Step

The color levels for the Zmax display are identical to those defined for the reflectivity. Input the number of levels, the first level value and the level step in dBZ.

Resolution

The Resolution field consists of three numbers—the number of E–W pixels, the number of N–S pixels, followed by the height of the side panels. The following default low, medium, high and extra high values can be chosen from a pop-up menu:

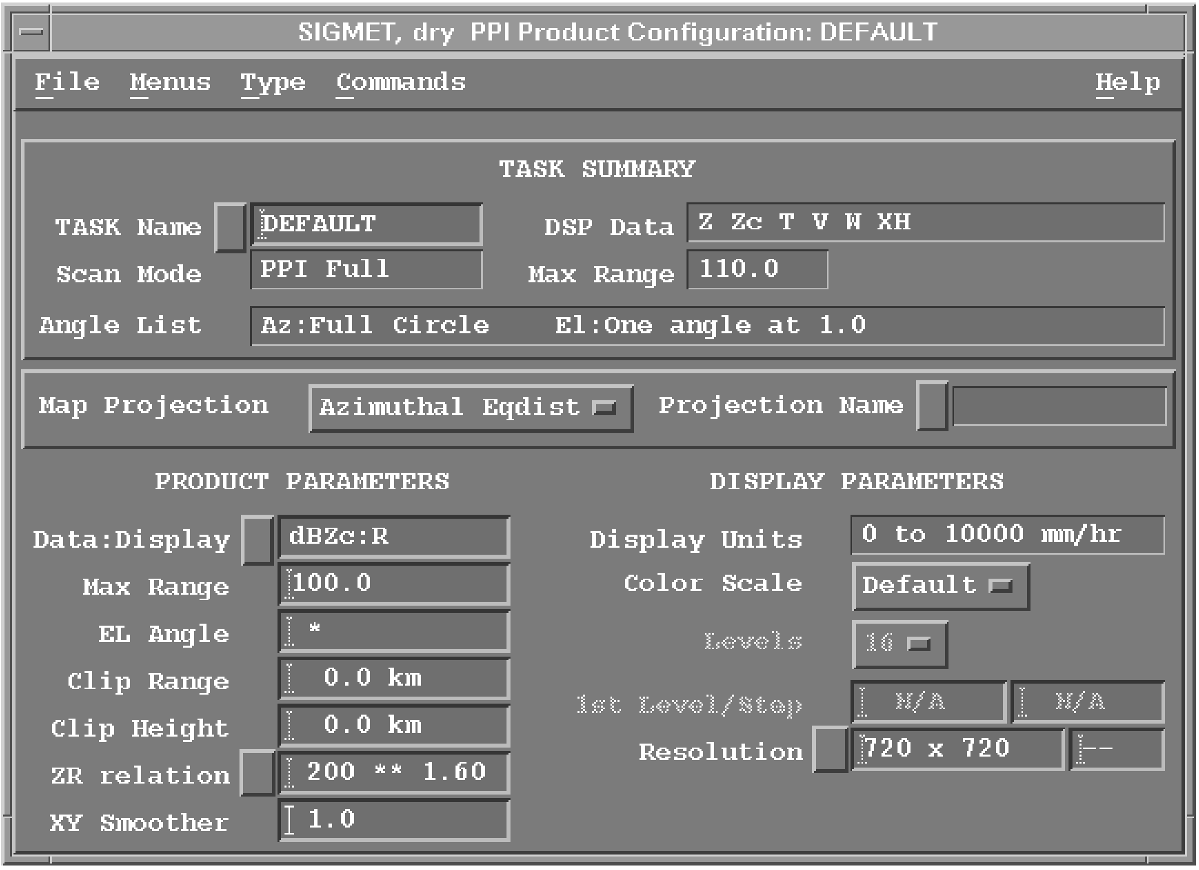
Low	240 × 240	20
Medium	480 × 480	40
High	720 × 720	60
XHigh	940 × 940	80

Or, you may enter other values directly into the field. If you enter your own values, remember that resolution values represent the total size of the display, including the side panels. Again it is helpful to make a layout sketch of the product before you do the configuration.

When the product runs, it first generates a series of CAPPI's spaced uniformly over the height interval. The number used is the larger of one for every 500 meters or one for every two pixels of side panel size, up to a maximum of 50. The values are interpolated to make up the side panel image.

Smoothing is performed as a final step. Note that in many applications you may want to use no smoothing so that maxima are not diminished by the smoothing filter.

3.9 PPI: Plan Position Indicator



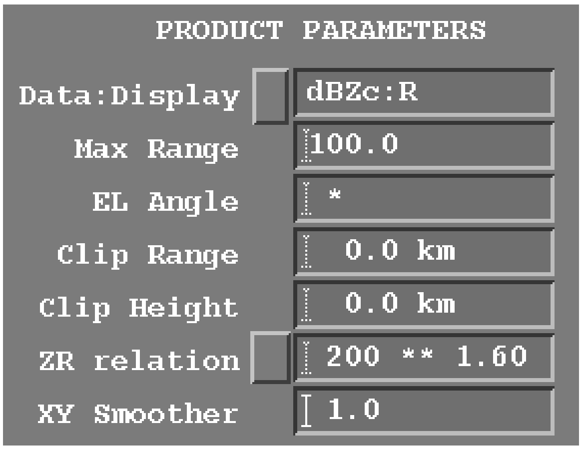
This section describes the fields of the Product Configuration menu that are unique to PPI products. For general information, see these other sections of this chapter:

- Task Summary area, Task Summary on page 24.
- Map Projection Area, Map Projections on page 26
- Product Parameters, see Product Parameters on page 31.
- Display Parameters area, Display Parameters on page 34.

The PPI product shows the distribution of the selected data parameter on a constant elevation angle surface — the classic radar display. IRIS PPI products are made as soon as the requested elevation sweep is completed rather than at the end of a volume scan.

To open the PPI Product Configuration menu:

Choose **Type**–>**PPI** from the menu bar.



Data : Display

All base data types are available in the PPI product, plus you can convert to rainrate using input data of dBT, dBZ, dBZc, or Kdp.

Max Range

The "Max Range" means horizontal range along the earth below the PPI surface, and similarly in displays the range rings show the horizontal range.

EL Angle

The elevation angle of data you want to display. IRIS will find the nearest angle in the specified task. Typing in the value "*" indicates that you wish to run the PPI product on every sweep angle in the task.

Clip Range

This is a rarely used feature. The PPI product can be configured to truncate the data at a range which is shorter than the actual task configuration range. Possible uses are: It can improve a composite display by forcing the PPI into a circle rather than a square. It can restrict the area of coverage for a WARN, TRACK, or DWELL product. This is useful for algorithms such as bird tracking. Specifying zero disables the feature.

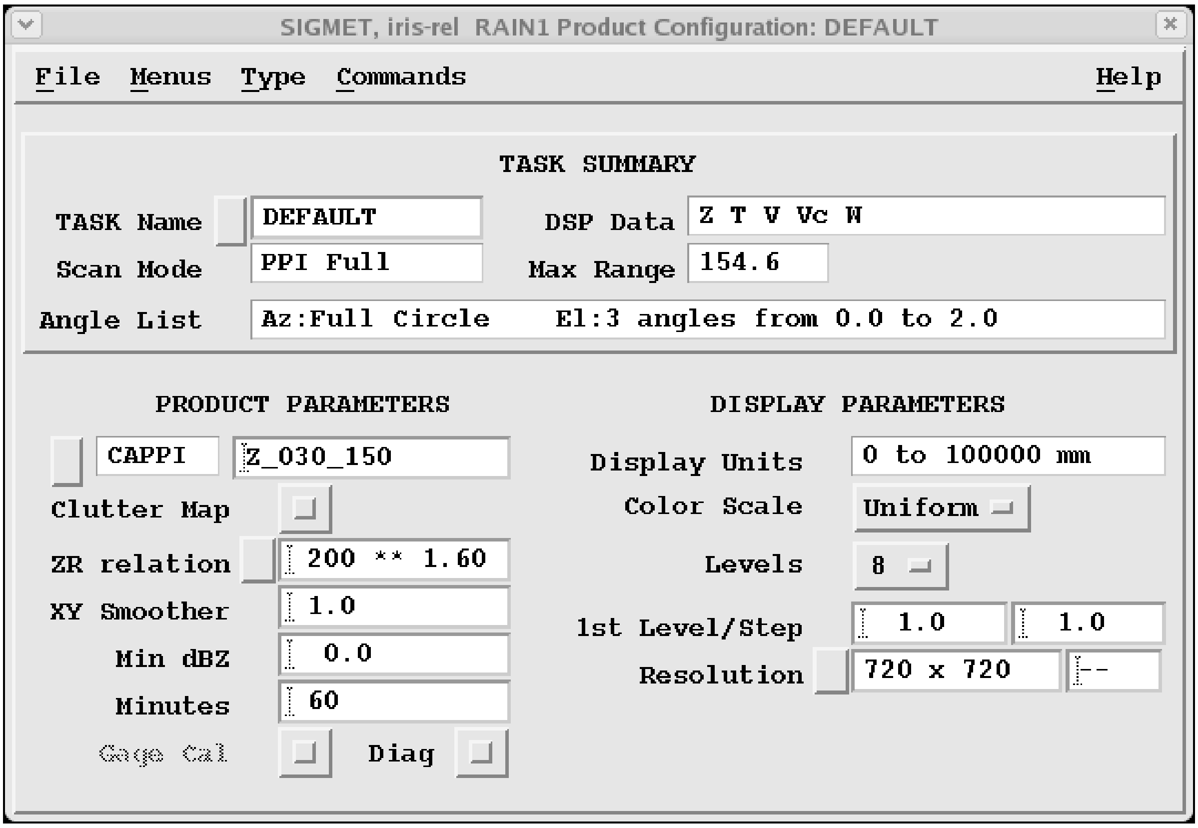
Clip Height

Same as Clip Range, except the range is specified as height.

ZR Relation

The ZR (reflectivity–rainfall rate) relation is used only if Rainrate (from dBT, dBZ, or dBZc) is specified as the data parameter. If you specify Rainrate from Kdp, then the label changes, and the KR relation is entered here.

3.10 RAIN1: Hourly Rain Accumulation



This section describes the fields of the Product Configuration menu that are unique to RAIN1 products. For general information, see these other sections of this chapter:

- Task Summary area, Task Summary on page 24.
- Map Projection Area, Map Projections on page 26
- Product Parameters, see Product Parameters on page 31.
- Display Parameters area, Display Parameters on page 34.

The RAIN1 product (or Hourly Rain) uses CAPPI or SRI data over a defined time interval, generally 60 minutes, to obtain an estimate of the rainfall that fell within that hour. The results can be displayed or used to derive the RAINN or CATCH product.

A general-purpose volume scan TASK such as the one shown in on page 26 usually serves for the rainfall product. Note that the accuracy of the rainfall product degrades with range because the beam is larger at greater ranges. For example, the beam for a 1 degree beam width is 3 km across at 180 km range. If you have a Doppler radar, select Z as one of the TASK data outputs; this is corrected for ground clutter effects.

To open the RAIN1 Product Configuration menu:

Choose **Type–>RAIN1** from the menu bar.

CAPPI or SRI

Press the button, to select first the product type (either CAPPI, or SRI), then the name of an input product. The input data type can be corrected dBZ, uncorrected dBZ, or rainfall rate. If you are integrating rainfall rate inputs, then the "ZR Relation" and "Minimum dBZ" fields below are not applicable.

The priority of the RAIN1 product should be lower than that of the CAPPI and SRI products to ensure that all of the inputs are ready before the RAIN1 product is made. Use the **setup** utility's **product** command to set the relative priorities of products.

Clutter Map

This button enables a clutter map feature. To use this, you must make a RAIN1 product with a matching name and resolution in clear weather. This file is then subtracted from each hourly accumulation. The clutter map file is marked using the Product Output Menu.

ZR Relation

The Z-R relationship that you select should be characteristic of the precipitation in your area and account for the type of precipitation, such as rain or snow. Much has been written in the meteorological and hydrological literature concerning the use of radar to estimate precipitation. Consult a standard textbook such as Battan or Doviak and Zrnic to become familiar with Z-R relationships and to understand the advantages and limitations of the technique.

Some standard relationships are:

$Z = 200R^{1.6}$	The Marshall-Palmer relationship for rain
$Z = 2000R^{2.0}$	The Gunn and Marshall relationship for snow

Minimum dBZ

This is the minimum value of dBZ that will be used for computing rainfall amounts, i.e., dBZ values that are less than this will be treated as zero rainfall. This prevents very weak echoes from being counted as rainfall. Typically, this should be set to -10 dBZ, although you should choose a value appropriate to your site. Setting the value to -33 will disable this feature.

Minutes

This is the period of time desired for rainfall accumulation. Generally 60 minutes is used to produced a one hour rainfall product. However, shorter intervals can be used. The minimum accumulation time period allowed is 15 minutes.

Gage Cal

This button is active if you have purchased the IRIS/Hydromet optional software license. Clicking the button configures the product to use a special raingage correction algorithm. See Appendix F, Hydromet Raingage Correction, on page 437 for a description of the IRIS/Hydromet radar/gage calibration features.

Diag

This button is used only internally for testing.

3.10.1 Scheduling RAIN1 Products

The data times that you specify when you schedule the product are quantized to the time value in the product configuration for the nearest interval that ends the integration. For example, if you want to schedule a 60 minute RAIN1 product to integrate the precipitation in the hour from 11:00 to 12:00, set the time to 12:00. If the associated TASK is running at the end of an hour, the Product Scheduler waits for it to complete, so the TASK data can be included in the hour's integration.

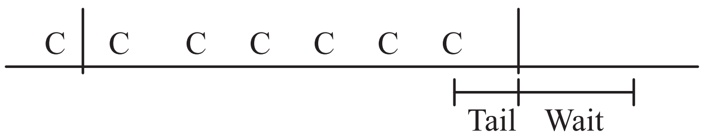
You should set the Skip Time field to 01:00 so the RAIN1 product runs every hour. This is highly recommended because the RAINN product for multiple hour accumulations works best if there is a RAIN1 product every hour. You can set the skip time to any multiple of the accumulation period.

The RAIN1 product must await the arrival of all the input CAPPI's during the accumulation period. The "trigger" is the arrival of a CAPPI that is in the next accumulation period. There are two cases that the product scheduler must handle, i.e., the next hour CAPPI either arrives or it doesn't arrive. These are illustrated below. Note that in the time-line figures below, the horizontal line represents "the data time"- the time of the start of a volume scan. The "C" represents an input CAPPI product. The vertical bar represents an the next accumulation period.

Case 1: Normal Case: Next hour CAPPI arrives

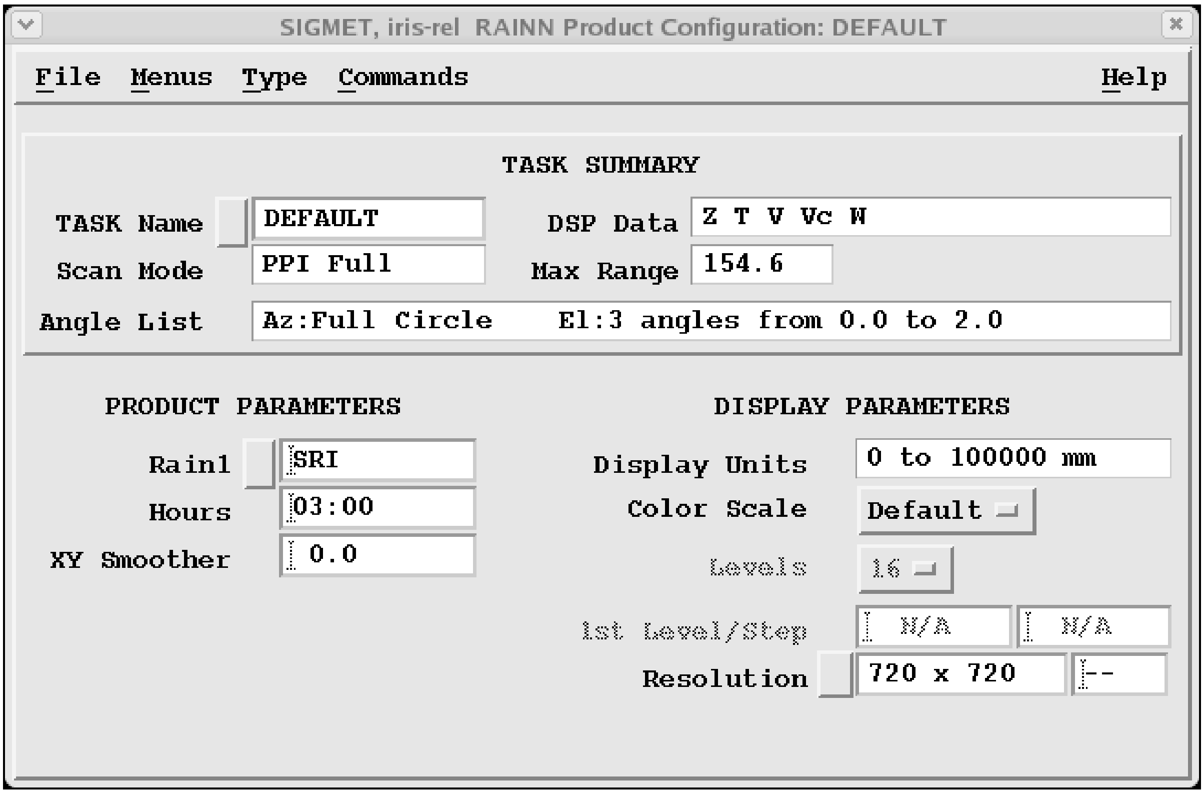
The RAIN1 product is run as soon as a CAPPI from the next accumulation interval arrives.

Case 2: Late Case: Next accumulation interval CAPPI does not arrive



The RAIN1 product runs after the "Tail" and "Wait" times have elapsed from the file arrival time of the last input CAPPI. Tail is the time difference between the data time of the last CAPPI and the next accumulation period. The Wait time threshold is configured in IRIS Setup/Product, where you can configure a different value for cases with raingage inputs. The Wait time threshold is tuned to account for any network delays.

3.11 RAINN: N-Hour Rain Accumulation



This section describes the fields of the Product Configuration menu that are unique to RAINN products. For general information, see these other sections of this chapter:

- Task Summary area, Task Summary on page 24.
- Map Projection Area, Map Projections on page 26
- Product Parameters, see Product Parameters on page 31.
- Display Parameters area, Display Parameters on page 34.

The RAINN product is unique — it is a product of a product. You can sum any number of hours of individual RAIN1 products. The only limitation is the number of RAIN1 products stored on disk. The product output shows the last N hours of accumulation.

When you specify the name for the RAINN product, it is a good idea to indicate the integration time in the name, as in 03_HOUR in the example above. This makes it easier to identify the product in the Product Scheduler and Product Output menus.

To open the RAINN Product Configuration menu:

Choose **Type–>RAINN** from the menu bar.

Rain1

In the Rain1 field, specify the product name of the input hourly RAIN1 product. You can click on the Rain1 button and choose from a list of products, or enter the name directly into the field.

When you enter a product name, the associated TASK information is displayed in the TASK Summary portion of the menu.

Hours

Specify the number of hours to integrate. When the product runs, it integrates data for the last N hours. If a RAIN1 product is missing for one of the hours in the interval, the algorithm assumes that no rain fell during that hour. The product output shows how many hours were actually integrated.

Color Scale, Levels, and 1st Level/Step

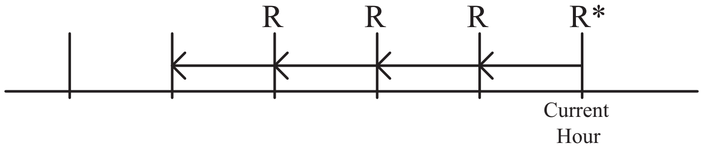
The color levels can be specified, but the resolution is fixed by the resolution of the RAIN1 configuration.

3.11.1 Scheduling RAINN Products

In the Product Scheduler, the Data Time field refers to the end of the period for which you are integrating. The Skip Time field can be used if you want only the accumulations for specific time intervals. For example, if you want a 3-hour integration only for the periods ending at 03:00, 06:00, 09:00, ..., set the Skip Time field to 03:00.

The scheduling algorithm for the RAINN product looks for the arrival of the most recent RAIN1 product (after the "current hour") and then runs the RAINN algorithm. There are two cases that the product scheduler must handle, i.e., the RAIN1 product either arrives or it doesn't arrive. These are illustrated below. Note that in the time-line figures below, the horizontal line represents "the data time" of the RAIN1 products which is always exactly on the ending hour. The "R" represents an input RAIN1 product and R* represents the current hour RAIN1 product whose arrival triggers the RAINN product to run. The vertical bars represents even hours. The examples are for the case of a 4-hour integration.

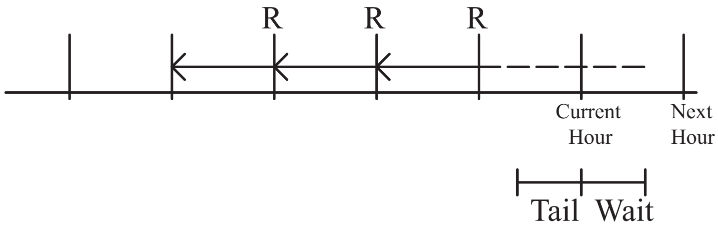
Case 1: Normal Case: The current hour RAIN1 product arrives



In this case, the current hour RAIN1 product arrives (R*). The algorithm runs on this and the prior RAIN1 products that are available over the previous 4 hours.

The two cases below are when the Current Hour RAIN1 does not arrive.

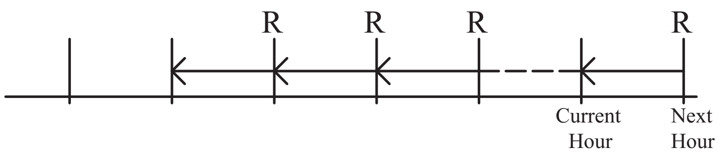
Case 2: Current hour RAIN1 does not arrive, but next hour RAIN1 does



In this case, the current hour RAINN does not arrive so the scheduler waits. Eventually the next hour RAINN arrives, so the scheduler assumes that the current hour RAINN will never arrive and runs the product on the available RAIN1's, without the current hour data.

If the Current Hour RAIN1 eventually arrives, it does not trigger the scheduling algorithm since the "Next Data Time" in the Product Scheduler will have already advanced to the next hour. However, it will be used in future RAINN processing, i.e., for the next hour.

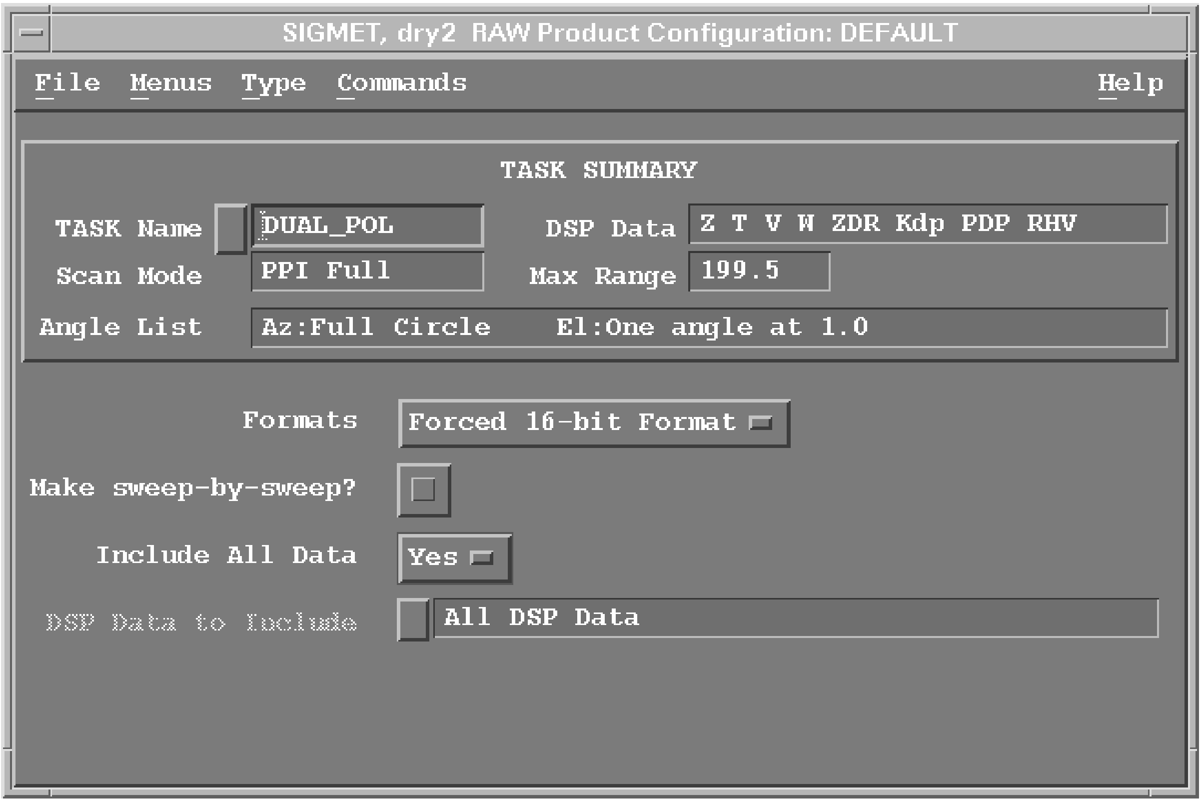
Case 3: Current hour RAIN1 does not arrive, but Wait time expires



In this case the RAINN product will run after the "Tail" and "Wait" times have elapsed. The Tail time is the time on the local computer between the arrival of the most recent RAIN1 and the current hour. The Wait time threshold is configured in IRIS Setup/Product to account for network delay.

If the Current Hour RAIN1 eventually arrives, it does not trigger the scheduling algorithm since the "Next Data Time" in the Product Scheduler will have already advanced to the next hour. However, it will be used in future RAINN processing, i.e., for the next hour.

3.12 RAW: Raw Data



This section describes the fields of the Product Configuration menu that are unique to RAW products. For general information, see this other section of this chapter:

- Task Summary area, Task Summary on page 24.

The RAW Data product (RAW) generates a compressed product file containing all of the signal processor data parameters collected during the selected TASK. RAW products are made one-for-one from Ingest files. Using a wild card will not allow you to merge data from hybrid tasks into one file. The RAW product cannot be displayed, but it can be archived to tape or sent to the disk of another IRIS computer in a network. When a RAW product file is either retrieved from tape or received from another IRIS computer, an ingest file is created, so that products can be generated. Thus, the RAW product is used in the following ways:

Offline Analysis System: RAW products are stored on tape and later read back to an IRIS Analysis system (not necessarily the radar host) so products can be generated for analysis or testing.

Real-Time Network System: RAW products are sent to another IRIS computer and the product generation is done there rather than by the radar host. This off-loads some of the processing burden from the radar host onto other network computers that may be less busy. This is valuable if some users prefer to generate products that are not normally produced by the radar host.

To open the RAW Product Configuration menu:

Choose **Type**–>**RAW** from the menu bar.

The RAW product is a simple product to configure. There are few configuration parameters beyond the RAW product name (assigned when you save the product) and the TASK name. It is recommended that you give a RAW product the same name as its associated TASK.

Formats

This pop-up menu allows you convert products between 8-bit and 16-bit formats. Choose the format that you would like, or choose "Preserve Format" to perform no conversion on the in-coming data.

Make sweep-by-sweep?

Press this button in to generate RAW products incrementally—on a sweep-by-sweep basis. If these products are sent to a second machine over a network, that machine will also assemble the ingest data one sweep at a time. Push this button out to generate the RAW product from the entire volume scan.

Include all data

The RAW product now has the option to filter and only include some of the data types of the original data. For example, you might want to send all data to a research customer but skip sending the dual-pol data to a simple display computer. We recommend that all customers leave this set to include all data until a need arises.

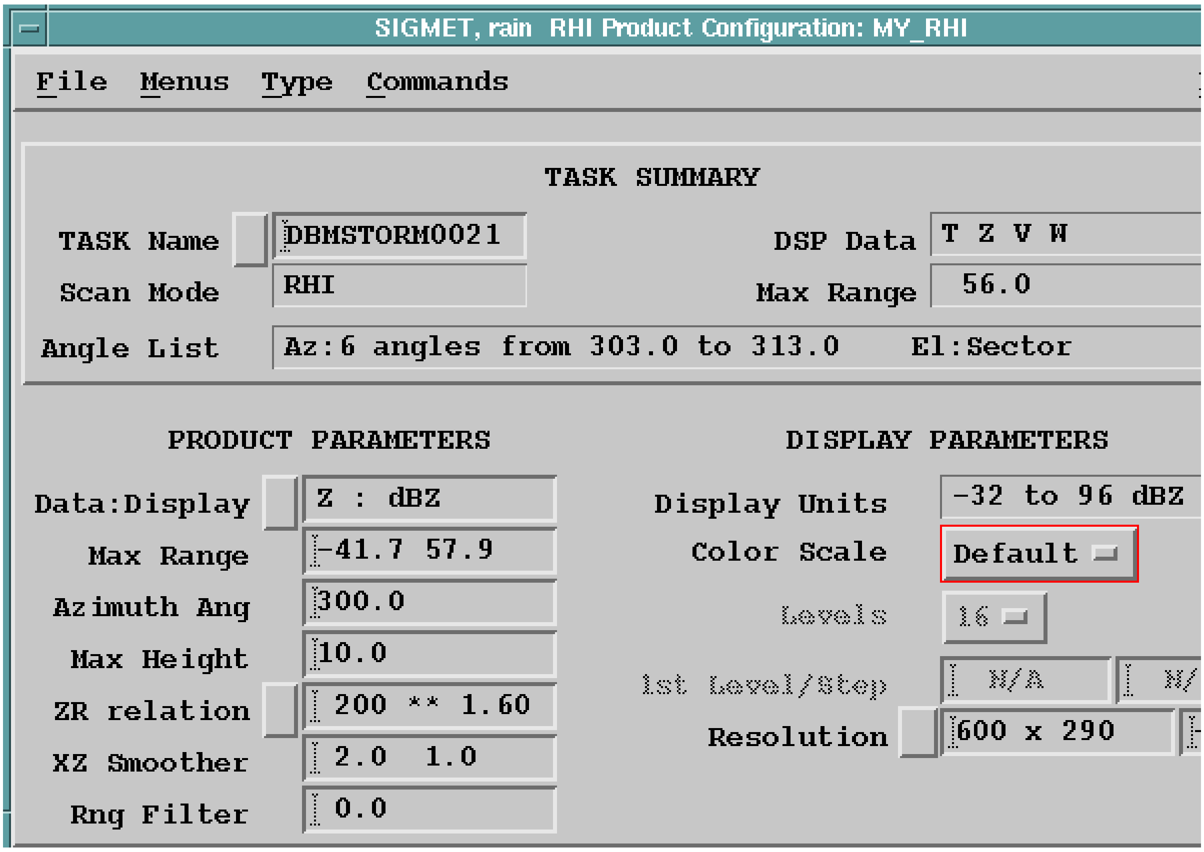
3.12.1 Recording RAW Data Automatically

To record a RAW product automatically whenever the associated TASK runs, perform the following steps after you have configured the RAW product:

1. Load the associated TASK into the TASK Scheduler and choose –>**Go** to get it running.
2. In the Product Scheduler menu, load the product and choose –>**All**. This causes the RAW product to be generated every time the TASK runs.
3. In the Product Output menu, specify the desired archive media as the output device and choose –>**All** in the header line for the product, so all output is sent to the archive.
4. In the Archive menu, mount a tape or disk and choose **Commands**–>**Record**.

NOTE	Note: Because RAW products require substantial disk space, it is best to record them "on the fly," so they are not automatically deleted by the disk Watchdog.

3.13 RH I: Range Height Indicator



- Task Summary area, Task Summary on page 24.
- Product Parameters, see Product Parameters on page 31.

- Display Parameters area, Display Parameters on page 34.

The RHI product is excellent for viewing the detailed vertical structure of a storm. In general, you should schedule the associated RHI TASK through a region of interest. During RHI scanning, the antenna azimuth is fixed and the elevation is swept, typically from near 0 to 90 degrees to create a vertical cross-section effect. If your antenna permits, it is often useful to make an over–the–top RHI task (elevations e.g. -2 to 182). Thus, you get one picture covering two elevations at the opposite sides of the antenna. Negative elevations are most useful in RHI if you select the azimuth to the direction of least beam blocking of the radar horizon.

To open the RHI Product Configuration menu:

Choose **Type**–>**RHI** from the menu bar.

Data : Display

You can choose any of the data types defined in your RHI task, and in addition to that, if you measure V you can select SHEAR ar output data type for radial shear. Radial shear is simply differences between the velocity of successive bins in range. Note that SHEAR is allowed as an output data type to the RHI, but not to other similar products like PPI.

Max range

You can enter two values in format of xx.x kilometers. If you enter only one, the first one is assumed to be zero. The first limit is the beginning of your display. Zero means the image starts from the radar site. You can enter negative values, then data is picked from another azimuth on the other side of the radar site in the same task, or if your task is scanning over–the–top. You can also enter positive values, especially if you don't use high elevations and you want to avoid the flat corner of a triangular–shaped image. See the chapter Max height about negative elevations.

Azimuth Angle

RHI product configuration requires that you specify an azimuth angle, which you may not know in advance. This is not a problem — IRIS selects the closest angle at run time, so you are always assured of getting a display. If the associated TASK has only one azimuth angle sweep, that is the angle used for the RHI product.

If you enter * to the field, the product is made for every azimuth in the associated task.

Max Height, XZ Smoother and Range filter

Specify the Max Height field in XX.X km. Because you specify both the maximum range and height, you can make an RHI at any horizontal-to-vertical aspect ration. Note that the final display will be from 0 to the Max Height above the reference height. The radar is located on the left edge, above the corner if the radar is above the reference. Negative elevation angles will be included in that case. Rays are inserted straight, and the grid of constant height lines is curved to show earth curvature. The X-Z (height) Smoother values can be entered independently in km.

If you have SHEAR as an output data type, it is somewhat noisy, and has to be smoothed with a "range filter". See the documentation in the SHEAR product (SHEAR: Wind Shear on page 182) for radial shear and range filter for details. This number is unused for data types other than shear.

Resolution

You can choose Low (288 × 136), Medium (600 × 290), High (840 × 530), or XHigh (1060 × 750) resolution from the Resolution pop-up menu, or enter a resolution directly into the field. RHI's look best with a rectangular resolution.

RHI or XSECT ?

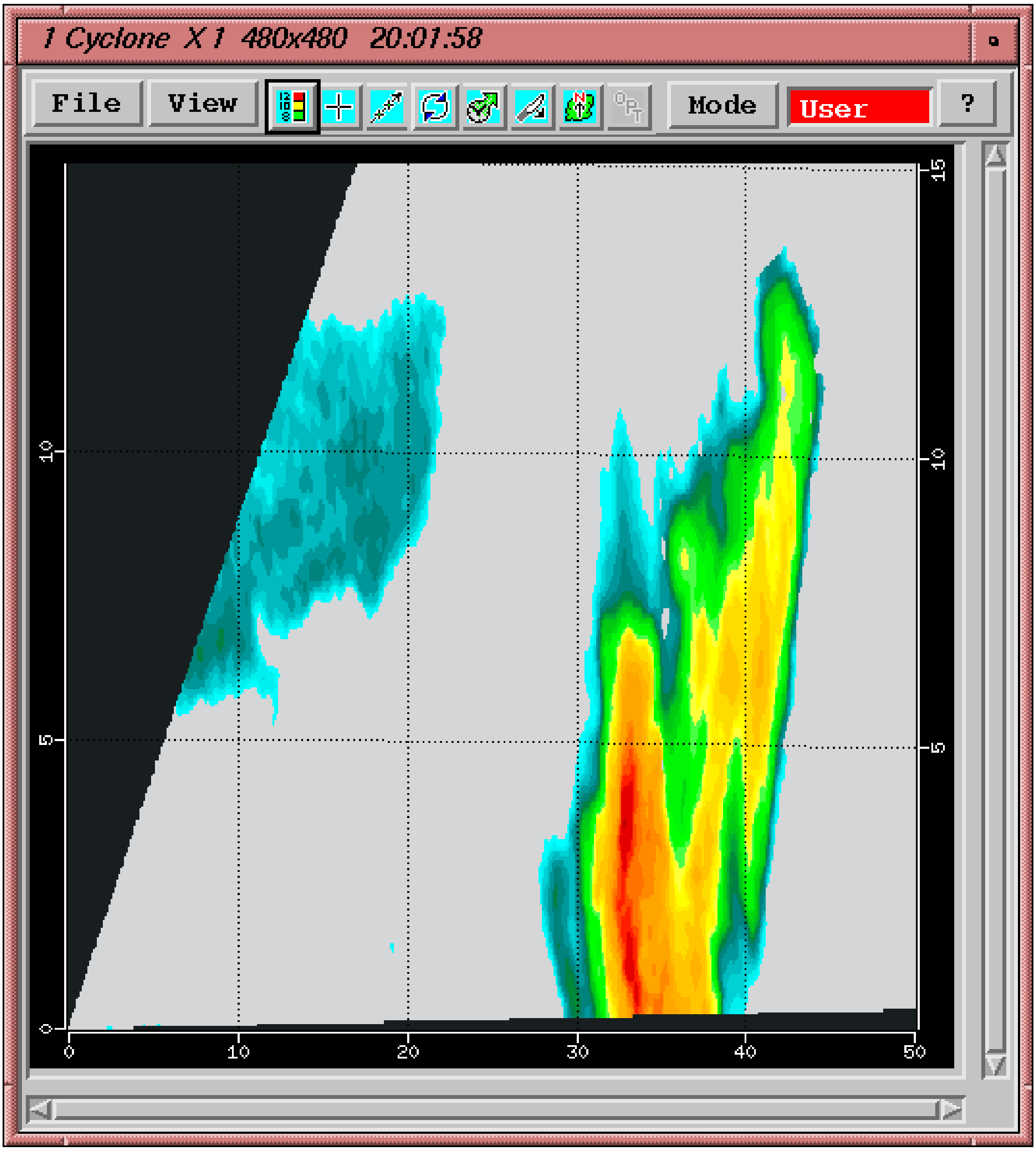
You can study the three-dimensional structure of the atmosphere with the XSECT and RHI tools. Typically, RHI gives you a much better resolution. If the user of the radar images can control the tasks, then it can be a good idea to define a product configuration in advance (using * for the azimuth), and when something interesting appears, run an RHI task with an azimuth determined with a help of other IRIS products.

If your radars are in a network of several users, or if your task schedule is tight, you perhaps can't let the users run RHIs whenever they want. Then a cross–section with XSECT product is a convenient option. While RHI has always one point fixed to the radar, a XSECT can be cut through any part of the polar volume. Remember, though, that you cannot get below the lowest elevation !

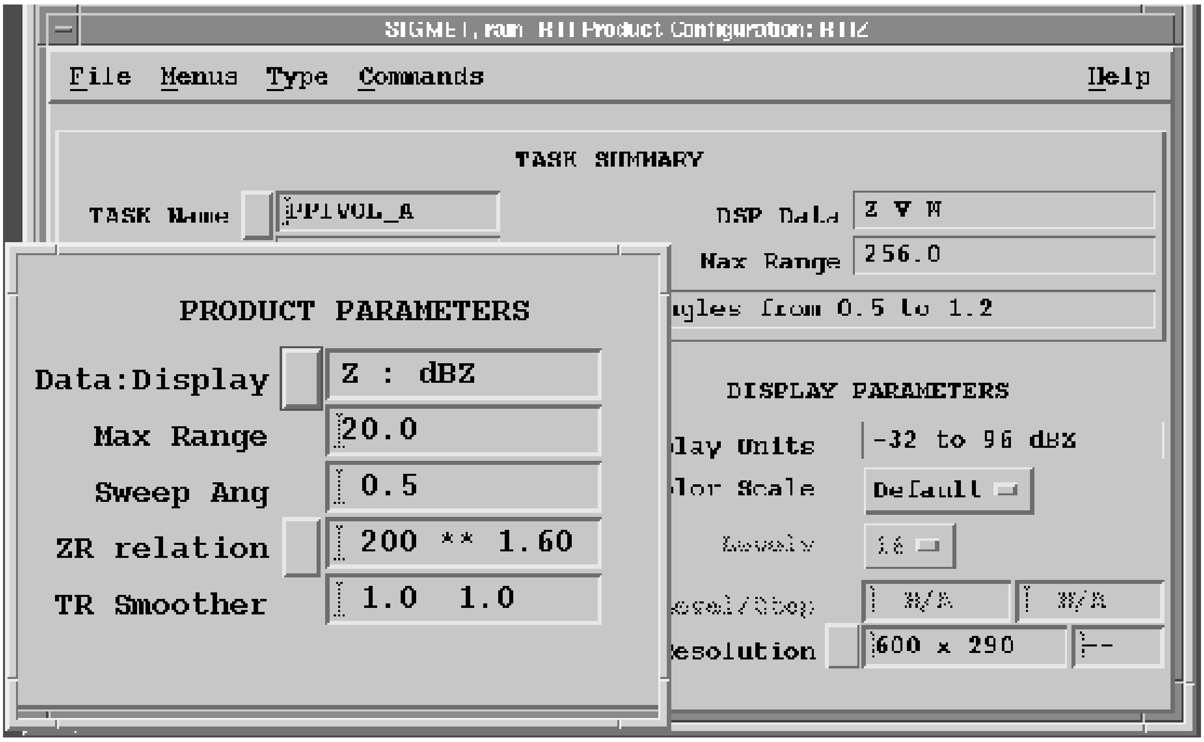
If you have particular areas of interest, such as paths to runways at an airport, you could run RHIs or XSECTs associated to those in you routine schedule.

Example

Here is an example of a cumulonimbus seen with RHI from the southern part of the US in summer. The RHI shows clearly that this is a powerful, actively growing Cb with top at 13 km. The echo over-hang and weak echo region on the right indicates a well–organized strong inflow and vertical motion, both characteristic of a severe thunderstorm. The reflectivity core (red is >56 dBZ) indicates a probable hail shaft. Upper level anvil, presumably from another Cb can be seen close to the radar. For detailed vertical structure, there is no substitute for a good RHI.



3.14 RTI: Range Time Indicator



- Task Summary area, Task Summary on page 24.
- Product Parameters, see Product Parameters on page 31.
- Display Parameters area, Display Parameters on page 34.

In an RTI plot, the horizontal axis is the time (seconds after the beginning of the scan), and the vertical axis is the range from the radar. This type of display can be used for any scan type (e.g., PPI, RHI), but is most useful for manual scans or "searchlight" scans which are manual scans at a fixed position. Perhaps the best application is for vertical incidence scanning in which case the RTI product shows a time-height cross-section of the atmosphere.

To open the RTI Product Configuration menu:

Choose **Type**–>RTI from the menu bar. The fields are described below.

Data: Display

Choose any parameter available in the task configuration.

Max Range

Enter maximum range in kilometers.

Sweep Angle

Select any of the elevation angles in the task. You can see a list of them in the upper part of this menu, at Angle list.

ZR relation

How to transform reflectivity (dBZ) to rainfall intensity (mm/h). This is used only in the case when you select rainfall rate (R) for output.

TR Smoother

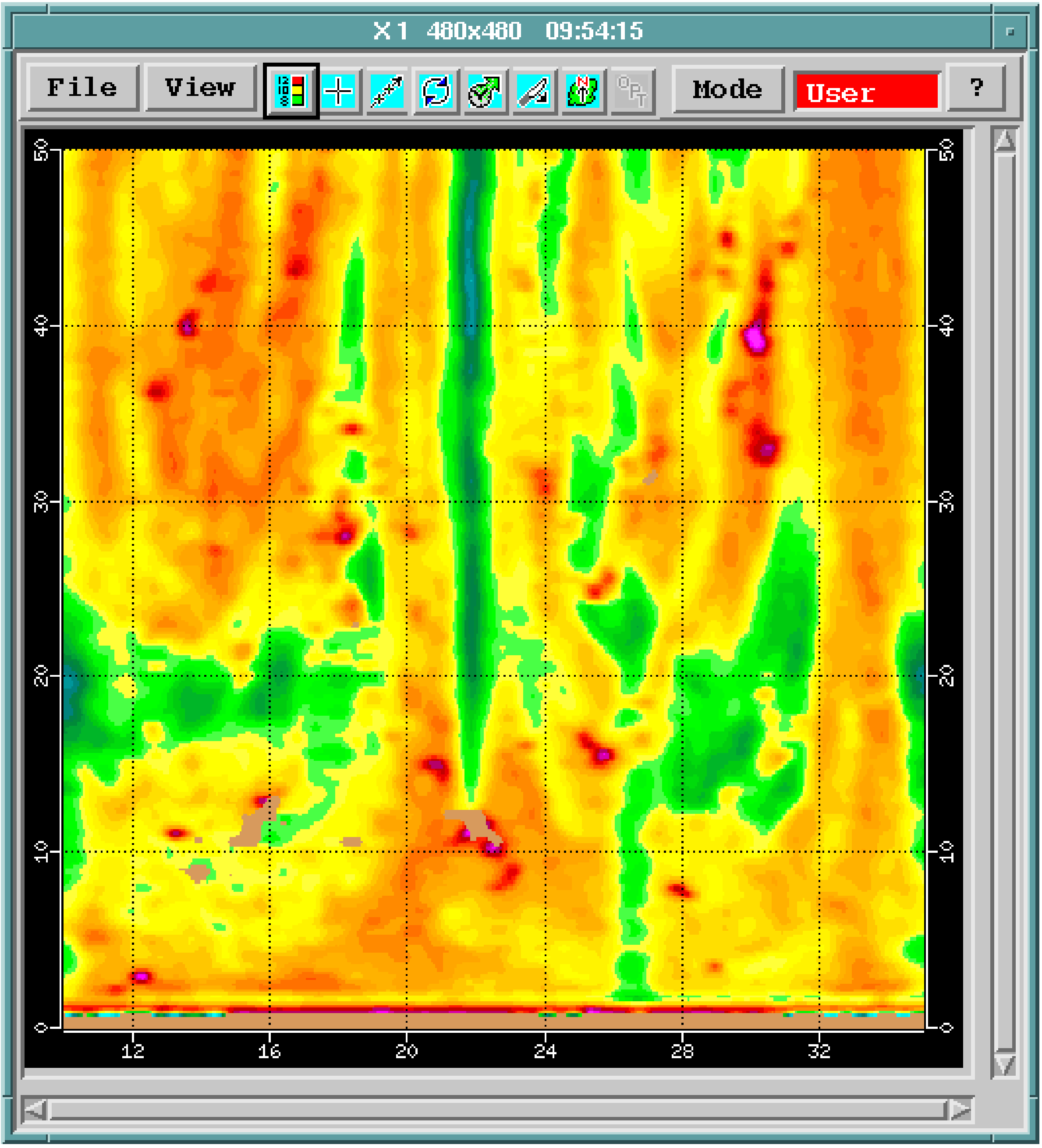
Smoother in XY directions of the RTI image. Typically, a small value is used for research purposes and a bigger value for customer products. The time direction smoother is expressed in seconds, the range direction in km.

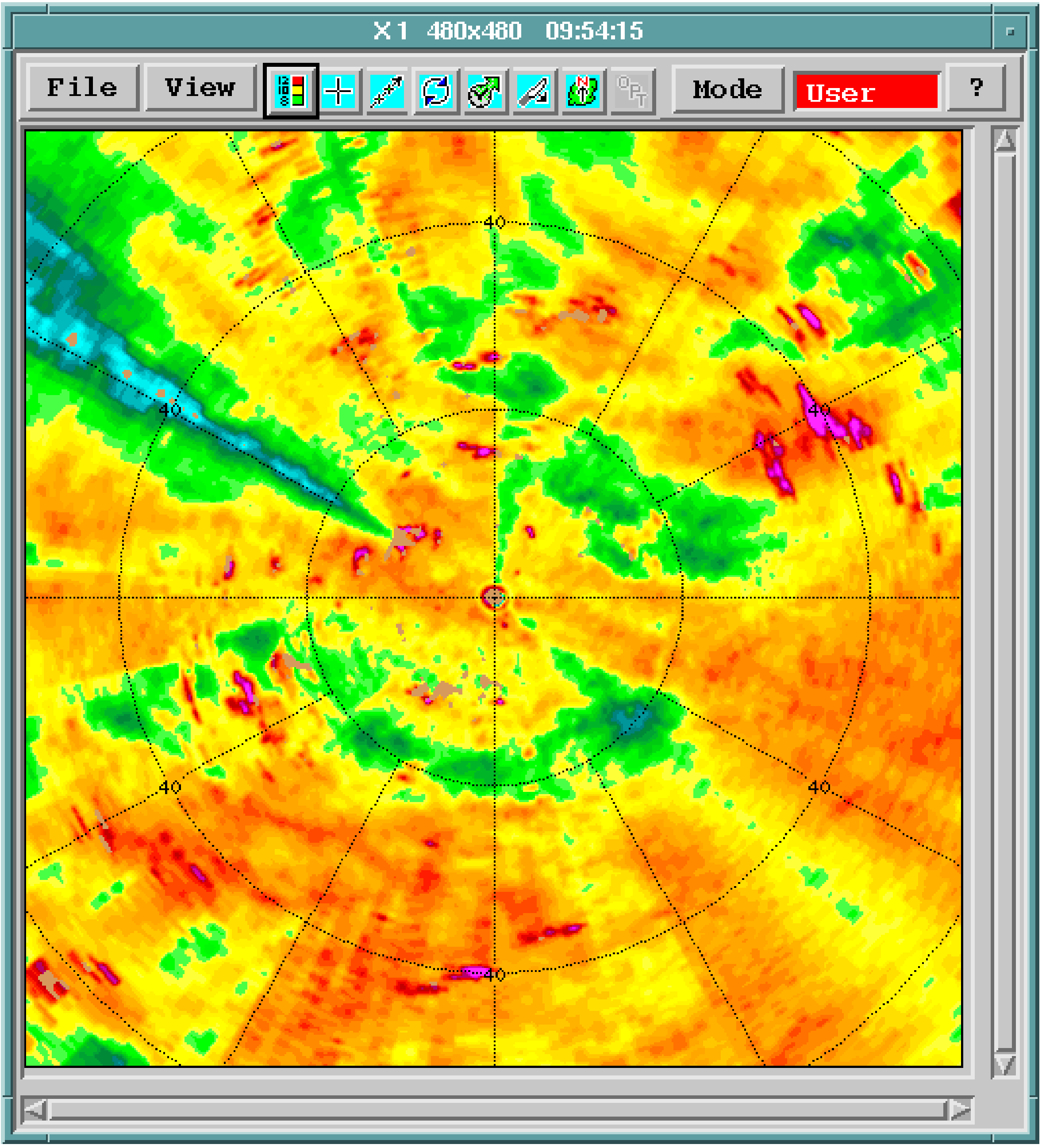
Resolution

You can choose from four resolutions: Low, medium, high and extra high. The default resolutions are rectangular to match the default rectangular window sizes of the Quick Look Window.

Examples

Here you see a RTI and a PPI from the same situation. From both pictures, the maximum range is 50 km and the color scale is same. In this case, RTI has been made from a PPI task rotating 10 degrees per second so the horizontal axis is both seconds from start and azimuth in tens of degrees. You can see the weak echo region near 220 degrees, starting from 15 km in both. This can be beam blocking, which is probably easier to recognize in the RTI.


X1 480x480 09:54:15
File
View
Mode
User
?
50
40
30
20
10
0
12
16
20
24
28
32



3.15 SRI: Surface Rainfall Intensity

Overview

IRIS Surface Rainfall Intensity product, SRI, is mainly used of as input into the RAIN1 product, to get the best possible estimates of accumulated precipitation even at longer ranges from the radar.

Vertical reflectivity profile is the most important source of error in radar rainfall measurements in cool and moderate climate. Upper parts of precipitating clouds give typically weaker echo than the cloud base, except near melting layer where the echo is much stronger. Thus a correction is needed to estimate surface rainfall intensity.

IRIS SRI allows the user to apply his/her local knowledge and provides several ways to input infomation of the actual reflectivity profile, as well as methods to make educated first guesses. It distinguishes convective cases from large scale precipitation, and applies the correction only to the latter, while for convective precipitation the value of the lowest clutter free bin is presented.

The reflectivity profile and melting level estimation will not be perfect, but they will improve the rainfall estimates as compared to performing no correction. The typical corrections obtained will be of the order -10 dBZ to +5 dBZ (in mm/h scale up to factor of 4 !) depending on the melting level altitude, distance from radar and the lowest elevation angle. For a discussion of profile corrections refer to articles mentioned in the end of this chapter.

Algorithm

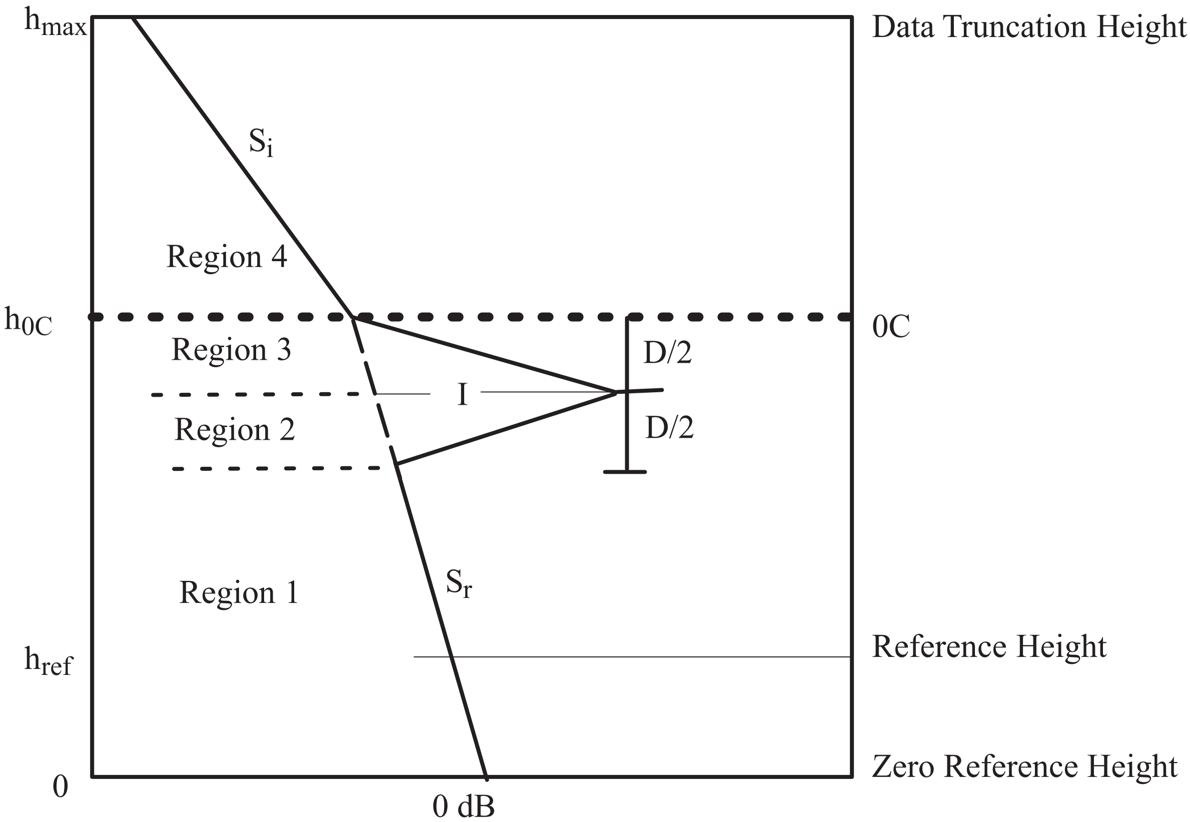


Figure 5 Example reflectivity profile

The profile includes the following features and definitions:

- Height h=0 corresponds to the setup/product "Zero Reference Height". This is typically set at either the nominal ground level or sea level.
- The max height corresponds to the setup/ingest "Data Truncation Height"
- The reflectivity varies linearly in dBZ above and below the bright band. Separate slopes are used above and below the bright band (S_r for the rain and Si for the ice).
- The bright band starts at the 0C level ($h=h_{0C}$), has depth D and intensity I, defined as the intensity difference between the peak and the intensity the rain would have at the center of the bright band, i.e., determined by the continuation of the rain slope into the bright band.

The surface rainfall intensity at each pixel is calculated by finding the lowest clutter-free bin, and bringing the measured reflectivity there down to reference level by making two corrections:

- 1.) The correction for the beam weighted averaging.

- 2.) The adjustment for the profile to obtain the reflectivity at the reference height.

The SRI product also supports using a terrain map to determine the height that that radar beam is corrected to. See Format of the Terrain Map File on page 86 for the file format.

Convective check algorithm

In convective precipitation there is usually no detectable bright band or perhaps a very weak one. This is thought to be caused by the types of particles near the melting level that are typical of convective precipitation. These are usually heavily rimed snowflakes, graupel, frozen drops (carried aloft) and even hail. Since these particles tend to fall more rapidly than snow aggregates, they do not contribute to a bright band in the same way as large wet snow flakes falling at 1 m/s, i.e., there is no convergence of large wet particles.

Thus in cases where the precipitation is convective, it is not appropriate to perform a profile correction that includes a bright band and serious errors could result from doing this. In the SRI product this is handled by detecting convective regions and not applying any profile correction, i.e., the measured value of the lowest clutter free bin is assigned to the reference height. This is done because in convective regions, the vertical reflectivity in the lower altitudes tends to be rather constant in height.

Each range bin is checked to determine if it is a "convective" range bin. The approach is to run an echo tops algorithm within the SRI product for a selectable threshold. Note, this is done entirely within the SRI so there is no need to define a separate TOPS algorithm for this. The product, in cylindrical coordinates, is made at the same resolution as that selected for the SRI product. It is then used as a "mask" for determining convective regions, i.e., any bin in a ray for which the top height is more than a selectable height above the melting level is assumed to be convective.

3.15.1 Input reflectivity profiles

User defined profiles

Reflectivity profile is defined using five parameters.

- Reflectivity gradient above the melting layer. (7 dBZ/km)
- Reflectivity gradient below the melting layer. (1 dBZ/km)
- Melting layer height. (given in tenths of kilometers)
- Melting layer thickness. (1 km)
- Melting layer peak intensity (7 dBZ)

The melting layer height is given to the **setup**/product. The value can be changed without restarting IRIS by using the **setup_change** utility, thus giving a possibility to adjust the reflectivity profile frequently based on external data sources such as numerical model or temperature soundings.

The melting level is attached to the ingest file. Hence, in a network of several radars and separate analysis machine, the profile information is given to the IRIS at each radar site.

Setting the current melting level without restarting IRIS

Normally, when you change the **setup** files, you have to quit and start IRIS to have the changes valid. For SRI this is not practical, since in the case of fast moving front you might want to update the melting layer height every hour! Changing setups while IRIS is running is made by pushing information through a pipe to a program called **setup_change**.

Open a terminal window and type the following command:

```
$ echo "iris_setup.misc.ifallspd_melts[1]=20" | setup_change
-load
```

This changes the February melting level to 2.0 km. Note the number of the month is UNIX style table index, thus 0 is January, 1 is February etc. The units are in 1/10 of km. You can change many of the profile and melting level setups on the fly.

Several changes can be made at the same time, if the data is put in a file, as follows:

```
$ echo "iris_setup.misc.ifallspd_melts[1]=20" >testfile

$ echo "iris_setup.misc.ifallspd_melts[2]=25" >>testfile

$ cat testfile | setup_change -load
```

Or, alternatively you can put several name=value pairs in the same string if separated with "\n". You can ssh this string from a central computer to all your various radars. This interface is primarily intended to be invoked from automated script files. To see the current values you can type the following:

```
$ setup_change -list | grep ifallspd
```

Note that setup also can specify that the melting level is not known. If your system has it set invalid in **setup**, then you need to also set is valid, and similarly invalid when you stop providing this information. The string to do this is:

```
"iris_setup.misc.lMeltHeightValid = 1"
```

Methods to get the input data

The most accurate way to determine the melting layer height is to study measurement from the same radar at the same time when the profile correction is needed. Melting layer is seen nicely in IRIS VVP and XSECT products of either reflectivity or, even better, vertical velocity. However, this is not always available: when the precipitation area is approaching the radar, there is data only from the upper parts of the profile.

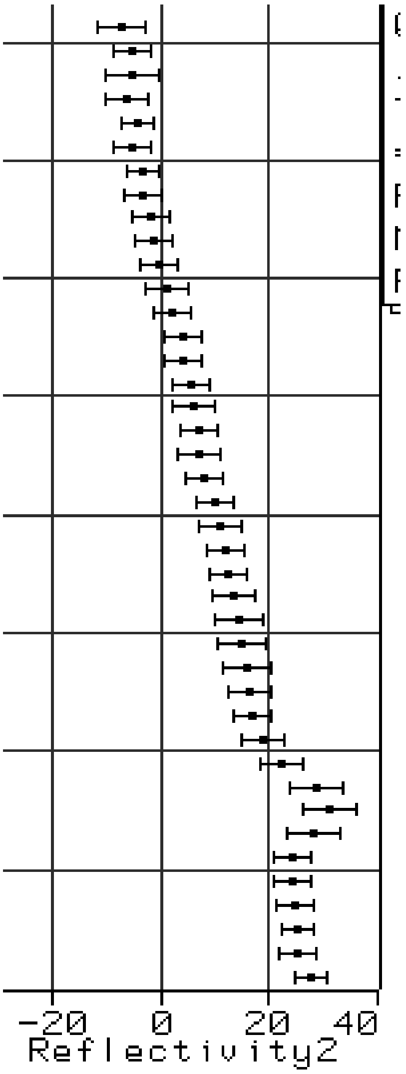


Figure 6 Example of VVP Reflectivity profile

Numerical weather prediction models and balloon soundings are good sources of temperature profiles.

A bulk method is to take average temperature (daily or even monthly averages) and calculate the melting level height assuming the moist adiabatic lapse rate 6.5 deg C / km. This lapse rate is a rather good estimate during the precipitation event.

To get you started, here is a table to be used if nothing else is available. It describes a first guess of melting level height in three different climates on the Northern Hemisphere.

Table 4 Suggested Monthly Melting Height Values

Month	Polar climate	Mid latitudes	Tropics
January	-1	1	2.5
February	-1	1	2.5
March	-1	1.5	3
April	0.2	2	3.5
May	1.3	2.5	4
June	2.2	3	4.3
June	2.5	3.5	4.5
August	2.0	3.5	4.5
September	1.5	3	4.3
October	0.5	2.5	4
November	-1	1.5	3.5
December	-1	1.0	2.5

What if there is no melting level ?

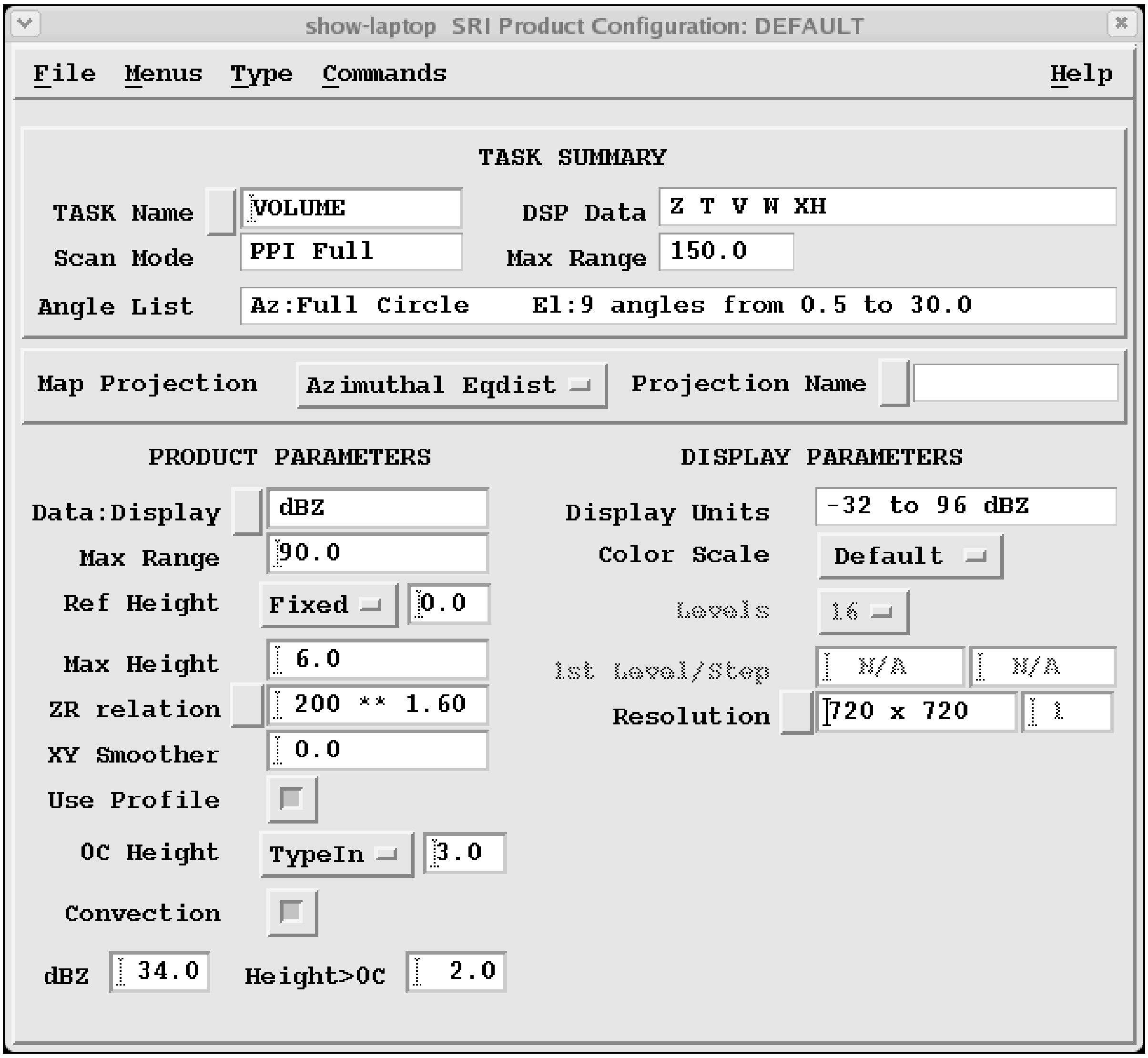
When it''s snowing, there is no melting layer (indicate by –1 in the table above). Then the profile becomes a simple descending line, defined by parameter set

- Reflectivity gradient above the melting layer 7 dBZ/km
- Reflectivity gradient below the melting layer 0 dBZ/km
- Melting layer height. 0 km
- Melting layer thickness. 0 km
- Melting layer peak intensity 0 dBZ

The most demanding task is to get the profile right when the melting layer is close to surface. Even small errors misplace the bright band and thus lead to severe overestimation and underestimation close to the radar. If you can't change the profile frequently, and the temperature fluctuates below and above zero with bright band appearing and disappearing, we recommend you apply the snow profile as described above. Thus you still have the bright band overestimation problems, but at least you fix all the weakening above the bright band.

NOTE	Note: Make sure you give the altitude information from external data source referring to the same reference height (sea level, antenna level) as defined in IRIS setup. Please be careful when the bright band is close to ground.

3.15.2 Product Configuration



This section describes the fields of Product Configuration menu that are unique to SRI products. For general information, see these other sections of this chapter:

- Task Summary area, Task Summary on page 24
- Map Projection Area, Map Projections on page 26

- Product Parameters, see Map Projections on page 26
- Display Parameters area, Display Parameters on page 34

DSP Data and Data Display

SRI products need two kinds of data as input: T and Z values. Make sure that both are recorded in your task. For Data Display you can select if you want to see the result in dBZ or in intensity mm/h (dBZ:R) . dBZc and dBZc:R the "c" refers to the included corrections for attenuation, beam blockage, etc. as configured for the TASK. Even if you display mm/h, the convection threshold is given in dBZ.

For radar systems that import data, the SRI product can also run without T (Total power) data. In a such a mode, the "lowest clutter-free bin" feature will not be available, but the product can still be run.

Ref Hgt

Reference height to which the reflectivity profile of the SRI product is calculated. You can select either "Fixed" or "Map". If you select "Fixed", then type in the height you wish in km. This is height above zero reference. If you select "Map" then IRIS will get the height information from a terrain map file, see Format of the Terrain Map File on page 86.

Max Height

Maximum height where the "lowest clutter free bin" is searched for. If there are no clutter free bins below this height, no correction is performed. It is important to set a reasonable level, like below 5 km. Note that at far ranges, when the lowest beam is above the Max height, the lowest beam is still used.

Use profile

Having this button on causes a profile to be used in the correction. HINT: If you want to switch the correction temporarily off, this is an easy way to do it, and you don't have to change other places of your production chain.

0C Height

There is three ways to input the height of the melting level: Ingest, Setup, and Type-In. For **Ingest**, the height of the melting level is extracted from the **setup** on the radar computer at the time of the measurement. (This is important if you process archived data.) All the other gradient numbers are pulled from the current setup on the product computer. **Setup**, means that IRIS will use the melting level heights given in General Setup on the product computer. **Type-In** lets you to enter the value in adjacent box, which is very convenient for interactive testing of the product.

If you have a network of radars and make the products centrally in one IRIS analysis, you can set an individual melting level for each radar at the Setup of the IRIS radar and use "ingest" setting here. If you want to use the same melting level for all radars and keep adjusting just one value, then you can select "Setup" here.

Convection

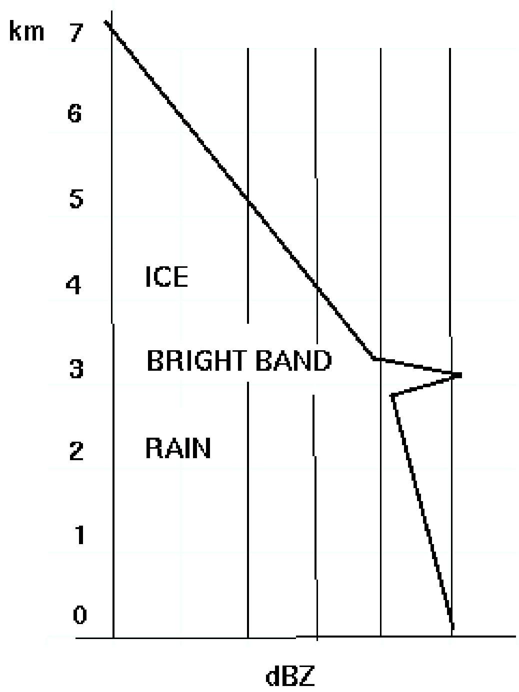
If you switch the convection check button off, all precipitation is corrected with the above given profile. If you have it on, you can define criteria to determine whether precipitation is convective or large scale, and only the later is corrected. Convection is defined as an area of strong (precipitation) echo above melting layer.

The **threshold** (in dBZ) is given in the first box. This would be determined by customers based on the intensity of convection in their locale. Typically a value of 35 to 40 dBZ would be appropriate for most locations in mid latitudes, 20 in cool climate.

The convective top **height** (how much above melting layer it should be, in km) in the next box. This would typically be set at 1 to 2 km to allow some clearance above the bright band. The suitable value for threshold height depends of the accuracy of the melting level height estimate. The smaller the value, the more often pixels are considered convective.

3.15.3 Correction example

Here is an example of the profile correction in a typical situation with bright band at 3 km, gradient below the bright band (in rain) 3 dBZ/km and above the bright band (in snow) 10 dBZ/km. Radar is located at height of 0 km and the reference height is at 1 km. Full power half beam width is 1 degree. The correction is calculated for 2 elevations, 1.0 degrees (in black) and 2.0 degrees (in grey). Note that the correction is negative near the radar where measurement it made below the reference height and that the curves have different shapes since the bright band is filling the Gaussian beam only partially.



The reflectivity profile in the case of the example. Note, that at high altitudes the profile soon reaches values below the minimum detectable signal MDS, and or the cloud top.

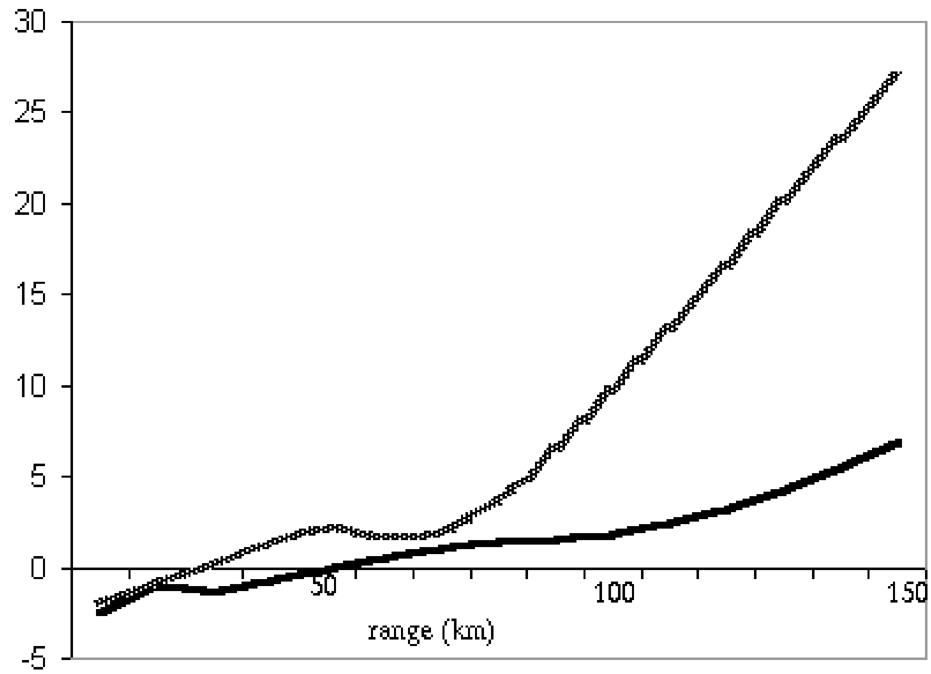


Figure 7 Example Profile Correction vs. Range

Profile correction in dB as function of distance from radar for elevations 1.0 degree (black) and 2.0 degree (grey).

3.15.4 Format of the Terrain Map File

The terrain maps are stored in a file called "surface_height.conf" in the ${IRIS_CONFIG} directory. This file contains information for each radar site stored in a simple ASCII polar format. Here are the first few lines of such a file:

```
SITE Boston

AZ_RESOLUTION 1.0

RANGE_RESOLUTION 1.0 300.0

AZ 0

5

3

3

3

8

14

15

12

10
```

The **SITE** command indicates the site name for data until the next SITE command.

The **AZ_RESOLUTION** specifies the azimuth resolution of the file. In this case it is 1 degree. We would expect to find 360 different azimuths in the file. Match this to your normal azimuth resolution, though it will find the closest in any case.

The **RANGE_RESOLUTION** specifies the range step in km, and the total number of km we are going to. In this case, 1 km steps out to 300 km.

After that comes the **AZ** command, followed by the surface altitude in meters for each km in range. After 300 altitudes will come another AZ command, then possibly another SITE command.

References

Koistinen, J. (1991). Operational Correction of Radar Rainfall Errors due to the Vertical Reflectivity Profile. In *Proceedings of the 25th International Conference on Radar Meteorology*, AMS 1991, p.91–94

Joss, J. and Pittini, A. (1991): Real–time Estimation of Vertical Profiles of Radar Reflectivity to improve the Measurement of Precipitation in an Alpine Region. In *Proceedings of the 25th International Conference on Radar Meteorology*, AMS 1991, p.828–831

Vignal, B., Galli G., Joss J. and Germann, U. (2000): Three Methods to Determine Profiles of Reflectivity from Volumetric Radar Data to Correct Precipitation Estimate *Journal of Applied Meteorology* 39(10) 1715–1726

3.16 STAT: IRIS System Status

Overview

STATUS products are normally made on all IRIS systems that are critical to system operation, this usually includes the radar host, the product generator, and sometimes critical display systems. These products are very much like other products, for example PPI and RAW products. They show up in the product output menu, and they can be transferred to other IRIS systems using the product output menu. Rather than containing radar data, they contain information about how well the source IRIS system is working. When transferred to another IRIS system, the receiving system becomes aware of faults or problems with the sending system. For example, the radar–host status products are distributed to essentially all the systems in a radar network, and the red–X is displayed on various windows based on these STATUS products.

Configuration

Status products can are configured in the Product section of the IRIS setup menu. See the *IRIS Utilities Manual* – Section 8.7.2 for more information. Once STATUS products are enabled, they can be configured for output in the product output menu. SIGMET recommends the following steps:

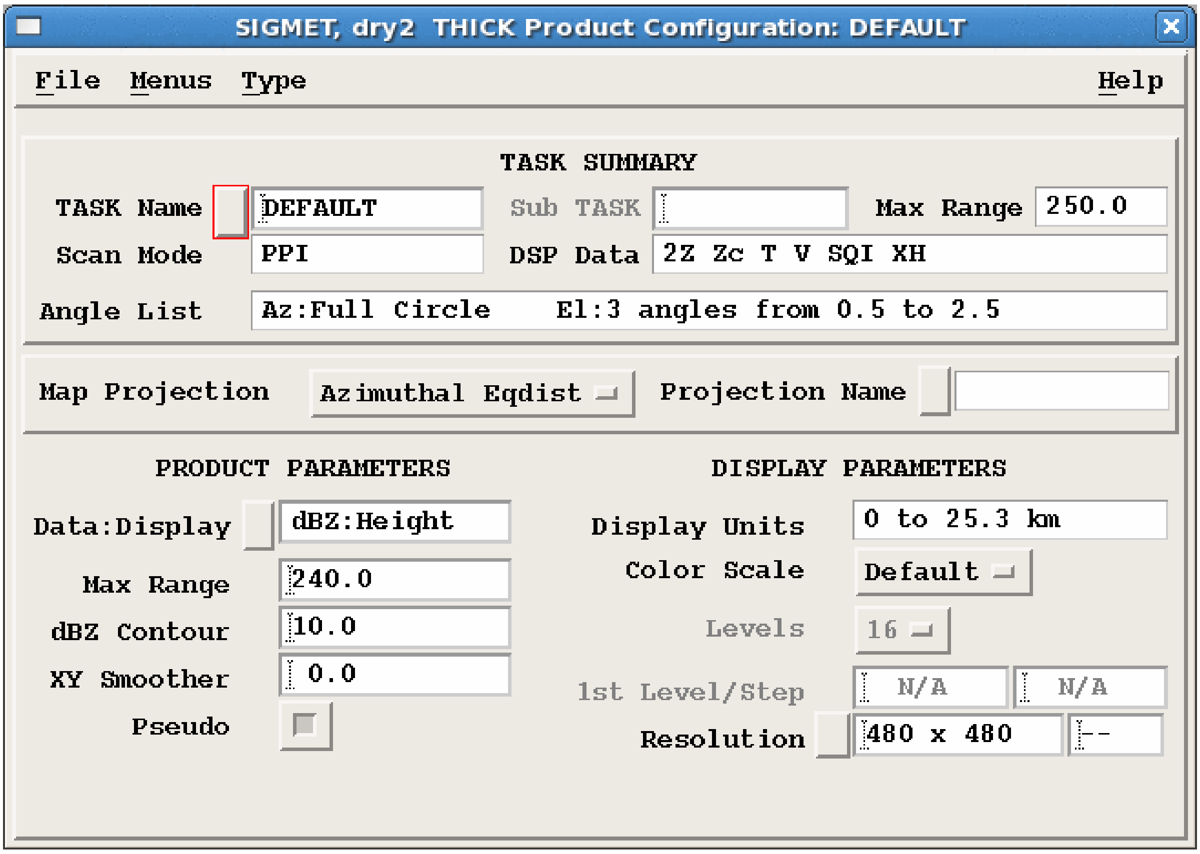
- Identify critical systems
- Identify separate receiving system(s)

- Configure STATUS products in **setup**
- Output STATUS products to receiving systems
- Determine which STATUS products will be referenced by the SIGNALS.DAT for action
- Configure the SIGNALS.DAT to take the appropriate action

Recommended Uses

STATUS products enables IRIS systems to alert other systems on the network that they are in trouble or that a particular event has just occurred. These messages can then be parsed by the SIGNALS.DAT file and actions can be taken (i.e. sending an email to a beeper or cell phone).

3.17 THICK: Echo Thickness Product



This section describes the fields of the Product Configuration menu that are unique to THICK products. For general information, see these other sections of this chapter:

- Task Summary area, Task Summary on page 24.

- Product Parameters, see Product Parameters on page 31.
- Display Parameters area, Display Parameters on page 34.

The THICK product is used to detect the thickness of cloud echoes. It is the same as the difference between the TOPS and BASE values. The user specifies a "dBZ Contour". For each output pixel in the product, the algorithm searches downward through successive elevation angles to find the height at which the signal goes above the the contour. Similarly it searches up from the lowest elevation angle to find the height at which the signal goes back down below the contour. The thickness is the difference between these. The THICK product also computes the average reflectivity within the layer identified by the select "dBZ Contour".

The final output of the product is a color-coded map of echo thickness heights for the selected dBZ contour. Users may also use the OPT button within the IRIS Quick Look Window to optionally display the average reflectivity within the same layer. Optional Cartesian smoothing can be applied

The THICK product suffers from all the limitations of both the TOPS and BASE product.

To open the THICK Product Configuration menu:

Choose **Type**–>**THICK** from the menu bar.

Data : Display

The choices are:

dBT Height

dBZ Height

dBZc Height

Max Range

This is to select the maximum range for the product. Recall that earth curvature effects are greater at greater ranges. You can display a PPI at your lowest elevation angle and use the cursor tool to see what heights are possible to observe at various ranges. For example, for a 0.5 degree elevation angle at 100 km, the beam is centered at 2.3 km. Therefore it will not be possible to detect echo bases lower than this.

dBZ Contour

This is to select the dBZ threshold for the echo base.

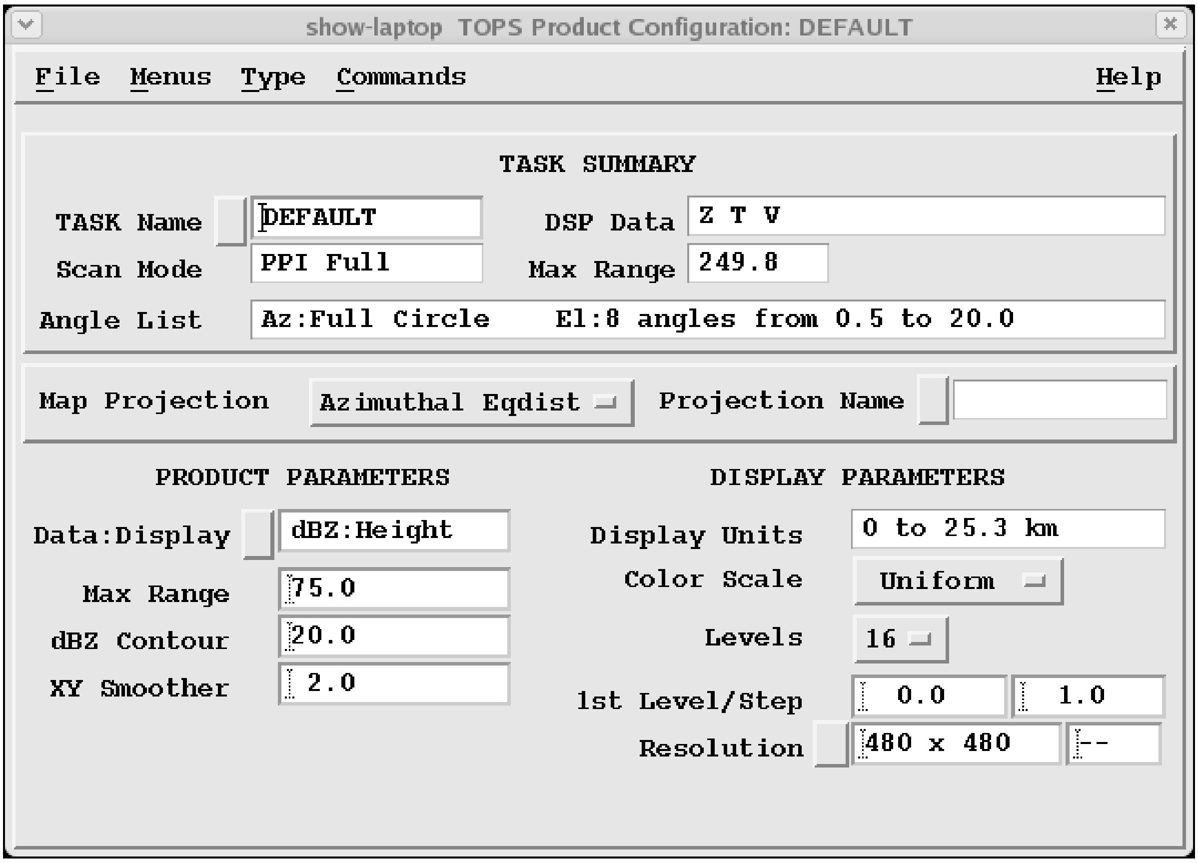
AZ/EL Smoother

The smoother is applied as the final step of the product generation. Enter the values in degrees, first for the azimuth and then for the elevation direction. Typical values would be 1.0, 1.0.

Pseudo

If you select this button, then all pixels at which the lowest elevation angle is above the contour will use the height of the lowest elevation angle as the base. Similarly, all pixels at which the highest elevation angle is above the contour will use the height of the highest elevation angle as the top.

3.18 TOPS: Echo Tops



This section describes the fields of the Product Configuration menu that are unique to TOPS products. For general information, see these other sections of this chapter:

- Task Summary area, Task Summary on page 24.
- Map Projection Area, Map Projections on page 26

- Product Parameters, see Product Parameters on page 31.
- Display Parameters area, Display Parameters on page 34.

The TOPS product is a display image of the height of the highest occurrence of a selectable threshold dBZ contour. Heights are displayed in kilometers and tenths of kilometers. A PPI volume scan TASK is required (either FULL or SECTOR).

The TOPS product is an excellent indicator of severe weather and hail. For example, a 50 dBZ top 1 km above the freezing level can be produced only by a vigorous convective storm, and is most probably caused by the presence of hail. For air traffic applications, the search can be made using a lower threshold value, such as 10 dBZ, to determine the height of surrounding precipitation.

To open the TOPS Product Configuration menu:

Choose **Type**–>**TOPS** from the menu bar.

Data : Display

Z	Height	The product can be derived from either Z or T data. If Z is selected as the Product Data parameter, but at run time only T is available (or vice versa), the product runs with the available data parameter.
T	Height	

dBZ Contour

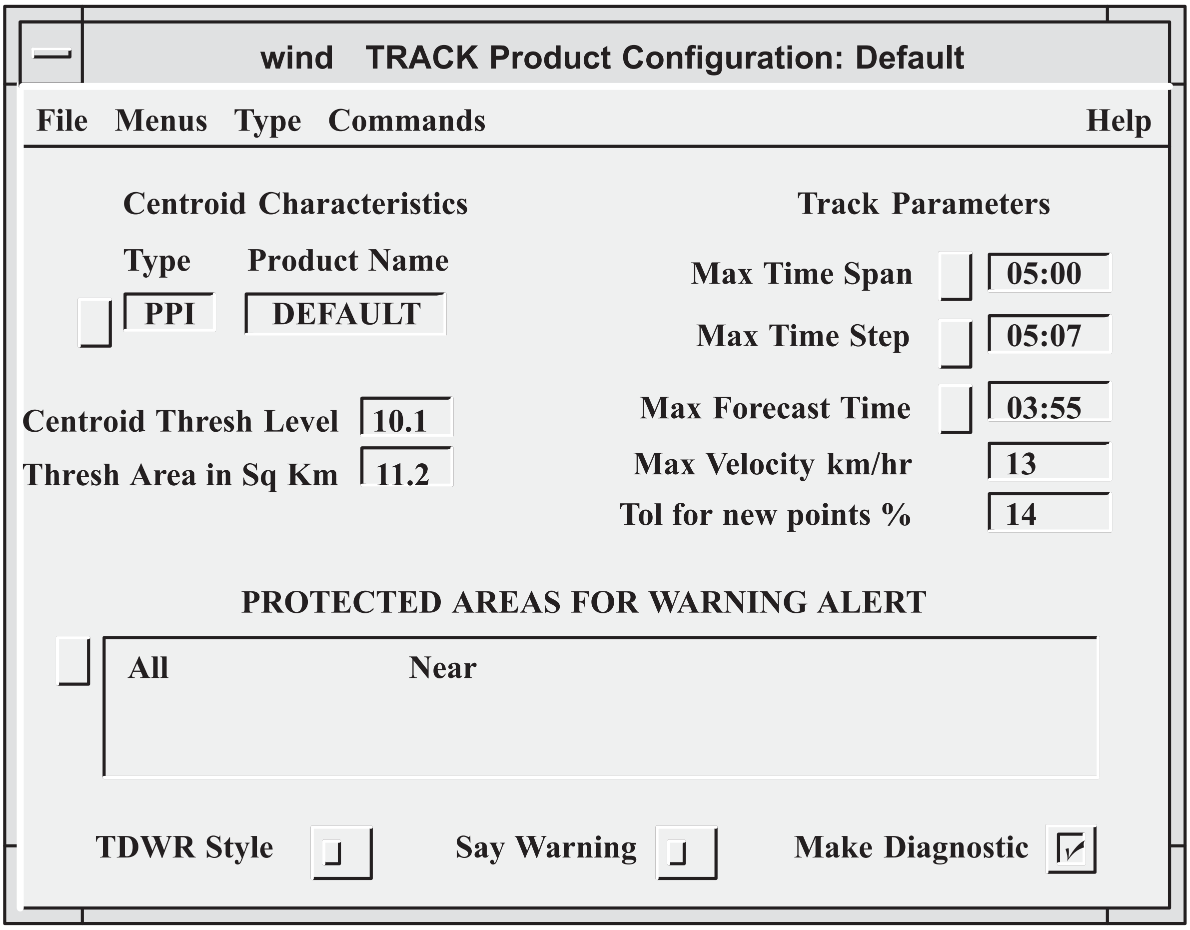
You can select the threshold contour level in dBZ. The TOPS algorithm then makes a downward search at constant range in cylindrical coordinates to determine when the threshold is crossed. It then interpolates in height to obtain the height of the threshold contour. Similar to the CAPPI, there must be an elevation tilt both above and below the contour to obtain a valid top height.

When the downward search detects a dBZ value greater than the threshold, there are three cases:

Normal Case	The dBZ value in the next higher ray (elevation angle) at the same surface range is used to interpolate the height of the contour that must lie in between.
Undetected Echo Aloft	If there is no detectable echo in the next higher ray aloft, then an interpolation cannot be done. However, a top must exist somewhere between these two rays. In this case, the top height is taken as the height of the point where the detection of dBZ >> Threshold was made.
No Ray Aloft	If there is no higher elevation angle aloft, then a top exists somewhere aloft, but there is no information as to how much higher the top may be. In this case a special color (indicated by "???" in the legend) denotes that an indeterminate top exists.

For example, at ranges less than 5 km in the volume scan shown in on page 26, the algorithm cannot determine tops that are above the highest elevation angle.

3.19 TRACK: Track/Forecast



TRACK products show the projected motion for storm features (centroids) based on a series of input products from different times. The TRACK product consists of a series of track points connected by lines, or "tracks." Each track shows the motion of one centroid over a specified time span, plus a forecast point showing where the centroid will be given its current direction and speed. A TRACK product may contain multiple tracks if more than one centroid shows up in the input product, as shown in on page 94.

The input product can be any horizontal Cartesian product, such as a PPI product. The TRACK product applies the same logic as the warning product to locate the centroids within the input product. You define the threshold level and size of the centroids, below which weather features are ignored. When new data comes in, the TRACK product compares the previous TRACK product to the new data to obtain a motion vector. This information is used to define the new TRACK product, including the forecast point. Warnings are issued if a centroid hits, or is forecast to pass through, a protected area.

As new data comes in, the TRACK product must determine whether a new track point is an extension of a previous track, the start of a new track (when a centroid is born), or the end of a track (when a centroid dies). Track parameters, such as the maximum velocity and tolerance for new points, influence this determination.

To open the TRACK Product Configuration menu:

Choose **Type**–>**TRACK** from the menu bar. You can use **File**–>**Open** to load an existing TRACK product.

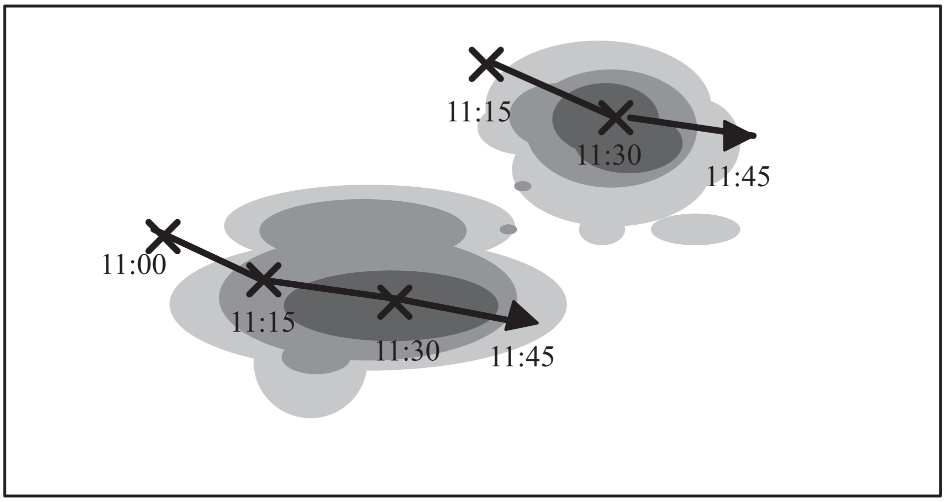
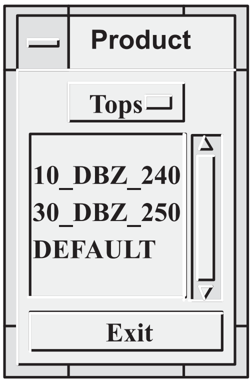


Figure 8 Track with Two Centroids

Product Type and Product Name



The input product type and name are specified by menu selection. Pick the type first, and the list of product names then corresponds to the selected type. Note that there must be a product configuration file for the type of product you pick.

In the case of products received over the network, you can make a product configuration file or copy the file over the network.

Centroid Threshold Level

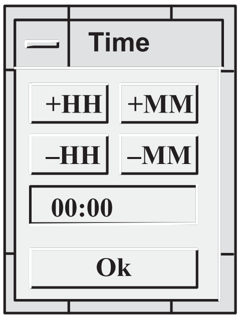
The TRACK product considers only those centroids whose values meet or exceed this threshold level. The units of measure depend on the selected product. For example, a Tops threshold is specified in km, while a VIL threshold is specified in mm. You may want to refer to the appropriate Product Configuration menu if you are uncertain about the units of measure.

Threshold Area in Sq Km

Enter the minimum size of a centroid region. Areas that do not meet or exceed this size are not tracked. Enter the desired value in sq km. For example, for a 3 km by 3 km size area, enter "9".

Max Time Span

Enter the maximum time allowed between the newest and oldest track points to be included in the TRACK product. When a new input product is processed, points that are older than this time span are removed.



You set the time using the plus and minus button to increase and decrease the hours or minutes. When you are satisfied, press Ok to exit from the window. The time you specify is inserted into the field.

You may also type a time value directly in the Time window and press Ok to insert it into the field.

Max Time Step

Enter the amount of time that can elapse between two points in the same track. If more than this amount of time has elapsed between the last point in a track and a new point coming in, the new point is considered the beginning of a new track.

Max Forecast Time

Enter the amount of time to project ahead for forecast points. The forecast time should be comparable to the lifetime of the feature that you are tracking. For example, for an isolated severe storm, a forecast time of 30 minutes would be typical. For a squall line, a period of 1 hour could be used. You will need some experience with the types of weather found in your part of the world.

Max Velocity

Enter the maximum velocity allowed between two points in the same track. If this velocity would be exceeded by a new point coming in, that point is considered the beginning of a new track. A typical value for this field is 100 km/hr.

Tolerance for New Points

Enter the margin of error that can exist between a new point and a forecast point. If the new point is within the tolerance limit, it is added to the end of the track and a new forecast point is created. If it falls outside the limit, a new track is begun.

Protected Areas for Warning Alert

Specify one or more protected areas. A warning is generated if a centroid falls within or is forecast to move into a protected area. Click on the Protected Areas button to see a list of areas. Simply toggle a choice on or off. When you exit from the list, the names of the selected areas are displayed in the field.

Protected areas are configured with the **setup** utility. They are constrained to be rectangles with arbitrary size and orientation angle. Up to 32 areas can be configured. (If you make a change to **setup**, you must restart IRIS for the change to take effect.)

TDWR Style

IRIS supports two formats of warning messages. In TDWR format, only the strongest centroid in the highest priority area is reported along with its strength. For example: "MBA 3MF 30K-", in spoken language: "Microburst Alert, Three Mile Final, 30 Knot loss". The older IRIS format reports all centroids in all protected areas, for example: "3 MBA warnings at 11:30 in: 3MF, 2MF". These messages are displayed at the bottom of the display screen, signalled as a pop-up when they are generated, and optionally spoken.

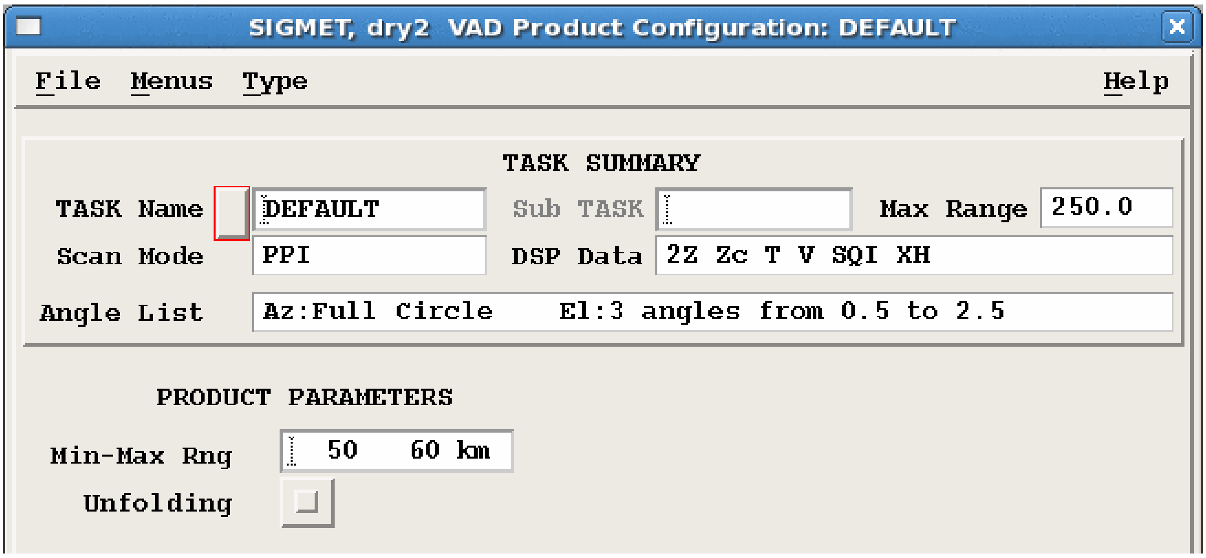
Say Warning

Pushing this button tells the product generator to verbally signal the warning message in addition to displaying it as a pop-up message. You must also select "Enable Speech" from the Setup pull-down menu in IRIS.

Make Diagnostic Results

In addition to the TRACK product, you can create a thresholded version of the input product, useful for testing purposes. Unless you encounter a problem with the TRACK product, you can turn this feature off.

3.20 VAD: Velocity Azimuth Display



This section describes the fields of the Product Configuration menu that are unique to VAD products. For general information, see these other sections of this chapter:

- Task Summary area, Task Summary on page 24.

There is not much to this product configuration, because it is really just a display.

Min–Max Rng

You can select the range over which to average the velocities. The VAD product will average all velocities in this range for all rays, and store a structure for each ray. This structure includes the average value, standard deviation, data count, as well as the azimuth, elevation and sweep number.

Unfolding

Press this button if you wish to enable unfolding the data before generating the product.

3.20.1 VAD Product Output

At display time you can select to see all of the elevation angles in the product, or just one. on page 98 shows an example of a single angle being displayed. This data has not been unfolded.

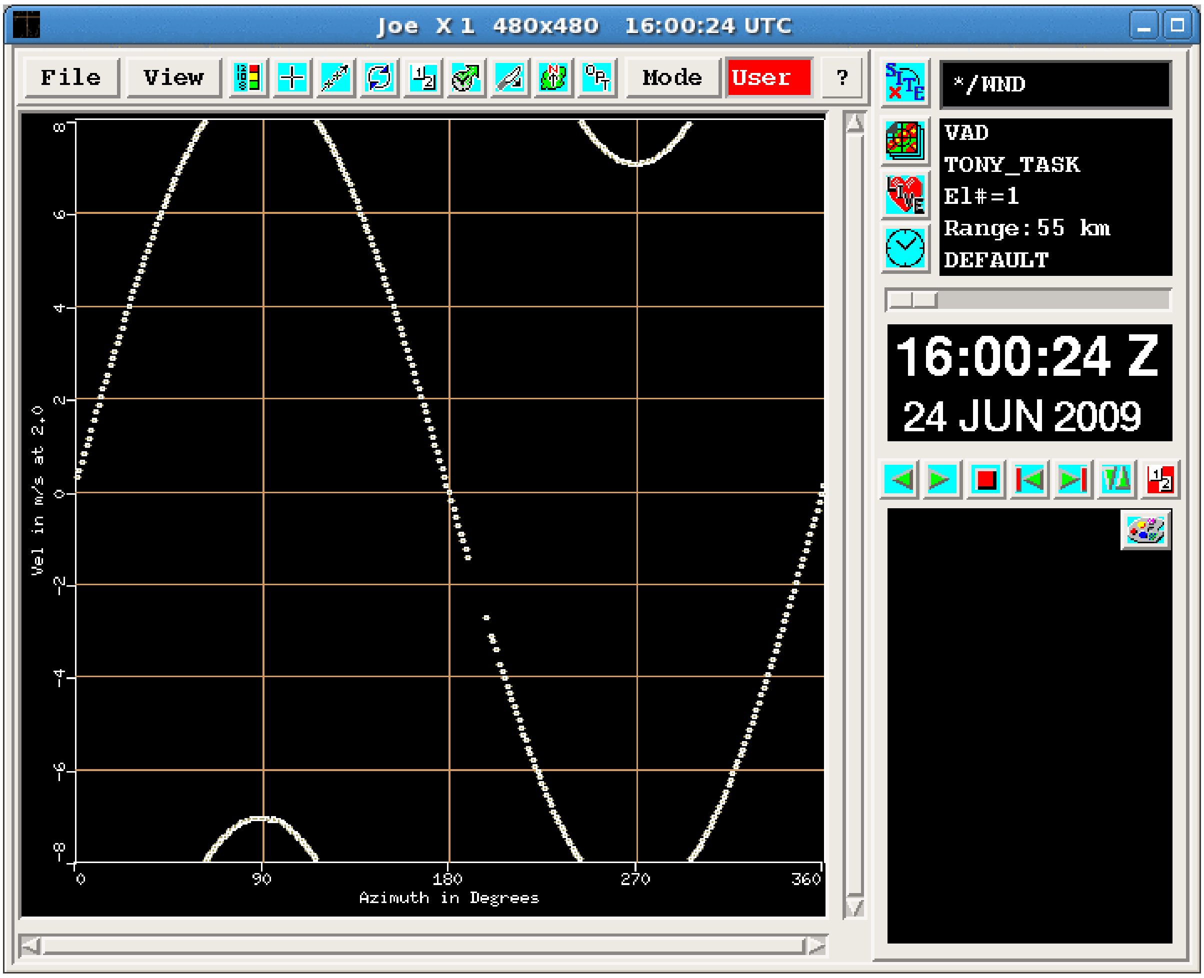
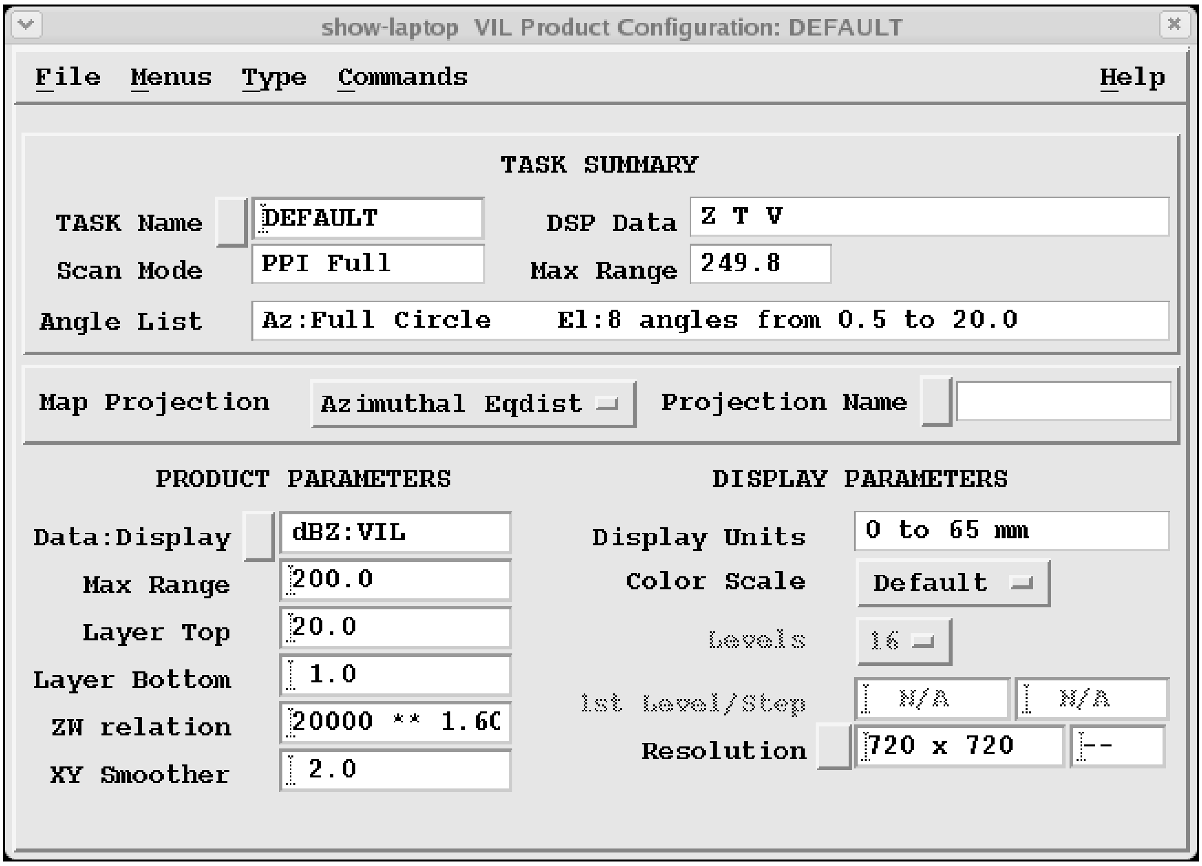


Figure 9 Example of Velocity Azimuth Display

3.21 VIL: Vertically Integrated Liquid



This section describes the fields of the Product Configuration menu that are unique to VIL products. For general information, see these other sections of this chapter:

- Task Summary area, Task Summary on page 24.
- Map Projection Area, Map Projections on page 26.
- Product Parameters, see Product Parameters on page 31.
- Display Parameters area, Display Parameters on page 34.

The VIL product can compute several different values over an altitude interval or layer in the atmosphere. It can compute integrated liquid, or averaged reflectivity. These can be excellent indicators of severe storm activity, especially with regard to the rainfall potential of a storm. Because VIL can be set to look over the entire depth of the atmosphere, it is good at seeing precipitation aloft that is not reaching the ground—a case that can be missed by a PPI or CAPPI display.

If the layer height is above the freezing level, high VIL values are an excellent indicator of severe storms and hail. If the layer height extends from the surface up to 3 km, then the VIL values serve as a forecasting guide as to how much precipitation is likely to fall during the next few minutes.

When computing integrated liquid data (VIL-data), the output shows the estimated precipitation (in millimeters) contained within the user-defined layer. This number is sometimes also labelled in kg/m**2. The VIL algorithm first searches out all points in the layer (accounting for earth curvature) over a given range and at a given azimuth that intercept the PPI scans of the volume scan, including one point above and below. Next, the algorithm converts the Z or T values to W values (here, W refers to water content) and integrates the values in the layer. Each data point is assigned a weighting corresponding to the height interval that it represents in the layer. The result is an intermediate PPI product that has the total water content as a function of surface range and azimuth. Finally, the intermediate product is transformed to Cartesian and stored. If Z is selected as the Product Data parameter, but at run time only T is available (or vice versa), the product runs with the available data parameter.

When computing Layer Average Reflectivity (LAR-data), the output is stored in normal reflectivity. The processing is nearly identical to VIL-data, except that the dBZ inputs are converted to linear Z instead of W, and we divide by the layer thickness in the end. The average Z is then converted back to dB.

To open the VIL Product Configuration menu:

Choose **Type**–>**VIL** from the menu bar.

Data:Display

Use the **Data:Display** button to control which type of data will be computed.

dBT:VIL Select input type to compute VIL data.

dBZ:VIL

dBZc:VIL

dBT Select input and output type to compute the layer average.

dBZ

dBZc

Layer Top and Layer Bottom

Select the top and bottom heights of the VIL layer in kilometers and tenths of kilometers.

CAUTION	Caution: The bright band biases the VIL measurements, so you should select the VIL layer to avoid the freezing level height.

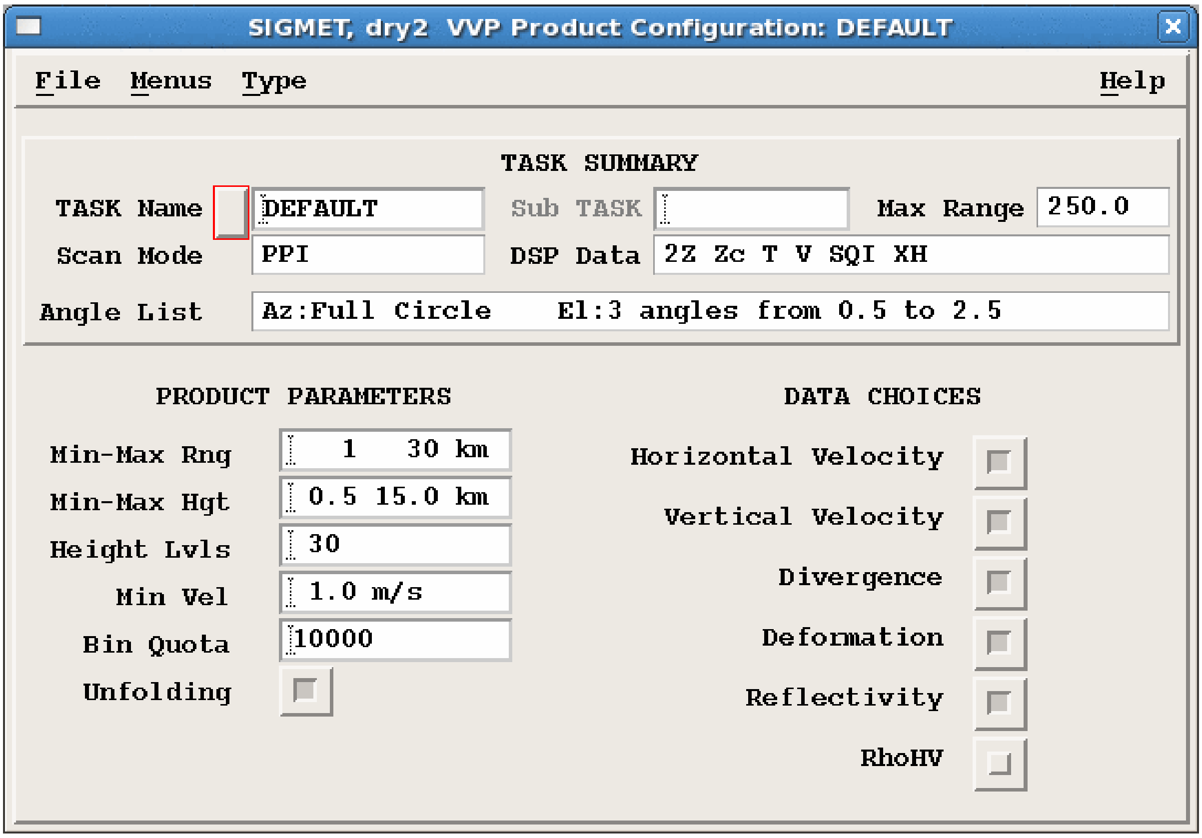
ZW Relation

Select the reflectivity-water content (Z-W) relationship. This field is desensitized if we are computing a reflectivity based product rather than a water based product. A default value for rain is provided. For snow, reduce the coefficient to a smaller value, such as 2000, to account for the lower reflectivity of ice.

VIL can function when only one angle is in the TASK, but this is not recommended for best results. If no angle in the associated TASK passes through the VIL layer, no VIL can be calculated.

For a VIL layer of 5 to 10 km, in the volume scan example in on page 26, VIL cannot be calculated for ranges less than 5 km. In the resulting product display, black would be displayed in this region to indicate that IRIS did not even sample the region.

3.22 VVP: Velocity Volume Processing



This section describes the fields of the Product Configuration menu that are unique to VVP products. For general information, see these other sections of this chapter:

- Task Summary area, Task Summary on page 24.

The Velocity Volume Processing algorithm (VVP) obtains the following parameters averaged over a volume centered about the radar:

- Horizontal wind speed and direction
- Particle vertical velocity (airspeed and particle fallspeed combined)
- Horizontal divergence (related to vertical air motions)
- Horizontal deformation and axis of dilatation (related to frontal forcing)
- Average reflectivity.
- Average RhoHV.

The user can select which data they wish to calculate, and store in the resulting product. Data and be turned on/off at will except for the constraint that of the top 4 velocity related buttons, any button turned on implies those above are also turned on. Also you must turn on at least one data type.

This algorithm is similar to the so-called VAD technique, except that it is an improved analytical approach. For details on the technique, refer to Waldteufel and Corbin (1979, *Journal of Applied Meteorology*, p. 532).

A Doppler radar can only measure the component of wind either towards or away from the radar. This is called the "radial wind." However, by looking at the wind over all azimuths around a full circle, the average wind speed and direction can be determined. This is shown schematically in on page 103 for the case of a south wind. The figure shows the radial velocity at a range bin as a function of azimuth. When the radar is looking directly south, the radial velocity measures the full speed of the wind (toward the radar). The IRIS convention is that positive radial velocities are away from the radar. When the beam is pointed east or west, there is no component of the wind toward the radar, so the radial velocity is zero. The divergence over the radar is estimated by taking the average of the radial velocity. Other kinematic parameters can be estimated, such as the deformation and the axis of dilatation of the wind.

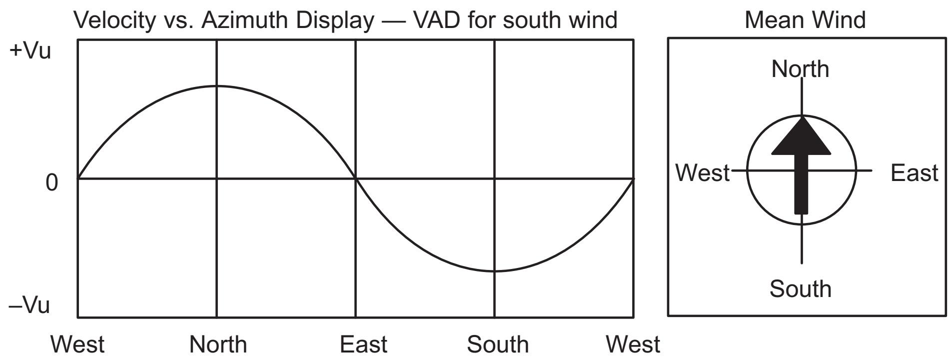


Figure 10 Example of Radial Velocity vs. Azimuth Display

The VVP algorithm assumes that the wind field varies linearly and, in the IRIS implementation, computes the mean wind speed and direction and divergence as a function of height. For each height interval, the VVP algorithm performs a least squares fit of the observed radial velocity to linear windfield model. Many thousands of points are used. The output is a line graph display of each of the three parameters vs. height with error bars to indicate the uncertainty in the least squares fit. The VVP Product Configuration menu is different from most others, because there is no display configuration necessary for the line graphs.

To open the VVP Product Configuration menu:

Choose **Type**–>**VVP** from the menu bar.

Min/Max Range

The minimum and maximum ranges are entered in the Min/Max Range field. No comma is required to separate the numbers. The minimum range is selected to avoid strong ground clutter near the radar — for example, 2 to 5 km. The maximum range is selected so that the highest elevation angle extends past the maximum height that you select.

Min/Max Height

Configure the minimum and maximum height to cover the span of altitude where you want wind information.

Height Levels

Specify the number of height intervals. The example in the figure covers the height span from 0.5 to 15.0 km in 20 intervals, so one value for each 500 meters.

Min Velocity

Specify the minimum velocity to be included in the wind volume fit. This is used as a simple way to remove bias toward zero at low heights due to clutter which passes the clutter filter. A value of zero will disable this feature. The recommended value is 0.5 m/s.

Bin Quota

This is the maximum number of bins that is included in the least squares fit for each height interval. The maximum allowed is 10,000 bins. Vaisala recommends using the maximum of 10000.

In the event that only the mean velocity is selected (i.e., vertical velocity, divergence and deformation are not selected), then the bin quota can be reduced for faster product generation.

Unfolding

Unfolding can be turned on or off. The unfolding technique, developed by SIGMET (reference Siggia and Holmes, 1991 25th Conference on Radar Meteorology, Paris), is based on the use of specially selected prototype wind profiles to determine which yields the best result in the least squares fit. In the processing, the VVP is run several times, and the best result is selected. In general, the VVP technique and the unfolding require at least 90 degrees of echo coverage for reliable results.

Reflectivity, Vertical Wind, Divergence, Deformation

The VVP product can optionally compute the vertical velocity, deformation and axis of dilatation of the wind field and the mean reflectivity profile above the radar. Use these buttons to select the set of parameters you want computed and recorded. Note that the vertical velocity is the particle velocity— the effect of fallspeed is included.

3.22.1 Configuring the Associated TASK

The VVP algorithm performs unfolding of the data. However, for best results, you should configure a TASK with a large unambiguous velocity range. That is, use a high PRF (such as 1200 Hz) and dual-PRF velocity unfolding (either 4:3 or 3:2) so that velocity folding does not occur. If your standard volume scan does not use dual PRF unfolding, you might want to set up a separate TASK for the VVP, as is recommended in the Radar Configuration Example. Four elevation angles, such as 30, 20, 10 and 5 degrees, are usually adequate because each of these angles contributes to many heights.

3.22.2 Producing VVP Product Output

VVP product output consists of a data file containing the VVP parameters for each height. The displays are computed "on-the-fly" from the data file and are designed to be easily customized by the user. The two styles of VVP displays in IRIS are:

- **Line graphs vs. height** — Up to 5 parameters can be selected for plotting vs. height. Standard deviation bars are included on the plots.
- **Time-height cross-sections** — Wind barbs, wind strings or axis of dilation/deformation lines are superimposed on a colored background of reflectivity, RhoHV, deformation, divergence or vertical velocity. Time scale and height are selectable.

The selection of the display style, parameters, plot limits, and so on, are all made interactively in the Output Options menu of either the Quick Look window (see VVP Output Options: Time-Height on page 276) or Product Output Menu.

Thresholding in the displays is based on the goodness of fit of the velocity. The threshold level is selectable between 0 (display all data) and 1 (threshold all data) in the Output Options.

3.23 WARN: Warning/Centroid Product

The WARN product looks at other IRIS products to detect significant weather. For example, the occurrence of 45 dBZ at 1.5 km above the freezing level is a good indicator of hail in many mid-latitude locations. Suppose the freezing level is at 4 km, and you run an echo TOPS product for the 45 dBZ contour. If the TOPS product shows 45 dBZ tops at heights greater than 5.5 km, there is a high probability of hail.

Before issuing a HAIL alert, you might also check for a region of hail signature at least 10 km^2 so you don't issue an alarm based on a single pixel. This is called a "threshold region." To further reduce the possibility of a false alarm, you might also look at the VIL for the same region between 1 and 10 km to see if it is greater than 5 mm (or some other value determined from the local climatology of hail). Clearly you could construct some powerful tests, but it would be nearly impossible to monitor all of the various displays and parameters in real time.

The WARN product automates this procedure so you don't have to spend time searching every product for significant weather. In other words, the WARN product rather than the operator does the tedious task of searching the products for significant weather, then alerts the operator when an event is detected. on page 107 shows how the WARN product works.

1. Threshold the input product (45 dBZ TOPS in the example) so that only points greater than the threshold are considered (for example, >>5.5 km). The result is a 2-D array of "ones and zeroes."
2. Smooth and connect the regions that are almost touching, and eliminate any isolated bins.
3. Contiguous regions are identified by a Region Finder procedure. The centroid location and area of each region is computed. Regions below the threshold size are discarded.
4. Determine whether any part of any region is in a protected area. If so, a warning message and audio beep are broadcast to all IRIS terminals.
5. The output of the WARN product is a situation display, also called an overlay display because it can be overlaid on any X-Y product display as selected in the Product Output menu. For example, a HAIL warning display can be overlaid on a display of PPI reflectivity to show the relationship between the warning and the current weather.

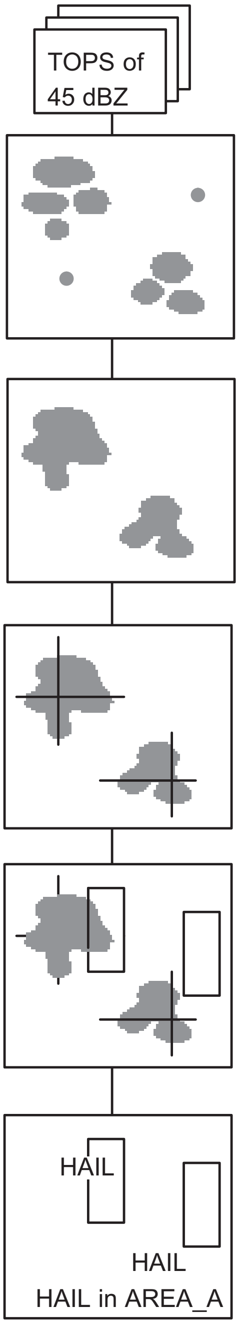


Figure 11 HAIL Warning/Centroid

The text of the message can be constructed by the user. For example:

```
2 HAIL Warnings at 11:30:00 in: AREA_A AREA_B
```

In this case, "HAIL" is the user-selected warning text and "AREA_A" is the user-selected name of the protected area. The names and locations of protected areas are defined in the IRIS **setup** utility. As with all IRIS messages, these messages are added to the Message Summary menu.

The contents of the Situation Displays are as follows:

- Outlines of active protected areas.
- Warning text at each centroid location which exceeds threshold size (such as, HAIL or MBW).
- A warning message.

An example is shown in on page 108 for the case of a microburst warning (MBW) based on the optional radial shear product. Note that a warning display can also be transmitted with a selectable geopolitical overlay (as with any other product).

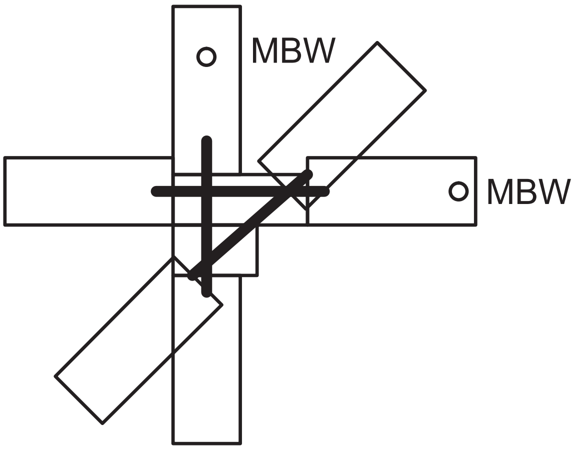


Figure 12 Example of Warning Situation Display

The outlines of the protected areas are shown for the areas included in the WARN product. Note that in the example, the runway outlines are from a separate overlay map which is merged with the product when it is displayed.

The warning text (MBW in the example) is displayed at the centroid location of the weather phenomenon that has been detected. If a weather phenomenon has been detected in a protected area, the warning message is displayed in large characters across the bottom of the screen. The time associated with each warning is also displayed. If more than one hit is detected in a protected area, then the number of hits is displayed. A legend on the right of the display summarizes the characteristics of the product. This includes the product ID, date, data time and a summary of the product configuration parameters.

Up to three criteria can be used. The thresholding and smoothing is performed separately for each, then the results are ANDed together so that centroid definition is performed on the combined field. For example, the additional criterion of the 1 to 10 km VIL >> 5mm could be added to reduce a HAIL warning false alarm rate.

Because of this general approach, the automatic warning feature can provide alerts for a wide variety of weather phenomena, such as the approach of a severe storm, turbulence, lightning hazard or flood potential. Some additional examples of warning criteria are summarized below:

- **Wind Shear Detection**

  [Shear > 10 m/s/km at 0.5º EL] .AND. [... at 0.7º EL] over an area of 3 km^2
- **Storm Turbulence Detection**

  [Spectrum Width > 6 m/s] .AND. [Reflectivity > 20 dBZ] over an area of 10 km^2
- **Hail Detection**

  [45 dBZ TOPS > 1.5 km above freezing level] over an area of 10 km^2
- **Precipitation Surveillance Detection**

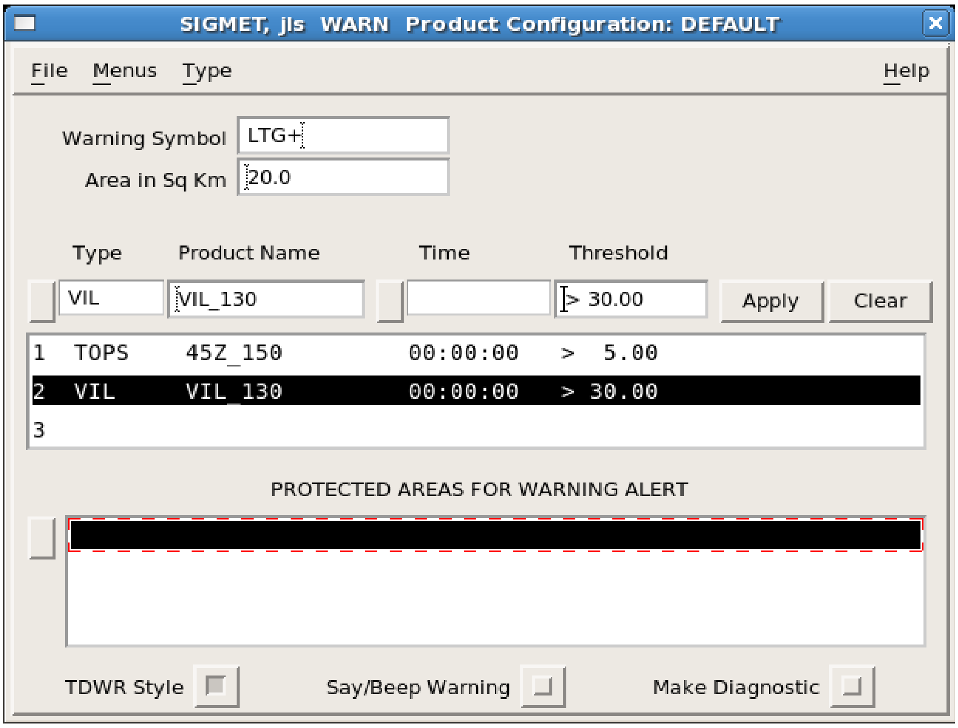
  [1.5 to 14 km VIL > 1mm] over an area of 10 km^2
- **Severe Storm Detection or Lightning Hazard**

  [1.5 to 15 km VIL > 10 mm] .AND. [10 dBZ TOPS > 8 km] over an area of 10 km^2
- **Flash Flood Warning**

  [Hourly Rainfall or N-Hour Rainfall > 5 mm] over an area of 25 km^2

Each criterion, surrounded by square brackets above, is one TASK. The results of multiple TASKS are ANDed together.

3.23.1 WARN Product Configuration Menu



The WARN product configuration menu looks different from the other product configuration menus. It lets you specify the message, the area of the threshold region, up to three products to use as criterion for the warning, and up to 16 protected areas.

To open the WARN Product Configuration menu:

Choose **Type–>WARN** from the menu bar.

Warning Symbol

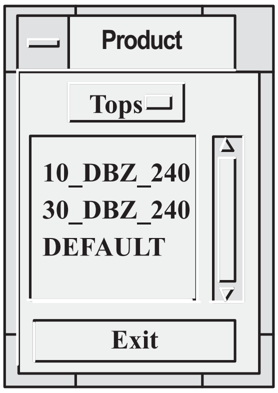
Use the Warning Symbol field to specify the text is used in the warning messages and the text displayed at the centroid position on the situation display. For example, the text may be, "HAIL" or "MBW", "S++", or "TRW+". Note that if there is a defined icon with the same name, then the icon symbol can be displayed.

Area in Sq Km

Enter the minimum size of a thresholded region in the Area in Sq Km field. Areas that do not meet or exceed this size are discarded. Enter the desired value in sq km. For example, for a 3 km by 3 km size area, enter "9".

Product Type and Product Name

The automatic warning algorithm operates by looking at other products. The center portion of the menu lets you select up to three products to be examined.



The product type and product name are specified by menu selection. Pick the type first — the list of product names then corresponds to the selected type. Note that this list is based on products currently on your system. If the product you want does not show, you should run your system until it is there. Alternatively, you can pick a different product of the desired type, then override the product name.

There are some important restrictions on the characteristics of the products that you select.

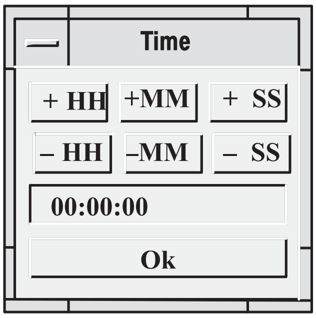
- The products must have the same maximum product range per the respective Product Configuration menus.
- The products must have the same resolution per the respective Product Configuration menus.
- The products must be of a supported data type. Current data types supported are: dBT, dBZ, dBZc, Height, Kdp, LDRH, LDRV, R, Rain, RhoH, RhoV, RhoHV, Shear, SQI, Time, VIL, Width and ZDR.

Errors are reported at run time in the Radar Status menu. Note that as long as these requirements are observed, the associated TASKS can be very different.

Time

The Time field lets you use products taken from different TASKS or different runs of the same TASK. This field applies only when there is more than one criterion. For example, suppose the second criterion has a time of 00:10:00. When the first product becomes available, the scheduling algorithm searches back in time as far as 10 minutes to find a version of the second product.

If you are using products based on different TASKS, you must set the Time field to some nonzero number or the product never runs. Some knowledge of your TASK schedule is required. In general, if all of your product criteria are based on the same TASK, you should set all of the times to 00:00:00 so that only data from the same run are used.



You set the time by clicking on the Time button. This pops up the Time window. Using the plus and minus buttons, you can increase and decrease the hours, minutes or seconds. When you are satisfied, press Ok to exit from the window. The time you specify is inserted into the field.

You may also type a time value into the window and press Ok to insert it into the field.

Threshold

The Threshold field selects the value of the product parameter used as the threshold. The WARN product considers only those values that meet or exceed the threshold. The units of measure depend on the selected product. For example, a Tops threshold is specified in km, while a VIL threshold is specified in mm. You may want to refer to the appropriate Product Configuration menu if you are uncertain about the units of measure.

It is important to realize that the WARN product operates on the color bands in the product image and that the threshold is set accordingly. For example, suppose you want to set up a reflectivity warning based on a CAPPI product. First, display an example of the product, then pick your threshold to match the number displayed with the color band that will serve as your threshold. If 45 dBZ is the number displayed with the red color, and you set your threshold to 45 dBZ, then all of the regions displayed as red (or "greater") will be included in the warning algorithm. This is convenient for verifying the algorithm. If you display the reflectivity product along with the situation display (warning overlay), the centroid labels will be positioned precisely in the red-colored regions.

For the VVP product, the threshold refers to the divergence in units of m/s per km (10^{-3} s^{-1}). When the Warning product is run for the VVP, a warning is generated if the divergence exceeds this value at any height in the VVP. Strong low-level divergence over the radar could be an indicator of a microburst. Proper setting for microburst alert applications requires that the user have knowledge of the local characteristics of the phenomena.

Protected Areas for Warning Alert

Click on the Protected Areas button to see a list of areas. Simply toggle a choice on or off.

The protected areas are configured in the **setup** utility. They are constrained to be rectangles with arbitrary size and orientation angle. There is a limit of 16 areas. (If you make a change to **setup**, you must restart IRIS for the change to take effect.)

NOTE	Important Hint: It is a good idea to make a large area (for example, 500 by 500 km) named ALL. When ALL is selected, the entire radar area out to 250 km range is a protected area.

TDWR Style

IRIS supports two formats of warning messages. In TDWR format, only the strongest centroid in the highest priority area is reported along with its strength. For example: "MBA 3MF 30K–", in spoken language: "Microburst Alert, Three Mile Final, 30 Knot loss". The older IRIS format reports all centroids in all protected areas, for example: "3 MBA warnings at 11:30 in: 3MF, 2MF". These messages are displayed at the bottom of the display screen, signalled as a pop-up when they are generated, and optionally spoken.

Say/Beep Warning

Pushing this button tells the product generator to verbally signal the warning message in addition to displaying it as a pop-up message. You must also select "Enable Speech" from the Setup pull-down menu in IRIS.

Make Diagnostic

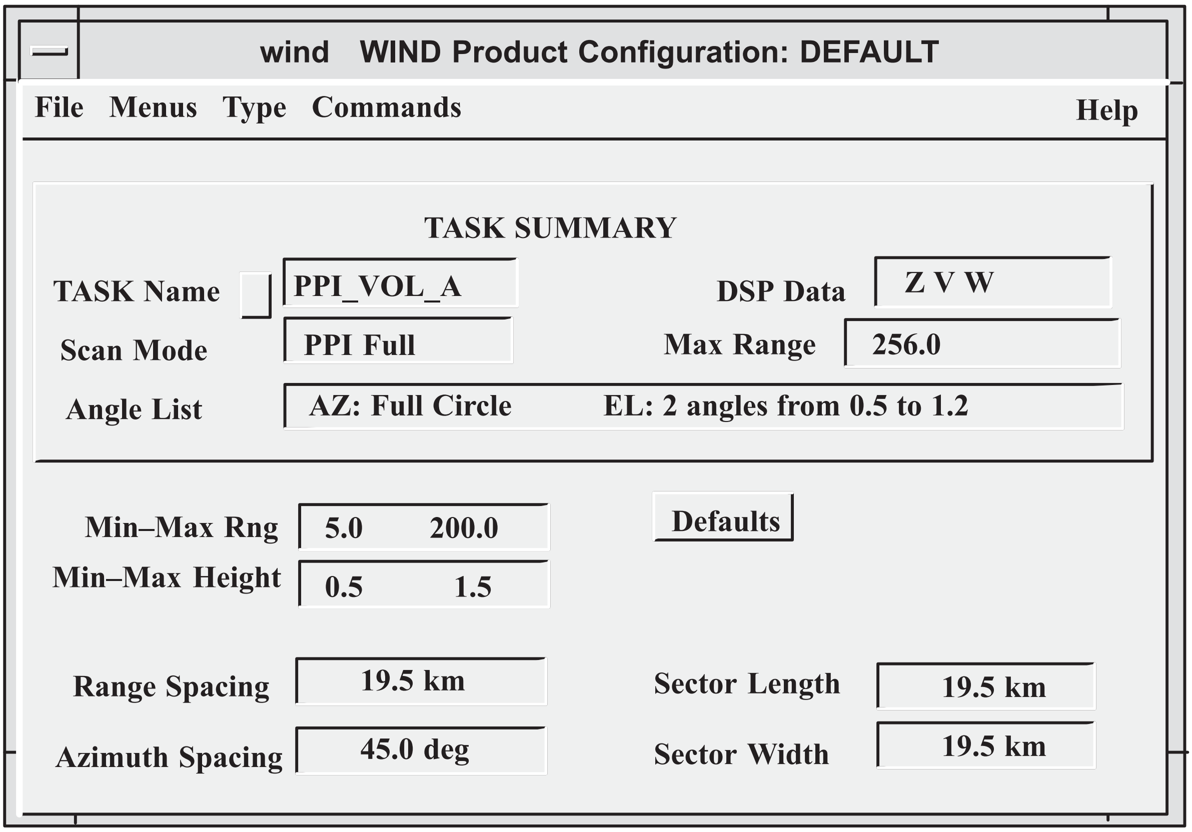
If you press this button, the product generator will run as usual, but will make an additional diagnostic output. The diagnostic will be a USER product type, with a USER data type, and with the same name as the WARN product, except for a suffix of "MSK". This product can be displayed in the Quick-Look Window, if desired. This product contains the output of the initial thresholded input data. The LSB is the first input, bit 1 is the second, and bit 2 is the third. For a WARN of only one input, you would expect a binary file. You can use this to see your actual regions being processed.

3.23.2 Using the WARN Product

The WARN product is designed to save the operator from the tedious TASK of screening data for significant weather. To function effectively, a WARN product must be based on the local climatology and experience. SIGMET, Inc. can work with customers to assist them in developing such a climatology or in advising customers on the capabilities and limitations of the WARN product.

NOTE	SIGMET makes no warranty, either express or implied, that the WARN product will detect all hazardous weather situations. In no event can SIGMET, Inc. be held liable for damages of any kind for failure of the WARN product to issue a warning, or for false alarms that may be issued by the WARN product.

3.24 WIND: Wind Speed and Direction



The WIND product computes a 2-D array of horizontal wind vectors (the horizontal wind field) using the radial velocity information and the assumption that the wind is uniform over a limited sector (e.g., 10 km by 60 degrees). By computing the mean wind in a number of such sectors, an approximation to the 2-D field of horizontal winds can be made. Because the algorithm assumes uniform winds over a sector, it is sometimes referred to as the "sector uniform wind algorithm." The algorithm can show gradual changes in the wind vectors over the radar coverage area. It cannot show sharp gradients such as fronts or microbursts.

The output can be displayed as wind barbs or wind strings as an overlay product. The mean wind can be subtracted at output so that the perturbation wind is displayed. These selections are made when the product is displayed in either the Quick Look Window or the Product Output Menu using the Output Options.

This section describes the fields of the Product Configuration menu that are unique to the WIND product. For general information, see these other sections of this chapter:

- Task Summary area, Task Summary on page 24.
- Product Parameters, see Product Parameters on page 31.
- Display Parameters area, Display Parameters on page 34.

To open the WIND Product Configuration menu:

Choose **Type–>WIND** from the menu bar.

Min-Max Rng

This field specifies the radius of the product, starting at some point close to the radar and ending at some distance away from the radar. Wind vectors are computed only within this range.

Min-Max Height

This field defines the layer from which the radial velocity information is taken to produce the wind vectors. Because vertical shear can be substantial, it is recommended that this layer be ~1 km.

Range and Azimuth Spacing

These fields define the resolution for computing the wind vectors in polar coordinates. For example, if the Range Spacing is set to 10 km and the Azimuth Spacing is set to 45 degrees, a wind vector is computed over the Min-Max Range every 45 degrees in azimuth and 10 km in range.

Sector Length and Width

Each wind vector is computed at the center of a sector which is defined by the Sector Length (or range) in km and the sector width (or azimuth) in degrees. The Range and Azimuth Spacing can be set so that the sectors overlap. It is recommended that the sector width be ~60 degrees.

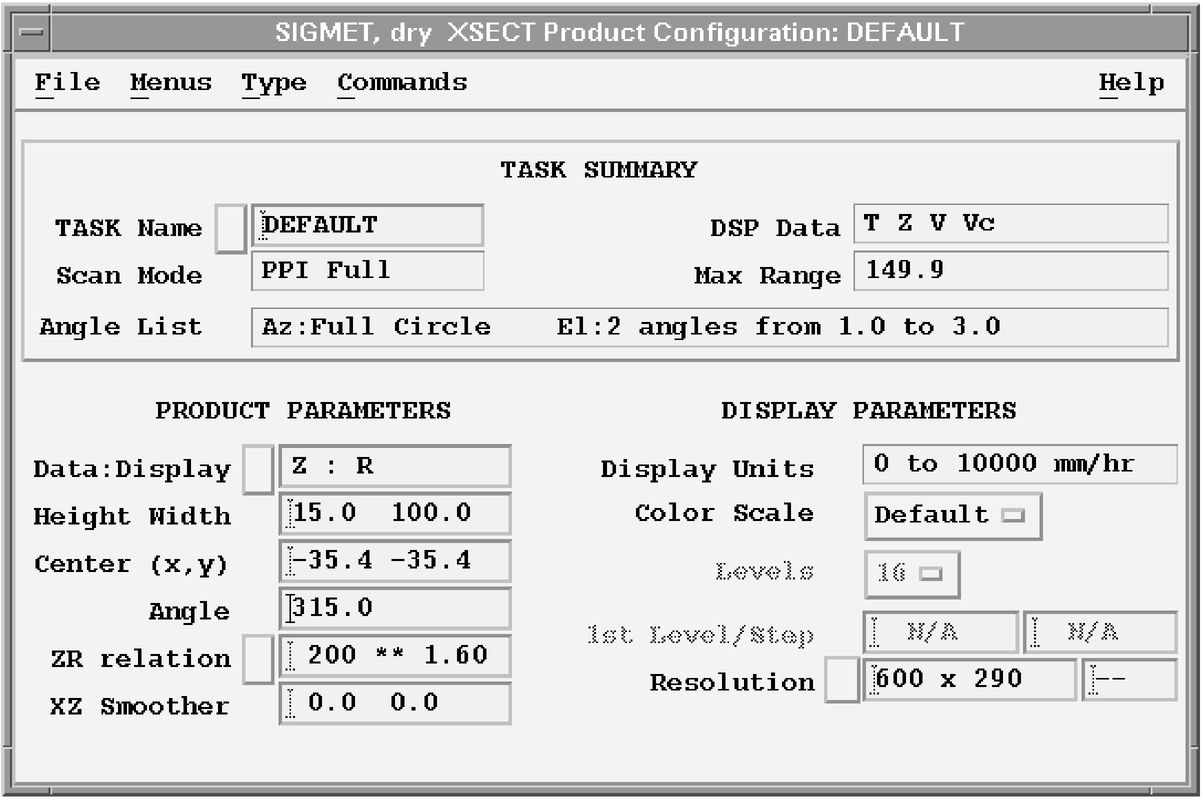
Defaults

Click on this button to set all fields in this menu to their default values.

Note on Thresholding During Display

If there are insufficient radial wind points in a sector, the algorithm still computes a mean wind. However, the estimate is not reliable. For each sector, the total number of valid velocity range bins found is stored, as well as the total number expected for full coverage. When displaying the results, the output options allow thresholding by the percentage of coverage in a sector. Using this threshold reduces noisy values. A value of 40% areal coverage is a good starting point.

3.25 XSECT: Cross Section



This section describes the fields of the Product Configuration menu that are unique to XSECT products. For general information, see these other sections of this chapter:

- Task Summary area, Task Summary on page 24.
- Product Parameters, see Product Parameters on page 31.
- Display Parameters area, Display Parameters on page 34.

The XSECT product is similar to an RHI in that it shows a range-height representation or vertical "slice" of a radar parameter. Unlike the RHI, the antenna is not scanned in elevation. Rather the cross section is constructed from a PPI volume scan. This means that if you are running a standard volume scan at regular intervals, an XSECT can be constructed without having to schedule a special RHI TASK.

The other difference between an RHI and an XSECT is that the radar location is fixed for an RHI, while the XSECT product lets you make a cross section at any point and along any line — in effect letting you move the radar wherever you want.

In defence of RHI's, which are typically composed of about 100 elevation angles, the resolution in an XSECT is limited by the number of elevation angles in the volume scan, typically 10 to 20. However, the 3-D interpolation used by the XSECT algorithm yields an excellent representation of the height distribution of radar parameters. Aside from performing 3-D interpolation, the algorithm also corrects for earth curvature effects so that the height scale corresponds to the actual height above your product reference height (usually sea level).

There are two ways to use the XSECT product. If you have a region of interest, such as a watershed area or air terminal, you may configure an XSECT as a standard product to slice through the area. However, you may also use the XSECT on an *ad hoc* basis to cut through a line of storms or an area of suspected severe weather. For *ad hoc* cross sections, use the XSECT Tool on the Quick Look window to configure the cross section line with a mouse. If you do not use the mouse to define a cross section line, display a PPI or CAPPI product with range rings and range numbers to help you configure the cross section.

A sample XSECT Product Configuration menu is shown at the beginning of this section. Its corresponding geometry is shown in on page 118. Refer to this figure as you read through the instructions for configuring an XSECT product.

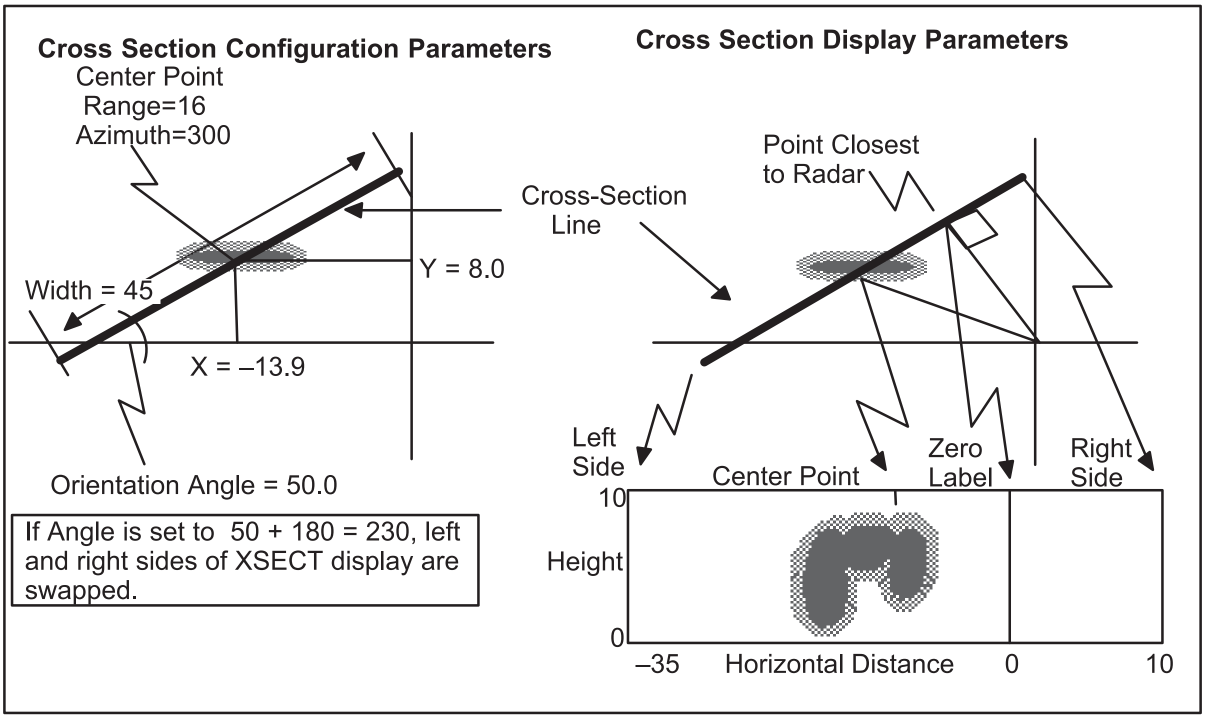


Figure 13 Cross Section Geometry

To open the XSECT Product Configuration menu:

Choose **Type–>XSECT** from the menu bar.

Data : Display

Z	dBZ
Z	Rain
V	Vel
W	Width
T	dBZt
T	Rain
Zd	ZDR
Zd	Rain

Center (x,y)

Look at the CAPPI or PPI image that you want to "slice" and decide where you want to make your cross section. Next, select the center point for the cross section. This is where the range marks and azimuth lines are very useful. Usually, you place the center point on the radar feature that you want to "slice," as shown in the example.

You enter the coordinates in X-distance (east) and Y-distance (north). Distances south and west are entered as negative numbers. All distances are entered in km.

Height Width

Select the maximum height and the horizontal width of the cross section in km and enter them in the Height Width field. There is no need to be exact—simply use the range and azimuth marks that are on the display to estimate the horizontal width. In the example, the height is 10 km and the width is 45 km.

Angle

Select the orientation angle in degrees. In the example, the angle is 50º. The angle that you select determines the end of the cross section slice that is displayed on the right side of the display. An angle of 50º will display as follows:

```
Left Side           Right Side
23º end             50º end
```

To reverse the ends in the output display, select an angle of 50º + 180º = 230º.

XZ Smoother

The XZ Smoother field lets you set the X and Z smoothing length scales independently. However, because of the interpolation performed in constructing the cross section product, the output displays usually require little, if any, smoothing.

In the final output display, the zero point of the horizontal range scale corresponds to the point on the cross section closest to the radar. This is also shown schematically in the example. This means that if you select a line that goes through the radar (which is allowed to make a pseudo RHI), the 0 point is actually at the radar, so the horizontal distance equals the radar range.

CHAPTER 4

OPTIONAL IRIS PRODUCTS

This chapter explains how to configure the optional IRIS meteorological products.

In this chapter:

4.1 CATCH: Subcatchments Precipitation Accumulation

4.1.1 Overview

The CATCH product calculates the precipitation accumulation in subcatchment regions such as a watershed areas. It is used for hydrometeorological applications such as estimating the total rainfall in a river basin for the purpose of flood forecasting. Both the time of the integration and the subcatchment areas can be selected. The CATCH product can also issue warnings if the precipitation in a subcatchment region exceeds a threshold value.

Like the RAINN product, CATCH is a product of a product for which the hourly RAIN1 product serves as the input. You can sum any number of hours of individual RAIN1 products. The only limitation is the number of RAIN1 products stored on disk. As part of the IRIS Hydromet Option, the RAIN1 products can be calibrated by means of raingage input, thus CATCH products also get the benefit of this calibration. See Appendix F, Hydromet Raingage Correction, on page 437 for a description of IRIS Hydromet raingage calibration.

The subcatchment areas are defined in a manner similar to overlays, i.e., subcatchment regions are defined by using LAT/LON vector points and stored in a file in the IRIS_OVERLAY directory. A "catch" file will typically contain many subcatchment areas. There can be more than one catch file so that users can have different "mixes" of subcatchments.

The output of the CATCH product is a file that contains the precipitation depth for each subcatchment for each hour and the total over the selected integration time. This file can be displayed by itself or overlaid on another product display. There is an interactive pop-up bar graph display that shows the hourly precipitation amounts in each subcatchment.

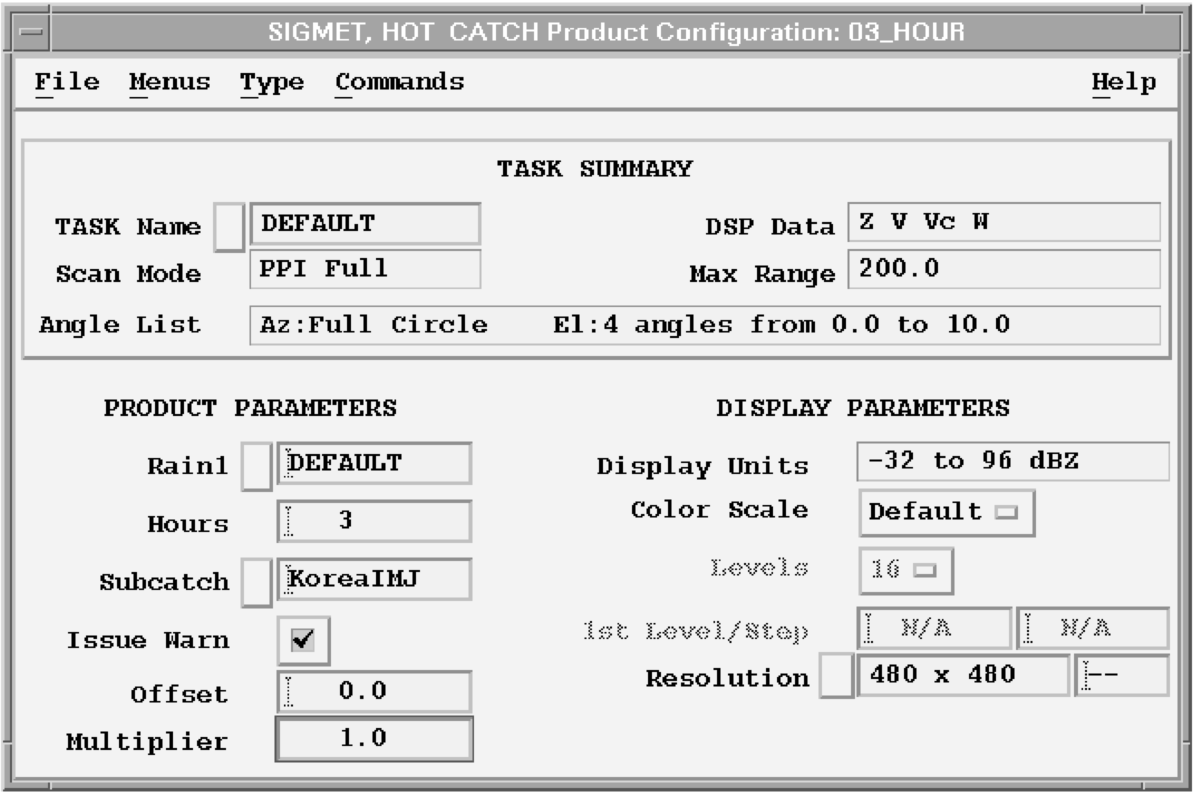
In this section is described:

4.1.2 CATCH Product Configuration

To open the CATCH Product Configuration menu:

From the Product Configuration menu choose **Type**->**CATCH** from the menu bar. The fields are described below.

NOTE	The CATCH product requires that the Hydromet Option be purchased. If the CATCH product does not appear in the Product Scheduler or in the list of available product types in the Product Configuration Menu, then you do not have a license for the CATCH product.



Rain1

In the Rain1 field, specify the product name of the input hourly RAIN1 product. You can click on the Rain1 button and choose from a list of products, or enter the name directly into the field.

When you enter a product name, the associated TASK information is displayed in the TASK Summary portion of the menu.

Hours

Specify the number of hours to integrate. When the product runs, it integrates data for the last N hours. If a RAIN1 product is missing for one of the hours in the interval, the algorithm assumes that no rain fell during that hour. The product output shows how many hours were actually integrated.

Color Scale, Levels, and 1st Level/Step

The color levels can be specified, but the resolution is fixed by the resolution of the RAIN1 configuration.

Subcatch

Select the subcatchment file name. The subcatchment file contains the definitions of the various subcatchments. See Subcatchment Definition on page 125 for more information.

Issue Warn

The CATCH product can generate warnings if the amount of precipitation for a subcatchment exceeds a threshold value. The threshold value for each subcatchment area is configured in the subcatchment file. See Subcatchment Definition on page 125 for more information.

Offset and Multiplier

These are used to modify the thresholds that are set for each subcatchment. This might be done to account for different integration times. For no adjustment of the thresholds in the subcatchment file set Offset=0.0 and Multiplier=1.0.

It is recommended that users configure their thresholds in the subcatchment file to be characteristic of accumulation over a standard time such as one hour. The offset and multiplier can then be set to to adjust all of the thresholds.

For example suppose that as an indicator of flood hazard in a subcatchment experience shows that the one hour threshold is 10 mm and the two hour threshold is 15 mm for flood hazard. The 10 mm value can be configured for the subcatchment and then the multiplier can be set to 1.5 and the offset set to 0.0. This allows some degree of adjustment of the subcatchment thresholds for different time periods.

Another technique is to configure different subcatchment files with the thresholds set for different integration times. In this case the name of the subcatchment file should reflect the integration time such as CATCH_06 to indicate that the thresholds are set for 6 hours.

Save As: Naming CATCH products

Similar to RAINN products, it is recommended to name your catch product by the number of hours of integration and a general descriptor of the area, perhaps even the name of the subcatchment file. For example, if the subcatchment file for a large river watershed is called RED_RIV and the integration time is two hours, save the product under the name "RED_RIV_02".

4.1.3 Subcatchment Definition

Subcatchment areas are defined in a file that is stored in the IRIS_OVERLAY directory (typically /usr/sigmet/config/overlay). These are given the special suffix ".cat" and referred to as "catch" files. When IRIS is started via the siris command or from IRISnet, the start-up log shows the processing of the catch files.

The detailed data format for the catch files is described in the *IRIS Utilities Manual* section on the **overlay** utility. In general the files contain the following information for each subcatchment:

- Subcatchment index number (an integer 1, 2, 3, ...) and name. The name is used for display.
- The threshold in mm of accumulation depth for the warning.
- The subcatchment points in LAT/LON coordinates. These points must define a closed region and be in sequence about the perimeter of the region, i.e., the first point and the last point will always be the same. Subcatchments that share the same boundary must be entered as complete closed regions, i.e., the shared boundary points are the same for adjacent subcatchments.
- The location of an internal point for the labeling. This point must be within the bounded region of the catchment.

Each catch file will generally have many subcatchment regions. There can be multiple subcatchment files for different applications such as:

- For different radars in a network.
- To specify different warning thresholds to account for different integration times.
- To cover different major watershed areas.

It is also allowed to have overlapping subcatchments in a file. For example, a large watershed region could be input as a single large catchment and the smaller tributary watersheds within it be specified as well. IRIS allows a maximum of 20 different catch files to be created.

4.1.4 Scheduling CATCH Products

The scheduling of CATCH products is identical to the scheduling of RAINN products. See RAINN: N-Hour Rain Accumulation on page 63 for a discussion of the RAINN scheduling algorithm. If the RAIN1 input is corrected by means of raingage input data, then there will be a delay in the CATCH product since the input RAIN1 product is delayed as it waits for the arrival of the raingage data.

In the Product Scheduler, the Data Time field refers to the end of the period for which you are integrating. The Skip Time field can be used if you want only the accumulations for specific time intervals. For example, if you want a 3-hour integration only for the periods ending at 03:00, 06:00, 09:00, ..., set the Skip Time field to 03:00.

4.1.5 CATCH Product Algorithm

The CATCH product algorithm takes the RAIN1 products for the specified integration time (Hours) and then performs the following steps:

- For each subcatchment, all pixels in the RAIN1 product that are within or touching the subcatchment perimeter are added together and then divided by the total number of pixels. Thresholded pixels are treated as zero rainfall. The result is the average hourly rainfall for the subcatchment.
- This is repeated for each hour and each subcatchment.

After this is done, the following computations are performed:

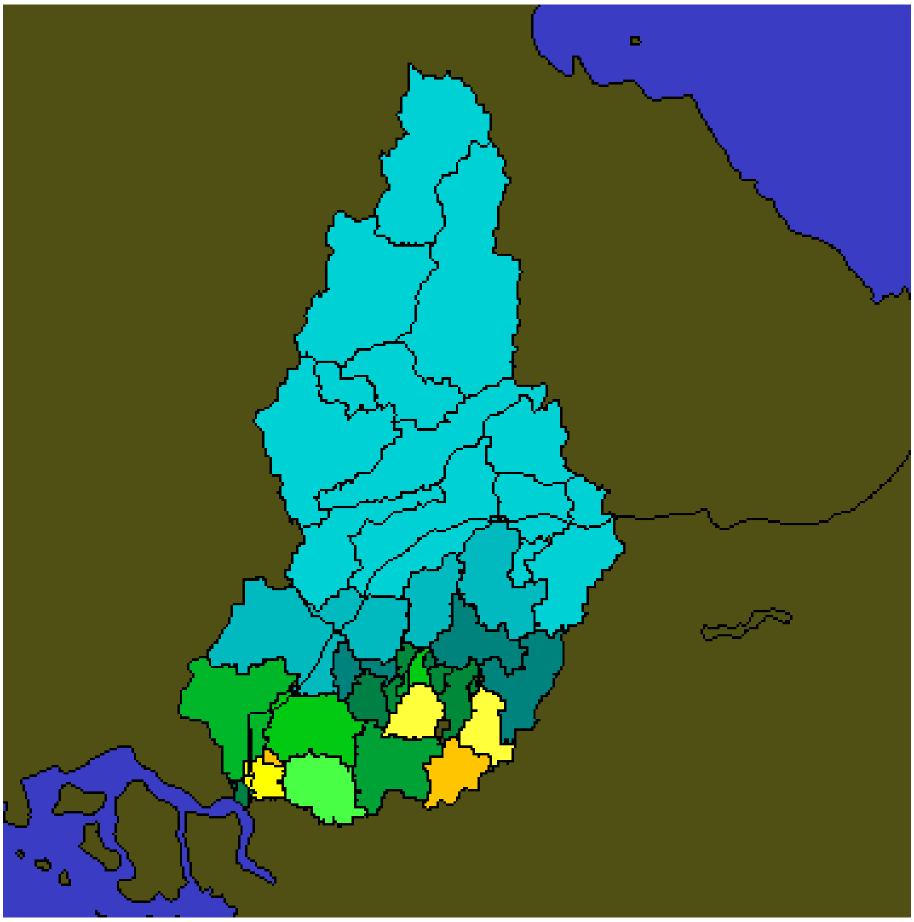
- The sum over all hours in the integration time is taken for each subcatchment to get a total average accumulation for the time period.
- If the "Issue Warn" button is clicked-on, this sum is checked against the catch file warning threshold (adjusted by the "Offset" and "Multiplier") and a single IRIS warning is issued for all subcatchment areas that exceed the threshold.

The final output file contains for each subcatchment:

- The LAT/LON of the label point, the point name and index number.
- The hourly average accumulations over the selected integration time. These are used for the pop-up bar graph display.
- The total average accumulation for the integration time.
- The fraction of pixels in the subcatchment that had non-zero precipitation.

The output file does not contain the subcatchment boundary definitions. This has implications for display when the CATCH product is transferred to another machine. See the next section for a discussion of this.

4.1.6 Product Display

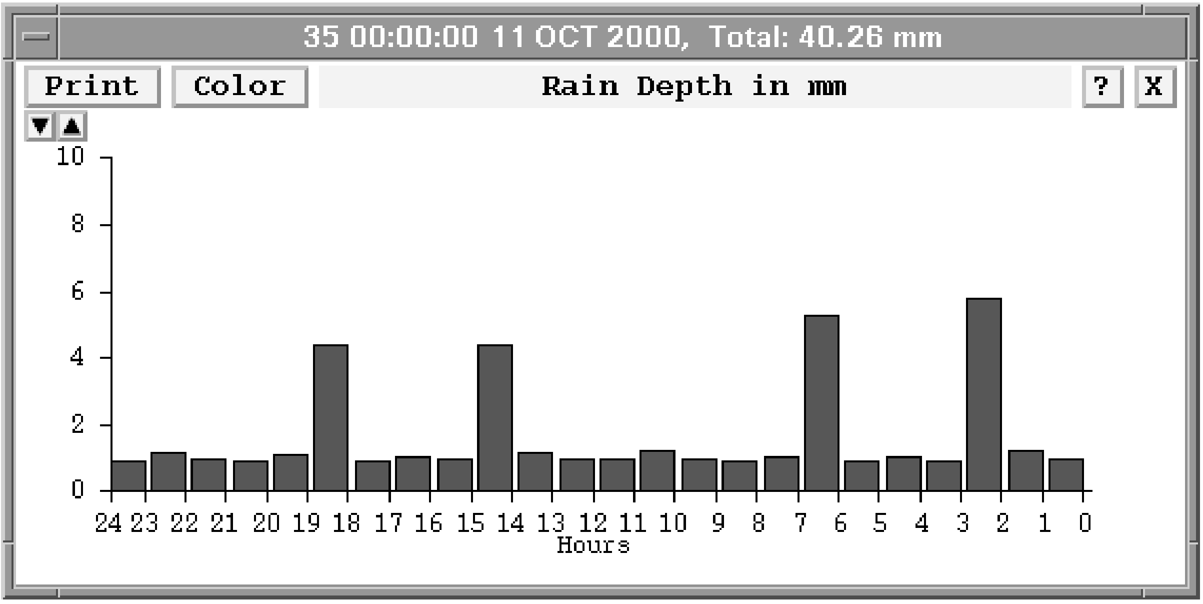


The Quick Look Window display for the CATCH product shows either:

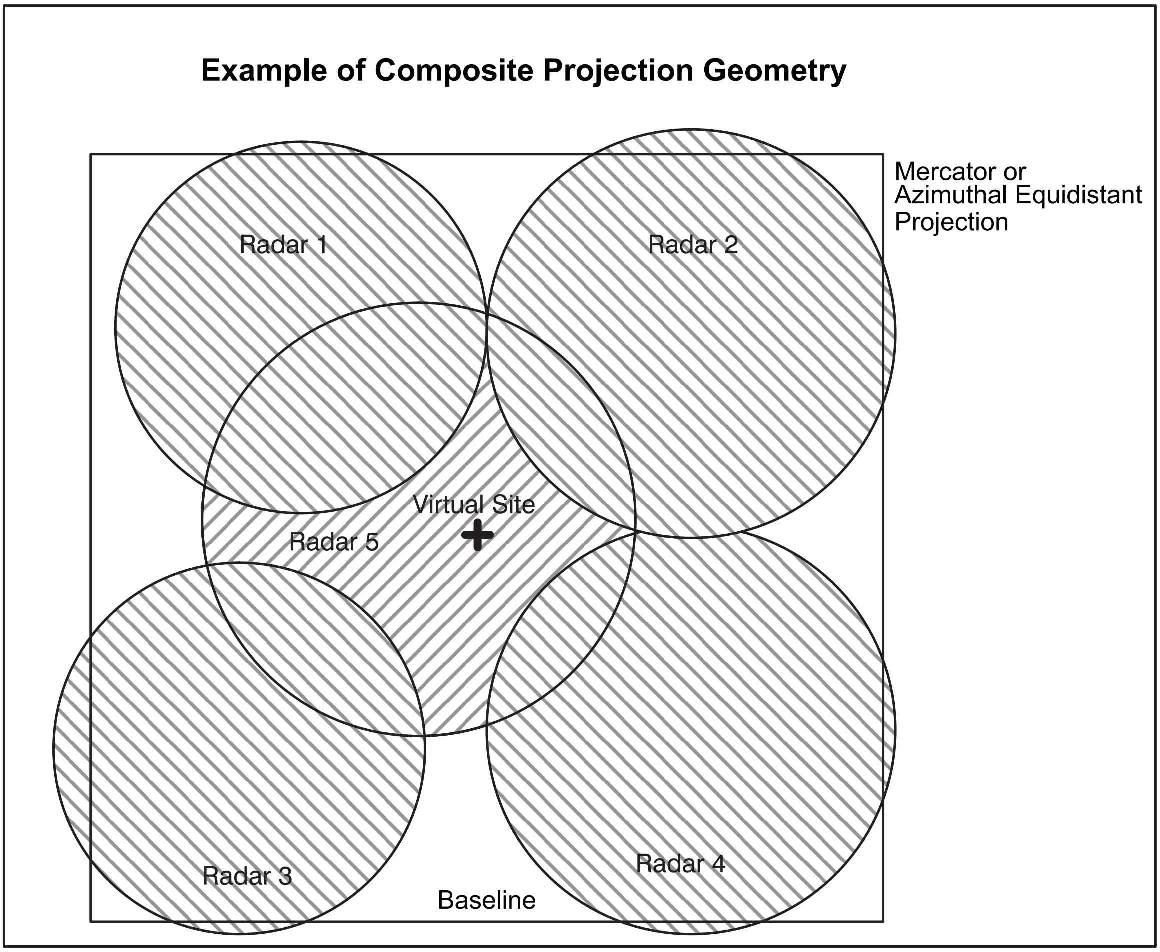
- Color coded subcatchment map regions where the color code shows the precipitation depth (see example above). The color scale is the rainfall depth scale in mm or inches. These color scales and the units are configured in the **color_setup** utility (see the *IRIS Utilities Manual*)
- Colored icons where the icon (a raingage bucket shape) is drawn in the color code for the precipitation depth. This display style is used when the CATCH product is overlaid on another product.

The choice of display style is made in the "Options" button at the top of the Quick Look Window. You must first display a CATCH product to activate this button.

In either case, clicking the right mouse button on a subcatchment causes bar graph to pop-up. This shows the hourly precipitation accumulation for the integration time. The bar graph vertical scale can be selected by pressing the up and down triangles next to the top of the scale.



4.2 COMP: Composite



In this section:

4.2.1 Overview

Advantages of Composites

COMP allows you to combine data from many different radars. The advantages of compositing are:

- Expanded area of coverage to give forecasters the "big picture".
- Fill-in of blind spots caused by mountains or required sector blanking.
- Fill-in of blind spots caused by scan strategy limitations (e.g., not scanning to high elevation angles).
- Easier management of products since forecasters are not required to look at many different single-radar images.

Types of Products for Compositing

Unlike other products, when you schedule a COMP product, IRIS does not make a product of type COMP, rather it makes a composite of the input product and saves it as the input product type. For example, if PPI's serve as input to the COMP product, then the output is a "PPI" product.

The types of products that can be combined by COMP are:

- BASE
- CAPPI, including 3D CAPPI's (dBZ and R)
- HMAX
- MAX (side panels are removed)
- PPI (dBZ and R)
- RAIN1
- SHEAR
- SRI
- THICK
- TOPS
- USER
- VIL
- WARN

Use of Composites by Other Products (e.g., RAIN, WARN, TRACK, FCAST)

A powerful feature of the COMP product is that it does not just "paste" the images together to make a combined picture, rather it produces real IRIS products. This means that other IRIS products, which use products as input, can be run on the composites. For example, a composite CAPPI can be used as input to a RAIN1 accumulation product. A composite 3D CAPPI can be used as input into the optional IRIS 3D package. Products such as WARN, TRACK and FCAST can all be run on IRIS products that are composites.

Automatic Remapping of Input Products

Compositing of products can be complicated because of issues of different radar resolutions, maximum range, angle spacing, number of pixels, map projections, etc. IRIS makes it easy by automatically remapping the input products to the final output projection and resolution. This means that you can input products that have different pixel resolution, center position and maximum range, even in different projections (Mercator versus azimuthal equidistant), and IRIS will do all the work of remapping to make the final product. The advantage of this is that when you make composites, you can use normal single-radar projections — there is no need to make a special set of products to serve as input to the composites. This simplifies the system configuration management.

Sources for Input Products

You have complete flexibility for specifying on what host computer the input products are made and even who makes them (IRIS vs non-IRIS). The products used by COMP can be,

- Generated locally on the same workstation where the composites are made.
- Sent over the network from another workstation (IRIS or non-IRIS using UPI).
- Any combination of the above.

Input of Products from Non-IRIS Systems

The ability to send products over the network to a central compositing computer, plus the ability to automatically remap data, makes it easy to combine data from non-IRIS systems. Here the remapping feature is especially important since you may not have control over the range or resolution of the non-IRIS data. Products from non-IRIS systems can be reformatted to match the standard IRIS formats and then inserted into IRIS using the Input pipes mechanism. SIGMET supplies source code examples to customers who want to reformat non-IRIS data and insert it into IRIS. These products can then be sent to the composite IRIS workstation either directly, from an external user program, or via another IRIS.

Composites of Composites (Regional, National/International Composites)

The maximum number of radars that can be used in a composite is 16. This is adequate for most applications. For larger networks, it is recommended to first make regional composites, and then composite the composites to make national or international composites.

System Manager Preparation for Composites

The following items need to be set up in advance for compositing. Chances are that these have already been configured for your system. Check with your system manager if you are unsure.

- **Configure the radar sites.** Use setup->general as described in the *IRIS Utilities Manual* to define the available sites.
- **Configure the projections.** This is done right from the IRIS menu **setup**->**projection** tool described in Map Projections on page 26 of this manual.

4.2.2 Composite Algorithm

The rules and steps in the composite product generation are described below. See COMP Scheduling on page 138 for a discussion of the scheduling rules. Understanding these will help you to understand how to setup your system(s) to make composites.

Basic Rules

COMP takes products from several radar sites and combines them into a single product. There are only two rules for combining the products:

- **The input products must be of the same type (e.g., CAPPI's) and all have the same name.** This is the recommended way to manage products on your network in general. Note that IRIS sorts everything by site for you, so there is no need to put a site ID in the name. The product type and name are specified in the COMP Product Configuration Menu described in COMP Configuration Menu on page 134.
- **The products must be within a certain time window to be combined.** You would not want to combine data if the input products were more than a few minutes apart. The time window is specified in the COMP Product Configuration Menu described in COMP Configuration Menu on page 134.

Remapping

The products to be composited are remapped to the common projection that is specified in the COMP Product Configuration Menu. Ideally, PPI's and CAPPI's should be at the same elevation angles and heights. However, in the event that they are not, there are tolerances for combining PPI's of slightly different elevations (i.e., 1 degree) and CAPPI's of different heights (1000 m).

Combining

Now that the products are in the same space, they can be combined. In regions where radars overlap, there are three combining rules from which to choose:

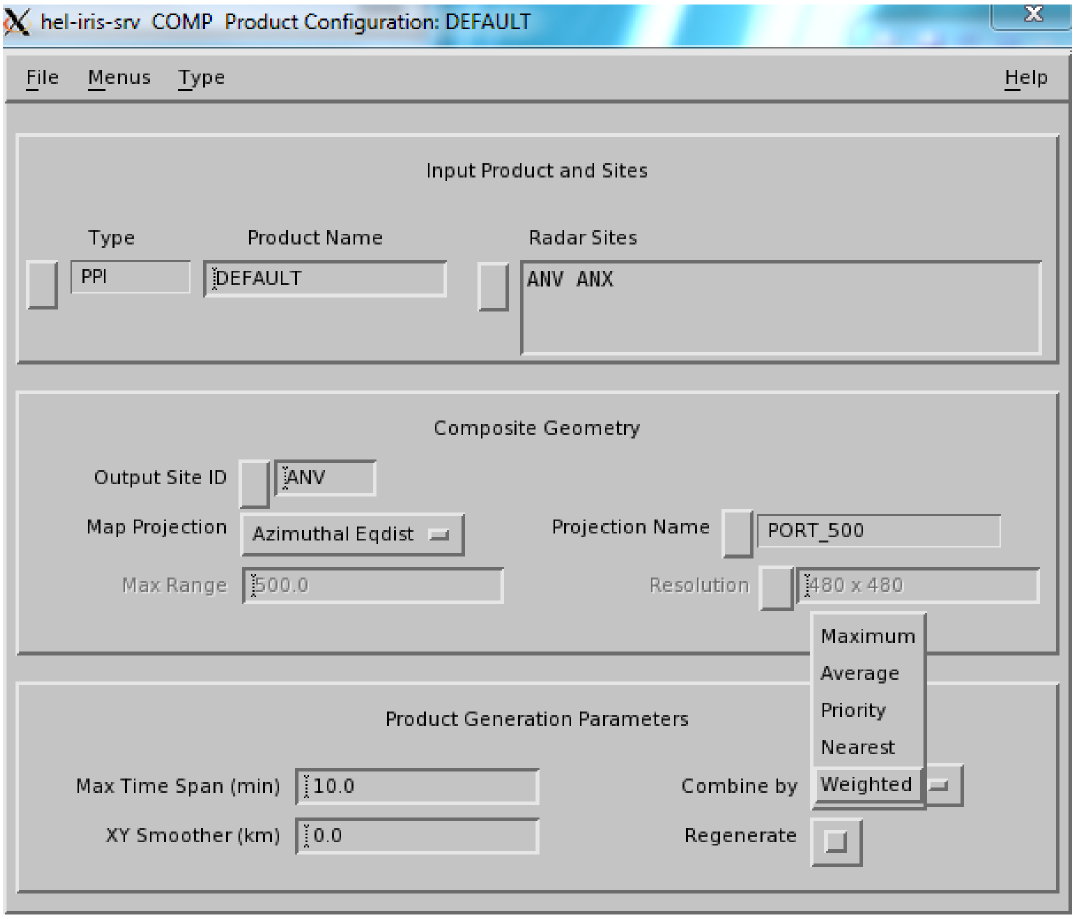
- **Maximum**—This is the most common setting. Here the maximum value is used to combine the data.
- **Average**—Uses the average of the available data. This is a poor choice if you are trying to cover blocked regions.
- **Priority**—Use data from the available radar that is highest on the site list that is configured in the COMP Product Configuration Menu.
- **Weighted**—The assigned value at a location is determined by a weighted average from all the radars detecting a signal at that location. The weighting is inversely proportional of the distance to the radar site. Thus, data from closer radar sites have a bigger impact to the final value than data from sites farther away.

The choice of combining algorithm is set in the COMP Product Configuration Menu (COMP Configuration Menu on page 134).

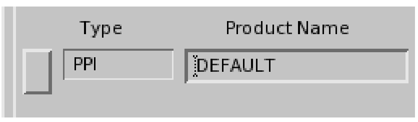
Output

There is no COMP product. The output of a COMP PPI is a PPI product with the name that is assigned in the COMP Product Configuration Menu (COMP Configuration Menu on page 134).

4.2.3 COMP Configuration Menu



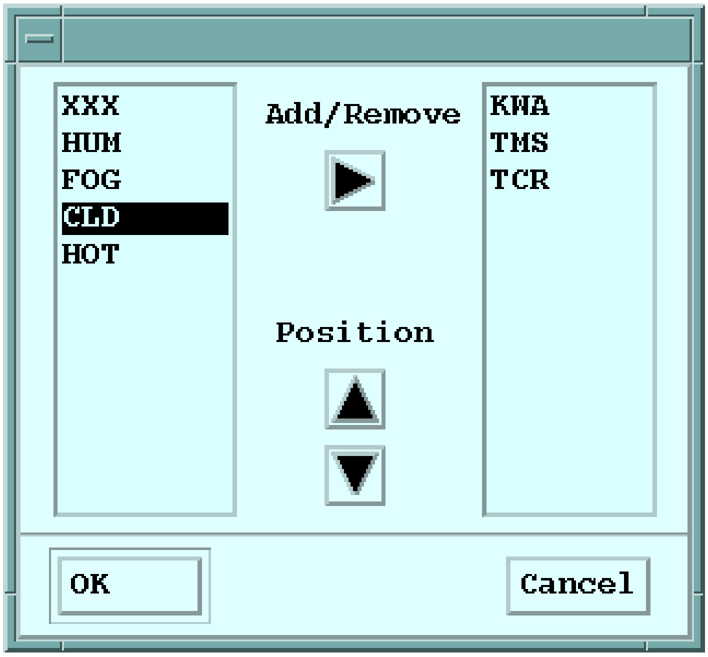
Select the Product



Use the selection widget to pick the product type and name that you want to composite. Remember that the products from the different sites must all have this name. IRIS will only allow you to composite those products listed in Overview on page 129 which are licensed on the compositing computer.

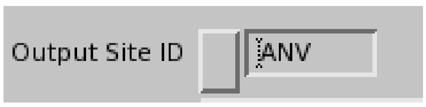
Select the Radar Sites

Use the radar site selection tool shown below, to load the sites that you want to composite.



Remember the order of the sites is important The highest priority (first on the list) site that is in the composite (some may be missing) will determine the "Data Time" that is associated with the product. It is also used for filling data in overlapped regions if you select the "Priority" combining rule.

Output Site ID



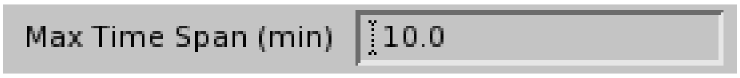
This specifies what site will be used to identify the composite. It does not have to be an actual radar site. You can use a "Virtual Site" associated with the projection or your network. Sites are configured by your system manager in the **setup** general utility (*IRIS Utilities Manual*).

Map Projection

This is the common projection that will be used. Input products will be remapped to this. See Map Projections on page 26 of this manual for a description of projections and how to configure them. This is done by your system manager.

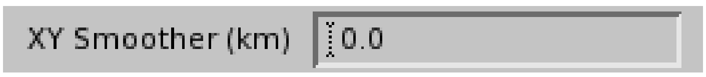
The "Max Range and "Resolution" fields are determined by the projection, i.e., you cannot edit these.

Max Time Span (min)



This is the maximum time difference that the algorithm will allow for compositing products. The product times for volume scan products correspond to the start of the volume scan (the Data Time). For PPI's it is the actual sweep time. A value of 5 minutes is probably close the the maximum that you would typically allow. If you are unsure, consider how quickly things move in a typical loop. This number should always be less the period between volume scans in your input data.

Output Smoother



Chances are the input products are smoothed. However, you can add additional smoothing here.

NOTE	Smoothing is computationally intensive, especially for 3D CAPPI cubes. If your workstation is too busy, you may want to reduce the smoothing.

Combining Algorithm

This is the algorithm that is used in regions where the radars are overlapped. Select Maximum, Average, Priority, Nearest, or Weighted (per the site list).

NOTE	Max is recommended for filling blanked or blocked regions.

4.2.4 WARN Algorithm

Since it is a special case, the composite algorithm for the WARN product is described here.

Remapping

WARN products are not stored in Cartesian format, so there is no remapping required. The output projection specified in the COMP configuration will determine the default display location and range when the composited WARN product is displayed.

Overlapping

The key to combining WARN products is determining which of the input centroids are really the same feature, and which are different. We do this with the adjustable **Centroid Distance** specified in the Product Configuration Menu. For WARN products, this field replaces the "Output Smoother" field used for other products.

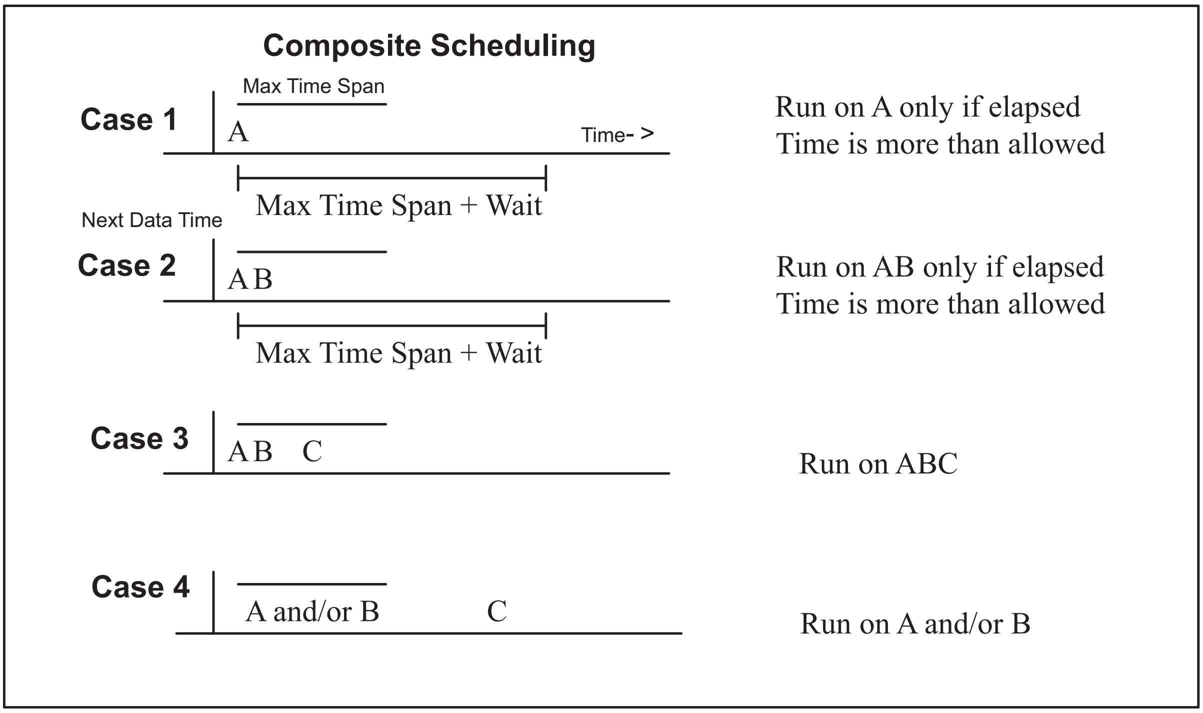
The composite is started by copying the highest priority input. Then all the other inputs are looped through in priority order. Each new centroid is compared with all the centroids in the composite being assembled. If the center of a new centroid is within the centroid distance of the ellipse of a composite centroid, then they are treated as overlapped in the combination algorithm below.

Combining

The choices for combining algorithms in the Product Configuration Menu (COMP Configuration Menu on page 134) are completely different for WARN:

- **OR Max** — The output contains a centroid for each centroid in any of the inputs. If 2 centroids overlap, then the maximum strength centroid is kept.
- **OR Avg** — The output contains a centroid for each centroid in any of the inputs. If 2 centroids overlap, then the centroids are averaged together.
- **AND Max** — The output contains a centroid only if all the inputs have a centroid at that location. The maximum strength centroid is used.
- **AND Avg** — The output contains a centroid only if all the inputs have a centroid at that location. The average value centroid is used.

4.2.5 COMP Scheduling



The scheduling algorithm takes into account that not all radars will be on the same schedule and not all radars will be working 100% of the time. The rules are actually quite simple. Consider a simple case of products arriving from radars A, B and C shown schematically in the figure above.

- A, B and C refer to products from different radar sites.

- The vertical line at the left represents the Product Scheduler "Next Data Time". The scheduling algorithm only considers data ahead (to the right) of this line.
- The overbar represents the "max time span" for making a composite. The max time span is set in the COMP Product Configuration Menu (COMP Configuration Menu on page 134)
- The underbar interval is the "elapsed time" between the time of arrival of a product and the current time.
- The products are positioned on the time line according to their "Data Time" (e.g., start of a volume scan).
- Each site is ranked in priority for the purpose of assigning the "Data Time" of the composite. When the composite is made, it will inherit the data time of the highest priority site that is used. The ranking is determined by the order of the site list in the COMP Product Configuration Menu (COMP Configuration Menu on page 134).

The four cases shown in the figure are described below:

Cases 1 and 2: Incomplete data — don't wait forever.

In these two cases, the scheduler waits for the data to be completed until the time between the arrival time of the earliest product and the current time exceeds the time window plus the "Product arrival wait time" from **setup**. This provides tolerance for radar workstation clocks that are not exactly synchronized, or for variations in the network transfer time. After running, the scheduler advances the "next data time" pointer to just after the data time of the latest product. Note that only the radar computers must have their times synchronized. The system clock on the compositing computer is irrelevant.

Case 3: A, B and C are all available and in the time window.

Run on A, B and C. This is the best case since all the data have arrived. After running, the scheduler advances the "next data time" pointer to just after the data time of the latest product that just ran.

Case 4: Out of Sequence Data or Late Arrival

A and B both arrive and then C arrives out of the time window. Run on A and B only. After running, advance the next data time to just after the data time of the latest product that just ran.

A arrives then B or C arrive out of the time window. Run on A only. Advance the next data time to just after the data time of A.

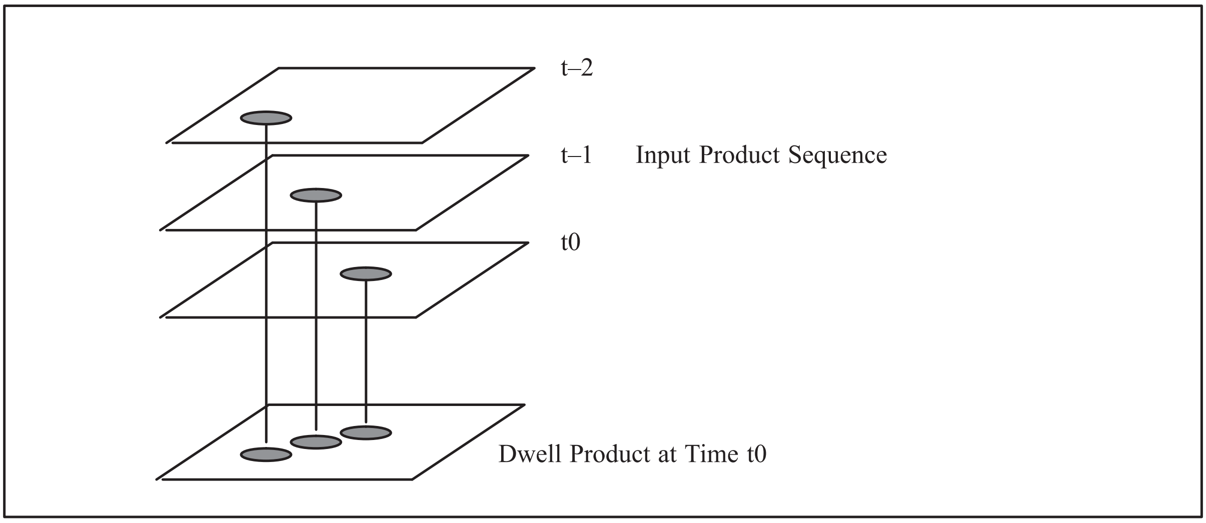
Using skip times

The discussion above is for a schedule where the skip time is set to zero. In this case, no data will ever be reused, and the next data time is set to just after the last product used as inputs. The only difference when using a skip time is that the next data time is set to the next multiple of the skip time after the *first* product that was composited. This guarantees that a composite is not skipped because of a single missing input file. It also means that in some cases the same input file may be used in two composites. Similarly, it is recommended that the Max Time Span be set to just under the skip time. Using a skip time is generally required if you are compositing radars with different times between volume scans.

4.3 DWELL Algorithm: Composite in Time

4.3.1 Overview

The DWELL product algorithm is used to composite successive images of a product in time. Moving targets will show a "streak" of echo. The product is similar to the photographic technique of leaving the camera shutter open while photographing a moving target. The background will be fixed and the moving target will show a "blur" behind it. A schematic example is shown below.



The DWELL product algorithm is essentially a "time composite" of the input products. Because of this the product that is generated by the DWELL algorithm is of the same type as the input product. For example, if we "dwell" a PPI product, a new PPI product is generated. However, we have two choices for the type of data that are displayed in the DWELL PPI product:

- **The original input data:** e.g., if a PPI of dBZ is used as input, then DWELL makes a time composite of dBZ. This is useful for showing where precipitation has fallen during the dwell time. When animated, the life cycle of growth, decay and motion of individual echoes can be easily seen.
- **Time:** In this case, the data points in the DWELL product are coded by their age from the time of the most recent product in the DWELL. The display shows a color coded time history of echoes.

Because DWELL products show the integrated time history of echoes, they are a useful alternative to the track product. There is also a special application of DWELL for airborne target detection, which is used for tracking and automatic warning for the presence of aircraft or migrating bird flocks.

In this section is described:

Example of DWELL Products	Dwell Algorithm Examples on page 141
Algorithm and Scheduling	DWELL Algorithm and Scheduling on page 145
Configuration Menu	Basic DWELL Algorithm Configuration on page 150
Target Warning Features	Target Detection: Input TASK and Product Optimization on page 153

4.3.2 Dwell Algorithm Examples

The DWELL algorithm takes a series of input products and composites them together in time. Either the original input data values (e.g., dBZ, rainfall rate) or the age of each point (relative to the most recent input product) can be selected for output. The example shown here is for DWELL applied to PPI products. The last (most recent) PPI product in the DWELL sequence is shown below. It shows a squall line in dBZ. The line was moving from east to west and developing/decaying as it traveled.

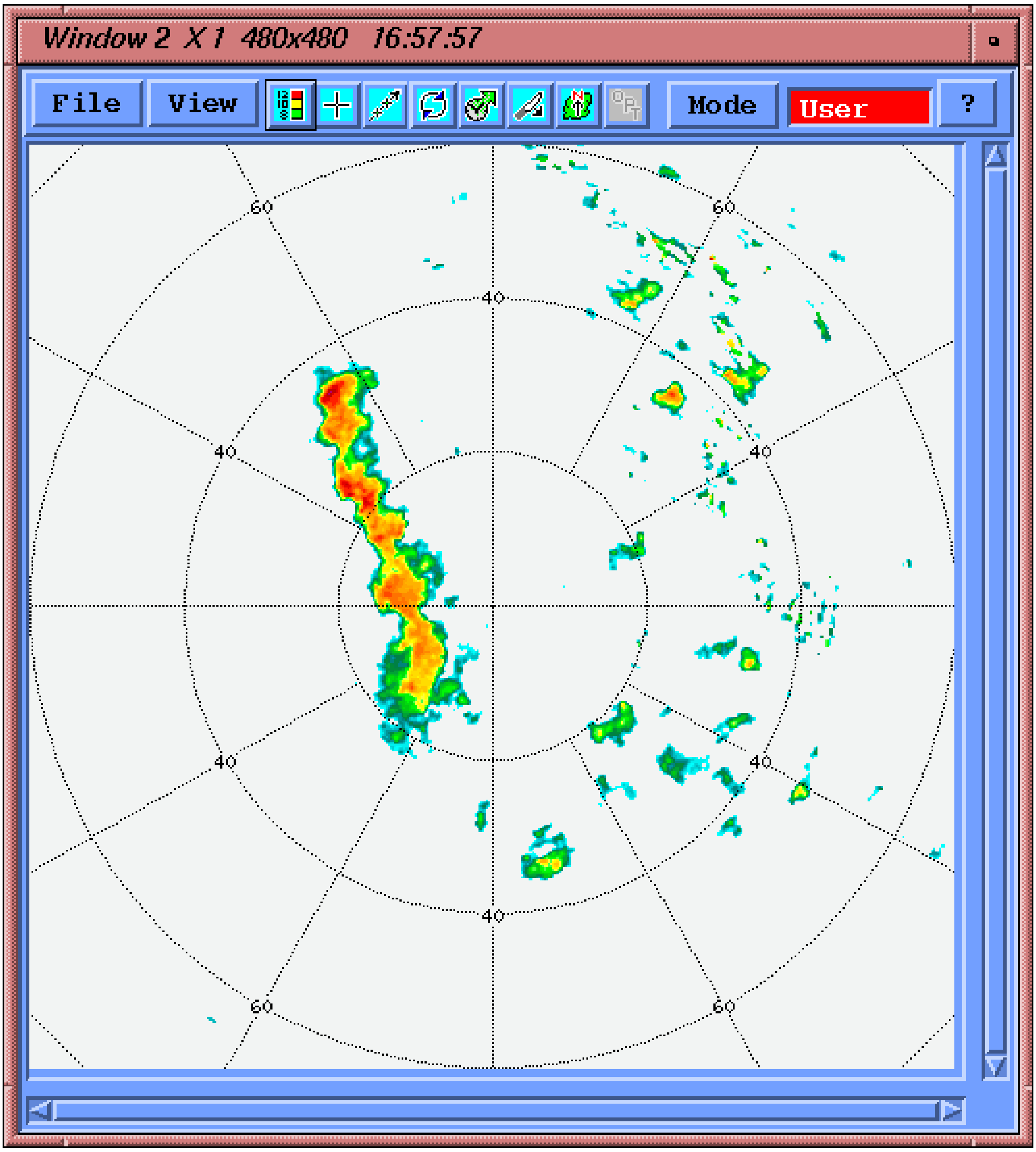


Figure 14 PPI of dBZ at a Single Time

NOTE	These examples are best viewed in color. See the on-line documentation using the "manuals" interface which can be accessed via IRISnet or by typing "manuals" in a UNIX terminal window.

The figure below shows a DWELL of the PPI's for the preceding two hours. This is useful to show where precipitation has fallen during the

DWELL period. Animation of this shows the expanding field of fallen precipitation and the echo motion.

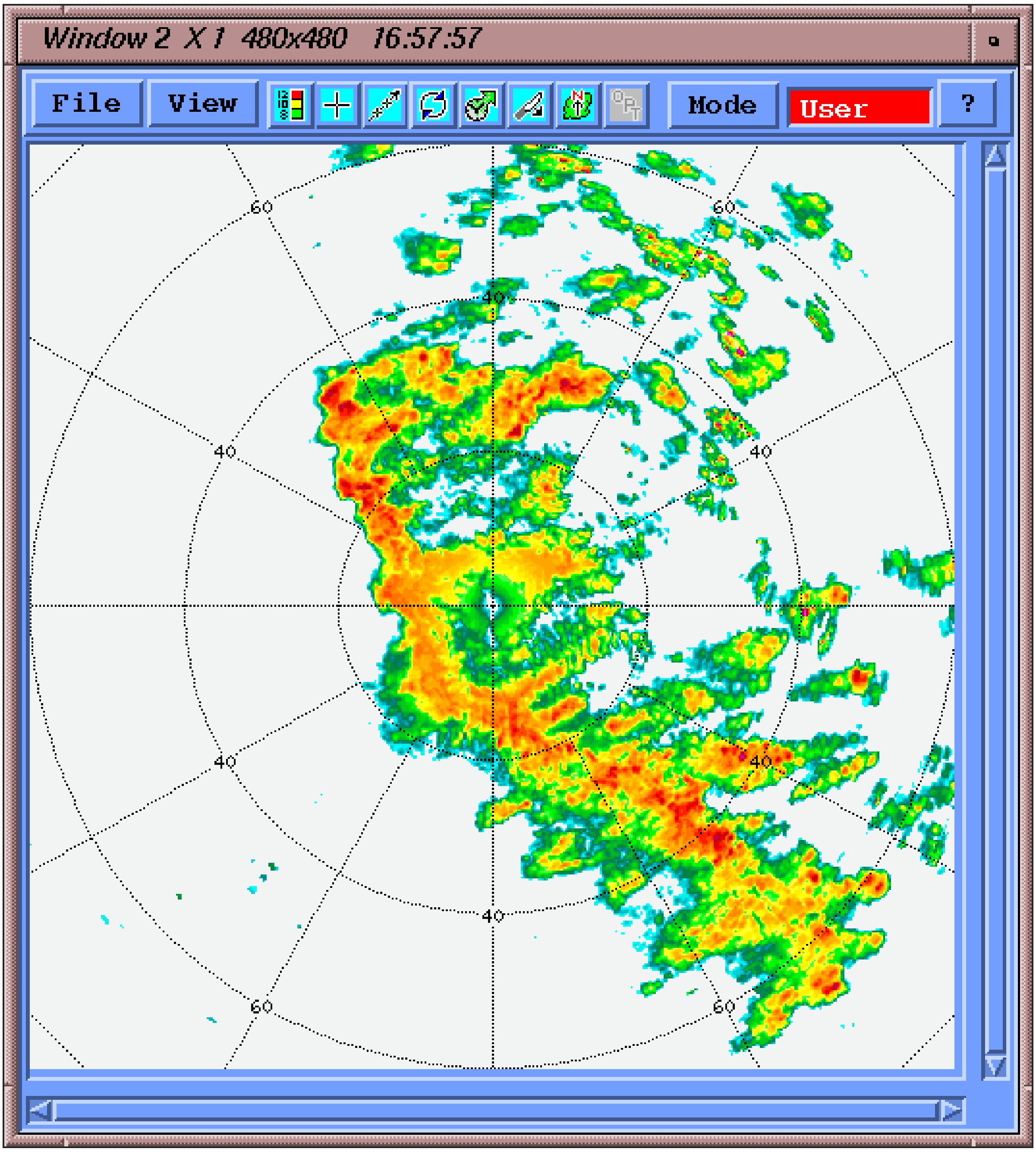


Figure 15 Dwell of PPI for the Previous 2 Hours Showing dBZ

The final figure in the example shows the age of the DWELL data points, i.e., the number of minutes since the most recent PPI product in the sequence. The color scale is configured so that blue shows the most recent echoes while red shows the oldest echoes. The example shows blue on the left (west) where the current echo is located. The red echoes on the right (east) are the older echoes from earlier in the sequence. This is to be expected for general east to west motion. Residual clutter shows a speckled pattern (e.g., at 50 km to the northeast).

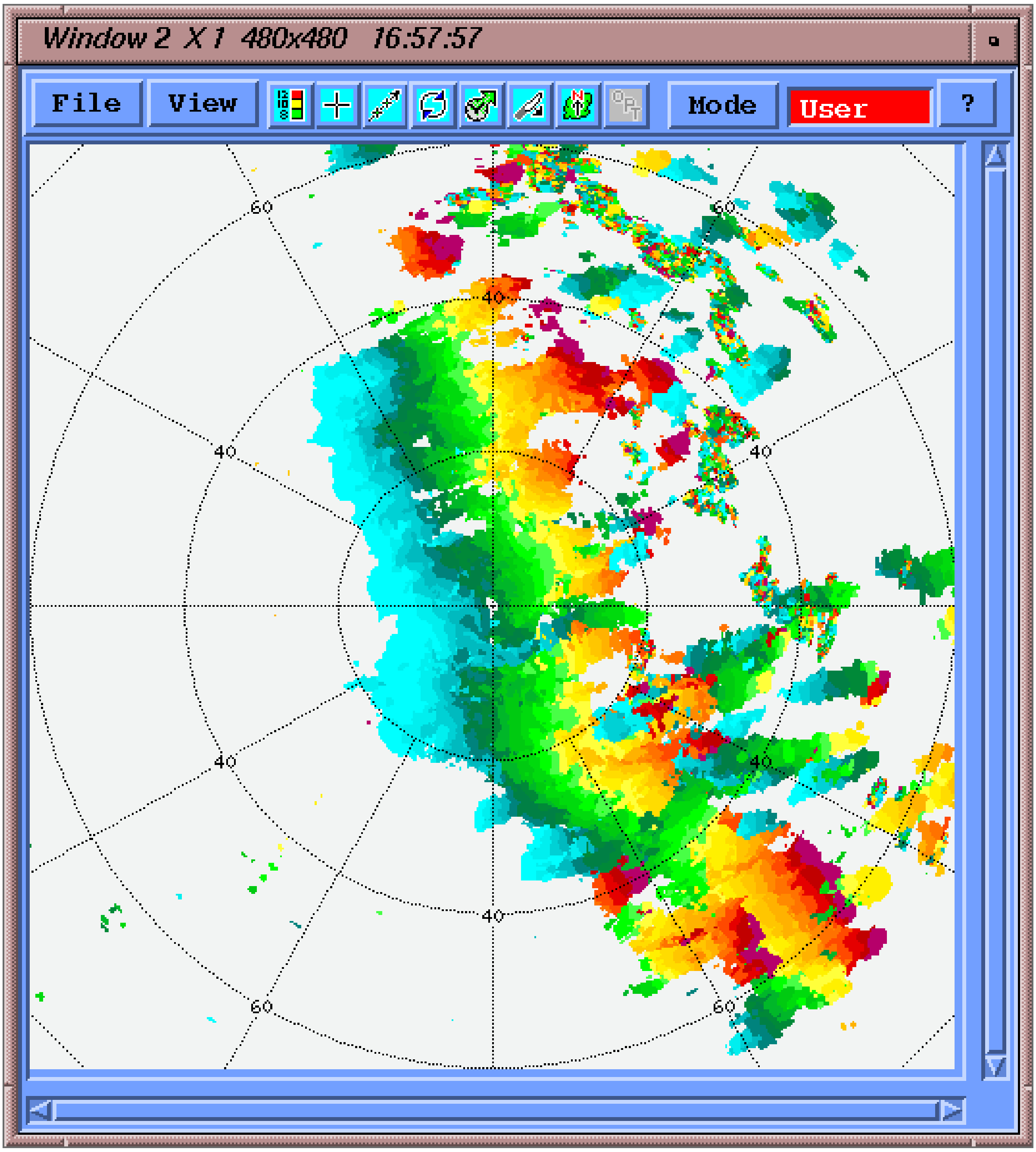


Figure 16 **Dwell of PPI for the Previous 2 Hours Showing Time (Age)**

NOTE	Hint: Use your <Page-Up> and <Page-Down> buttons to compare the examples.

4.3.3 DWELL Algorithm and Scheduling

The basic DWELL algorithm (without target warning) takes a series of products from the same site, of a given name and type and merges them together. This section describes how the algorithm works.

Product Scheduling

The DWELL algorithm is scheduled the same as an IRIS product, i.e., via the Product Scheduler. When the Product Scheduler detects an input product beyond the "Next Data Time", this product and all products from the same site, within the specified dwell time (e.g., the last 10 minutes), are combined together to make a new product of the same type. The data stored in the product can be either the data values of the original product or the age of each point relative to the most recent product in the series.

NOTE	If the DWELL is based on a PPI product where the elevation selection in the PPI product configuration is set to the wild card *, then some care must be used in scheduling since excess CPU loading and performance degradation could result. It is recommended that the Product Schedule "Skip Time" be set to the time required to complete a volume scan or longer. This avoids the DWELL product being produced on the completion of every PPI sweep.

Input Product Filters

There are three input data filters that can be applied to each input product before it is merged into the DWELL:

- **Min Filter**- discards any pixel in the input product with data value less than the specified minimum value. For velocity, absolute value is used. For the example of a PPI in dBZ, if the minimum value is set to 10 dBZ, all pixels with values less than this are discarded.
- **Max Filter**- discards any pixel in the input product with data value less than the specified maximum value. For velocity, absolute value is used. For the example of a PPI in of dBZ, if the maximum value is set to 50 dBZ, all pixels in the input product with values greater than this are discarded.
- **Contrast Filter**- discards any pixel in the input product with data value not exceeding the corresponding data value in the computed background field plus a selectable threshold. For velocity, the

absolute value of the difference between the background field and input product pixel is used. The background field is obtained by first creating a smoothed version of the DWELL product. For the example of a VIL product, if the contrast threshold is set to 3 (mm), then a pixel in an input product must have a VIL 3 mm greater than the corresponding pixel in the background field.

If a pixel fails any of these tests, then it is set to "thresholded", i.e., no data.

Data Merge

After filtering, each pixel in the input is "merged" into the corresponding pixel in the DWELL output. In the case (for example) when there are ten input products to merge, there is the possibility that there are up to ten possible values for assigning the output value. The merge algorithm simply uses the maximum value. In the case of velocity, the absolute value is used

Depending on the user selection, the algorithm then stores either the time of the merged pixel or its data value. Time is stored as the "age" of the pixel relative to the most recent input product in the DWELL sequence.

In the special case of merging WARN products, the centroid statistics are simply merged together, i.e., a new WARN product is created that combines all of the centroids in the time sequence of input WARN products.

Background Field

The contrast filter allows relatively strong echoes such as reflectivity cores, birds or aircraft to be isolated from relatively weak background echo. For the target warning algorithm, the contrast filter is essential to detecting airborne targets in weak clear air or weather echoes.

The background field is created by first running the DWELL algorithm without the contrast step and then smoothing the data with a 2D filter. Note that the Max and Min filters are used to filter the inputs to generate the background field. In the special case when the input product is PPI's at different elevation angles, there is an option to generate the background filed separately for each PPI elevation angle as opposed to simply merging the PPI's regardless of angle.

The merge algorithm for the creation of the background field is the same as for the main DWELL algorithm (i.e., maximum value), except that for velocity, the average value of the signed velocity is used. The reason for using the Max for everything except velocity is that weather echoes have a natural power fluctuation and these are better removed by the contrast filter if the background field is based on maximum, i.e., the background field has larger values so that fewer weather speckles are passed. In the case of velocity the average value is used to characterize the background field since it does not make sense to use the maximum when every velocity is equally likely.

After the merge, a smoothing filter is applied. This is a 2D averaging filter set to 10 by 10 km or 60 × 60 pixels (whichever is less), centered at the smoother output pixel. A triangular weighting is used to assign more weight to the center pixels. The filter requires a selectable percentage coverage to produce an average value at the center pixel, else a value of "thresholded" is assigned to the center pixel. The threshold is typically set to 20% coverage. This has the effect that isolated point targets such as birds or aircraft are excluded from the background field so that they are not filtered by the contrast filter.

An example of a smoothed contrast filed is shown below for the same case that was presented in the examples (Composite Algorithm on page 132).

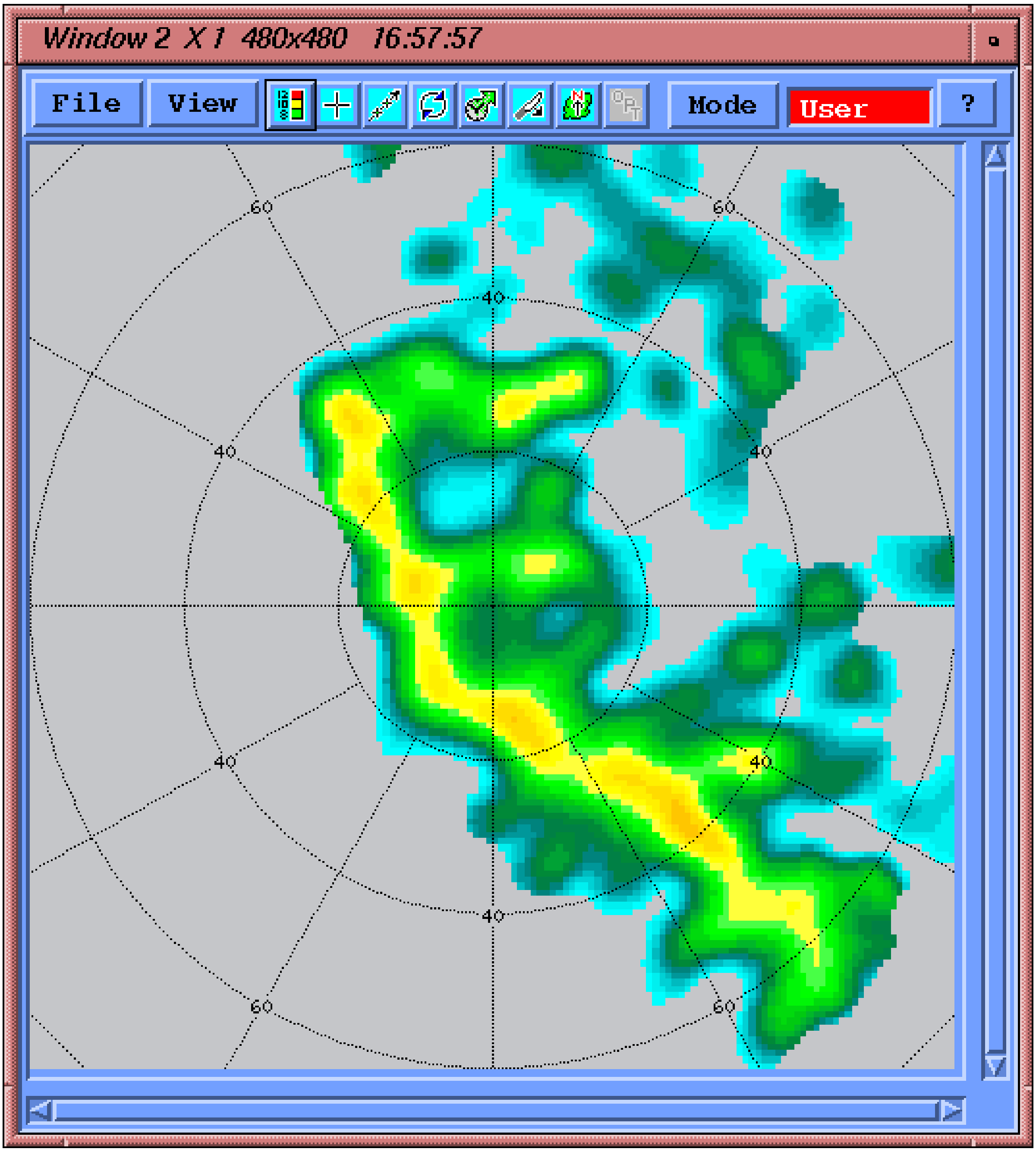


Figure 17 Background field for 2-Hour Dwell Showing dBZ

The smoothed background field has generally lower echo intensity as a result of the smoothing process. Note that there are no "speckles", i.e., only large scale echo features remain. Thus the background field is a representation of the average background echoes. When this is subtracted from the input products and thresholded (in applying the contrast filter), the background echoes are removed, leaving only the high intensity cores or point targets such as birds or aircraft.

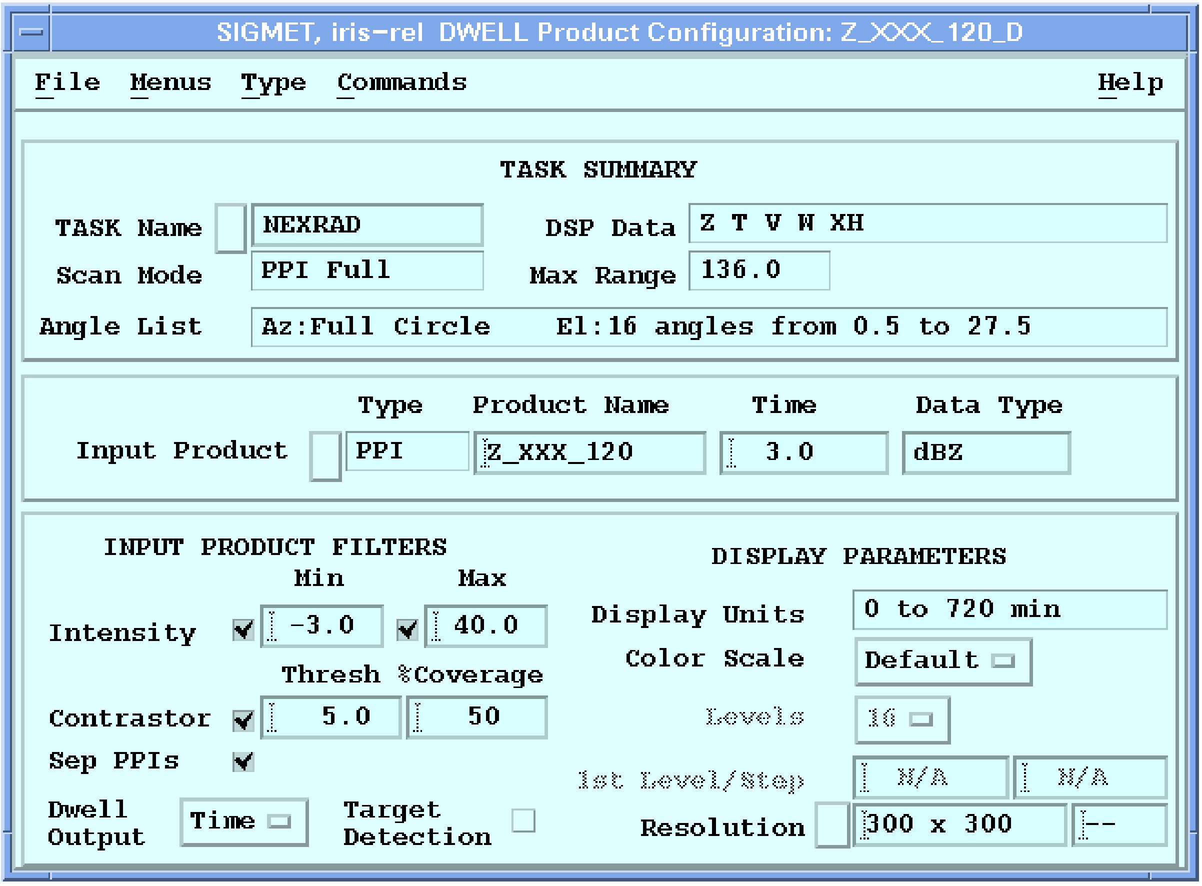
Diagnostic Output for Algorithm Verification

To assist with tuning the DWELL algorithm, especially in the case of target warning, The DWELL algorithm can produce diagnostic output. This is activated by clicking the "Diagnostic" button at the bottom of the target Warning section of the DWELL Configuration Menu. Note that diagnostic output will be produced even if target warning is subsequently disabled, as long as the diagnostic button is clicked-in.

The diagnostic outputs are stored as type USER products. The naming convention is as follows:

- **USER: <productname>DAT or TIM -** The main output of the DWELL product is a product of the same type as the input product (e.g., a PPI) for either the input product data type (e.g., dBZ) or time (age). The diagnostic USER product is for the data type that was not selected for the main output. For example, if dBZ is selected for the main output, the diagnostic USER product is for the time (TIM suffix). If time is selected for the main output, the diagnostic USER product is for the input data type (DAT suffix).
- **USER: <productname>CON -** If the contrast filter is enabled, the diagnostic USER product with the suffix CON shows the background field. An example of this is shown in the previous section.
- **USER: <productname>PIL -** If target warning is enabled, the diagnostic USER product with the suffix PIL shows the "pile" product, i.e., the number of target hits per pixel (X4) for the first in the sequence of the assumed motion vectors (i.e., the first trial). For diagnostic work, the target Warning can be configured to run a single motion vector so that any speed and direction can be isolated for study.

4.3.4 Basic DWELL Algorithm Configuration



The configuration menu for the DWELL algorithm is shown above for the case of Target Detection disabled. The various fields and options are described below.

Naming Convention for File->SaveAs

It is recommended that the name of the DWELL product be the same as the input product with a "D" appended to the name. For example,

- Input Product Name: Z_005_250
- Dwell Product Name: Z_005_250_D

Another alternative is to put the number of minutes after the D, e.g., Z_005_250D10 to indicate a 10-minute DWELL. Recall that names are limited to 12 characters.

Input Product Type and Name

Select the input product, i.e., the product that you want to "dwell" together. Any of the following can be selected:

- BASE
- CAPPI
- HMAX
- PPI
- RAIN1
- SRI
- TOPS
- VIL
- WARN

In the special case of combining WARN products, the centroid characteristics of all the input products are simply combined together. Therefore, most of the menu features in the DWELL product are disabled, except the DWELL time selection.

Dwell "Time"

This is the time period in minutes for which products will be dwelled-together. For example, when a new PPI product is created or received, this and all PPI's within the last 10 minutes will be included in the DWELL PPI product.

Data Type

A display-only field that shows the data type in the PPI. If you select the "Dwell Output" to be Data (e.g., in the lower left corner), then the DWELL version of the PPI will be made for this data type. In the example, a DWELL PPI of dBZ will be generated.

Input Product Filters- Intensity

Since the DWELL algorithms essentially add-together many products, it is sometimes useful to filter some of the data values that are not of interest. The intensity filter allows you to eliminate any data points that are less than the "Min" or greater than the "Max". Use the button to enable the filter and type in the value. The units are for the "Data Type" of the input product. In the example menu, this would be dBZ.

NOTE	Hint: It is important to look at an example of the input data to determine how to best set the thresholds.

A useful application is to set a "Min" threshold to eliminate weak echoes so that the DWELL algorithm result will show only the strongest precipitation cores.

Input Product Filter- Contrastor

NOTE	For target detection, the contrastor is necessary in order to pick-out an airborne target from weak clear air or weather echoes.

The contrast filter provides a way to eliminate relatively weak echoes so that only the embedded stronger echo cores remain. It first computes a smoothed version of the DWELL (the background echo) and then subtracts this from the original input data to get the final "contrasted" version of the DWELL. Essentially the DWELL algorithm is run twice — the first time to compute the background field and the second time during which the background field is used to threshold the original input data. For more information on the contrast algorithm see COMP Configuration Menu on page 134.

The parameters to configure the contrast filter are as follows:

- **Thresh-** Each input product data pixel must be greater than the corresponding pixel in the average background field by this amount, else it is discarded.
- **% Coverage-** The background field is produced by a smoother that averages data pixels in a 10 km by 10 km box that is passed over all the pixels in the fist pass DWELL product. If the percentage of valid (non-thresholded) pixels in this box does not exceed the % Coverage limit, then a value of "thresholded" is assigned to this box, i.e., there are not enough points to compute the average.

Sep PPI's

This button selection only applies to the special case when the input product consists of PPI's at different elevation angles. For example, a PPI product that is made with a * in the elevation angle filed will have every angle in the volume scan. In this case, the background field can be in either of two ways:

- Default Method- all of the angles are simply merged together to compute the background field.
- **Sep PPI's** enabled- the background field is computed separately for each PPI elevation angle and the contrast thresholding is performed separately for each angle before merging the results. This technique is provides better results when there are vertical gradients in velocity or

reflectivity. If the vertical gradients are weak then it does not really matter which approach is used.

Dwell Output

Select either one of (see the examples in Composite Algorithm on page 132):

- **Data**- the DWELL algorithm will produce a time composite product in the same units as the input products. In the example product configuration menu, a PPI of dBZ would be produced.
- **Time**- the DWELL algorithm will produce a product that shows the age of each point relative to the most recent input product. The display of this makes it easy to spot moving targets since they leave a streak of colors ranging from the oldest to the most recent.

Display Parameters

This will reflect the choice of either "Data" or "Time" and you are free to select the color scales as for any other IRIS product. Note that the output pixel numbers cannot be changed since it is controlled by the resolution of the input products.

4.3.5 Target Detection: Input TASK and Product Optimization

The airborne target detection, tracking and warning features of the DWELL algorithm are designed to detect aircraft or flocks of migrating birds and issue automatic warnings. Aircraft and migratory bird flocks tend to move with a fairly constant speed and direction and this property is used to distinguish between airborne targets and other targets. In many cases, targets embedded in weak weather targets or clear air echoes can be distinguished.

As with any automatic detection algorithm, there is a direct tradeoff between the probability of detection and the false alarm rate. For best performance, the scan TASK and the input product generation need to be optimized as discussed below:

Scan TASK Optimization

Target detection requires that extraneous targets such as clutter, second trip echo and noise be eliminated. The update rate should be fairly rapid to resolve the target motion and provide more continuous information on the target locations. Some knowledge of the likely altitudes of flight is required to construct the volume scan TASK. The maximum range of detection depends on the performance characteristics of the radar. Typically about 60 km detection range can be expected for a 1 to 1.5 degree beamwidth antenna.

For target detection, the scan TASK should be optimized as follows:

- Maximum range of 60 to 100 km.
- Maximum resolution permitted by the signal processor (e.g., 125 meters). This will depend on the processor performance characteristics.
- Maximum PRF and minimum pulse width.
- 2nd trip echo cancelation. On magnetron systems, SQI thresholding of the dBZ may be used in lieu of this. This will discard non-coherent targets such as 2nd trip echoes.
- Ground clutter filtering with an aggressive CSR threshold (lower value). The value depends on the radar phase stability performance characteristics but will typically be in the range 10 to 20 dB. The goal here is to completely eliminate strong clutter targets which could produce false alarms.
- SQI adjusted higher than usual (e.g., approximately 0.45). This is to eliminate velocity speckles which could produce false alarms.
- LOG adjusted higher than usual for weather. This is to eliminate speckles in intensity which could produce false alarms.
- The speckle remover should be disabled so that single bin targets are passed. These could contain a point airborne target.
- Few elevation angles covering only the heights of interest to a range of approximately 60 km. This allows more rapid updates. For example, for a 1 degree antenna beam, the 5 elevation angles of 0.5, 1.5, 2.5, 3.5, 4.5 would provide continuous vertical coverage up to 2 km (nominally 6000 feet), from 25 to 60 km. At 10 km the coverage would be to 2600 feet above the radar.
- Moderately fast scan rate (>3 RPM) consistent with rapid updates, but still allowing approximately 50 pulses per antenna beamwidth. For example a PRF of 1000 Hz and a scan rate of 3 RPM (18 degrees per second) would provide 1000/18=55 pulses for each degree of antenna motion.

Input Product Selection and Optimization

The input product types suggested for target warning are:

- PPI of dBZ or radial velocity at single or multiple sweeps.
- VIL covering the layer of interest.

Radial velocity is recommended for discriminating between airborne targets and background clear air or weak weather echoes. The reason is that airborne targets, such as aircraft or birds, move at a different velocity than the air so that, provided the targets are stronger targets, they will produce a velocity anomaly which will be passed by the contrasting algorithm. In the case when the motion of the target is perpendicular to the radar beam, the clutter filtering can remove targets so there is a possibility of some "blind" sectors because of this.

VIL is also a useful product for target warning since it integrates echo over a selected layer. Single PPI products can be used, but since they are at only one elevation angle, not all heights are covered. However, a PPI product made with the wild card * in the elevation selection can be used to combine together all the PPI's in a volume regardless of the elevation angle. In this case, the DWELL algorithm will run at the completion of every sweep, and since the algorithm is intensive, the system may not have enough CPU power to do all of the DWELLs plus the other functions (e.g., user display, animation, other product generation, communication). The DWELL product generation would then fall behind real time. Therefore if all of the PPI's are used, it is recommended that the DWELL product schedule entry use the "Skip Time" feature of the product scheduler, set to the time between volume scans. Thus a new DWELL product is produced on the completion of the volume scan rather than on completion of each individual PPI.

Some general tips for configuring the input products for target detection optimization are:

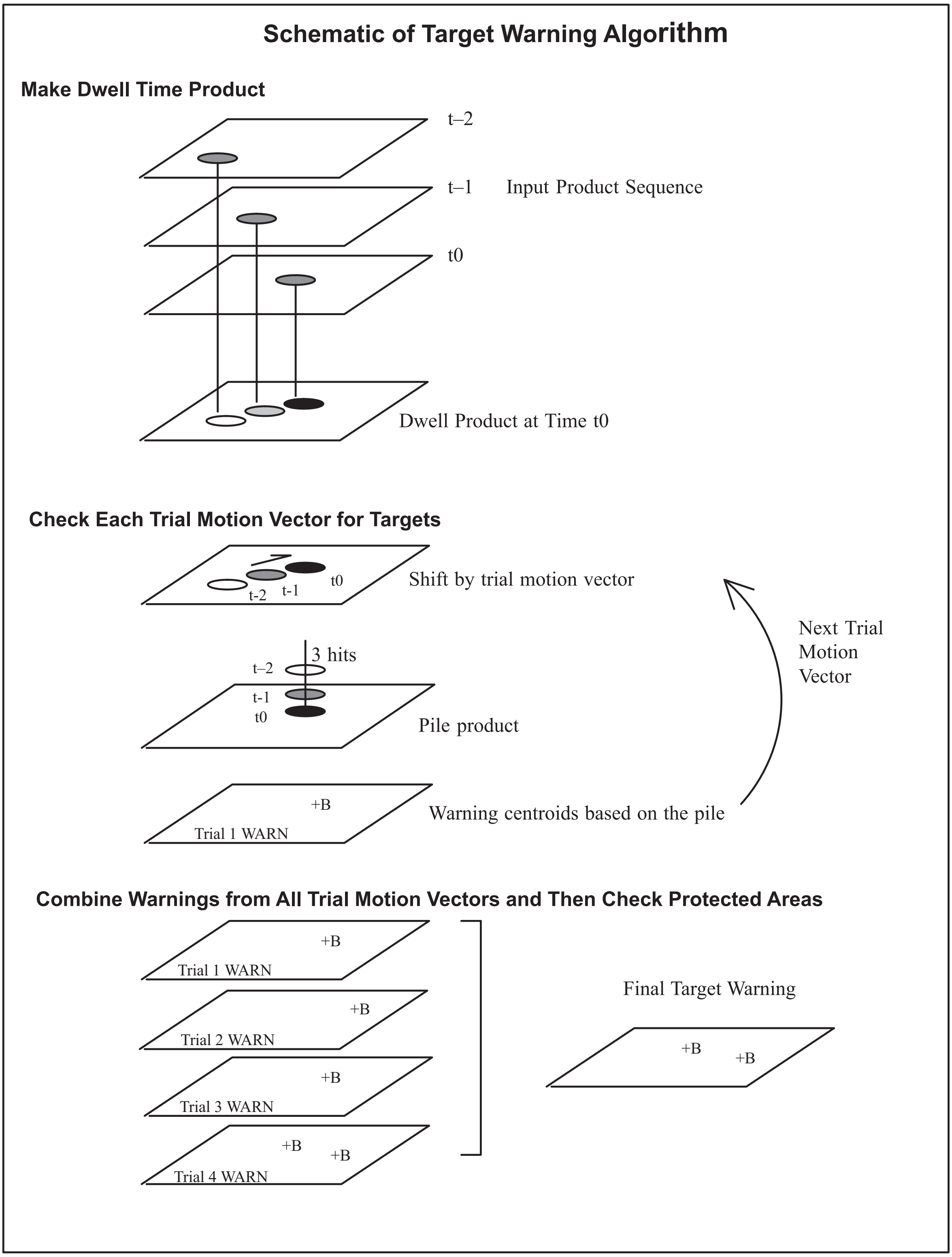
- The maximum range and the pixel resolution should be set so that the resolution of the original input data is preserved. For example, for 125-m bin spacing to 45 km, the product pixel size should be set to 720 × 720 (corresponding to 90 km diameter and 0.125 m per pixel).
- The product smoother must be set to 0. This is so that isolated single-bin targets are not removed.

4.3.6 Target Detection: Algorithm and Configuration

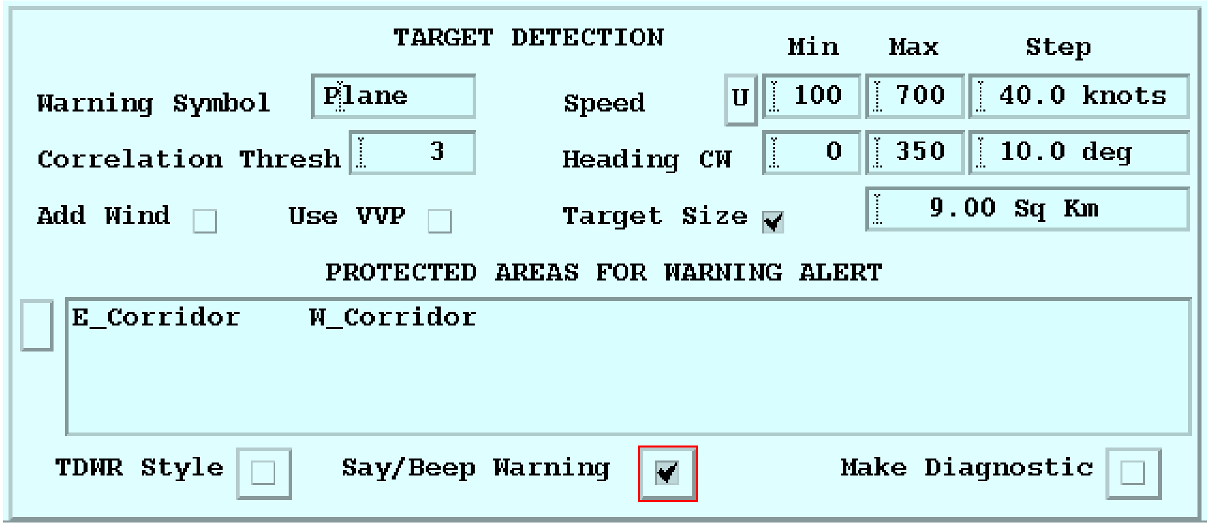
Algorithm

The target detection algorithm is shown schematically below. The algorithm uses a series of motion vectors, spanning the possible range of target speed and direction, to shift a time DWELL product. Targets whose motion matches the assumed motion vector will "pile-up". The depth of the pile provides a measure of the "coherent motion" of the target. Essentially this is an autocorrelation approach. The various steps are:

- A time DWELL product is made in the usual manner. Note that if the target warning is enabled, then even if a data DWELL product were requested, the time DWELL would be created for the warning.
- The time DWELL points are shifted back in horizontal space according to a trial velocity vector. Targets that are moving at a constant velocity will be "piled" on top of each other. The output of this step is an intermediate "pile" product which has the number of data points that are accumulated (piled) on each pixel.
- A warning/centroid algorithm is then run using a selectable threshold for the number of "pile" points. The approach is identical to the standard IRIS WARN product described in WARN: Warning/ Centroid Product on page 106. Note that the pile product units are 4X the actual number of points, e.g., for a pile of 3 points, the representation would be 12 in the diagnostic pile product (PIL).
- The previous two steps are repeated for each trial.
- After all trials have been run, the centroid products for each trial are combined to eliminate "double hits" which occur for the same flock, i.e., there may be several trial winds that produce centroids of sufficient intensity (pile number). The combination combines all centroids that are within 3 km of each other by choosing the one with the largest pile number.
- The resulting combined warning product is then checked for protected areas that have been hit.
- The final output WARN product is named using the same name as was assigned to the DWELL product.



Target Detection Configuration



The Target Warning features are activated by clicking the Target Warning button in the main DWELL Configuration Menu. A new section of the menu appears at the bottom of the main menu (see above). Some of the features are described in the WARN product configuration menu in WARN: Warning/Centroid Product on page 106. The special configuration options for target detection are described below:

Warning Symbol

Enter the name of an icon to display. If no icon exists by this name, then the text that is entered shall be displayed at each centroid location. The icon will be automatically rotated to point in the direction of target motion. In the example above, "Plane" is an icon of an airplane that is flying to the north. Bird icons are also provided.

Correlation Threshold

This is the threshold for the number of points in the "pile" product X4. For example, the number 8 represent 2 points. Note that the smoothing in the pile product typically reduces the number of points from the maximum value. Thus a pile product value of two would actually correspond to a greater number at very sharp maximum.

NOTE	The correlation threshold is the primary tunable parameter to optimize the probability of detection and false alarm rate.

NOTE	The appropriate value of the correlation threshold will depend on the length of the DWELL sequence. Longer DWELL times (more input products) produce larger "piles".

Add Wind, Use VVP, Speed and Heading Range

The track of the targets is used during the "pile" process to add up targets that are moving at the expected velocity. The velocity of the targets is the result of the target's flight (air velocity) and the wind. These fields are used to account for these effects.

Add Wind specifies whether you want the wind effect to be added to the target flight velocity vector. If this is enabled, the **Speed Range** should be interpreted as the expected range of speed of the targets in still air, i.e., their flight speed.

NOTE	If you choose not to use the Add Wind feature, then the range of speeds must include the expected variation in the wind speed as well as the target speed. The greater range of speeds results in more false alarms and requires more trial winds (slower algorithm performance).

If you select Add Wind, then the "Use VVP" button controls is where does the algorithm get the wind. If selected, then the UNFOLD VVP product is used for mean wind information. Otherwise the **setup** product section has a default wind speed and direction. In tropical maritime trade wind regions this could be set fairly reliably to a single value of speed and direction. However, for most regions of the world, the default wind would usually not be a very good value. However, it is the value that is used by IRIS when there is nothing better around to use. This value can be changed in real time using our **setup_change** utility.

Target Size

If this button is clicked-in, then the DWELL "pile" product will be further qualified to remove all large piles. The number entered is in square km. This is to reduce false positives. If there is a squall line moving in the same direction as the expected airborne targets, it will normally generate target warnings. These warnings generally have a larger area than the true targets, so you can filter them out.

Diagnostic Output

If this button is clicked-in, then DWELL will product three diagnostic products. These will be stored as USER products under the same product name assigned to the DWELL product and a suffix indicating the type of diagnostic (DAT or TIM, CON and PIL). See the description of these diagnostic products in DWELL Algorithm and Scheduling on page 145.

Target Detection Data Format

The target detection algorithm generates a standard IRIS WARN product. Part of that warning_results structure are 3 data values. For normal WARN products, these contain the average and maximum data values within the detected centroid. When generated with the target detection algorithm, these contain:

- The average and maximum height of the target returns in km.
- The average and maximum pile height.
- The average and maximum elevation angle of the target returns in degrees.

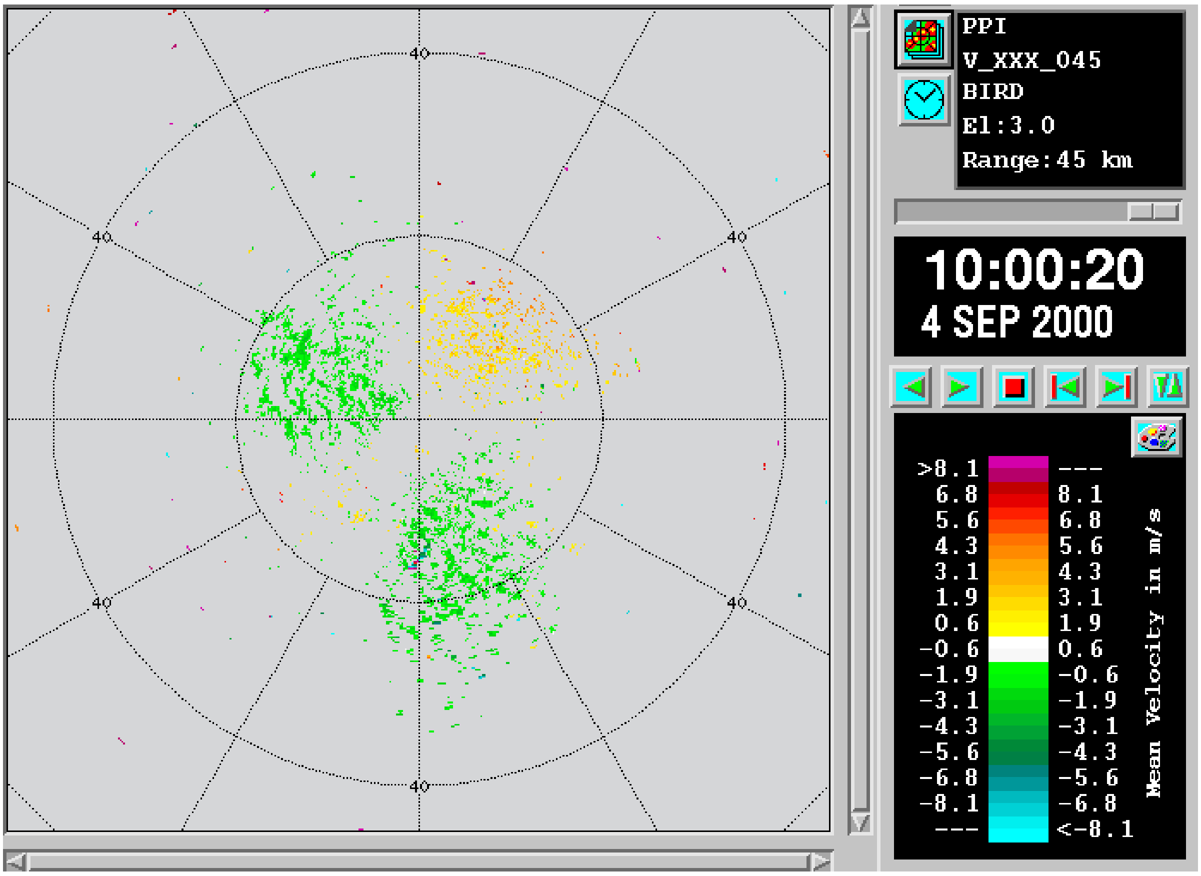
4.3.7 Target Detection: Migratory Bird Examples

The following examples are for bird tracking during a fall migration. Targets are primarily flocks of large storks comprised of 30 or more individuals. These were traveling from northeast to southwest (heading range of 200 to 250) at about 12m/s (speed range of 8 to 16 m/s).

These figures show various products and displays produced by the Target Algorithm.

NOTE	Note: These examples are best viewed in the on-line manuals in color.

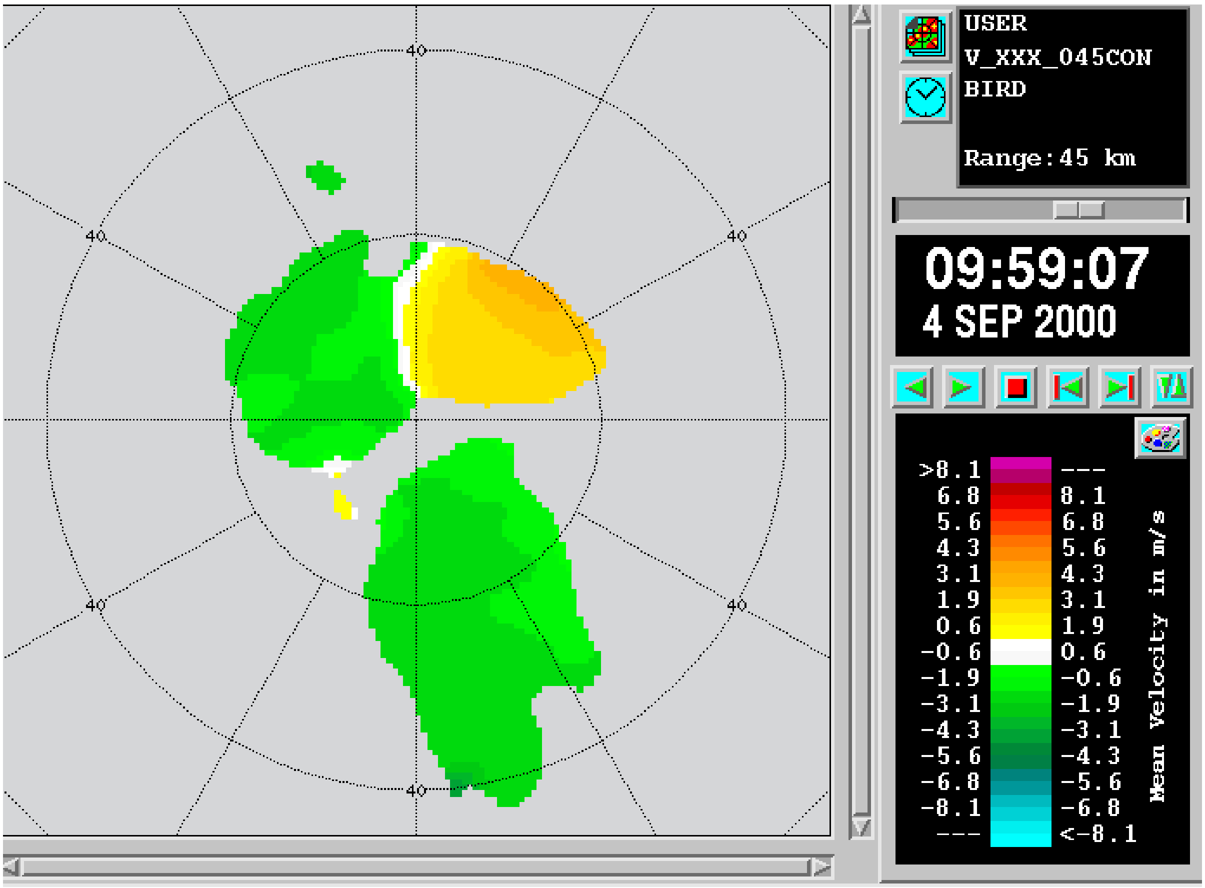
Input PPI's of radial velocity



The input data were based on a volume scan of four elevation angles at 0.5, 1.0, 2.0 and 3.0 degrees elevation angle. The input resolution is 125m. PPI's of radial velocity to 45 km range for all angles are used, i.e., a product named V_XXX_045 is generated with the wild card * in the elevation selection. A product pixel resolution of 720 by 720 is used to match the 125-m input data resolution.

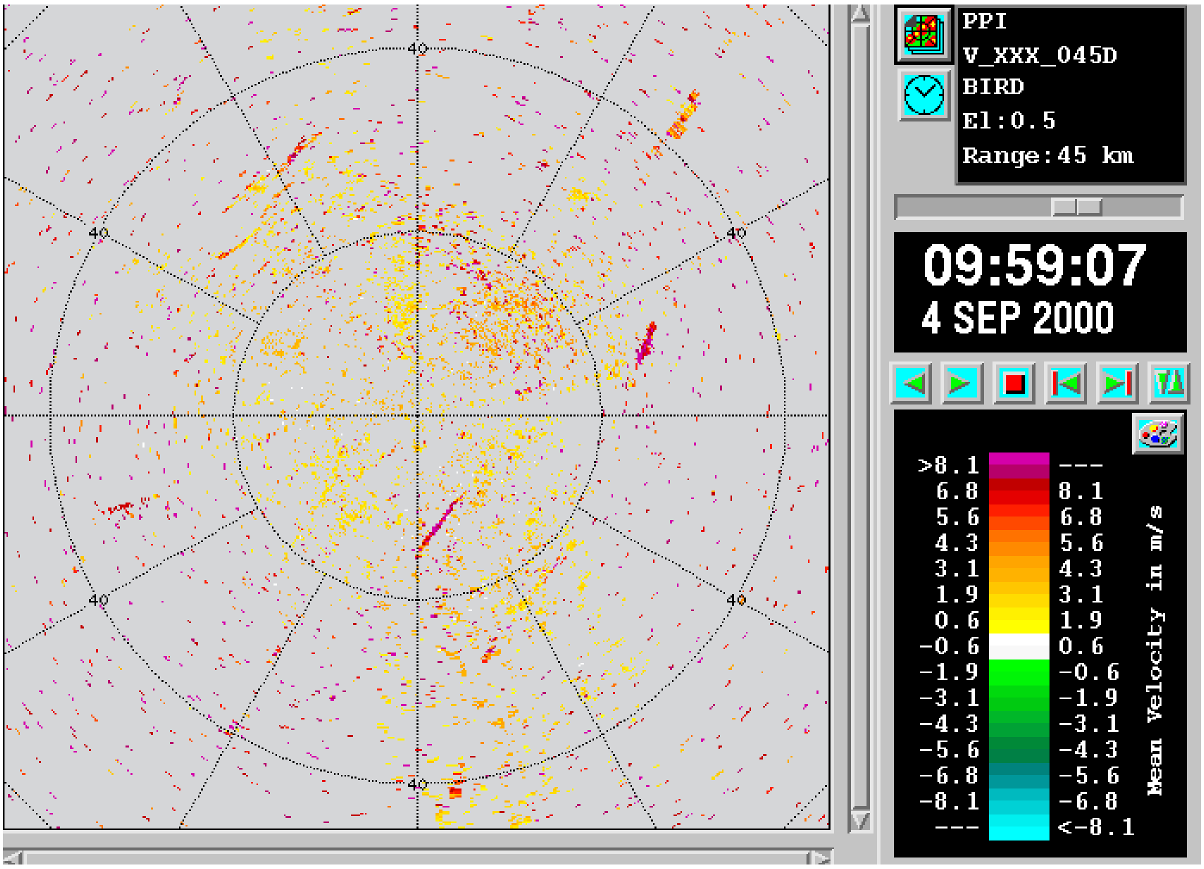
The figure below shows an example of a 3 degree elevation PPI. There is clear air echo only and winds are generally weak. At 15 km south of the radar there is a velocity anomaly that will later be identified as a bird flock. There are other airborne targets as well, but since they may only be 1 or 2 pixels, it is difficult to separate these from the background noise and clear air echo.

Background Field



The contrast filed is a smoothed version of the DWELL data which is used as a dynamic threshold for the contrast filter. For this example a minimum coverage criterion of 25% was used. The DWELL is 10 minutes. Note that aggressive clutter filtering has removed nearly all of the clear air echo at zero velocity. Also not that only the large scale echoes are included in the background field. This is important, otherwise airborne targets would be removed during the contrast step when this background velocity is subtracted.

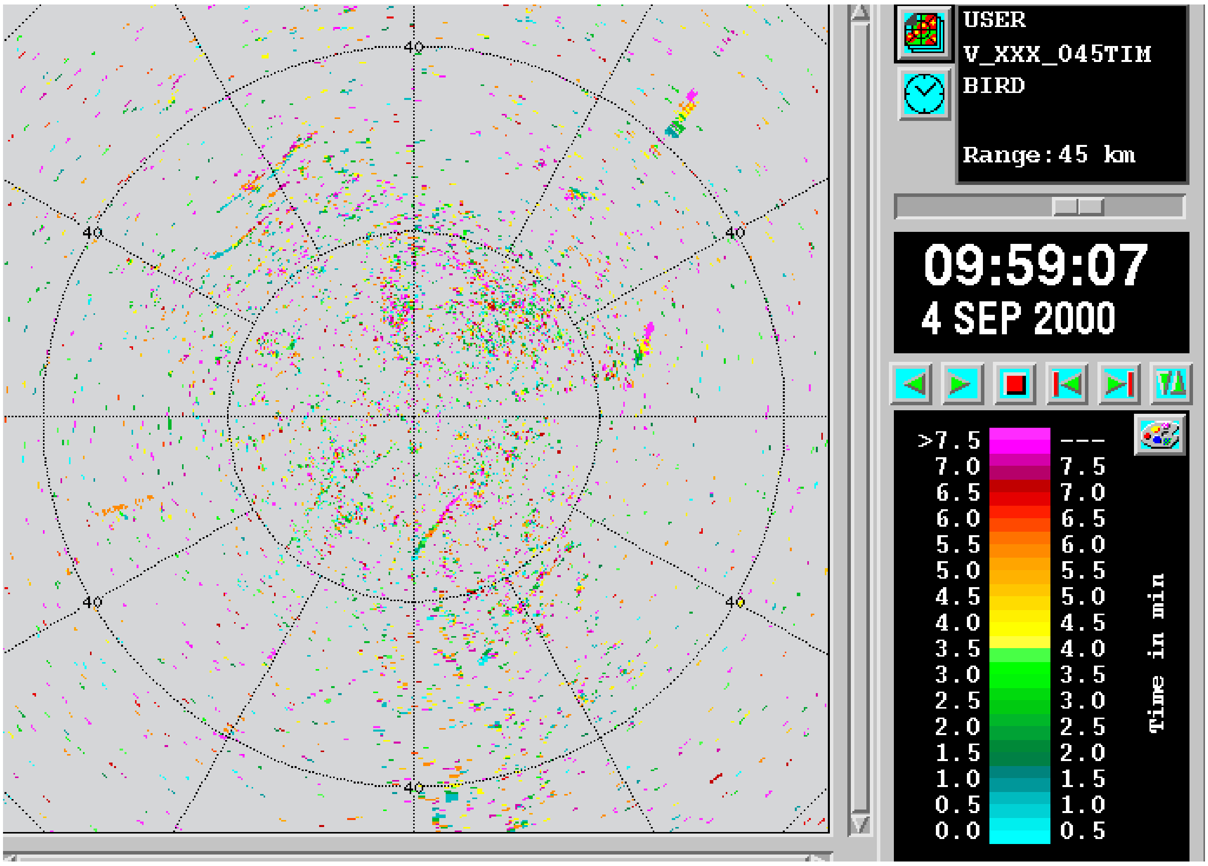
Data Dwell Product



The data DWELL product (data was selected as the primary output) is a PPI product combining all of the PPI's from all elevation angles for the prior 10 minutes (22 PPI's in this case). Only positive values are included since the output is the absolute value of the velocity anomaly as compared to the background field. A contrast threshold of 1 m/s was used, i.e., only data points that differ from the background field by more than 1 m/s are included in the DWELL PPI product.

This shows streaks of velocity anomaly which are likely bird targets. Note that all of the speckles in all of the PPI's are unfortunately passed through the DWELL algorithm. Also note that most of the clear air echo has been effectively removed by the contrast filter.

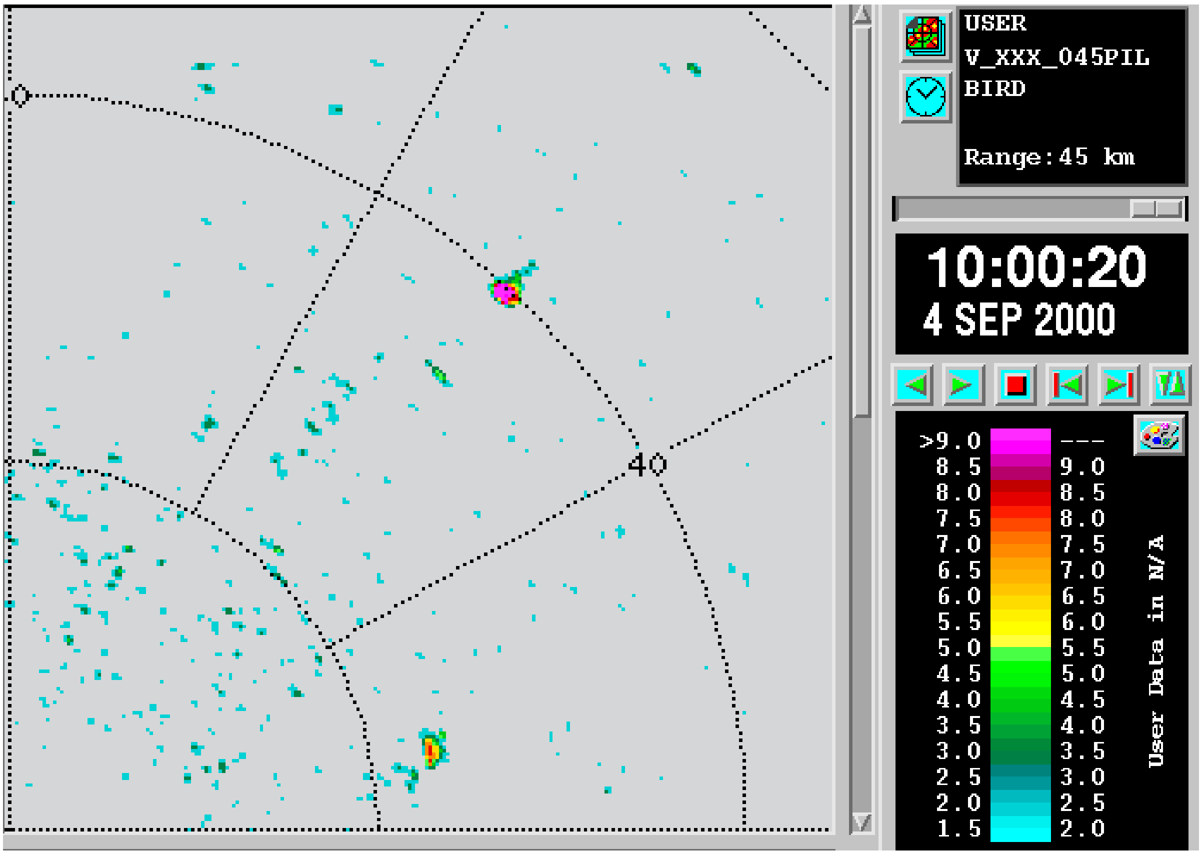
Time Dwell Product



The time DWELL product shows the age of the points in minutes. The most recent points are represented in blue and the older points in red. This clearly shows the streaks of motion from northeast to southwest. This is even more apparent in animation since the streaks move across the screen to the southwest.

The random noise shows a chaotic speckled pattern in time. There is a streak of interference echo which shows only a single color (to the southwest at 30 km).

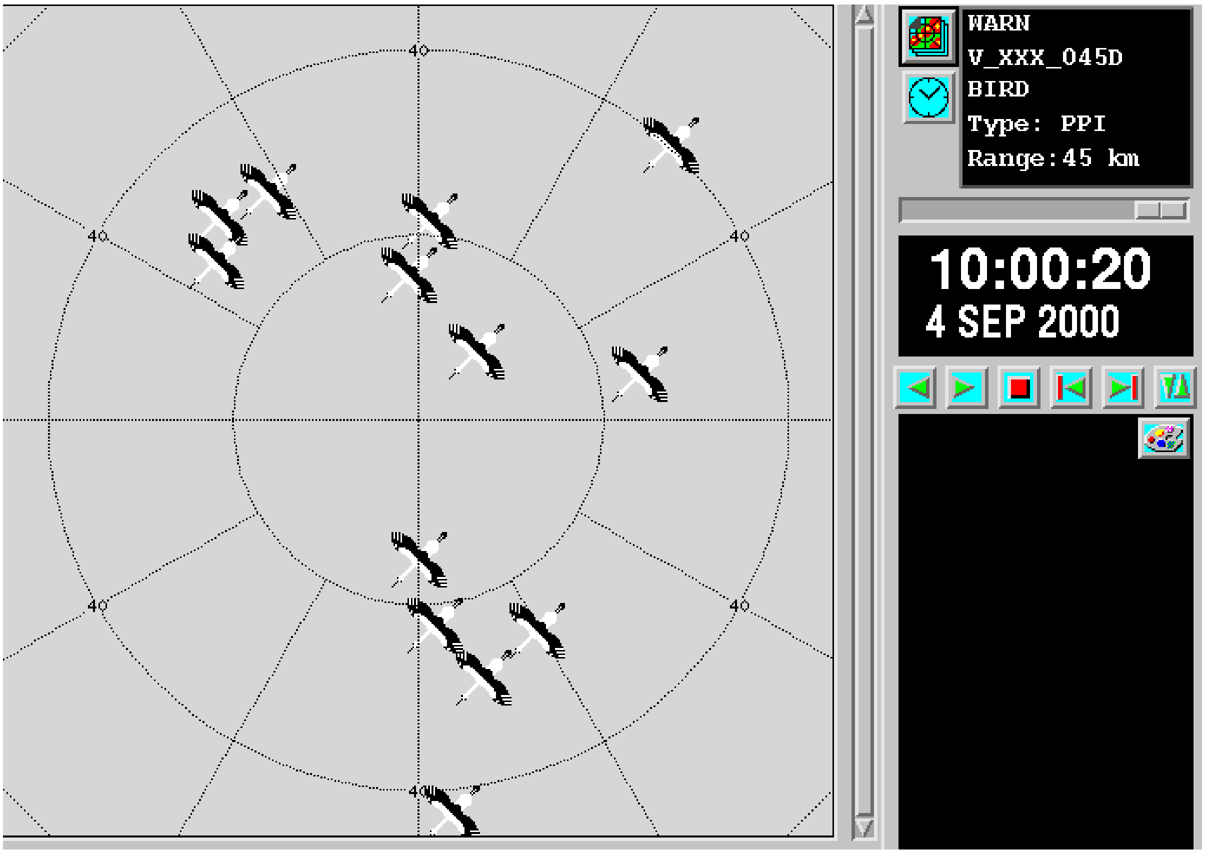
Pile Product (2X Zoom example)



This shows the result of correlation step in which the time DWELL points are "piled". Since each trial wind produces a different pile product, the diagnostic output only shows the pile product for the first trial wind. In this case the result for the particular trial wind of 210 degrees and 12 m/s was selected by inputting only these values into the limits for for the speed and direction ranges.

The results show that the coherent streaks of echo as seen in the DWELL time display are effectively "piled-up" by this trial wind, while background noise produces only weak values. Not all streaks produce a large value since the targets may be moving at a different velocity. This is why it is important to use a spectrum of trial winds.

WARN Product

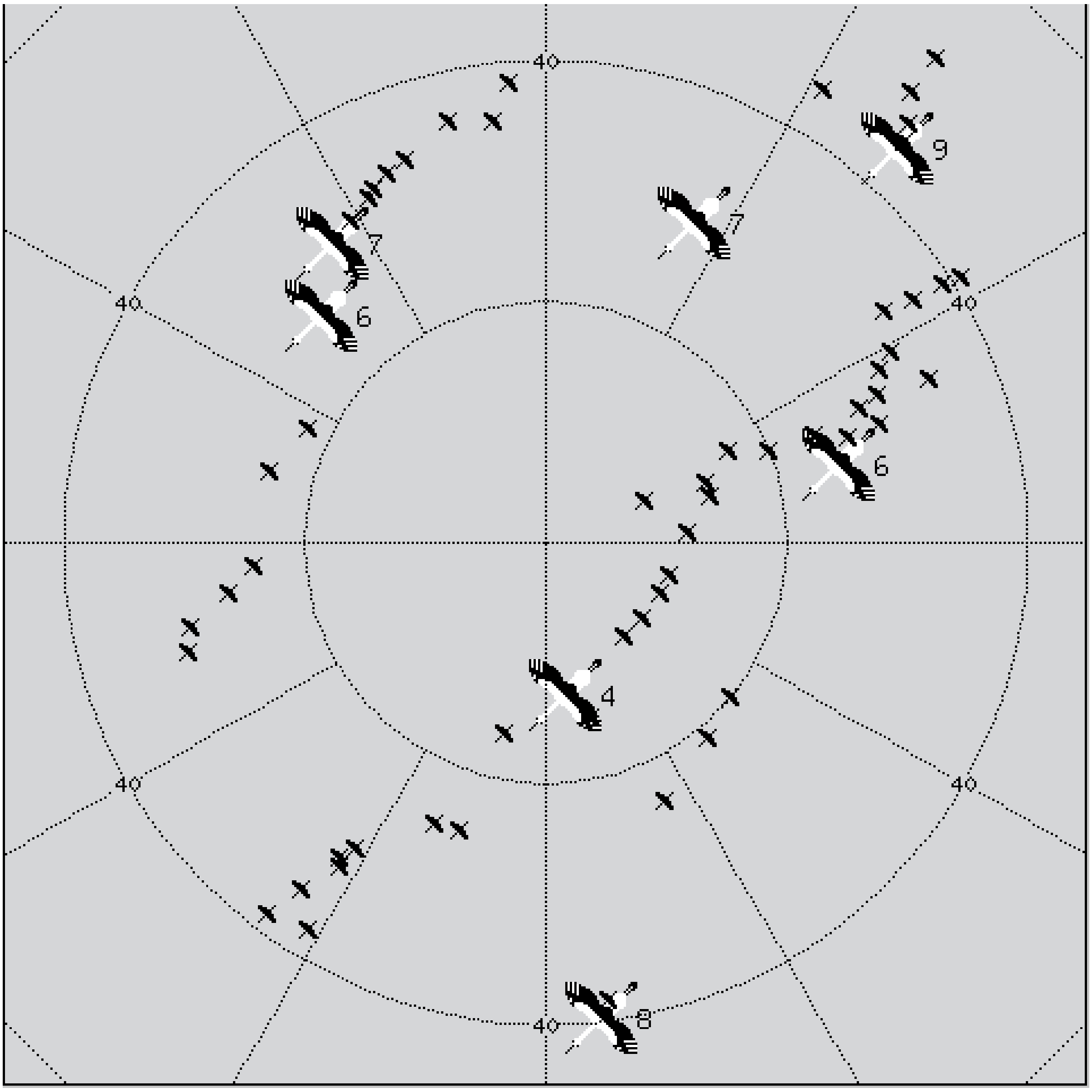


The final result is a warning product based on a composite of all warnings for all trial winds. This example used a threshold of 8 for the correlation threshold (pile product value). The icon here is drawn to make a clear indication of the type of warning.

Alternatively, the warning display can be configured via the output options button to display the numerical value of the height in Kfeet of the bird flock beside the icon, or to display the speed in knots of the flock. The height information is only available for track detection based on PPI input products since there is no height information available from the other input products that can be used for DWELL (e.g., VIL and TOPS).

When this is animated, the birds appear to fly across the screen at their proper velocity. Some icons may drop in/out if they are small flocks on the edge of detection. Occasional false alarms will show as isolated flashes during animation. The primary tuning parameter to balance the probability of detection and false alarm rate is the Correlation Threshold (pile height).

Dwell WARN Product



The example above shows the results of the DWELL algorithm run on WARN products generated by the bird warning feature. This display is recommended for use by air traffic controllers who must advise pilots of possible bird activity. In the example above, the individual bird warnings are dwelled for 45 minutes. The display shows the selected icon (in this case a large bird) at the position of the most recent warning in the dwell sequence. Prior warnings are shown using a different icon which is also rotated to the direction of motion. The prior warning icon name is made by appending "d" (short for dwelled) to the primary icon. In this case we get "birdd.xbm".

The result is a track style display that shows the bird activity over the dwell time. Inactive tracks do not have the large bird icon at the end. Tracks can become inactive if the birds fly into an obscured region or if the flock is small near the threshold of detection or if the birds stop to roost or perhaps "funnel" in a local thermal to gain altitude. However, even inactive tracks show controllers that there is confirmed bird activity in the area near the last sighting.

4.4 GAGE: Raingage Reports

4.4.1 Overview

The IRIS GAGE product is used to store reports from rain gauge sensors for the purpose of displaying and use in product generation. Unlike most other products, GAGE products are not produced from radar data, so there is no need for a Product Configuration Menu, and they do not appear in the Product Scheduler. Instead these products are produced using an input pipe from data send by a weather station system. See Hydromet Raingage Correction on page 437 for details on this. Each GAGE product file contains reports from all the rain gauges for one time interval. Usually the time interval is one hour, but it can be for something else like 15 minutes.

4.4.2 Product Display

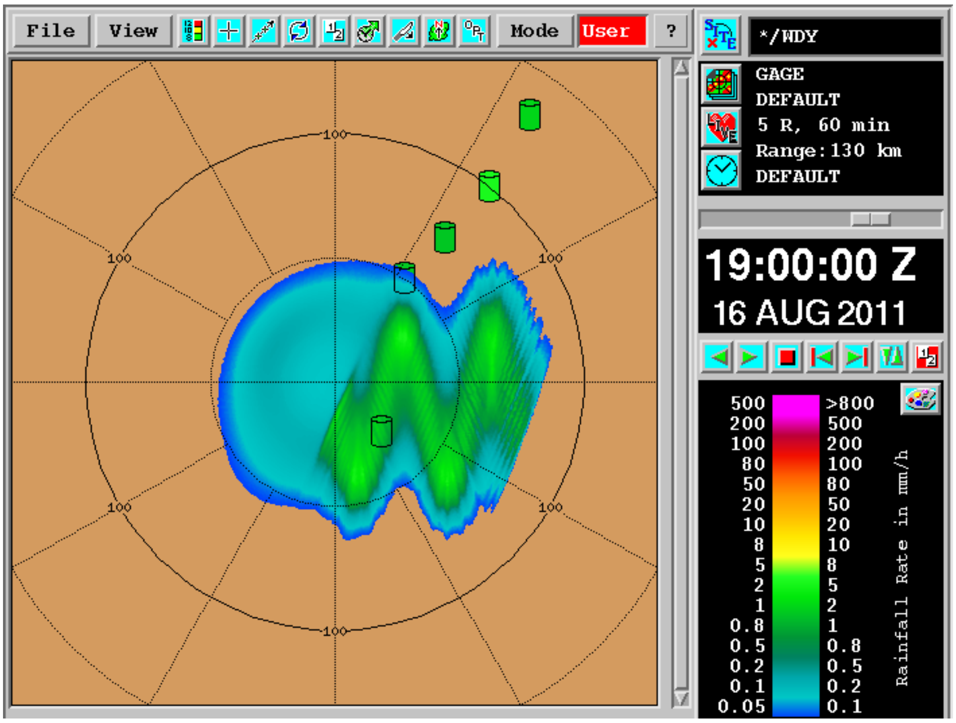


Figure 18 Raingage Product Display

GAGE products can be displayed on the Quick Look Window, and on other display outputs. They are displayed in the form of a situation display showing a graphic of a rain gauge can at the location of each gauge. Each gauge is colored with the color for the rainfall accumulation measured by the gauge. See Figure 18 on page 169 for an example of this display with radar data underneath.

There is a product specific output option for gauge products. It allows you to specify if the gauge label is shown next to each gauge.

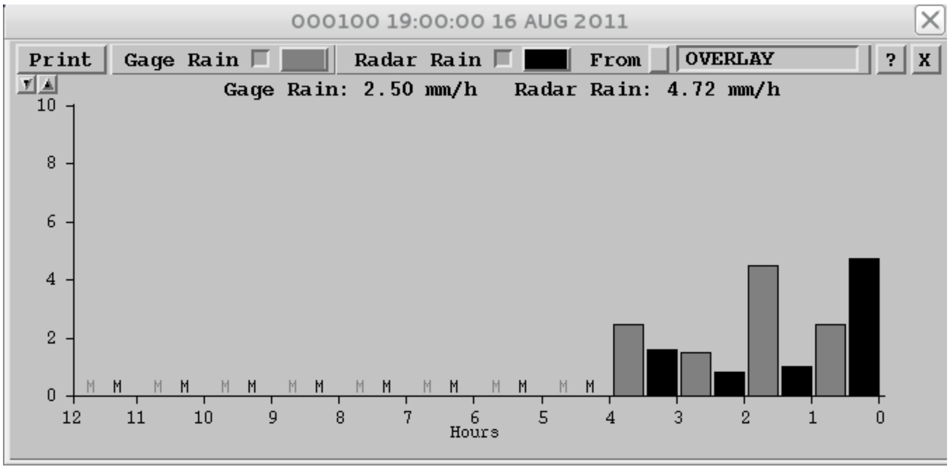


Figure 19 Raingage Datagram

When displaying GAGE products, if the user right-clicks the cursor on the display window, IRIS will look for the nearest rain gauge location, and will display a pop-up showing a rain gauge datagram with 12 hours of history. Figure 3-Z shows an example of this. It shows the hourly rainfall accumulation for the last 12 hours. You can configure it to show just the rain accumulations from the rain gauge, or radar rain accumulations from RAIN1 products, or both. If you are displaying the radar rain accumulations, then you can select which named RAIN1 product to display from. This RAIN1 product will default to the RAIN1 being used as the topmost overlaid product. If there is no overlaid RAIN1, then it will default off. Once you change it, future pop-ups will use the new product, until all pop-ups are dismissed. You can pop-up multiple rain gauge datagrams simultaneously, up to 10. This will allow you to compare two different gauges, or radar RAIN1 products.

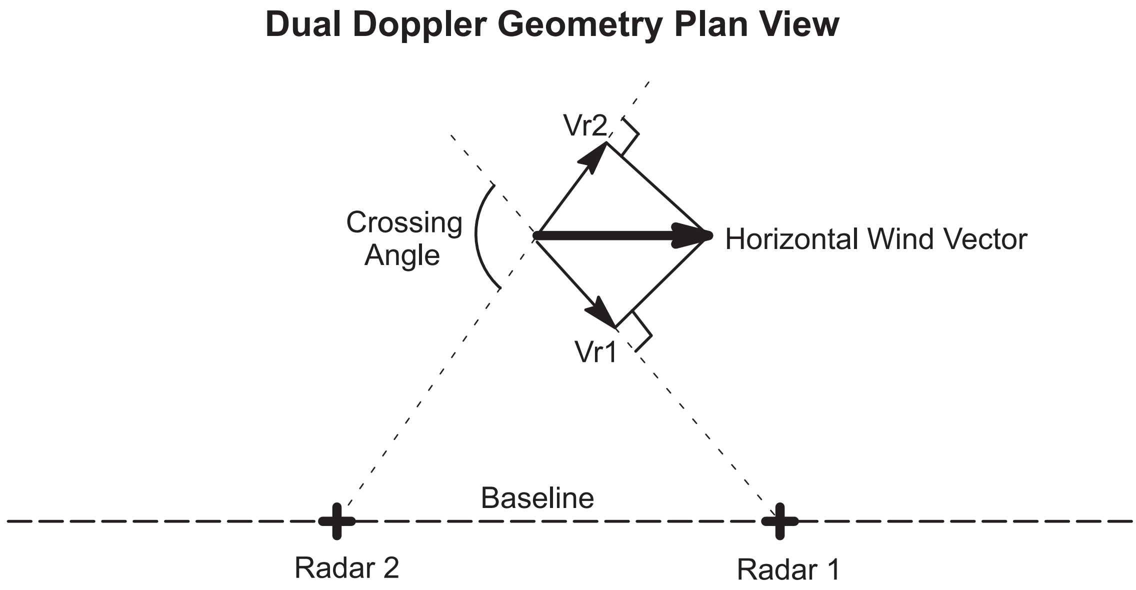
4.5 NDOP: Multiple Doppler

Overview

A single Doppler radar measures one component of a 3D wind vector, i.e., the component of wind towards or away from the radar — the radial wind. We can think of the 3D wind vector as being made up of the 2D horizontal wind and the vertical wind. Typically the horizontal wind is much stronger than the vertical wind, except in local areas of strong convection.

With a second Doppler radar, we can measure two components of the wind, provided that the radar beams are crossing at some angle (not parallel). If the vertical component of the wind is assumed to be small, then with two radars we can measure the horizontal wind.

The figure below shows a plan view (looking down) of the dual Doppler geometry. The horizontal wind is sampled by each radar which measures the radial component of the wind, Vr1 and Vr2. These two radial velocity measurements at the same point, along with some simple trigonometry, can be used to estimate the horizontal wind at the point, provided that the crossing angle is not 0 or 180 degrees (parallel beams).



This means that along the baseline (crossing angle 0) or at far ranges (crossing angle 180) we cannot use the algorithm, since the two radars will essentially measure the same radial wind.

While in theory the crossing angle could be anywhere between 0 and 180 degrees, our radial velocity measurements are not perfect so that in practice, a crossing angle of <20 degrees will lead to unreliable wind estimates.

The NDOP product performs the dual Doppler algorithm to obtain estimates of the horizontal wind field. NDOP makes two assumptions:

- The vertical wind is assumed to be weak as compared to the horizontal wind.
- The input radial velocity measurements represent the radial velocity of the air, i.e., the velocity is unfolded and corrected for particle fallspeed.

The output of the NDOP product is a multi-level grid of horizontal wind vectors.These can be displayed by themselves, or overlaid on other echoes.

The remainder of this chapter discusses:

- Input radial velocity fallspeed correction and unfolding. NDOP typically uses the corrected radial velocity data Vc which is described.
- NDOP Product Configuration Menu
- NDOP display and coverage

4.5.1 Input velocity corrections

Corrected Radial Velocity Vc

The IRIS corrected velocity (Vc) can include correction for fallspeed and velocity folding. The fallspeed correction is based on VT–Z relationships above and below the melting level. The unfolding correction is based on a VVP product.

Vc can be generated in either of two places:

- Vc can be generated when the data are collected from the signal processor. This is configured in the TASK Configuration Menu.
- Vc can be generated when RAW restored from tape or received over the network are re-ingested (to make ingest files). This is configured in the **setup** utility.

Note that in the second case, if Vc is already in the data when they are re-ingested, it will be re-calculated from V. When Vc is generated, the uncorrected radial velocity V is still preserved.

The first way, generating Vc when the data are ingested from the signal processor, is the recommended way for real time operation. The second way is useful for archive data, or in systems where the communication bandwidth is limited so that the extra burden of transmitting Vc (as well as the standard radial velocity) is too much for the network.

Fallspeed Correction for Vc

A key assumption is that the vertical airmotions are weak as compared to the horizontal airmotions. This means that the radial winds are assumed to be caused by the horizontal wind only. However, while vertical airmotions may be weak, the fallspeeds of the hydrometeors (of order 1 to 10 m/s for rain) can make a significant contribution to the radial velocity. Therefore it is necessary to correct the radial velocities for the effect of fallspeeds.

The effect of particle fallspeed depends on the sine of the elevation angle. For example at 0 degrees elevation, the fallspeeds do not effect the radial velocity. At 30 degrees elevation angle (a typical maximum elevation in a volume scan), then half of the fallspeed would be observed (sine 30 = 0.5).

Thus a 10 m/s fallspeed (hail and rain mixed) would contribute 5 m/s to the radial wind which is significant.

The fallspeed correction in Vc is made using a VT–Z relationship (terminal fallspeed – reflectivity). These take the general form of $VT=aZ^b$. Since the particles are very different above and below the melting level, it is important to use different VT–Z relationships for these two cases. The default relationships used in IRIS are:

- Above the melting level (snow and graupel) $VT = 0.8\ Z^{0.06}$
- Below the melting level (rain) $VT = 2.70\ Z^{0.11}$

Here Z is in mm^6/m^3 and VT is in m/s. For a discussion of VT–Z relationships refer for example to a text on radar meteorology such as Battan's book (Battan, Louis, J., 1973: **Radar Observation of the Atmosphere**, University of Chicago Press, p 132).

These relationships are entered by your system manager in the **setup** utility. In addition, the average height of the freezing level is input for each month of the year.

The VT–Z relationships, and freezing level estimation will not be perfect, but they will improve the radial velocity estimates as compared to performing no correction. The corrections obtained will be of the order 1–5 m/s depending on the elevation angle. The corrections will have essentially no effect (<1 m/s correction) for elevation angles less than 5 degrees.

Radial Velocity Input for NDOP- Unfolding for Vc

The NDOP product assumes that velocities are unfolded or dealiased. A Doppler radar has a limit on the unambiguous velocity which is:

$$Vu = +– (Wavelength*PRF)/4$$

Radial velocities that exceed this are said to be folded. On a color display with blue representing radial velocity toward the radar and red representing radial velocity away from the radar, a fold will appear as an adjacent blue-to-red color shift.

Unfolding can be performed in the signal processor itself (e.g., using the dual PRF technique), or can be done by IRIS when Vc is generated.

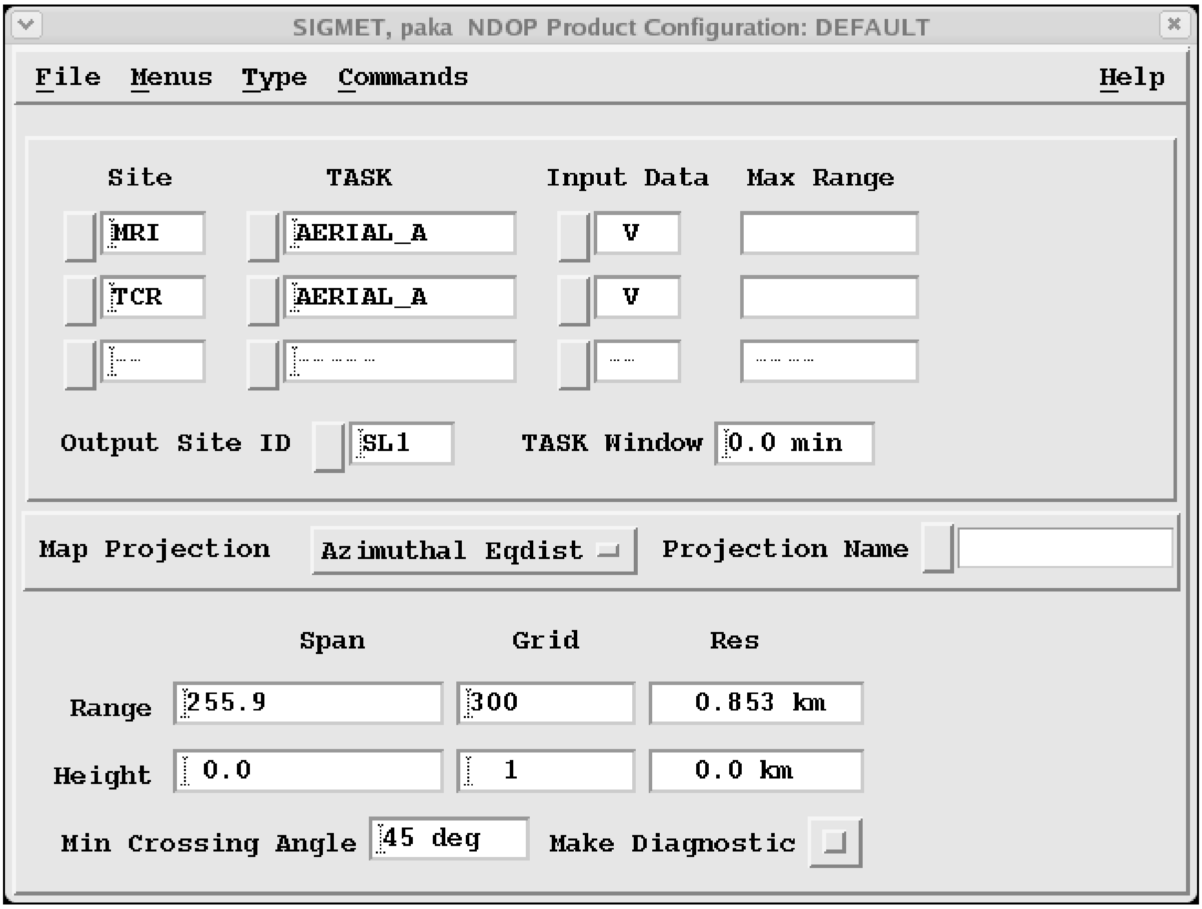
The unfolding for Vc is based on a VVP product which assumes that the wind field varies linearly with distance from the radar. The VVP product used by Vc must have the special name "UNFOLD" and must be available on the system where the unfolding is being performed. This technique achieves 3 times unfolding. For example, for an S band system operating at 1000 Hz PRF (range 150 km), the unambiguous velocity is +-25 m/s. With unfolding the unambiguous velocity will be +-75 m/s (+-150 knots) which can handle most extreme meteorological situations.

As with the fallspeed correction, the Vc unfolding correction can be made at ingest when data are collected from the signal processor (selected in the TASK Configuration Menu) or at reingest (selected in **setup**).

The VVP unfolding technique works very well provided that there is adequate echo coverage and that the wind field is approximately linear in its variations. In the vicinity of strong shear lines or fronts, this may not be the case.

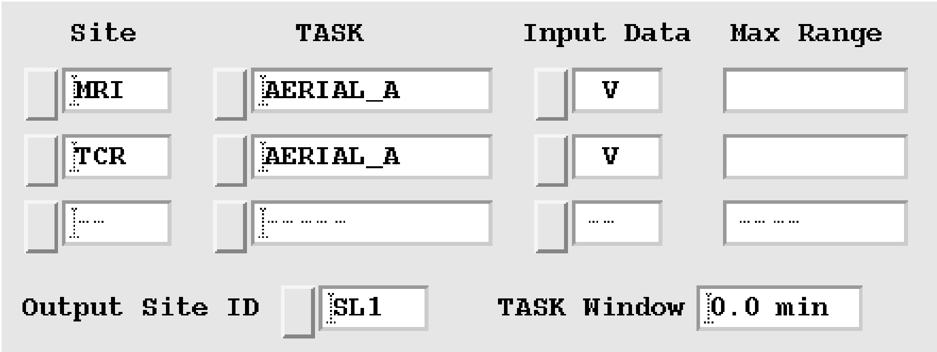
NOTE	If you are using dual-PRF velocity unfolding and it is adequate to prevent folding it is recommended that you not use the VVP-based unfolding in Vc since you may actually harm the data in some extreme cases.

4.5.2 Product Configuration



The Product Configuration menu for NDOP is shown above. The top section is used to configure what sites and TASK's will supply the input data. The center section describes what projection shall be used. The bottom section is used to specify the parameters of the product generation such as the resolution and the minimum allowed crossing angle.

Specifying TASK's and Sites



Click the left **Site** button to get a list of sites and select the site.

Click the **TASK** button to get a list of TASK's (based on the ingest files on your system). If the TASK that you want is not in the list, simply type in the TASK name. For the **TASK** field you can use the customary wild card conventions in IRIS, such as:

- PPI* Use any TASK that starts with PPI
- PPIVOL_A Use only the A part of the hybrid TASK
- PPIVOL_BC Use only the BC parts of the hybrid TASK.

If you have specified a single TASK, the range field will be filled-in with the maximum range of the data for that TASK. However, if you use a wild card or hybrid TASK specification (as in the examples) the Range field will be blank.

Finally select the input data — either V or Vc (radial velocity or corrected radial velocity).

Click the **Output Site ID** button to enter the Site ID to be associated with the output of the product. When the NDOP products appear in inventories such as the Product Output Menu or Quick Look Window, they will be associated with this site.

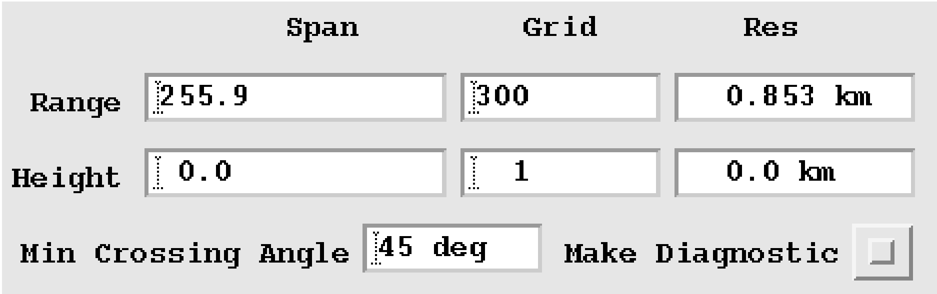
The **TASK (time) Window** is the maximum time difference that will be tolerated for combining the data from the two radars. If the difference in the TASK start times is greater than this value, NDOP will not make the product. This is to avoid problems caused by advection and temporal changes that could cause inappropriate winds to be combined. The example value of 2 minutes is typical.

NDOP Projection

It is recommended that you specify a map projection for NDOP. Please refer to Map Projections on page 26 for more information on Map Projections. The projection should be at a convenient point perhaps between the radars and cover a range that is no more than approximately 4 times the baseline length. This is typically the useful range of the NDOP product.

If you do not specify a **Projection Name**, then the data will be centered on the location of the first radar site in the list above.

Output Resolution



The NDOP product produces wind vectors on a 3D grid. Here you specify the characteristics of the grid.

The **Range Span** is the distance in km from the center of the projection, east to the edge of the projection, analogous to a radar range. It is specified either in the named projection, or, if you are not using a **Projection Name**, you can type-in the range. Again a max range of about 4 times the baseline length is typical.

The **Range Grid** is an integer that specifies the number of points in the output array that will be used to represent the Range Span. This value is typed-in.

The Resolution is a display-only field calculated from:

$$\text{Range Res} = (\text{Range Span}) / (\text{Range Grid})$$

In the example, the Range span is 40 and the grid is 16, therefore the resolution is 2.5 km. The actual number of points in the output array that is made by NDOP will depend on the aspect ratio of the projection which may not be square. For a square projection and a grid specification of 16, the output array would be 32 × 32.

For the **Height Span**, specify a maximum and minimum height in km. The **Height Grid** is also specified. The resolution is then calculated from:

$$\text{Height Res} = (\text{Max Height} - \text{Min Height}) / (\text{Height Grid} - 1)$$

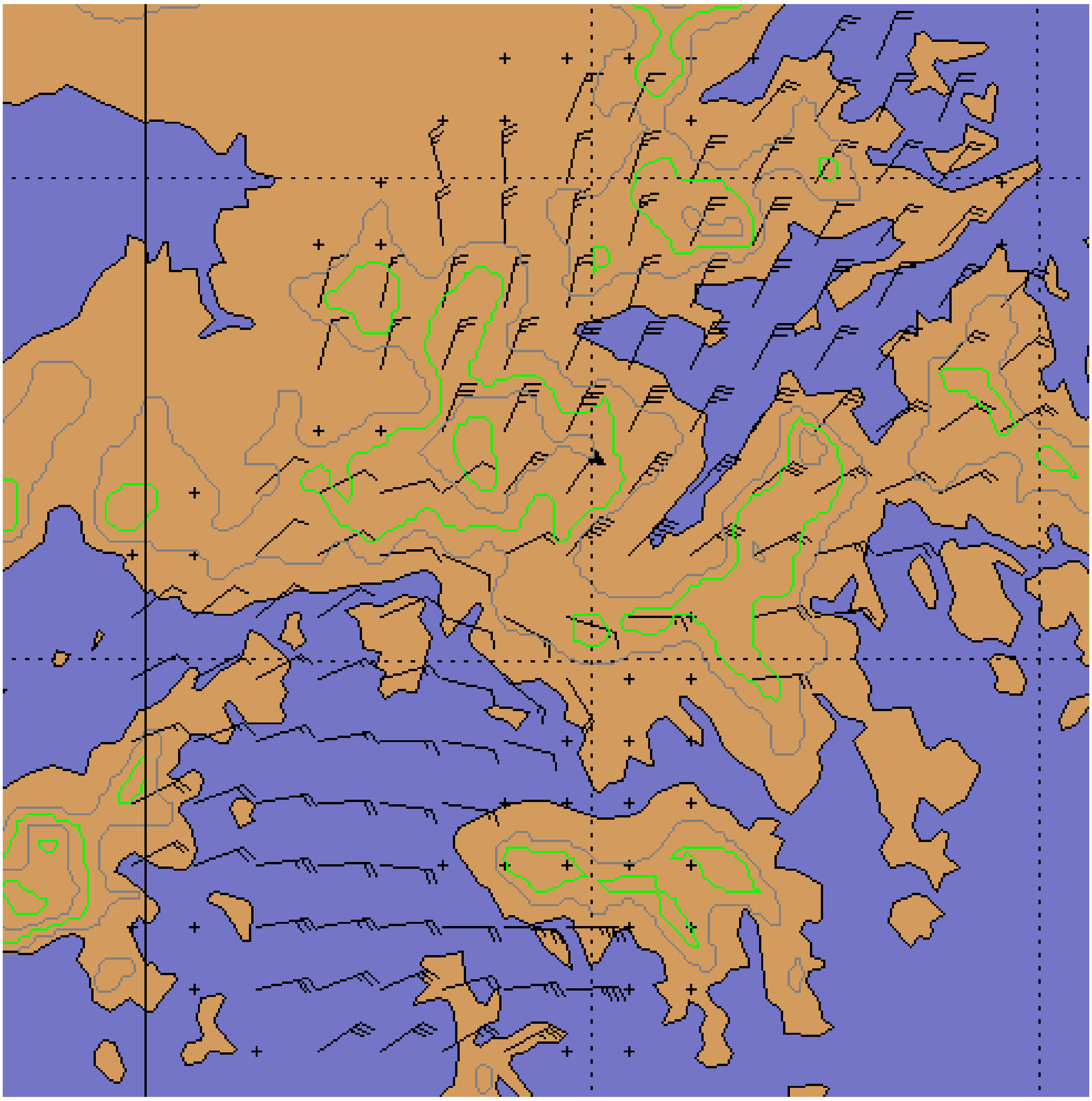
Min Crossing Angle

This is the minimum crossing angle that is used. The recommended value is 20 degrees. The same value is used by the algorithm to specify the maximum crossing angle, i.e., the max crossing angle = 180 - Min Crossing Angle.

Make Diagnostic

When pressed, the NDOP product will make additional velocity CAPPI products, with product names NDOP_CAPPI_#. These are the input data used by NDOP.

4.5.3 Display and Algorithm Notes



An example of an actual NDOP Display (courtesy of the Hong Kong Observatory) is shown above. The example shows the low-level (1 km) winds for a projection 40 km across. Two S-band radar systems were used in this case.

The meteorological situation is an event of strong northerly winter monsoon flow over China colliding with easterlies over the sea. The overlap map shows the contours of the mountainous terrain north of Hong Kong. Note the 50 knot winds funnelling through the mountain pass to the north of Hong Kong.

The "+" points in the display show all regions where the crossing angle criterion was met. These regions are on either side of the baseline that connects the two radars. However, if there are no weather targets, then a wind cannot be calculated.

The algorithm takes the following steps to compute the grid point winds:

- Create 3D CAPPI's of radial velocity for the two radars in the common projection at the grid height spacing. The horizontal resolution of the CAPPI's is subject to the following constraints:
    1. The resolution of the CAPPI pixels is set to be twice the the spacing of the input radial velocity data. For example, for 125-m input bins, the CAPPI resolution will be set to 250 m.
    2. The number of CAPPI pixels for each output resolution grid element should be at least 9 (3 × 3). If this is not the case, then the resolution of the CAPPI is increased. In the same example, if the output resolution were 2 km then per the 250-m pixel spacing in (1) there would be 8 × 8 = 32 pixels for each output grid point.
    3. The maximum number of pixels in the CAPPI is 1100 × 1100. The CAPPI will be clipped at this value. For a 40 km range span (80 km total across the output array), there would be (4 pixels/km)*80 (km) = 320 pixels in the CAPPI (320 × 320 for a square projection).
- The data from the radial velocity CAPPI's are then processed with the multiple Doppler algorithms to obtain a grid of (x,y) wind vectors at the original CAPPI resolution (e.g., 320 × 320).
- The high-density wind vectors are averaged to reduce the data to the final output grid. Continuing the example, with 4 pixels per km in the CAPPI and a an output resolution of 2 km, we would average 8 × 8 = 32 wind vectors for each output grid point.
- To eliminate noise and speckle effects, a grid point is thresholded if there are fewer than 3 values to average or less than 25% coverage. In the example, the 25% would correspond to 8 wind estimates.

When the vector averages are computed, a Wind Quality Index *(WQI)* is also calculated and stored with the data. This is used for thresholding when the product is displayed, and the threshold can be adjusted by the user. See the description of the NDOP Display Options in the Quick Look Window NDOP Output Options on page 282.

The Wind Quality Index is computed from the variances #sigma#$^2{}_x$ and #sigma#$^2{}_y$ of the individual components of each (x,y) wind vector that is computed from the CAPPI data. For every CAPPI velocity pair that contributes to the final X and Y wind, the two variance terms are also computed so that WQI can be derived as:

$$WQI = 1.0 - \left(\sqrt{\frac{\sigma_x^2 + \sigma_y^2}{2}} \;/\; V_{norm} \right)$$

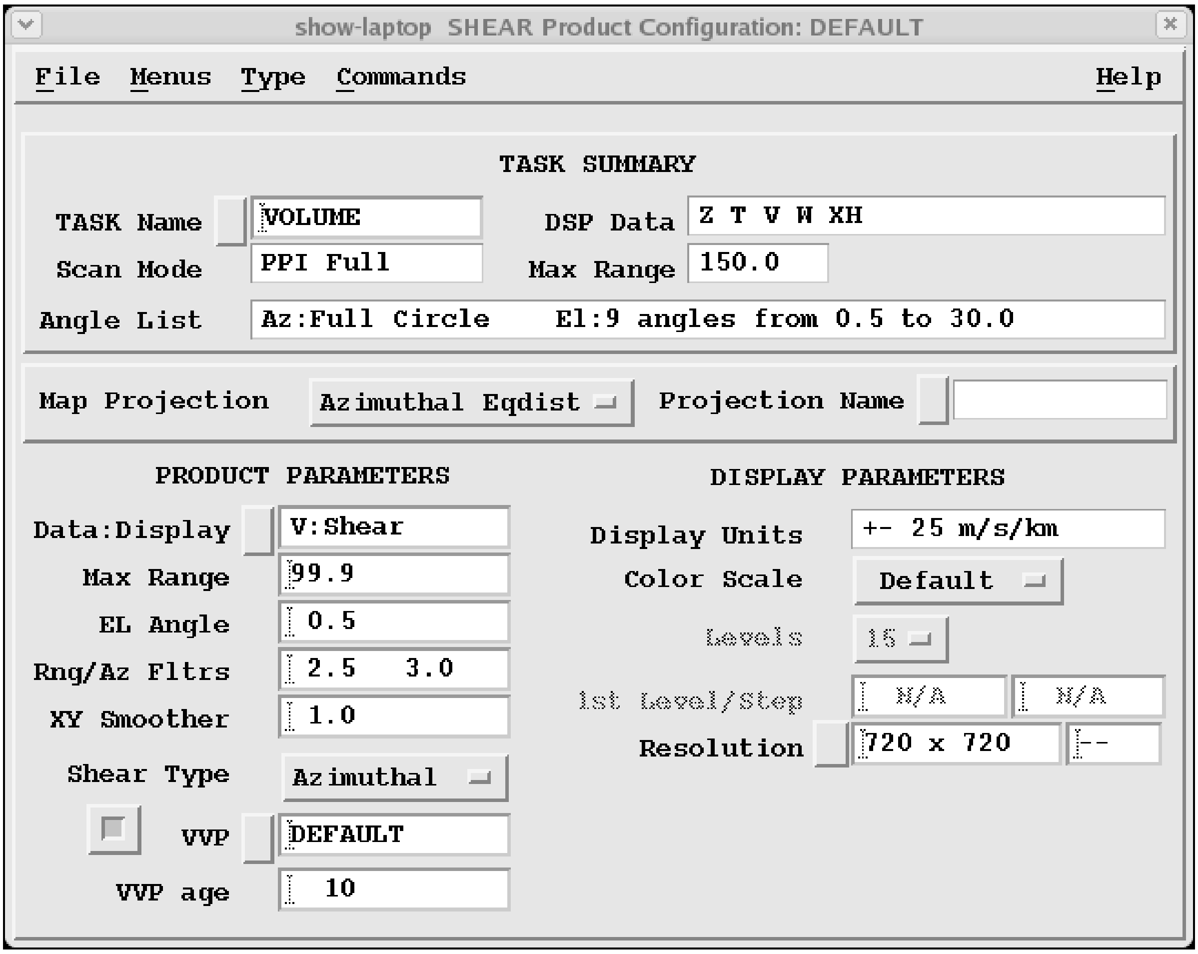
where V_{norm} is a normalization term, and is the standard deviation that would result if uniformly distributed random vectors at half the Nyquist velocity were input to the algorithm, i.e., that case would produce a Wind Quality of zero.

$$V_{norm} = \left(\frac{V1_u + V2_u}{2} \right) \;/\; 2\sqrt{2}$$

where $V1_u$ and $V2_u$ are the Nyquist velocities for the two CAPPI input products.

Note that WQI is set to zero if the above calculation yields a negative number. Zero corresponds to a terrible fit among the dual Doppler winds that are averaged into each output grid; and 1.0 corresponds to perfect agreement of all the data

4.6 SHEAR: Wind Shear



This section describes the fields of the Product Configuration menu that are unique to SHEAR products. For general information, see these other sections of this chapter:

- Task Summary area, Task Summary on page 24.
- Map Projection Area, Map Projections on page 26
- Product Parameters, Product Parameters on page 31.
- Display Parameters area, Display Parameters on page 34.

The optional SHEAR product can detect wind shear in the atmosphere. Wind shear is associated with a variety of phenomena:

Microbursts	Associated with convective storms. Extremely hazardous to aircraft during landing or takeoff. Microbursts are characterized by positive values of the radial shear (strongly divergent outflow) in a roughly circular region, typically less than 3 km in size.
Gust Fronts	Caused by cold outflow from a convective storm (perhaps a microburst) colliding with the surrounding air. They are characterized primarily by negative values of the radial shear (convergence). However, depending on the geometry, they can also create positive values of the radial shear and azimuthal shear of either sign.
Mesocyclones	Characterized by rotation. Mesocyclones are associated with tornados. The azimuth shear is used to detect mesocyclones.
Cold Fronts	Similar to gust fronts, but much larger in extent.
Atmospheric Waves	Produced at a variety of wavelengths and intensities. The shear values can be positive or negative, depending on the nature of the wave and the "phase" being observed.

These phenomena, except for atmospheric waves, are shown schematically in on page 184

There are three different types of basic shear values that can be computed for the radial component of the wind:

- **Radial shear** — computed by differencing the radial velocity in range. Positive values are for radial velocity increasing (more away) with range. Divergence of the radial wind is positive.
- **Azimuthal shear** — computed by differencing the radial velocity in azimuth. Positive values are for radial velocity increasing (more away) in the clockwise direction. This corresponds to positive vorticity.
- **Elevation shear** — computed by differencing the radial velocity in elevation. Positive values are for radial wind increasing (more away) with height.

In addition to the basic shears, there are combinations of these which are computed by taking the RMS values. For example, the total combined shear magnitude is:

$$\mathrm{SQRT}\ (\mathrm{RAD}^2 + \mathrm{AZ}^2 + \mathrm{EL}^2)$$

where RAD, AZ and EL denote the basic shear values. Combined shears are positive.

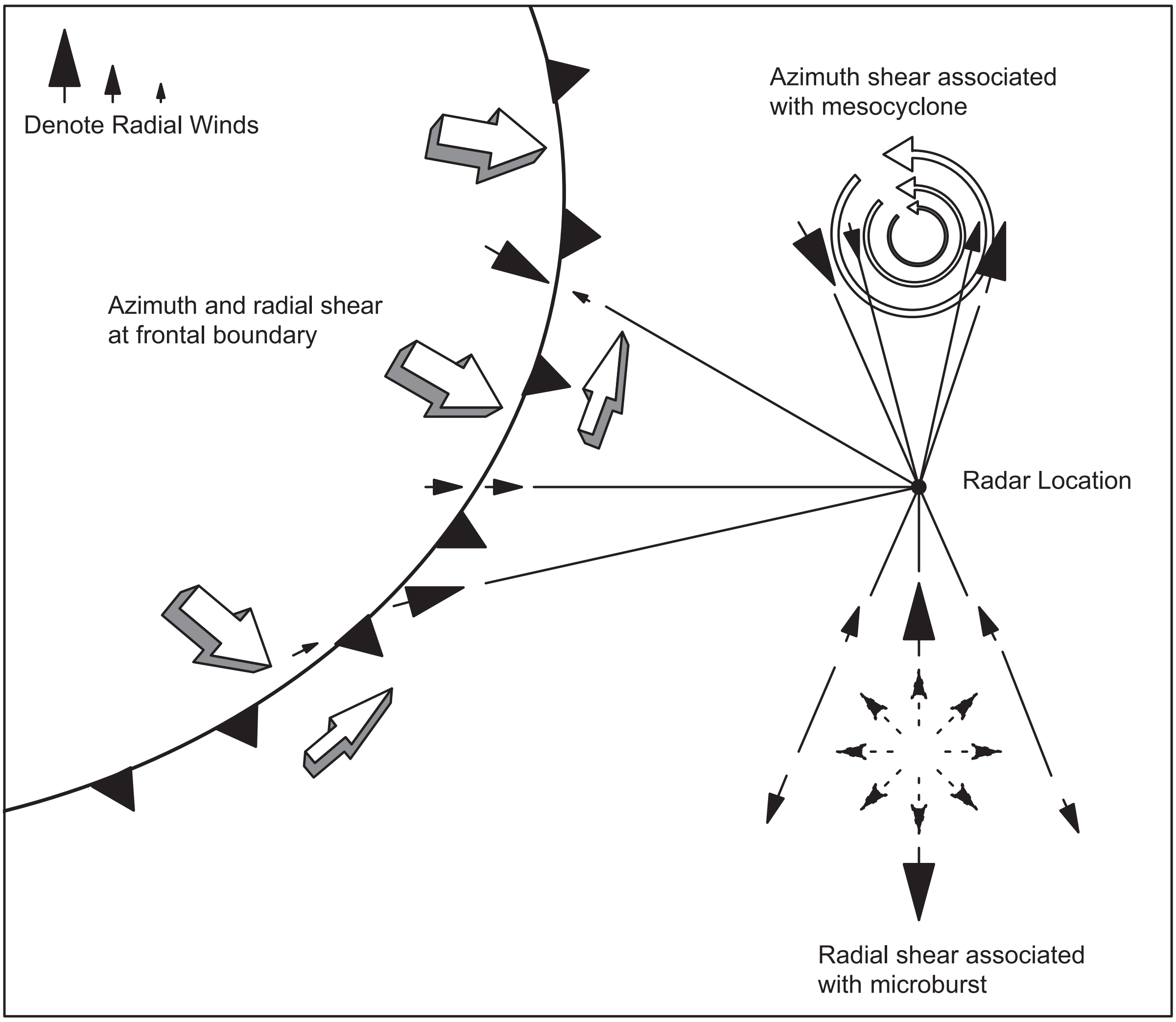


Figure 20 Schematic Examples of Wind Shear

NOTE	SIGMET does not warrant that the SHEAR product will detect all hazardous shear conditions. Whenever convective storms are in an air terminal area, there is danger of microburst. Normal precautions to avoid suspected wind shear should be used, even if the SHEAR algorithm does not detect shear. The SHEAR product is only one of many indicators that such a hazardous condition may exist. SIGMET, Inc. shall not be liable for damages of any kind for failure of the SHEAR algorithm to detect hazardous wind shear or for false alarms that may occur from use of the SHEAR algorithm.

To open the SHEAR Product Configuration menu:

Choose **Type**->**SHEAR** from the menu bar. You can use **File**->**Open** to load an existing product into the menu.

Data : Display

V Shear

EL Angle

The elevation angle of data you want to display. Wind shears associated with gust fronts and microbursts are usually low-level phenomena, so angles of 1 degree or less are typically used to detect these.

Rng/Az Filter

The first number defines the range length scale for the SHEAR product, in km. This distance determines the size of the skip that the SHEAR product can tolerate when differencing over missing data. It also specifies the length of the the radial smoother, which is applied before the XY smoother.

The second number is the azimuth length scale in degrees.

Shear Type

Choose one of three types of shear to be computed:

Radial
Azimuthal
Elevation
AZ+EL
Rad+AZ
Rad+EL
Rad+AZ+EL

Radial Shear — The bin-to-bin difference in the radial velocity.

Azimuthal Shear — The azimuth-to-azimuth difference in the radial velocity.

Elevation Shear — The difference between the radial velocity at the selected and next higher elevation angle. Requires a volume scan.

Combined Shears — The RMS value of the three basic types of shears in all of the various combinations.

VVP

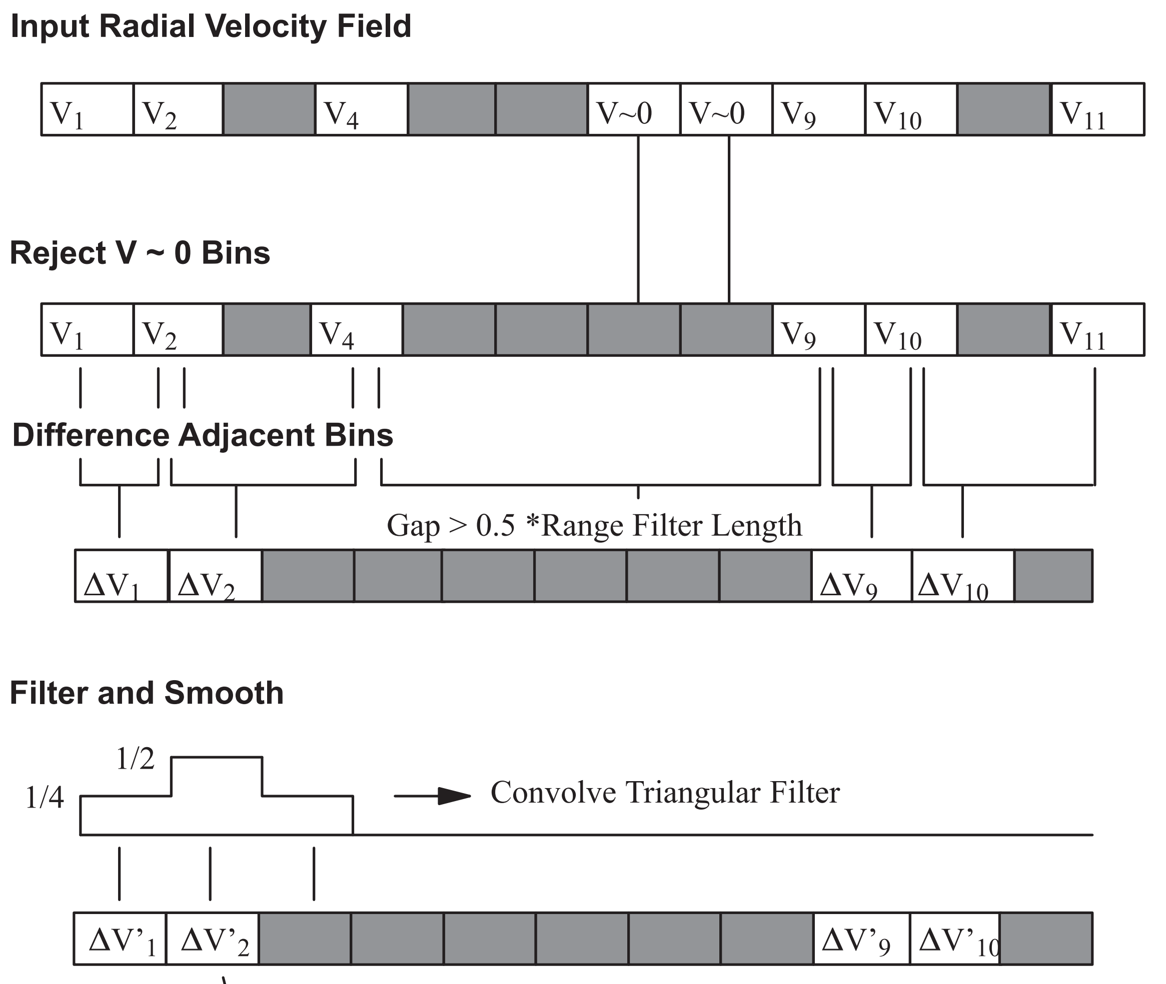
Select the name of a VVP product. The wind speed and direction from the nearest VVP wind product of this name is used to remove the effects of the mean wind on the azimuth shear calculation. This VVP product should be scheduled to run. Use of the azimuth or combined shear is not recommended without this correction.

VVP Age

The maximum number of minutes between the data for the VVP product and the data for the SHEAR product. This prevents old VVP winds from being misapplied. If no VVP product is found in this time window, then no mean wind correction is applied when computing the azimuth shear.

4.6.1 The SHEAR Algorithm

The SHEAR algorithm depicted in on page 187 is for radial shear, but the azimuth shear is similar in "B-scan" space (range-azimuth).



$$\Delta V'_2 = \frac{\frac{1}{4}\Delta V_1 + \frac{1}{2}\Delta V_2 + \frac{1}{4}0}{W_2}$$

$$where \quad W_2 = \frac{1}{4}\delta_1 + \frac{1}{2}\delta_2 + \frac{1}{4}\delta_3$$

and $\delta_n = 0$ if ΔV_n *is thresholded, else* $\delta_n = 1$

If the weight W is $\leq \frac{1}{2}$, *then bin is thresholded (eliminates speckle bins).*

Figure 21 Radial Shear Algorithm Schematic

Point Clutter Bin Removal

Point clutter bins produce erroneous high shear values when they are differenced with surrounding valid velocities. The first step in the shear algorithm is to remove obvious clutter bins which were not canceled by the signal processor clutter filter. All velocity bins having a velocity within 2% of zero velocity (as compared to the full velocity range) are tagged as potential Clutter Bins. A Clutter Length Scale is defined as 1/3 of the Range Filter Length value in km. Contiguous runs of Clutter Bins that are less than or equal to the Clutter Length Scale are rejected. For example, suppose the bin spacing and Range Filter Length values are selected so that Clutter Length Scale corresponds to 3 range bins. Then any single isolated Clutter Bin would be rejected, as would runs of 2 or 3 clutter bins. Runs of 4 or more clutter bins would not be rejected because they are interpreted as real weather. Regardless of the Clutter Length Scale, isolated clutter bins (single bins) will always be removed.

Differencing (radial difference example)

The next step is to perform the range differencing of the radial velocities. The radial wind shear algorithm computes the shear by taking the bin-to-bin difference on a PPI surface. If the differencing algorithm encounters a blank bin, it skips out in range to the next valid bin to take a difference, provided the bin is within 0.5*Range Filter Length. For example, if the Range Filter is set to correspond to 3 bins, the differencing algorithm differences over a gap of one bin, but not over a gap of 2 or more bins. The velocity differences are placed as close as possible to the center of the difference interval, to the nearest bin that is less than or equal to half of the difference interval.

Smooth the Differences

Differencing is inherently noisy. The next step is to smooth the computed differences. This not only reduces the noise, it also fills in small gaps of missing bins and cancels any remaining isolated bins. The smoothing algorithm uses a triangular window whose total width is equal to the Range Filter Length value. The sum of the weights defined by the triangular filter is always 1 unless a bin is thresholded. In on page 187, the Range Filter Length corresponds to 3 bins. Each velocity in the filter range is multiplied by the corresponding weight and then summed. The mean is obtained by dividing by the total weight. Thresholded bins are not weighted. If the total weight is less than or equal to 0.5, the shear value is rejected. This eliminates isolated bins. This approach can also fill gaps. A longer range filter rejects a longer run of isolated bins and fills a longer gap.

Azimuth Shear Calculation

on page 189 is a depiction of "B-Scan" space (a PPI surface). The coordinates are range and azimuth. The radial shear is obtained by differencing in range along a radial.

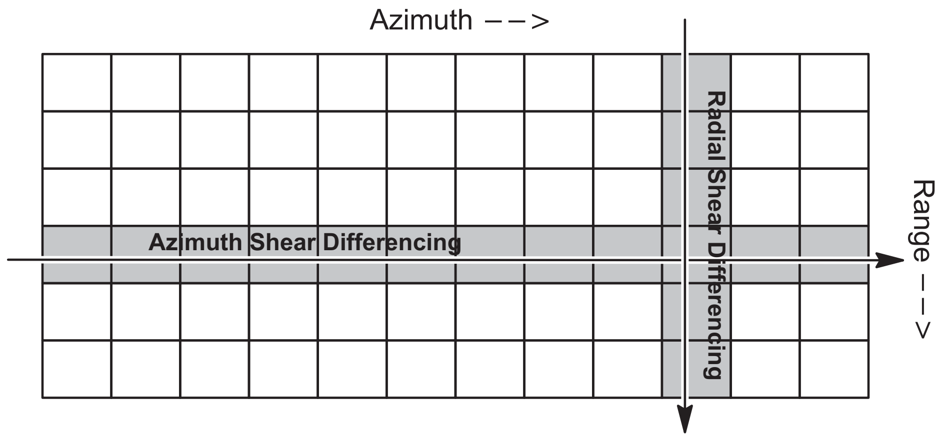


Figure 22 B-Scan Space (PPI surface)

The azimuth shear algorithm is analogous to the radial shear algorithm except that:

- Differencing is performed from ray-to-ray at constant range.
- The Azimuth Filter Length is specified in degrees.
- The final azimuth values are range normalized and corrected for the apparent azimuth shear caused by the mean wind. The mean wind value is obtained from the VVP algorithm. This correction is an optional step.

The mean velocity correction is discussed in detail in Table 5 on page 190.

Shear Magnitude

After both the radial and azimuth shears have been obtained, the next step is to compute the shear magnitude. This is simply the square root of the sum of the squares of the two shear values (radial and azimuth) associated with each bin. In the case where only a single shear is selected (radial or azimuth), this step is skipped.

Convert to Cartesian and Optional Final Cartesian Smoothing

The conversion to Cartesian transforms the B-scan values of the shear magnitude to X-Y coordinates. The algorithm is identical to the PPI algorithm, which uses a last-in approach for both range and azimuth filling. An optional 2D smoother with selectable length scale can be passed over the data at this point.

4.6.2 Optimizing for Microburst Detection

Accurate detection and timely reporting of microbursts in an air traffic control environment requires that the system be properly configured and optimized. This includes virtually all aspects of IRIS. SIGMET recommends that the customer hire a qualified consultant to assist with tuning and evaluating the IRIS SHEAR algorithm, data acquisition, radar siting and warning reports. The optimization steps presented here serve only as guidelines and should not be substituted for a thorough evaluation of your particular site. Fortunately, IRIS provides many of the tools needed to perform such an evaluation.

Table 5 Mean Velocity Shear Correction

The radial velocity can be expressed in terms of the u and v components of the wind (the vertical velocity is ignored here because the observations are typically near horizontal:

$$V_R = u\,cos\,\theta\sin\phi + v\sin\theta\sin\phi$$

where:

V_r is the radial velocity

u is the x-component of the wind (east)

v is the y-component of the wind (north)

θ is the the azimuth defined as positive CCW from the x-axis (east)

φ is the elevation defined as positive upward

Let the wind be represented by a mean wind [u_o, v_o] and a perturbation wind [u', v'], then

$$V_R = (u_o + u')\cos\theta\sin\phi + (v_o + v')\sin\theta\sin\phi$$

The azimuth derivative is then,

$$\frac{\partial V_R}{\partial\theta} + -u_o\sin\theta\,\sin\phi\; + v_o\cos\theta\,\sin\phi\; + \;\frac{\partial}{\partial\theta}\;[u'\cos\theta\,\sin\phi\; + v'\sin\theta\,\sin\phi]$$

where the first term is the apparent azimuth shear caused by the mean wind. Thus, when the azimuth derivative is computed, the correction term is applied as follows:

$$\frac{\Delta V_R}{\Delta\theta} + u_o\sin\theta\,\sin\phi - v_o\;\cos\theta\,\sin\phi\; = \;\frac{\partial}{\partial\theta}\;[u'\cos\theta\,\sin\phi + v'\sin\theta\,\sin\phi]$$

The values of u_o and v_o are obtained from the VVP algorithm. In terms of the azimuth #beta# measured in the traditional radar sense (clockwise from north) the correction is,

$$\theta\; = \;90 - \beta$$

$$u_o\cos\beta\sin\phi - v_o\sin\beta\sin\phi$$

The SHEAR product is first produced from specially constructed TASKS that are optimized for close-range, high-resolution measurement of radial velocity. The SHEAR products are then fed to the WARN product, which checks to see if the strength and size of the wind shear regions exceed a threshold value in the protected areas. Additional criteria, such as reflectivity aloft from a higher scan or a requirement to see the shear on two adjacent scans, can be added to the WARN product to reduce the false alarm rate if this is a problem for the particular location.

As recommended in Appendix B, Product Configuration Example, on page 333, an entire IRIS configuration should be set up for wind shear, so that when potentially hazardous weather approaches the terminal area, IRIS can be switched to wind shear monitoring mode by loading the configuration into the Radar Status menu. In addition, the WARN product can be operated in surveillance mode to alert the operator that the mode should be switched, or the automatic mode switching feature can be used. For example, the surveillance mode could consist of a 15 elevation volume scan sequence. The WARN product can be keyed on a severe storm indicator such as VIL. Whenever VIL exceeds a threshold value typical of severe storms for the area, and this VIL is within 30 km of the terminal, the WARN product can issue an alarm advising the operator or the automatic mode switch to change to the wind shear detection mode.

The TASK Configuration menu for wind shear detection should be optimized as shown in the example in on page 192 for an RVP6 processor. This example uses high-resolution sampling in range (125 or 62.5 m). Microbursts are low-level phenomena, so it is best to configure elevation angles that are as low as can be tolerated by the surrounding clutter. Typically an angle set such as 0.5º, 1.0º and 5.0º is useful. The bottom two angles can be used for shear detection, while the upper angle can serve as the basis for an additional reflectivity aloft criterion for the WARN product. Sector scan mode is used to limit the data coverage to the terminal area which speeds the update rate.

The TASK Scheduler in wind shear detection mode should be set to provide an update rate (repeat time) of at least one complete TASK per minute. To provide optimal response, no other TASKS should be scheduled. This allows IRIS to devote its full resources to detecting microbursts.

The SHEAR product configuration should be optimized as follows:

- The Product Range field should be set to the maximum range of interest, and should roughly correspond to the input bin spacing.
- The 30 km range and 480 by 480 pixel product resolution in the example match the 125 m sampling in the TASK.

- In the example elevation angles of 0.5, 1.0 and 5.0, separate shear products can be configured for each of the lowest two angles.
- It is recommended to not use any additional XY smoothing when the SHEAR product is used for microburst detection because smoothing tends to diminish the peak values that are of interest in the shear calculation. The radial smoothing performed by the range filter, and the subsequent smoothing performed in the WARN product are adequate.

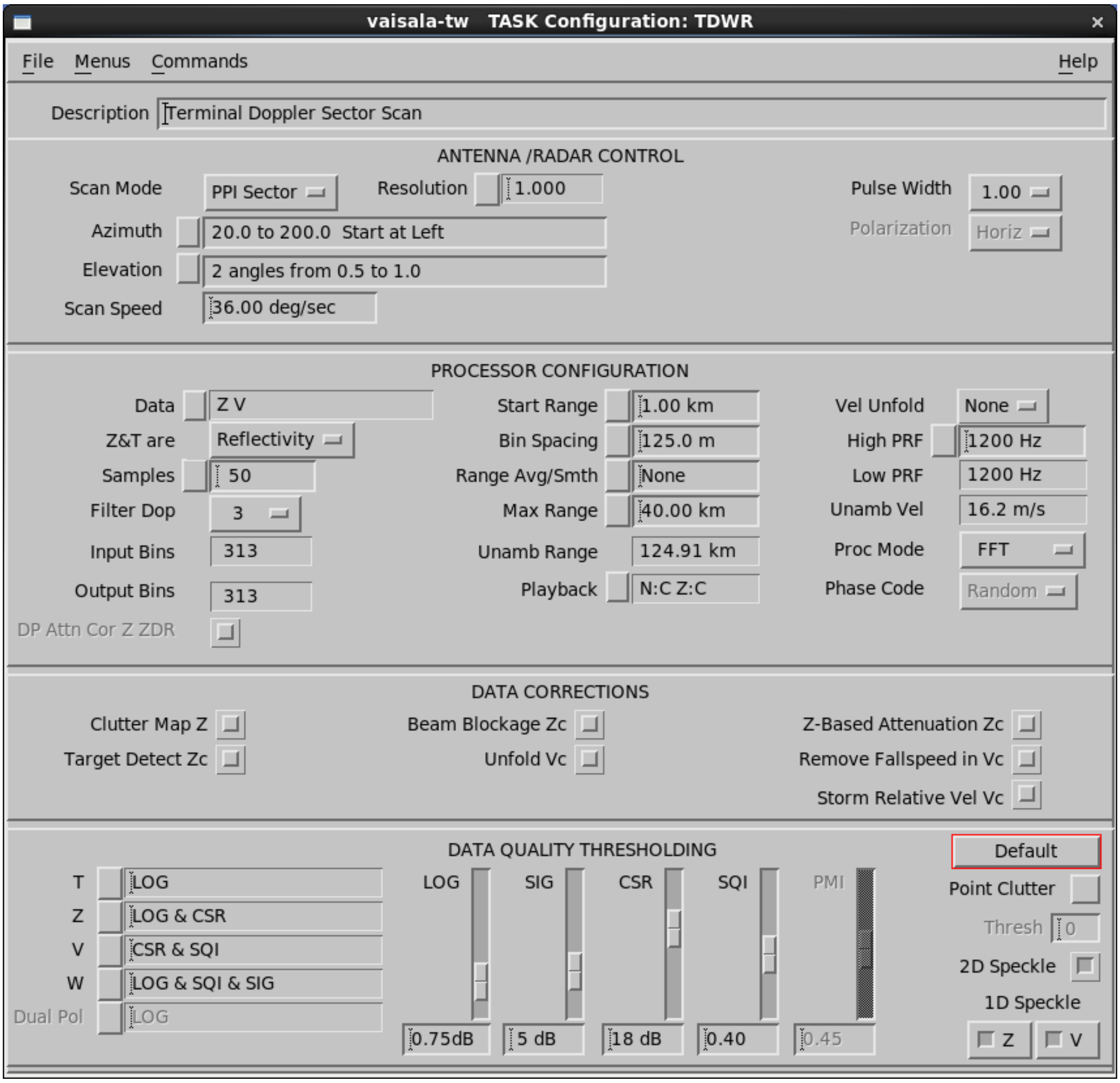


Figure 23 TASK Configuration for Microburst Detection

The WARN product looks at the SHEAR products to determine whether to issue a warning. In the example of two low-level scans (0.5° and 0.9°), each with its own SHEAR product, the WARN product can be set to examine each. A threshold level of 8 m/s/km is a good indicator of hazardous wind shear. A 1 km area threshold can be used which corresponds to roughly 64 pixels for the case of 125 m bin spacing, 30 km range and 480 × 480 product resolution.

The Product Output menu should be optimized to send the WARN product to a workstation so that personnel can view the situation display. The automatic output request should be made so that the shear product is sent every time that it is made. In addition, a workstation should be running the IRIS menus so that when windshear is detected, the audible warning message and text can be viewed. Warning messages are issued almost instantaneously when wind shear is detected. Within a few seconds of receiving a warning message, the situation display is presented. This depends on the speed of the communications link connecting your display. However, because the situation display is an overlay product without a complex picture, it can be transmitted very efficiently.

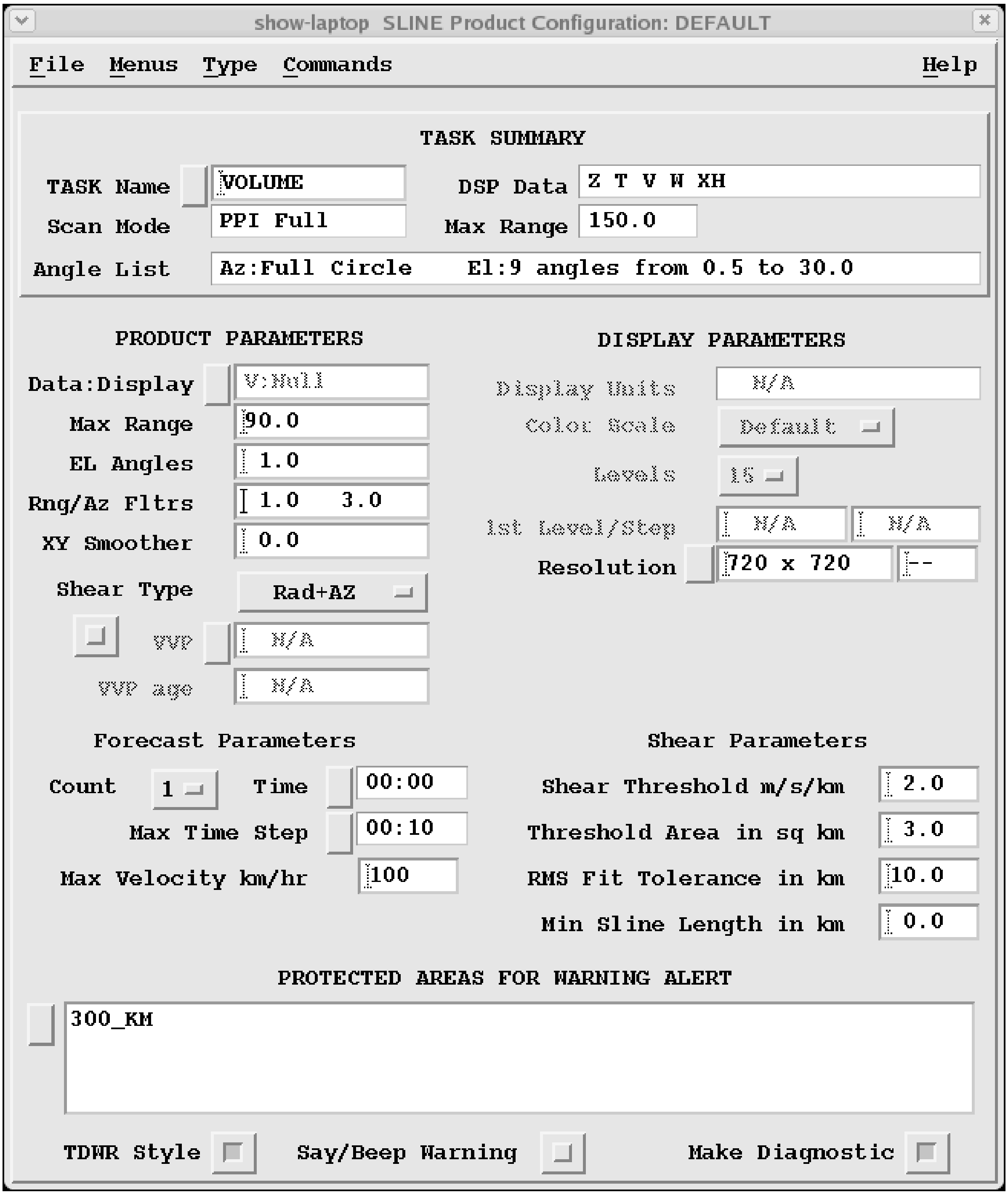
Wind shear detection algorithms are known to require tuning for each site. This requires that qualified personnel perform the necessary optimization for your particular meteorological and operational environment. It also requires that you go through a thorough evaluation phase to test your system on your particular site for your particular weather. It is recommended that you make and record a RAW product every time a microburst is detected and perform an analysis to determine weather it was a real event or a false alarm. To obtain a larger sample, you may want to expand the protected area to include all the total area around the radar to the maximum range of detection required (typically 20 to 30 km) for air terminal applications. Again, a qualified meteorologist should assist with this evaluation.

If it is determined that false alarms are occurring, there are several approaches you can take to balance sensitivity against false alarm rate. In tuning your system to reduce false alarms, it is important to make gradual changes and evaluate them on test cases that you have recorded. IRIS is ideal for this type of evaluation. Some examples of actions that you can take to reduce false alarms are as follows (note the reverse of each example can be used to increase sensitivity):

- Gradually increase the range filter in the SHEAR Product Configuration menu from 1 km to 2 km.
- Increase the SHEAR magnitude threshold in the WARN Product Configuration menu.
- Increase the threshold AREA size in the WARN Product Configuration menu up to 2 km.
- Require that two low-level scans from the same TASK both detect the SHEAR in the WARN product—a two-look test.

- Add a warning criterion that requires reflectivity aloft. This can be based on a dBZ PPI at a higher angle. However, be sure that dry microbursts are not common in your area. If they are, you may need to use a VIL criterion and employ more elevation angles in your associated TASK.

4.7 SLINE: Shear Line (Optional)



This section describes the fields of the Product Configuration menu that are unique to SHEAR products. For general information, see these other sections of this chapter:

- Task Summary area, Task Summary on page 24

- Product Parameters, see Product Parameters on page 31
- Display Parameters area, Display Parameters on page 34

A shear line, or frontal boundary, marks the transition between two air masses. Because the wind can be very different on either side of the air mass, sudden wind shifts occur when a frontal boundary passes. on page 196 shows an example of a typical shear line. The most severe wind shifts are associated with mesoscale gust fronts, which occur at the leading edge of a thunderstorm outflow, and with larger scale cold fronts, which may be associated with severe weather.

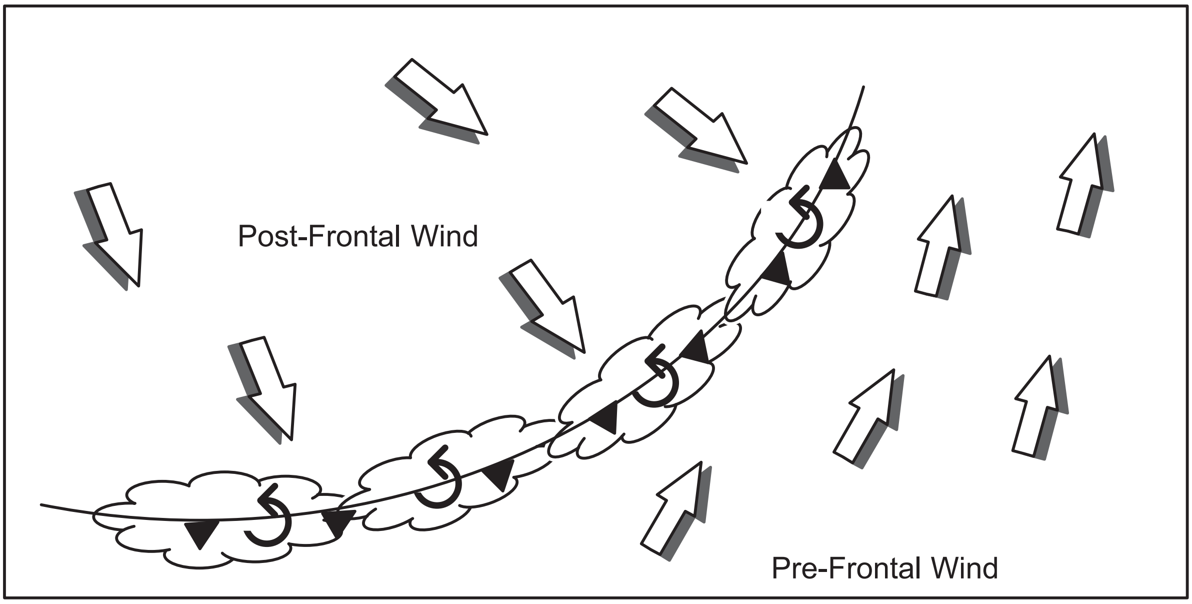


Figure 24 Typical Shear Line Features

The Shear Line product can detect these sudden wind shifts and provide advance warning of their approach, with best estimates of both the time of arrival and the expected speed and direction of the new wind.

To open the SLINE Product Configuration menu:

Choose **Type**->**SLINE** from the menu bar. You can use **File**->**Open** to load an existing product configuration into the menu. Note that many of the configuration parameters for Shear Line products are the same as for Shear products.

Data : Display

V Shear

EL Angles

Enter the elevation angles of data you want to process. Wind shears associated with gust fronts and microbursts are usually low-level phenomena, so angles of 1 degree or less are typically used to detect these. Either one or two angles may be selected. When two angles are selected, both must be above the threshold to be included in the shear line.

Rng/Az Filter

The first number defines the range length scale for the SHEAR product, in km. This distance determines the size of the skip that the SHEAR product can tolerate when there is missing data. It also specifies the length of the the radial smoother, which is applied before the XY smoother.

The second number is the azimuth length scale in degrees. The skipping and azimuth range length are analogous to the range filter. See the description of the SHEAR product, Target Detection: Input TASK and Product Optimization on page 153.

Shear Type

Choose one of types of shear to be computed:

Radial
Azimuthal
Elevation
Combined

Radial Shear — The bin-to-bin difference in the radial velocity.

Azimuth Shear — The azimuth-to-azimuth difference in the radial velocity.

Elevation Shear — The vertical difference in the radial velocity.

Combined Shear — The RMS value of the radial, azimuth, and/or elevation shear. This is sometimes referred to as the total shear.

Refer to the description of the SHEAR product in Target Detection: Input TASK and Product Optimization on page 153.

VVP

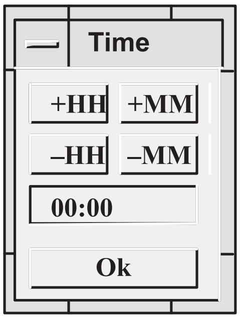
Select the name of a VVP product. The wind speed and direction from the nearest VVP wind product of this name is used to remove the effect of the mean wind on the azimuth shear calculation. This product should be scheduled to run. Use of the azimuth or total shear is not recommended without this correction.

VVP Age

The maximum number of minutes between the data for the VVP product and the data for the SLINE product. This prevents old VVP winds from being misapplied. If no VVP product is found, no mean wind correction is applied when computing the azimuth shear.

Count and Time

Enter the number of forecast points and the time interval between each forecast point.



You set the time using the plus and minus button to increase and decrease the hours or minutes. When you are satisfied, press Ok to exit from the window. The time you specify is inserted into the field.

You may also type a time value directly in the Time window and press Ok to insert it into the field.

Max Time Step

When making a forecast of shear line motion, the previous shear line product is used. The Max Time Step field specifies how far back in time the previous SLINE product can be. If none exists in this time frame, no forecast is made.

Max Velocity

Enter the maximum expected velocity. If the computed velocity exceeds this value, the shear line is considered to be a new feature, and no forecast is made.

Shear Threshold

Enter the minimum speed difference per km that must be present to indicate a shear line. Winds that do not meet this speed are ignored.

Threshold Area

Enter the minimum size of the wind shear area in square km that must be present to indicate a shear line. Wind shear areas that are below this threshold are ignored.

RMS Fit Tolerance

Enter the standard deviation allowed when fitting the shear line. The line is thrown away if the points do not fit within this tolerance, indicating a random scattering of points and not a shear line.

Minimum Sline Length

Enter the minimum length distance in km that will be used to estimate a shear line. Shear lines that are below this length will be ignored.

Protected Areas for Warning Alert

Specify one or more protected areas. A warning is generated if a shear line is within a protected area or is forecast to move into one. Click on the Protected Areas button to see a list of areas. Simply toggle a choice on or off. When you exit from the list, the names of the selected areas are displayed in the field.

Protected areas are configured with the **setup** utility. They are constrained to be rectangles with arbitrary size and orientation angle. Up to 32 areas can be configured. (If you make a change to **setup**, you must restart IRIS for the change to take effect. See the *IRIS Utilities Manual* for information on **setup**.)

TDWR Style

IRIS supports two formats of warning messages. In TDWR format, only the strongest centroid in the highest priority area is reported along with its strength. For example: "MBA 3MF 30K–", in spoken language: "Microburst Alert, Three Mile Final, 30 Knot loss". The older IRIS format reports all centroids in all protected areas, for example: "3 MBA warnings at 11:30 in: 3MF, 2MF". These messages are displayed at the bottom of the display screen, signalled as a pop-up when they are generated, and optionally spoken.

Say Warning

Pushing this button tells the product generator to verbally signal the warning message in addition to displaying it as a pop-up message. You must also select "Enable Speech" from the Setup pull-down menu in IRIS.

Make Diagnostic Results

In addition to the SLINE product, you can create a thresholded version of the input SHEAR product, useful for testing purposes. It will have the same product name as the SLINE. Unless you encounter a problem with the product, you can turn this feature off.

4.7.1 Shear Line Radar Signatures

Detection of shear lines is based on the Doppler velocity rather than the reflectivity. However, accurate measurement of the Doppler velocity requires sufficient returned power. The radar reflectivity associated with shear lines can be from precipitation or clear air echoes. Because clear air echoes tend to be weak, the most efficient detection requires that the radar scan slowly for sufficient averaging.

The climatology of shear lines for a particular location dictates the scan strategy. If shear lines tend to be associated with weak returns, a slow scan rate is necessary for reliable detection. The trade-off between reliable detection of weak echo features and the need for rapid updates to detect phenomena such as microbursts is a decision that you must make, based on your site and application.

Shear lines are characterized by both vorticity and convergence (negative divergence). The vorticity associated with cold fronts in the northern hemisphere is typically positive. The vorticity associated with thunderstorm gust fronts is usually, but not always, positive. Shear lines are not characterized by positive divergence, as are microbursts.

Both azimuthal shear (partial vorticity) and radial shear (partial divergence) typically show a signature for a shear line.

4.7.2 The Shear Line Algorithm

The Shear Line algorithm uses the uniform wind assumption.

1. The radial, azimuthal, or combined shear are computed using the SHEAR algorithm. The previous VVP wind is used to remove the apparent azimuth shear caused by the mean wind. The shears are computed using polar data and the output is then X-Y data to a selectable grid spacing.
2. The shear magnitude is thresholded with regard to strength and area within a specified area. Shear regions less than the threshold or smaller than the area limit are not considered.
3. The shear magnitude values of two elevations are ANDed. This step is optional if a second elevation is specified.

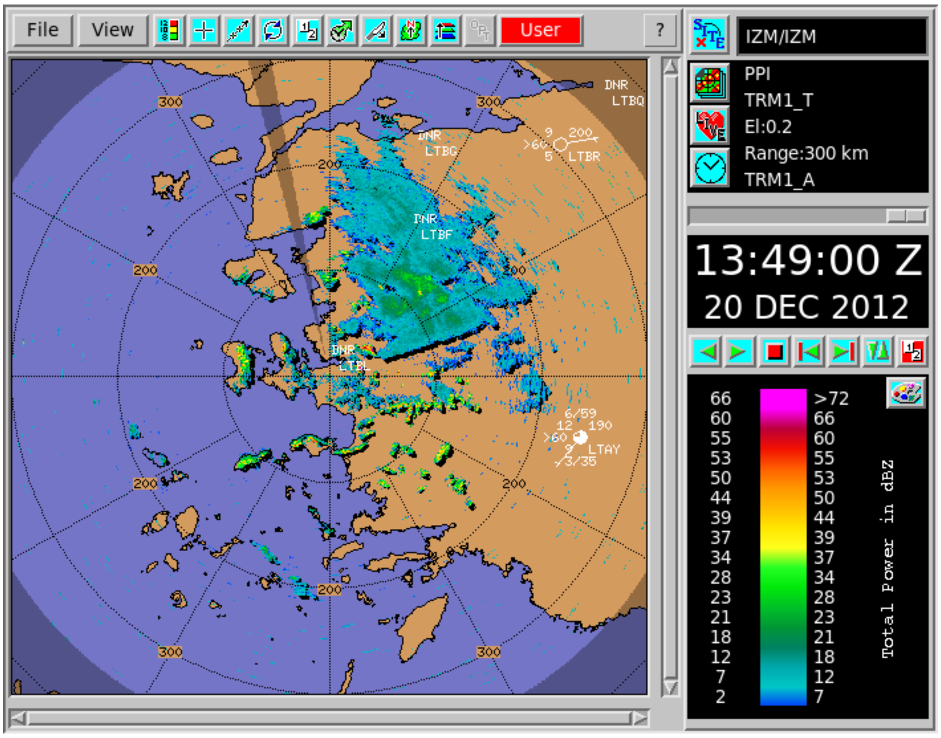
4. A curve is fitted to the shear field to detect a linear region. Points that fall outside the curve are eliminated, and the curve is refit. Only one shear line can be considered in a product.
5. The speed of motion normal to the gust front is obtained by comparing the data from the current shear line location with the data from the previous location.
6. The VVP wind is computed in both areas defined by the shear line using the uniform wind assumption.
7. The computed motion is projected to determine if and when the shear line will cross each protected area.
8. The results are output.

4.8 SWS: Surface Weather Stations

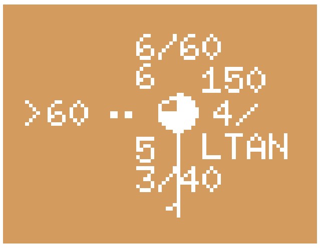
IRIS can store and display METAR and SYNOP reports from Surface Weather Stations. These are stored in the SWS product. A single product file contains reports from many (or all) stations in the radar coverage area. Since this data is not generated from the radar data, there is no product configuration menu to create such products. Instead the product file is created when METAR or SYNOP text messages from a surface weather station are passed through an IRIS pipe program.

This data is displayed as a series of "station plots", which show various stored data, such as the temperature, wind direction, pressure, etc. These can be plotted stand-alone, or on top of radar products. The user can also click the cursor to see the raw station reports, if desired.

4.8.1 Displaying SWS Data



The illustration above shows an example of radar data with an overlay of SWS station plots. The individual station plots are drawn centered at the station locations. All the stations in the display coverage area are displayed. Since everybody draws these station plots a little differently, we describe our format in detail here. The plot is standardized, even though different reporting stations have different capabilities as far as what they can measure, as well as the span and resolution of data.



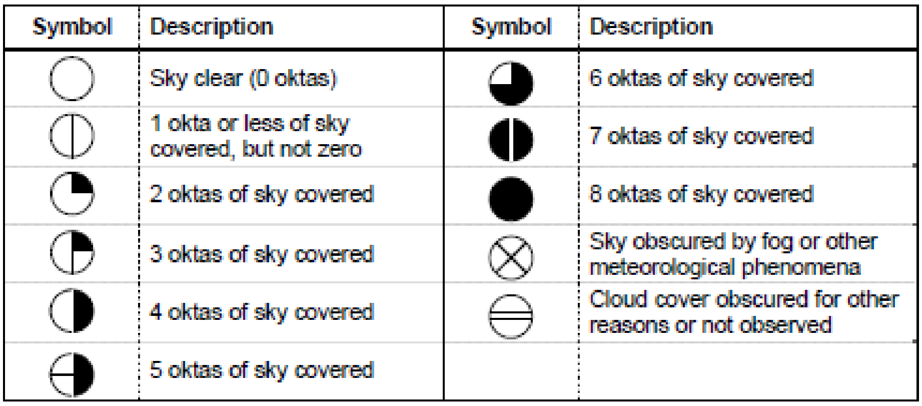
The illustration above shows a single station plot with annotation showing the different data being displayed. Individual numbers or graphics will not be shown on the plot, if the station did not report, or the data was turned off in the output options.

Here are details on the plot:

#1 - Cloud coverage. This is a pie chart, showing coverage in "oktas" (that is eights) of sky coverage. METAR messages do not give cloud cover in octa units, therefore METAR text is mapped as follows:

SKC orCLR	0 oktas
FEW	1 oktas
SCT	3 oktas
BKN	6 oktas
OVC	8 oktas

These are drawn using standard symbols as shown below, so this example is 6 oktas.



Symbol	Description	Symbol	Description
	Sky clear (0 oktas)		6 oktas of sky covered
	1 okta or less of sky covered, but not zero		7 oktas of sky covered
	2 oktas of sky covered		8 oktas of sky covered
	3 oktas of sky covered		Sky obscured by fog or other meteorological phenomena
	4 oktas of sky covered		Cloud cover obscured for other reasons or not observed
	5 oktas of sky covered		

#2 -Wind barb. This is a line with feathers showing the wind speed and direction, to the nearest 5 knots. A knot (nautical mile per hour) is close to half a meter/second, so 20 knots would be 10 m/s. The line points up wind. It has a half feather line for 5 knots, and full length lines for 10 knots, and a triangular flag for 50 knots. If the wind speed is zero, then a circle is draw outside the sky coverage circle. In this case, we have a wind of 5 knots from the south.

#3 -Present Weather. There is a large selection of possible symbols, shown in the illustration below. In the single station plot illustration on page 202, we have two dots, which means light rain.

Present Weather (METAR text-to-symbol matching)

Matching of METAR present weather text to symbol in table below is not necessarily endorsed by the National Weather Service or the World Meteorological Organization. Blue numbers in upper-left corner of white boxes indicate the priority for plotting in event more than one symbol is possible (symbols in gray boxes have no corresponding METAR present weather text). Graphical representation of METARs using this table found at http://www.rap.ucar.edu/weather/surface/

	0	1	2	3	4	5	6	7	8	9
00					3 FU VA	59 HZ	14 DU	13 SA BLSA VCBLSA BLDU VCBLDU BLPY	9 PO VCPO	12 VCSS VCDS
10	58 BR		56 MIFG	50 VCTS	57 VIRGA		51 VCSH	33 TS	2 SQ	1 FC +FC
20										
30		11 SS DS DRSA DRDU			10 +SS +DS		48 BLSN VCBLSN		47 DRSN	
40	55 VCFG	54 BCFG			53 PRFG	52 FG				49 FZFG
50		46 -DZ		42 DZ		39 +DZ	22 -FZDZ	21 FZDZ +FZDZ	35 DZ -RA -DZ RA -DZ -RA	34 DZ RA +DZ RA DZ +RA +DZ +RA
60		44 -RA		41 RA		37 +RA	24 -FZRA	23 FZRA +FZRA	26 -RA -SN -RA SN -DZ -SN -DZ SN	25 RA SN DZ SN +RA SN +DZ SN RA +SN DZ +SN +RA +SN +DZ +SN
70		43 -SN		40 SN		36 +SN	32 UP	19 SG	31 IC	20 PL PE SHPL SHPE
80	45 -SH -SHRA	38 SH +SH SHRA +SHRA		28 -SHRA SN -SHSN RA -SHRA -SN -SHSN -RA	27 SHRA SN SHSN RA +SHRA SN +SHSN RA	30 -SHSN	29 SHSN +SHSN	18 -GS -SHGS	16 GS SHGS +GS +SHGS	17 -GR -SHGR
90	15 GR SHGR +GR +SHGR					8 TSRA TSSN TSPL	7 TSGR TSGS	6 +TSRA +TSSN +TSPL	4 any TS and any SA or DU	5 +TSGS +TSGR

#4 -Visibility. This code is a 2-digit shorthand for a somewhat logarithmic scale, as shown in table XX. So the ">60" in the example means greater than 10 km. METAR reports have a maximum value of "greater than 10 km", so you will see a lot of ">60" on the displays.

Code Value	Meaning
00	Less than 100 meters
01 to 50	Code * 100 meters (100 to 5000 meters)
51 to 55	Unused
56 to 80	(Code-50) * 1000 meters (6 to 30 km)

81 to 88	(Code-74) * 5000 meters (25 to 70 km)
89	>70 km
90 to 99	Unused for land stations

#5 - Temperature in degrees C.

#6 -Cloud Height. There can be up to 3 levels of clouds plotted, all in the format O/HH. The lowest level clouds are drawn below the station, in this case "3/40", the second level of clouds is drawn above the station, which is "6/60" in the example. There can be a third level drawn above the second, not shown in this example. The first number is the oktas of coverage, and the second number is a code value for the height. These code values are similar to the visibility code values, except the units are feet, as shown in table XX. So we have 3/8 coverage of clouds at 4000 feet, and 6/8 coverage at 10000 feet. SYNOP reports contain only 1 level of cloud height, so the others will not be seen.

Code Value	**Meaning**
00	Less than 100 feet
01 to 50	Code * 100 feet (100 to 5000 feet)
51 to 55	Unused
56 to 75	(Code-50) * 1000 feet (6000 to 25000 feet)
76 to 99	Unused

#7 - Sea Level Pressure in 1/10 of a millibar, with the leading "9" or "10" removed. If the string starts with a 0 through 4, prefix a "10", otherwise prefix a "9". In this case we have 1015.0 millibars. METAR reports the pressure only to the nearest millibar, so all the numbers will end with "0". This pressure is the "QNH" pressure, which is corrected to sea level.

#8 - Pressure Trend. This shows the unsigned change in pressure over the last 3 hours in 1/10 of a millibar. It is followed by a graphic showing the change trend. So "4/" means that the pressure went up by 0.4 millibars in the last 3 hours. The possible graphics are show in table xx. METAR reports do not contain pressure trend, so this will be blank.

Symbol	Description of curve	Pressure now compared with 3 hours ago
	Rising, then Falling	Higher
	Rising, then steady	Higher
	Rising	Higher
	Falling, then Rising	Higher
	Falling, then Rising	Lower
	Falling, then steady	Lower
	Falling	Lower
	Rising, then Falling	Lower

#9 -Station ID. There are two type of IDs supported. METAR stations use a 4-character string for ID, while SYNOP stations use a 5-digit number.

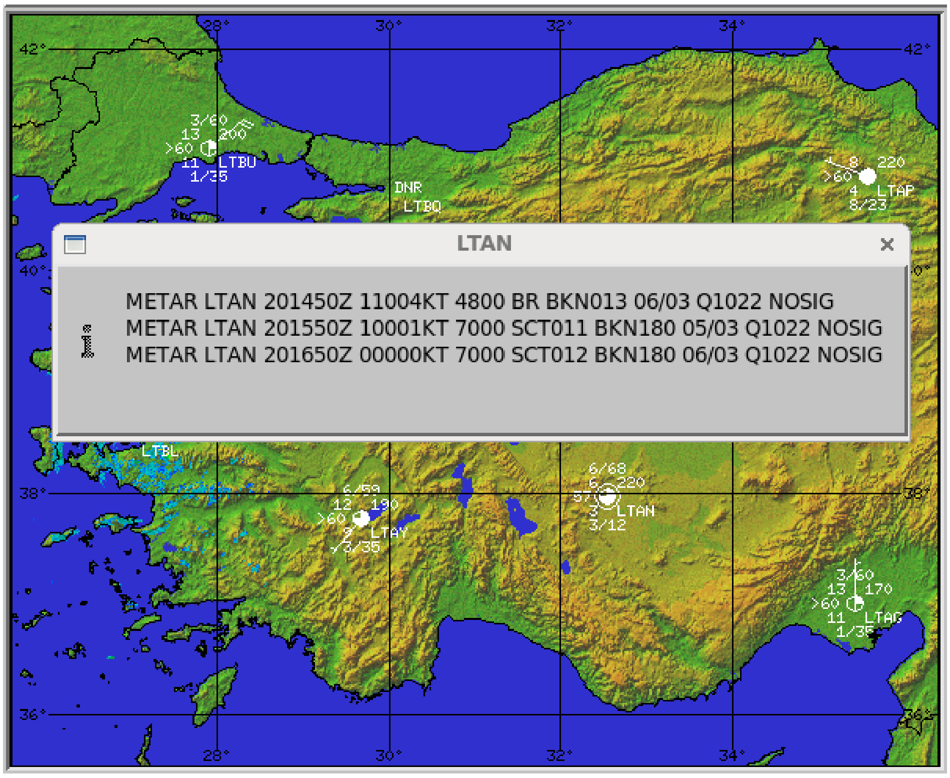
#10 -Dew Point. Also in degrees C.

4.8.2 SWS Output Options

When displaying an SWS product in the Quick Look Window you can configure what data is displayed using the SWS Tool (see the illustration below). This is launched from the **OPT** button on the top. It also can be launched from the Product Output Menu from the **Opts** button. IRIS displays all data fields for which the button is pressed, and the data is in the file. Pressure covers both the current pressure and the pressure trend. Ceiling covers the (up to) 3 cloud level heights.

4.8.3 Raw Report Pop-ups

When displaying an SWS product in the Quick Look Window, if you mouse over a station, and click the right button, it pops up a report showing the raw METAR or SYNOP reports for that station. If there are more than one report in the product file, it displays all; one on each line. The illustration below shows an example of this. The station plot shows only the most recent report in the product.

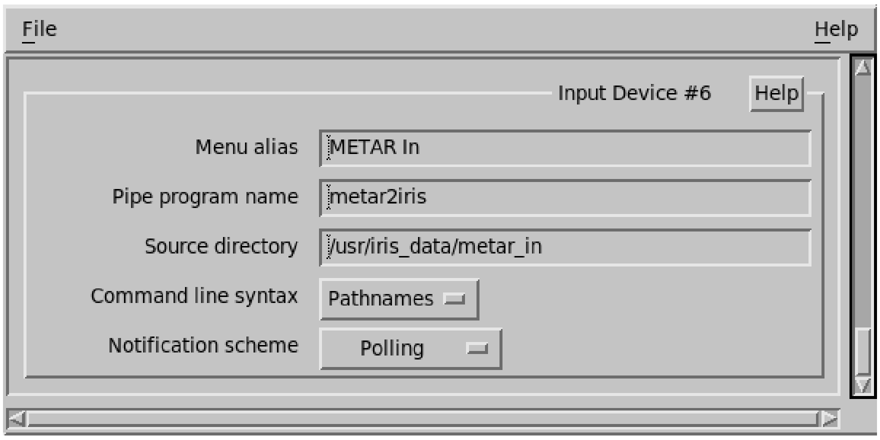


4.8.4 Configuring SWS Input

SWS data arrives onto the IRIS system through file transfer and ingest mechanism. A source of METAR and/or SYNOP messages should be configured to transfer ASCII files to a known directory on the IRIS analysis system. IRIS monitors this directory for new files, then runs an input pipe to convert this data to IRIS's internal SWS format and insert into the IRIS product directory.

To configure the SWS input:

1. Configure and save a new input device in Setup/Input. Here is an example of how this should be configured:



Ensure to use a recent version of the metar2iris pipe by copying the binary and config files from *config_template* directory to config directory. This pipe parses both metar and synop messages.

```
$ cd /usr/sigmet/config_template
$ cp pipes/metar2iris /usr/sigmet/config/pipes|
$ cp metar* /usr/sigmet/config
```

2. Edit the configuration files. There are three to edit:
   - The *metar_site.conf* file configures the METAR station site list consisting of ICAO site ID, (optional WMO site ID), lat/lon, altitude, description, and priority. Since the METAR text does not include the latitude and longitude of the stations, this file is essential. When a METAR file arrives, all stations in this file are expected. Any station from the config file, but missing from the report, will be marked at "DNR", short for "Did Not Report", similarly any station in the report, but missing from the file will be deleted, and a message placed in the pipe log file. It is important to maintain the metar_site.conf file to remove old stations, and add new ones. We are not yet using the priority value but may in future for determining which sites to plot. The template file is configured for Turkey. You can get a rough list of all the worlds METAR and SYNOP stations from:

     http://weather.rap.ucar.edu/surface/stations.txt

   - The *synop_site.conf* file is the same for SYNOP stations.
   - The f*metar2Iris.conf* file configures the product's geographical bounding box. Any station outside this box will be discarded. Also, this is the size of the box when the SWS product is

displayed alone. We also configure the SWS product name, and iris site name, etc. Again, the template is configured for Turkey.

3. Create the input directory. Remember that these directories must be owned by operator.

```
$ su
# mkdir /usr/iris_data/metar_in
# chown operator:users /usr/iris_data/metar_in
```

4. Restart IRIS.

4.8.5 Feeding Data In

Test this first by manually feeding in example data. Simply copy a data file into the /usr/iris_data/metar_in directory. See examples below for the file formats. For testing, you can download current METARs from:

http://aviationweather.gov/adds/metars/

You will need to edit the file to add the GTS header, and "METAR" on each line. Check that you are getting an SWS product in IRIS, and check for warnings in the pipe log file metar2iris.log in /usr/iris_data/log. Note that the time stamps consist of the day of the month, followed by hour and minute. The pipe has to guess the month and year, based on the current time.

IRIS expects to receive one ASCII file containing all SYNOP or METAR messages from the past 1 hour time. METAR special reports can also be sent into IRIS in-between hours.

4.8.6 File Format Examples

METAR ASCII file format. It includes a WMO GTS header line then each station's report. Each report has a separate time stamp. "=" signs are optional at the end of lines.

```
SATU20 LTAA 160150

METAR LTAB 160150Z VRB01KT CAVOK 14/06 Q1015 NOSIG RMK RWY06
VRB02KT=
METAR LTAD 160150Z 36003KT CAVOK 15/07 Q1015 NOSIG RMK RWY29
VRB02KT=
METAR LTAE 160150Z 35003KT CAVOK 12/04 Q1015 NOSIG RMK RWY21
02006KT=
METAR LTAG 160150Z 10003KT 9999 SCT035 25/22 Q1005 NOSIG=
```

SYNOP ASCII file format. It includes a WMO GTS header line, an "AAXX" line, then each station's report. All reports share the same time stamp.

```
SMTT60 LTAA 160000

AAXX 16004
17015 3//// /1605 10171 20168 30109 40120 57006 60001
17018 3//// /3101 10160 20069 38899 40112 57009 60001
17020 3//// /0402 10153 20147 30085 40124 56003 60001
17022 3//// /1203 10197 20120 39966 40120 57008 60001
```

CHAPTER 5

SCHEDULING PRODUCTS

The Product Scheduler menu tells IRIS when to generate a product for fully automatic or manual operation. Because the generation of a product has an impact on the host computer resources, this menu can be viewed but not controlled by an IRIS observer.

The Product Scheduler menu provides the following features:

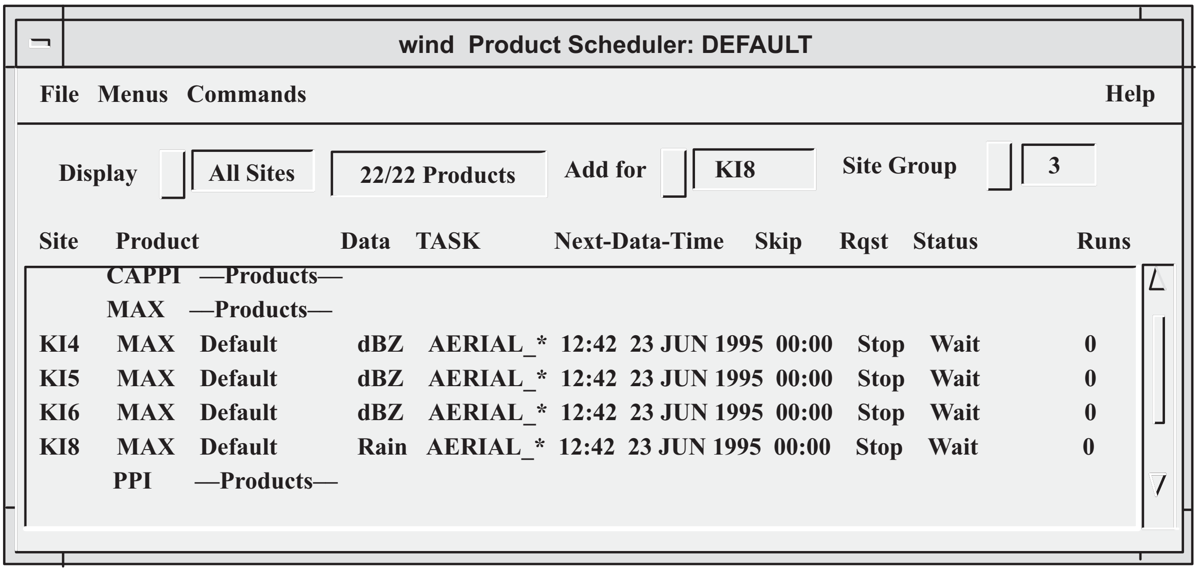
- Saving and loading entire schedules for easy system configuration.
- Listing the product types available on the system, including optional types.
- Listing all the individual products that are scheduled or pending, along with their associated TASK.
- Listing products by site in the case of multiple networked sites.
- Providing a summary of the product data parameters, so you can get a rough idea of the product configuration. Easy access is also provided to the Product Configuration menu for each product.
- Processing only TASK data when you specify a "next data time" for product generation. This allows you to do scheduling for either future or old TASK data, such as data retrieved from tape.
- Automatic processing of all associated TASK data after the next data time, or only the next occurrence of the associated TASK.
- Allowing the user to set the minimum skip time between products, so a product does not have to run every time the associated TASK runs. For example, a TASK may be scheduled to run every 15 minutes, but the product runs every 30 minutes.

To enter the Product Scheduler menu:

Choose **Menus**->**Product Scheduler** from the IRIS menu bar or from any of the IRIS menus.

In this chapter:

5.1 Product Scheduler Menu



When you first open the Product Scheduler menu, it contains a list of all the product types available on the system, including any optional types. These serve as header lines. As you add products to the schedule, they are placed under the appropriate header, according to product type.

The list of products can grow quite long. Use the scroll bar or the up and down arrow keys to move through the list.

Product Schedule Site Selection

IRIS can make products using data from many different sites. The menu allows the operator to specify which products are to be made for each possible site. The fields at the top of the menu allow the user to specify what sites are displayed, and for what sites the "Add" operation will apply.

Display

This specifies what sites are displayed. The adjacent text field shows how many products match the display selection. The options are

All Sites	To see the schedule for all sites.
Master	Shows the Master Schedule, which consists of one entry for every product that is scheduled. If a product is scheduled to run at multiple sites, the entry corresponds to the site that ran most recently.
Site Group	The Site Group is a subset of sites that is defined in the Site Group field. Selecting Site Group displays the products that are configured for all sites in the group.
Single Sites	To see the products configured for a single site, select the site name. Use this if your system supports only one site.

Add for

When a product is added to the schedule, this field specifies the sites for which the product is added. The options are:

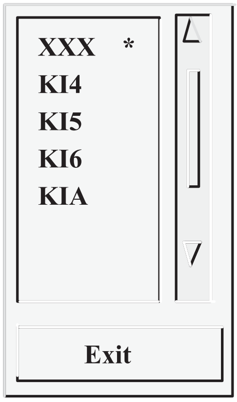
All Sites	When a product is added, it is added for all sites.
Site Group	When a product is added, it is added for all sites defined by the Site Group.
Single Sites	Select an individual site if you want to add products only for that site. This is used if your system needs to support a single site.

Site Group

It is sometimes convenient to define a group of working sites, i.e., a subset, and have the product schedule apply to just those sites. The submenu in this field allows you to tag with * the members of the site group. If you have a single site system, simply make your site the only member of the Site Group.

Site

The Site column of the main menu shows the site for each product that is scheduled. A product runs only if data from that site arrives at IRIS, either directly from the radar, over the network or from tape.



If the Display field is set to Master (the Master Schedule), there is only one product entry, regardless of the number of sites scheduled. In this case, a pop-up menu is available on the site column by clicking the right mouse button. The pop-up lists all sites with a * symbol next to each site for which the product is scheduled. By clicking on an entry, the * tag can be added or removed. This makes the Master Schedule convenient to use for adding or deleting sites from the schedule.

If the Display field is set to Master (the Master Schedule), there is only one product entry regardless of how many sites are scheduled. In this case there is a pop-up menu available on the site column by clicking the right mouse button. The pop-up shows a list of all sites with a * symbol next to each site for which the product is scheduled. By clicking on an entry, the * tag can be added or removed. This makes the Master Schedule convenient to use for adding or deleting sites from the schedule.

Product

The Product field shows the name of the product, which corresponds to the name assigned during product configuration. When you position the mouse cursor over this field, you can pop up a list of commands:

Add lets you add a product to the schedule according to the **Add for** field

Remove removes the selected product from the list for the site that is displayed. If the Master Schedule is displayed, then the product is removed for all sites.

Edit opens the Product Configuration menu for the selected product.

Data

The Data field shows the data parameter that has been configured for the product.

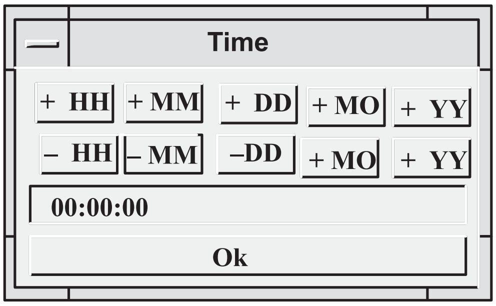
TASK

The TASK field shows the name of the associated TASK.

Next-Data-Time

Scheduling operates under the concept of data time — the time at which a TASK first starts collecting data. For an on-time TASK schedule, the data time corresponds to the time at which a TASK is scheduled to start.

When you schedule a product, you set the Next-Data-Time field, and only associated TASKS with data times later than the next data time are processed by the Product Generator.



To set the time, position the mouse cursor over the Next-Data-Time field and pop up the Time menu.

Use the plus and minus buttons to increase and decrease the hours, minutes, day, month or year. When you are satisfied, press Ok to exit from the window. The time you specify is inserted into the field.

When the Master Schedule is displayed, a change in the Next Data Time is applied to all of the sites.

Skip

The Skip field can be set so that not every occurrence of the associated TASK is processed by the Product Generator. The skip time breaks the day into equal intervals of time starting from midnight. A product is generated, at most, once for each skip time interval. The first occurrence of data from the associated TASK is used for each interval.

The default value of the Skip field is "00:00," indicating no TASKs should be skipped.

When the Master Schedule is displayed, a change in the Skip Time is applied to all of the sites.

Request

The Request field contains a pop-up menu that lets you schedule a product:

All
Next
Stop

All schedules all future occurrences of the selected product.

Next schedules only the next occurrence of the product.

Stop stops the selected product's schedule.

The command you choose is displayed in the field.

When the Master Schedule is displayed, a change in the Request is applied to all of the sites.

Status

The Status field shows the current status of each product. The possible entries are as follows:

Running	The product is being generated.
Wait	The product is waiting for either the associated TASK to run or for its turn to run pending the completion of other products. The Wait status is also displayed if the product is not scheduled to run.

After a product has completed, the status changes from "Running" to "Wait."

When the Master Schedule is displayed, the Status reflects the status of the site which is either currently running or ran most recently.

Runs

The Runs field is a 3-digit counter (000 to 999) showing how many times the product has run since it was loaded into the menu. If the number of runs exceeds 999, the counter simply starts over at 000. If you stop a product, the counter is not reset. The counter is reset only when you delete a product and reload it into the schedule. If you load a new schedule, the counters for all products are reset.

When the Master Schedule is displayed, the Runs field reflects the total number of runs for all sites that are scheduled.

5.2 Adding, Removing, and Editing Scheduled Products

To add a product to the schedule:

1. Select the header for the type of product you want to enter, or any product of that type.
2. Position the mouse cursor over the Product field and choose ->**Add** from the pop-up menu. IRIS then displays a list of products of that type.
3. Select a product, and it is added to the schedule. If you do not want to add any of the products in the list, click on the Cancel button.

To remove a product from the schedule:

1. Select the product you want to remove.
2. Position the mouse cursor over the Product field and choose ->**Remove** from the pop-up menu.

   You can remove products only. IRIS will not remove product headers from the schedule.

To edit the product configuration:

1. Select the product you want to edit.
2. Position the mouse cursor over the Product field and choose ->**Edit** from the pop-up menu. IRIS opens the Product Configuration menu with the selected product loaded into it.
3. Edit the product as needed, then choose **File**->**Save as** to save your changes.
4. Exit from the Product Configuration menu. IRIS returns you to the Product Scheduler menu. Your changes should be reflected in the product schedule fields.

5.3 Scheduling and Stopping Product Generation

1. Select the product that you want to schedule.
2. Set the Next-Data-Time and Skip fields, as described below. These two fields determine when the TASK begins, and how frequently the product is generated.
3. Position the mouse cursor over the Request field, and choose ->**All** or ->**Next** from the pop up menu.

   When you choose ->**All**, all associated TASK data collected after the next data time are processed. The product is generated on an on-going basis whenever the TASK collects data, subject to the skip time.

   When you choose ->**Next**, only data from the next occurrence of the TASK, after the next data time, are processed. The product is generated only once. The skip time is ignored.

You can generate products from either future or past TASKS by adjusting the Next-Data-Time field, as shown in on page 218. This allows you to generate products from TASK data received from another IRIS host or retrieved from tape.

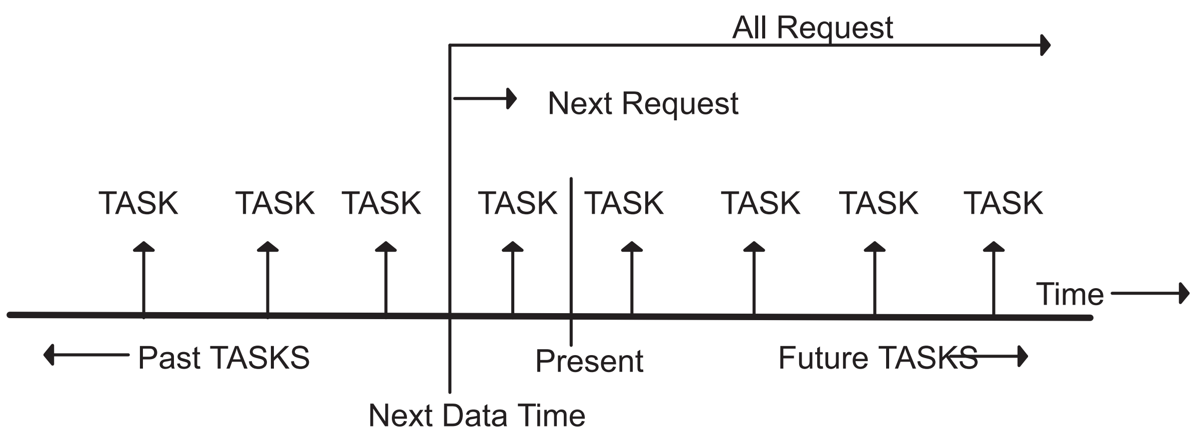


Figure 25 Illustration of Next-Data-Time, ALL and NEXT

When a product is first loaded into the schedule, or an entire new schedule is loaded, the Next-Data-Time field defaults to the current time. If an All or Next request is made, only data from future TASKS is processed.

When you make an All request, the Skip field can be set so that not every occurrence of the associated TASK is processed by the Product Generator. A Skip Time of 00:15 (15 minutes) means that the product is generated no more frequently than every 15 minutes, regardless of how often the associated TASK runs. In on page 219, the Skip field is set so that there are two occurrences of the TASK in each interval. Only the first occurrence is used to generate the product. Clearly, you must consider the TASK schedule when specifying the skip time.

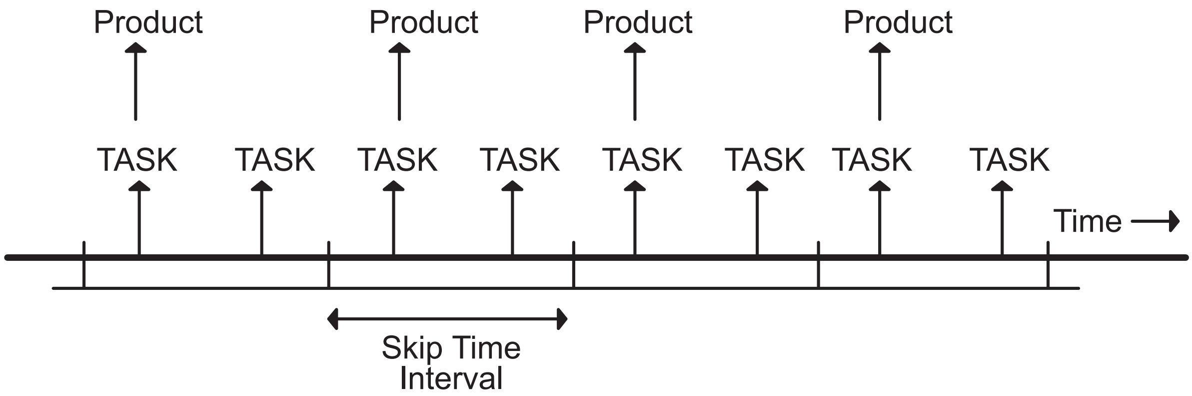


Figure 26 Illustration of Skip Time with and All Request

The default value of the Skip field is "00:00." By default, an All request causes data from every TASK to be processed.

During operation, the Next-Data-Time field changes to show the next possible time that the product can be generated. This depends on the skip time and the request (All or Next) as follows:

->**Next Any Skip Time**	After completion of a Next request, the Next-Data-Time field is reset to the data time (plus 1 second) of the TASK that was just processed. This means that issuing another Next request processes the next occurrence of the associated TASK. The skip time is ignored.
->**All Skip Time** = **00:00**	The product is generated for every occurrence of the associated TASK. The Next-Data-Time field is reset to the data time (plus 1 second) of the TASK that was just processed (identical to the Next request case). This is the same as issuing a series of Next requests.
->**All Skip Time** > **00:00**	The Skip field determines the earliest time that a new product can be generated. After completion of a product, the Next-Data-Time field is reset to the beginning time of the next skip time interval.

To stop a product:

1. Select the product you want to stop.
2. Position the mouse over the Product field and choose ->**Stop**.

   If the product is waiting to be generated, the Stop request unschedules the product from the All or Next states. If the product is being generated when you make the Stop request, no product output file is produced.

5.4 Some Hints on Running Products

Optimizing System Performance

IRIS offers so much flexibility for configuring products that there is an almost unlimited number of products that can be configured. Clearly, IRIS will not be able to run every possible product. This requires planning by the system manager to determine the product mix that is appropriate for your installation. Here are some considerations for performance:

- What are your CPU capabilities? Are you able to generate products on a separate IRIS/Analysis system? You can improve performance by off-loading product output processes onto a different machine.
- Avoid making products that no one will look at. This wastes computer resources. For example, making 12 CAPPIs may sound like a good idea, but people will not usually look at 12 CAPPIs. A mix of CAPPIs, VIL and TOPS may be more appropriate. Find out what the users want and need.
- Consider the trade-off between output devices and product mix. If you are driving many remote nodes, then you can generate fewer products.
- Do not make high resolution displays if they are not required. Medium and low resolution products run more quickly. The low resolution products are actually preferable for serial line remote displays because the update rates are faster.
- Do not use high resolution sampling in your TASK configuration if it is not required. If you are going to use high resolution sampling (in azimuth and range), do not sample at ranges greater than you need for your application.
- If users want to request many custom products, consider purchasing a separate workstation for running the IRIS/Display software. This allows you to obtain RAW data from the IRIS host and do products processing on the separate workstation.

Immediate Products

Most IRIS products are volume scan products that require all of the data from a series of PPIs. Immediate products can run even before a volume scan is complete. The immediate products can do this because they are based on a single sweep of data.

Use these immediate products for applications where rapid feedback is required:

- PPI
- RHI
- SHEAR

Making Products from Retrieved Data and Keep Flags

When RAW product files are restored from tape, they are automatically reingested to reconstruct the ingest files required for product generation. A reingest operation can also be invoked manually from the Ingest Summary menu. Because the data from tape are old, they are first on the list to be deleted by the system Watchdog process. To avoid this, do the following:

- Delete some unneeded ingest files with the Ingest Summary menu before retrieving RAW files from tape.
- Immediately after the files are restored, go to the Ingest Summary menu and tag the reingested files with Keep flags so they will not be deleted by the Watchdog when real time files come in.

Note that the space reserved for kept ingest files is limited, as allocated by the Setup utility (see the *IRIS Utilities Manual*).

CHAPTER 6
THE QUICK LOOK WINDOW

The Quick Look Window (QLW) is used to display IRIS products. Products can be sent automatically to the QLW or users can request products. The Live IRIS feature allows you to interactively generate and display many types of radar products right in the QLW without having to go through the product configuration, scheduling and output steps. Some QLW features are:

- Easy selection of product images for single-frame browsing, looping and slide show
- Selection of range rings, overlays, shadowing and color scales.
- Geographic cursor mode for position read-outs in radar and latitude/longitude coordinates.
- Interactive tracking, annotation and forecasting of radar echo features, such as typhoons or severe convective storms.
- Forecasting to shift radar displays forward in time. This feature can use the Forecast product or speed and directions entered manually.

The Quick Look Window is very easy to use and with just a little practice, you will soon be a power user.

In this chapter:

6.1 Setting-Up and Starting the Quick Look Windows

You do not have to do anything to start the Quick Look Windows. When IRIS is started, the windows that have been configured by your system manager (in **setup/output**) will automatically appear on the screen. The initial size of the window and its position on the screen and name (shown in the title bar) are all configured in **setup/output**. Most systems are set to have at least two windows, but you can have more (check with your system manager).

Windows can also be exported over the network from an IRIS workstation to other workstations that are running X-Windows, even PC's running X-Window's software under MS Windows. These workstations do not need to run IRIS (free displays). However, if you export displays over the network, your loop performance will not be as good as when you run loops on your local IRIS workstation. Again, your system manager, through the **setup/output** utility can configure these remote windows.

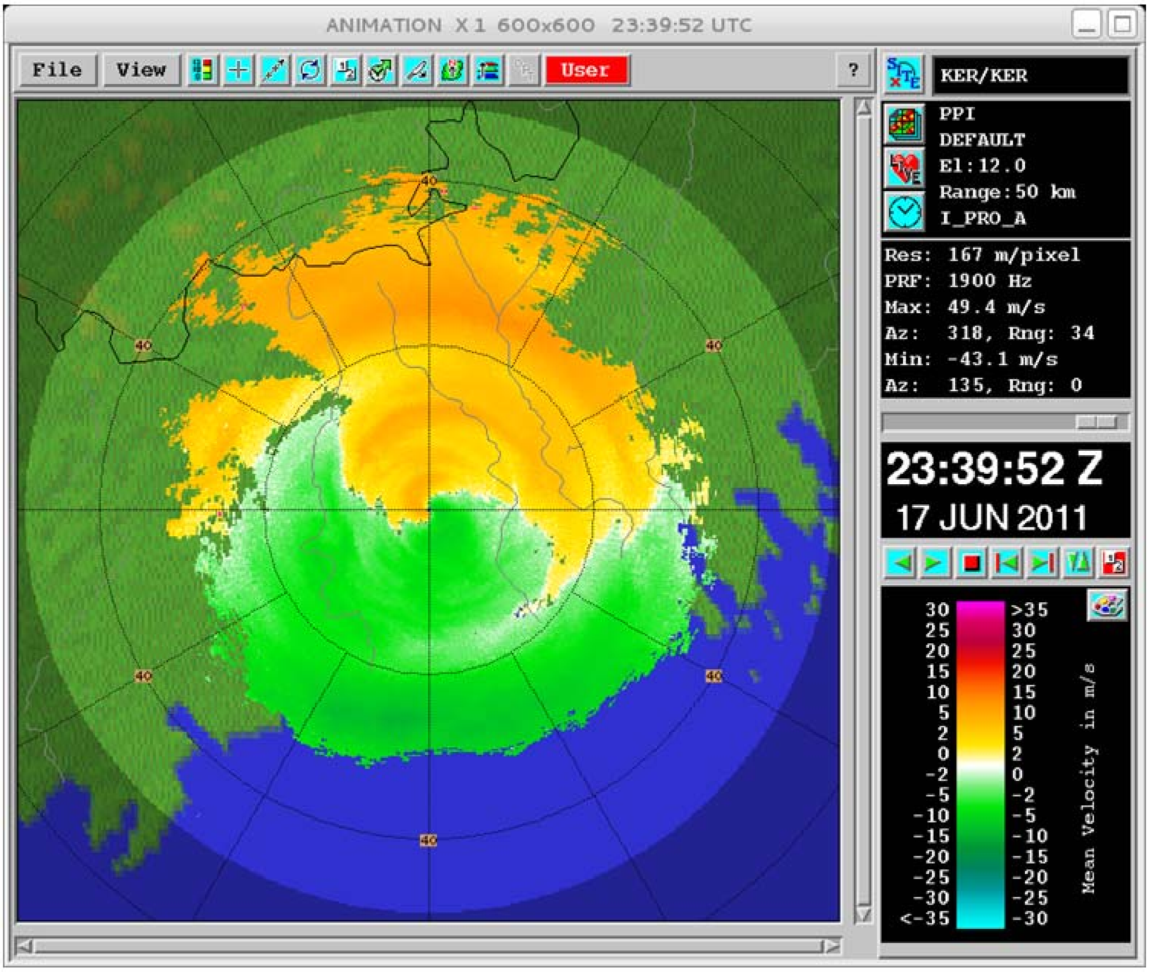
NOTE	If you logon to a system where IRIS is already running but there is no X-session running (e.g., screen lock or log out), then the windows will appear after one or two minutes. It takes IRIS a little while to realize that you are back.

After a window is up, there is no way to get rid of it except to iconify it where it is handy for quick viewing. This prevents users from killing windows either inadvertently or intentionally so that that weather images are always available. The iconified window will show a small "thumbnail" picture of the image in the display.

NOTE	In the unlikely event that our software is not perfect and a window "crashes", don't worry. IRIS is not damaged and all radar operation and other IRIS functions will continue normally. After a minute or two, the window will automatically be restarted. Please file a report at support@sigmet.com detailing what you were doing when this happened.

6.2 General Window Layout

The appearance of the window is shown in the next figure. The example is a PPI reflectivity image.



This example is of a 480 by 480 window size with range rings and overlay. The general features of the layout are described in this section.

Top Title Bar

The top title bar is always displayed. It contains basic information on the window itself, i.e.,

- Name of the window that was assigned by the operator in **setup/ output**. The name is the "Alias" that has been assigned. The example shows the name "wind #1".
- Zoom level which is selected by the **View** tool. The example shows "X 1" which indicates no zoom.
- Window size in pixels which is selectable via the **View** tool. The example shows 480 x 480 pixels. This refers to the size of the image area. The actual window size is larger because of the borders and legends.
- The data time of the image that is being display

NOTE	Window Naming Hints to Operators: If a VIL product is assigned by the Product Output menu to be displayed automatically in the window, then it may be helpful to name the window "VIL". Another helpful naming convention is to make the name of the window match the name of the workstation "work space" in the Common Desktop Environment (CDE) if this is supported on your workstation.

Tools Area

Beneath the title bar are icons for the various interactive functions of the QLW such as loop configuration, track, cursor, forecast and cross-section. Clicking on the icon will pop-up the relevant tool. Much of this chapter is devoted to describing how to use these interactive tools to get the most out of your IRIS system. At the far right hand side of the tool area is the QLW Mode Button and the QLW Indicator Panel which visually alerts operators to a change in the status of automatically assigned images in the QLW.

Legend Area

The legend area provides tools for selecting radar sites, products and times and displaying this information. The control buttons provide for looping and single-frame browsing. The color legend is displayed and labeled. The **Color Scale** legend tool allows users to select default color scales assigned by the operator, or to make their own color scales.

6.3 General Window Control/Monitoring

Quick Look Window Update Indicator

The Quick Look Window Update Indicator alerts an operator about the status of the images displayed in the QLW. This allows users to see, even from a distance, that a window is set to display live data. (The Quick Look Window Update Indicator is located next to the OPT Button in the Tool Area.)

(Green means automatic updating from IRIS)

(Red means no automatic updating from IRIS)

Window Modes

The Quick Look Window operates in the following modes:

(Green Background means automatic updating from IRIS)

- **Auto Mode**- The image is updated automatically by the Product Output Menu (as set by the operator) with new images. This is non-interactive use of the window.

(Red Background means no automatic updating from IRIS)

- **User Mode**- The user determines what images are displayed in the window and is actively manipulating these images (e.g. creating a cross-sections or tracks without an interruption from new products arriving from the Product Output menu). Images are not automatically displayed from the IRIS Product Output Menu.

(Green Background)

- **Slide Mode** - Images are displayed based on the Slide Show tool configuration.

(Green Background)

- **Loop Mode** - Images are displayed based on the Loop/Animation tool configuration and the "Most Recent" button is checked so new images are being displayed as they arrive from IRIS.

(Red Background)

- Images are displayed based on the Loop/Animation tool configuration and the "Most Recent" button is NOT checked so new images are not being displayed.

NOTE	User and Auto Mode can be selected by clicking the Mode button in the tools area. Loop and Slide Mode are selected automatically whenever a slide show or animation/loop is started.

In practice, it is very rare that you have to manually switch the display mode, since IRIS does it automatically for you:

- When you first start to do something in the display, IRIS will automatically switch from **Auto** to **User**. IRIS will not interrupt you by sending images while you are using the window.
- The QLW will automatically switch to **Auto** mode after five minutes of inactivity.

Legend ON/OFF Button

The legend area, title bar and scroll bars may by toggled off by the **Legend** icon which is located on the left side of the tool section. Click the right mouse button in the display window to restore the legend or if you are using a touch screen double tap the upper left corner (100x100 pixels) of the window. Turning the legend off is useful if you want to reduce the size of the windows so that you can fit more windows on your screen.

NOTE	This feature is useful for "tiling" the display windows such as for creating a multi-panel slide show. The startup location of each window and whether the legend is on/off is controlled in setup/output.

NOTE	With the legend turned off, you may want to enable the internal legend feature that shows a legend right in the display window rather than as a side menu. Refer to Display Options Tool — IRIS Product Output Menu on page 238 which describes how the Display Options Tool is used to enable an internal legend in a window.

Setting Operator Password

There are a few functions in the Quick Look Window that are for Operators only since they could effect other Windows. These are:

- Creating or deleting "home" reference points in the **Cursor** and **Track** tools.
- Creating or deleting names for virtual overlays (special combinations of various overlay layers) in the **Display Options** tool.

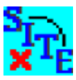
If you need to access these features, use the **File** tool to set the operator window password that has been configured in **setup/general**.

Select "Operator" and you will be prompted to enter the password. Note that in general, the window password that has been configured in **setup/general** will not be the same as the UNIX operator password.

NOTE	When you are done, use the File tool to set the privilege back to Observer

6.4 Selecting Products for Display

The legend area is used to select the radar site, product, and time for display.


Radar Site (Filter/Display)

The **Site** icon allows you to set a filter so that you will only see data from a particular site, or from all sites (select *). The three-letter site code is displayed- the first field shows your filter request and the second field shows the site of the product that is being displayed (please refer to the example).

NOTE	For networks with a single site, it is easiest to simply select the wild card * for the site filter.

In the preceding example, the XXX/XXX indicates that we are filtering to see the site XXX and the actual image is from site XXX.

NOTE	The site ID XXX is often used to denote sites that are "unidentified", i.e., not configured in the setup/general site list.

Product Selection

Clicking on the **Product** icon pops up a list of available products. First choose the type (e.g., CAPPI, PPI) and then choose the product name of the product that you want to display.

NOTE	For convenience, only products that are actually on your IRIS system for the selected site will be shown in the list.

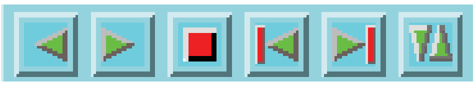
Time Selection

The **Time** icon pops up a list of the actual times at which there are images available for the selected site, product type and name. Select any time from this list. This is a convenient way to select a specific time.

Another way to select a time is to use the **Time Slider** located under the **Time** icon.

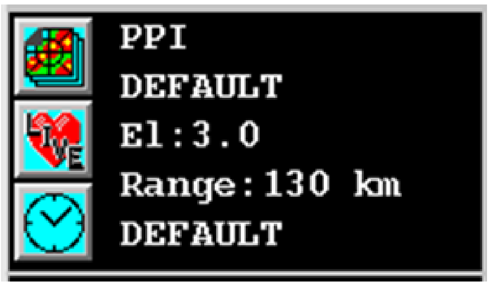
You can drag to select a time, and then release to display the product for that time. You can also click in the in the slider to move forward and back by single frames.

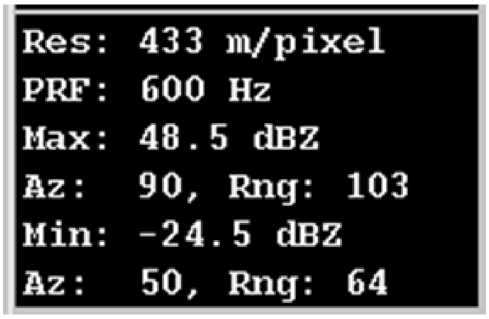
For convenience, the loop control buttons are included in the legend area and can be used to select which time is displayed.



These are described in detail in Animation or Loop Tool on page 248.

Product Legend





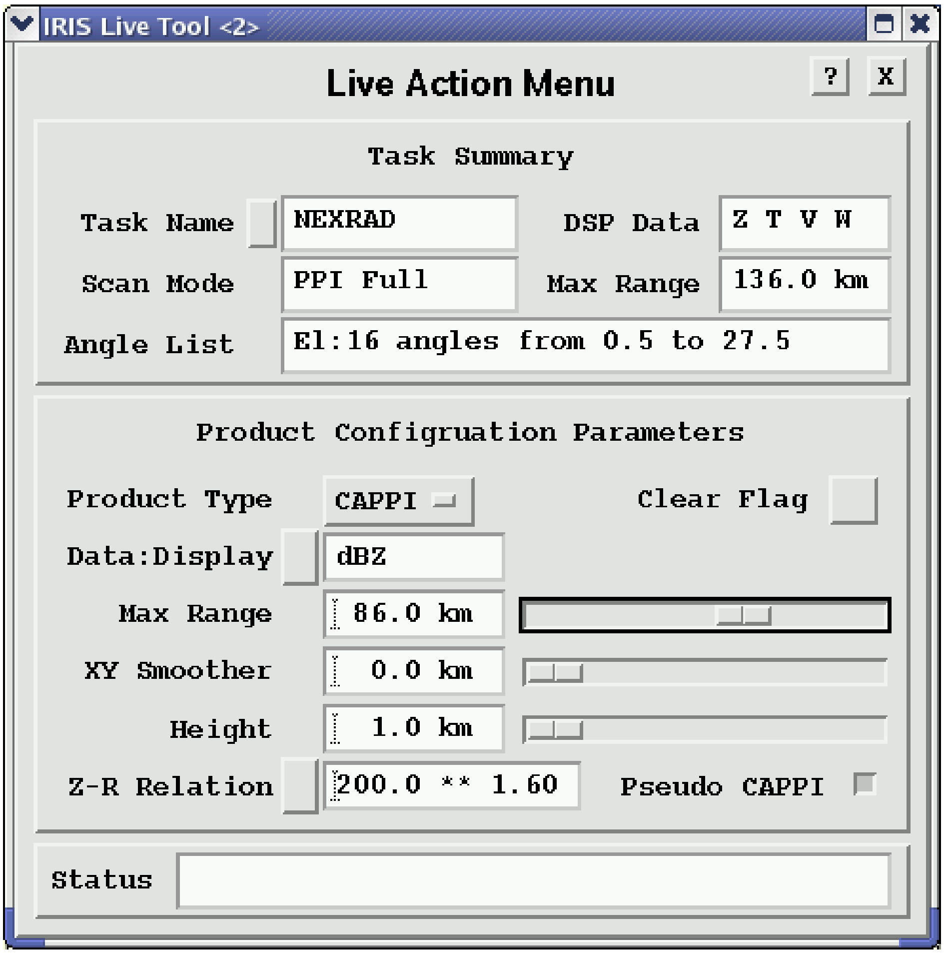
6.5 Live Action Tool- Product Generation and Display

The Live Action tool allows users to interactively configure, generate and display many IRIS products (see list in figure below). If one of these products is on the display, then the Live IRIS tool becomes active. Clicking the tool pops up a "lite" version of the relevant product configuration menu. An example of the Live Action Tool for CAPPI is shown below:

Live Action Tool Example for CAPPI.

Supported Live Action Products:

- BASE
- CAPPI
- PPI
- SHEAR
- SRI
- TOPS
- VIL
- XSECT



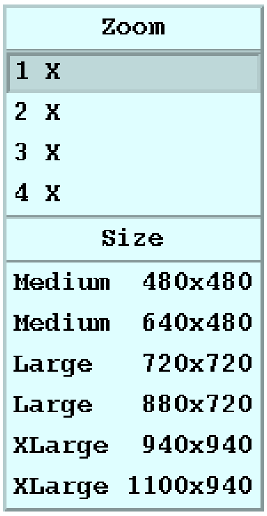
Users can then modify the product settings on the fly such as the cross-section line position or CAPPI height, and see continuous "live" updates on the display- typically at more than 10 frames per second. For example, the VIL layer top can be scanned to observe the VIL at various heights above the freezing level. The CAPPI hight can be scanned up and down to observe the vertical structure of the precipitation echoes. The type of display (Z, T, V, W) is also brought out to the user in the Live menu.

Since the Live Action feature actually re-generates the product, it is necessary to send RAW data to the display so that the Ingest Files are available. Also, the display must be licensed for the Live Action feature.

Please refer to the relevant section of Chapter 3, Configuring IRIS Products, on page 21 for a full description of the product configuration options for each product. Note that in this chapter, the Live Action icon is displayed next any product that is supported by the Live Action feature.

6.6 Changing the Size of the Window and Zoom Level

Click on the **View** icon at the top of the window to select the zoom level and the window size from the **View** tool



Zoom

Select a zoom level and then use the scroll bars to position your display in the area of interest. When you zoom, IRIS will try to preserve the center of the display.

Size

When you select a new window size, the image will be rescaled to exactly fit in the new size. The sizes are the number of pixels in the image area for the window (not including the legend and boarders).

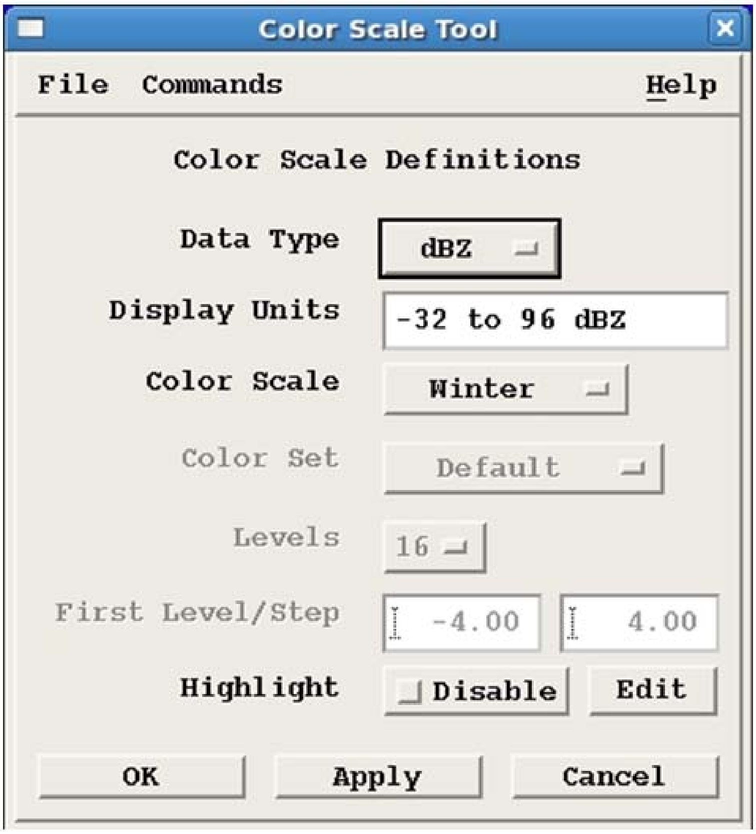
- Square image areas are recommended.
- Rectangular image sizes are useful if the legend information is included in the image itself (selectable as an output option in the QLW

or in the Product Output Menu in the case of automatic outputs to a window).

NOTE	Try square images and then use the Legend icon  to toggle legend on/off.

6.7 Color Scale Tool

The **Color Scale** tool, located in the color legend, lets you select different color scales that have been configured in your system (in the **Color Setup** utility) or to create your own custom scale. Click this icon to display the **Color Scale** tool which is shown below.



Data Type

When you first enter the Color Scale tool, the data type will match whatever is displayed in the window. Choose the type of data for which you want to define a color scale.

Display Units

This field shows the units of measurement for the data type that is currently selected. You cannot edit this field.

Color Scale

Choose one of the named custom color scales. Custom scales are defined by the system operator in the **Color Setup** utility. There can be up to 8 scales for each data type. These scales include the choice of color set, number of colors, and data levels for each color.

The existing color scales remain intact in the software upgrades. When installing fresh software, a default color scale and the choice "Uniform" are available for each data type. In addition, the color scales "Winter" and "Everything" are preconfigured for the reflecitivity data types, for the purpose of matching varied seasonal and application needs. The "Default" color scale of the HClass data corresponds to the class set of the legacy HydroClass. The HClass data type is equipped with further color scales "PRECIP", "CELLS", "METEO" and "METEO-CELLS" which correspond to the multiple Classifier methods (and their meaningful mergings), currently available in IRIS/RDA.

The choice of "Uniform" has a special meaning: you can interactively select the color set, number of colors, and start and step levels. This is convenient for simple thresholding out low and/or high data values, as well as for the simplest mergings of echo classes of HydroClass.

Color Set (selectable in Uniform mode only)

Up to four named color sets are available. The color sets are defined by the system operator in the **Color Setup** utility. Typically you would define a "Default" set for positive valued data such as reflectivity; rainfall rate, TOPS, VIL, etc. You would also define a "Velocity" set to be used for data that can be positive or negative such as velocity, ZDR or SHEAR.

Levels (selectable in Uniform mode only)

Enter the number of colors to place in the scale (range 2–16).

First Level/Step (selectable in Uniform mode only)

Set the start and step values here. Note that the start value is placed into the upper edge of the first color. Control over saturation of the first and last color is taken from the Default color scale for the data type as configured in the **Color Setup** utility.

Highlight

You can highlight one particular data interval to see if that data is on your display. Enable it with this button, and push the "Edit" button to launch the **Highlight Tool** (Highlight Tool on page 237) to interactively change the highlight color.

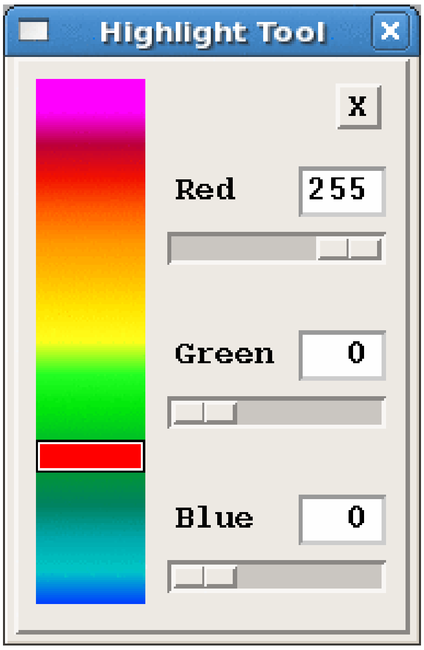
Save Your Results

Select **File->Save** to save your results.

NOTE	The results will be saved for only the Window where you are working. You cannot effect other windows. You may want to go to the other windows and make similar changes and save them.

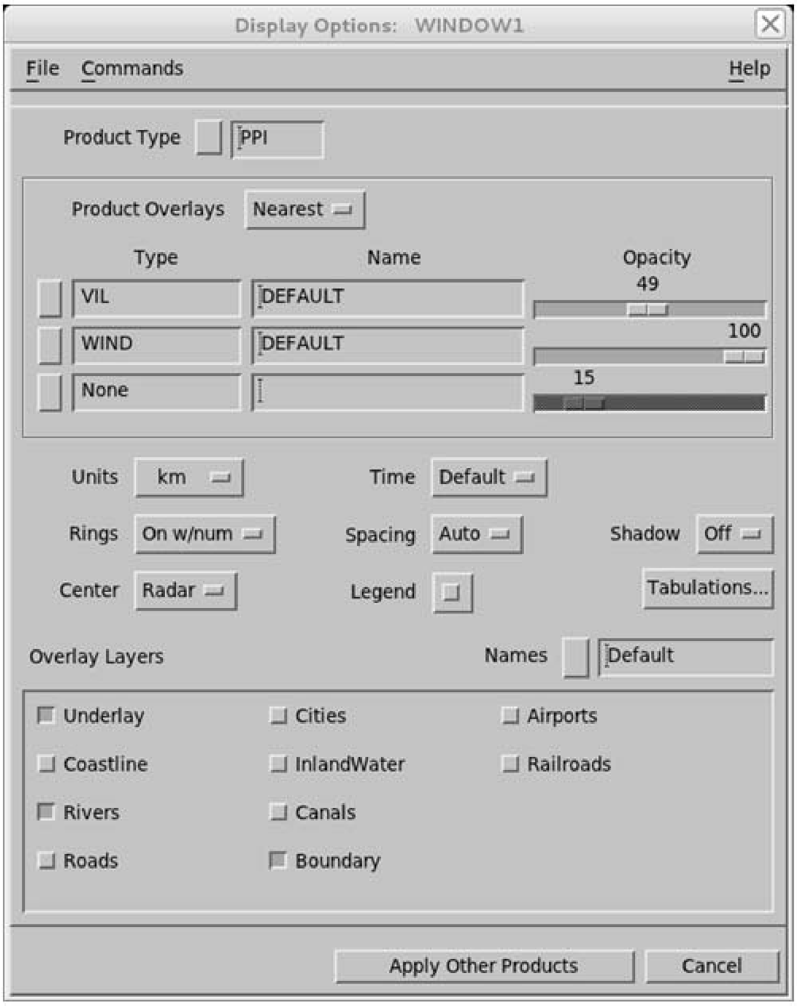
6.7.1 Highlight Tool

The **Highlight Tool**, launched from the Color Scale Tool, lets you highlight one particular data interval to see if that data is on your display. Use this tool to interactively select which color interval (from the 16 intervals in the legend). You can set the color for that interval using the color scroll bars. Those data values on the display will be shown in the new color.



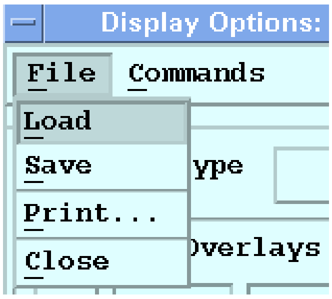
6.8 Display Options Tool — IRIS Product Output Menu

The **Display Options** tool allows you to select various components of a display such as geographic overlays, range rings, drop shadows, and even the overlay of multiple products, warning centroids, and echo tracks, along with adjusting the product overlay opacity. Click the icon to display the tool.



Saving Quick Look Window Display Options

Because there are many display options in this menu that have an important effect on the appearance of a Window, IRIS provides an easy way for you to save and recall configurations that you have made. Clicking on File provides the following choices:



Save will cause the menu current settings **FOR THIS WINDOW ONLY** to be saved. It is important to understand that when you save a configuration you are not effecting any other window, any other user or the operation of IRIS. This means that, with the permission of your system manager, you can make your own personal settings for a window without effecting anyone else.

Load will cause the current saved settings to be restored. This is convenient if you only want to make a temporary change.

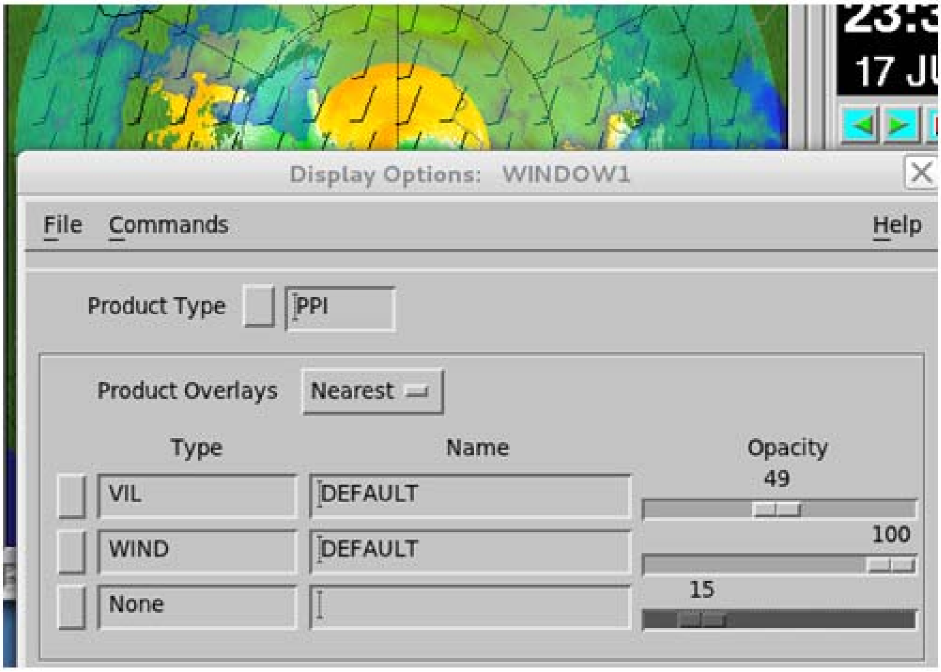
Print will make a hardcopy of the menu to the default system printer.

Selecting the Product Type

When you first enter the **Display Options** tool the product type will be inserted automatically into this field. Any changes that you make can be applied to this product type or for all product types according to the **Apply** buttons at the bottom of the menu. You can select a different product type by clicking the button.

NOTE	Important: If you are displaying a CAPPI and change the product type field shown above to say PPI, then any changes that are applied will not be reflected in the product that is being displayed (the CAPPI) unless you click "Apply All" at the bottom of the Display Options Menu.

Adding Product Overlays



The Product Overlay section of the Display Option Tool lets you combine different products together. Almost any kind of product can be overlaid on any other product.

In the example above, an interactive TRACK product has been overlaid on a PPI. Typical applications for this are:

- WARN product overlays
- WIND or NDOP (multiple Doppler) wind barb overlays
- TRACK
- SLINE (shear line).

Multiple products can be overlaid in this manner. For example, WIND and SLINE displayed together would show the wind vectors associated with a shear line.

Product overlays have time alignment options:

- Nearest — The overlay product is the nearest in time to the base product.

- Live — The overlay product is the most recent time.

It is also possible to combine two different types of image products. The example above shows VIL product with TOPS displayed underneath.

NOTE	Important: When combining two image products, it is important to select contrasting color scales to be able to separate the data. In this example a gray scale was used for the TOPS. The drop shadows on the VIL are helpful.

NOTE	If your IRIS system supports satellite IMAGE product ingest, then this is how you combine the satellite display with radar data.

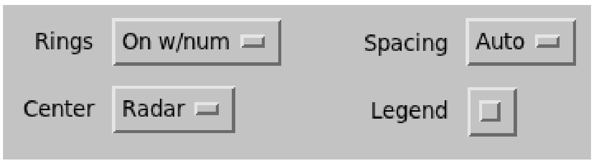
Range Units

This allows you to select range units for output displays. Choices are: either scientific (kilometers) or navigational (nautical miles for horizontal distances and kilofeet for altitudes).

Time

This allows you to select if we display UTC or local time on the legend. The time will have a "Z" suffix if it is UTC. Selecting "Default" means that we use the **setup** question to control this.

Range Rings



You can add range rings, adjust the spacing of the range rings and center the rings on predefined points (e.g. the radar or perhaps an airport. When you click on the Rings button, IRIS displays the following menu:

None — No range rings are displayed.

On — Range rings are displayed but not numbered

On W/Num — Range rings are displayed with range numbers.

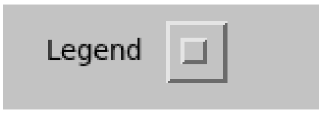
Lat/Lon — A latitude/longitude grid is displayed. In addition, the display legend for each product shows the maximum product range.

Ring spacing is selected by the button to the right (Auto in the example). This gives a pull-down list of range ring spacings. The spacings will be displayed as either km or nautical miles, depending on the units selection

The **Center** button allows you to select the center of the range rings from a list of pre-defined home points. The home points are defined in the Cursor or Track Tool.

NOTE	Note: You must have operator privilege to define home points in the Cursor or Track tools. Operator privilege for a Quick Look Window is set in the File tool by entering a password that is set in the setup/display utility.

Legend



This button causes a legend to be put into the actual image. Most customers prefer to leave this off since the Quick Look Window has a built-in legend.

If you elect to put a legend in the display, we recommend the following to optimize the Window size.:

- Use **View** to select a standard rectangular size (e.g., 880 × 720).
- Use the Legend icon  to toggle the Quick Look Window legend off.

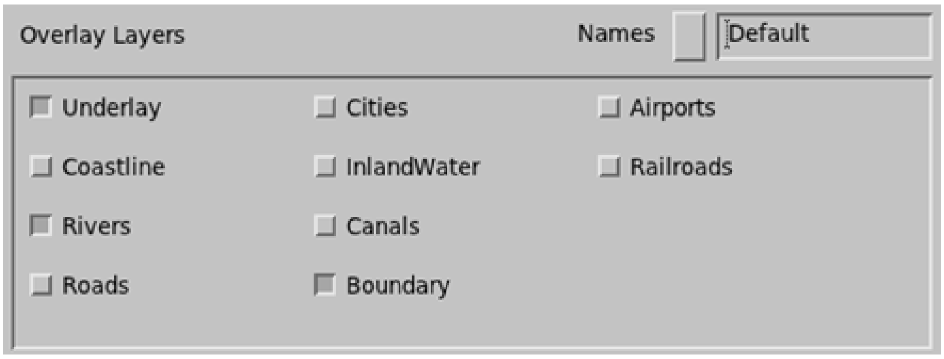
Shadow

The Shadow button lets you choose the kind of drop shadows displayed with products. A drop shadow shades weather features, making them stand out against the background as if they were clouds shaded by the sun. With this button, you can turn drop shadows off, or choose from three shadow depths.

Tabulations

IRIS overlays can contain abbreviations or numbers for important places, such as airports, city centers, etc. Pressing this button will display a pop-up menu showing the full names for the abbreviations on the screen.

Overlay Layers



Geographic overlays show coastlines, roads, political boundaries etc. See the description of the **overlay** utility in the *IRIS Utilities Manual* for more information.

The **Overlay Layers** button actually stretches the Display Options menu to include the menu shown above. IRIS overlays are usually constructed in multiple layers so that users can turn on/off the layers. After selecting some layers, hit the appropriate apply button at the bottom to see your changes take effect.

"Virtual Overlays" are simply names given to different combinations of layers. To select a pre-defined virtual overlay, simply click on the button next to the overlay name and select a new name from the list.

Operators can create "virtual overlay names" If you have operator privilege, enter your password via the Quick Look Window main **File** tool. Once you have privilege in the Window:

- Click the button next to the overlay name and select "New".
- Type in the new name in the prompt pop-up.
- Select the layers that you want.
- Use **File**->**Save** at the top of the Display Options Menu to save your result.

When you save, the Virtual Overlay Name it is shared among all IRIS windows, printers, etc. This is why it is limited to operators.

Apply Other Products, Cancel

After you make changes to the Display Options, the **Apply Other Products** applies the changes. Any changes that are applied will effect only the window that you are in. You do not have to worry about effecting other windows (and vice versa).

Apply Other Products applies the changes to all product types, again for your window only. **Cancel** exits the menu without making any changes.

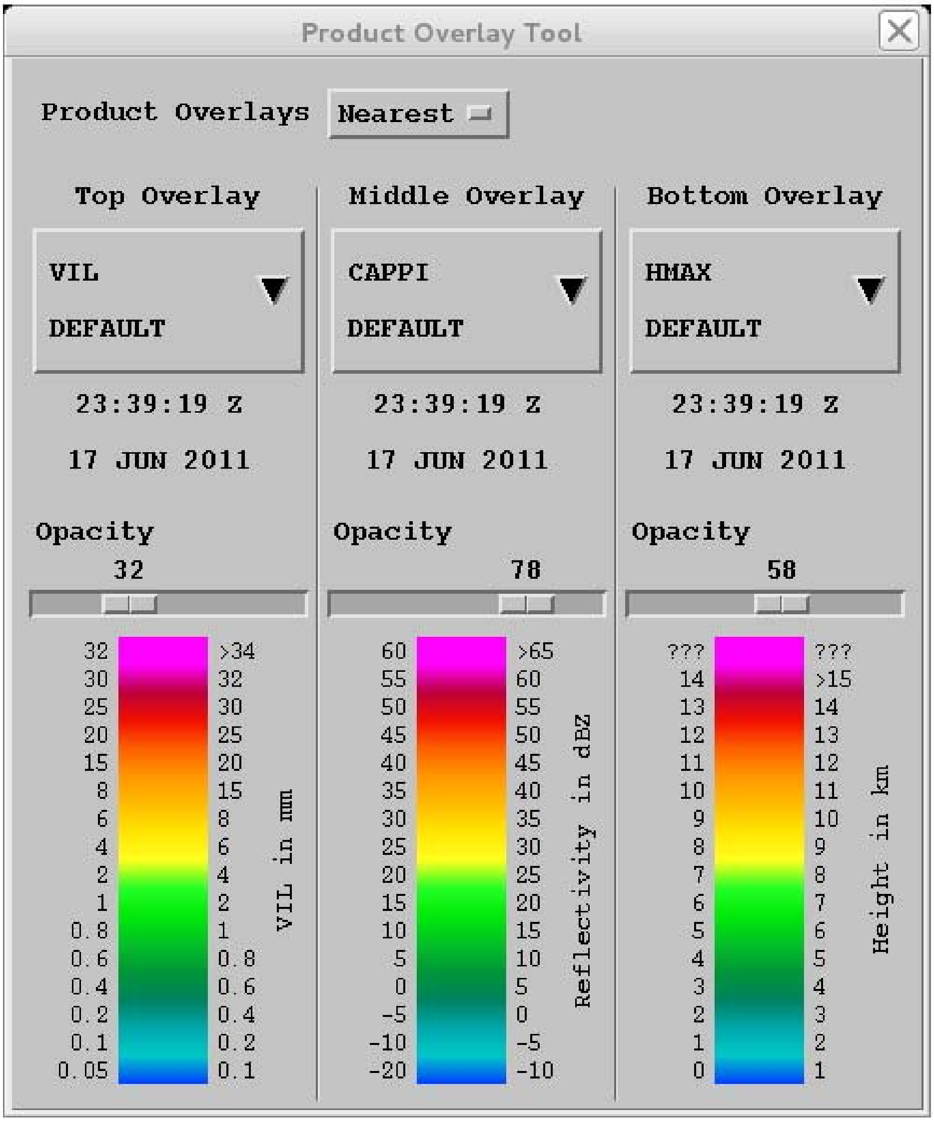
NOTE	Pressing any button and auto apply applies your changes to the current product type for your window only.

6.9 Display Options Tool — Quick Look Window

The **Display Options** tool allows you to select various components of a display such as geographic overlays, range rings, drop shadows. Click the icon to display the tool.

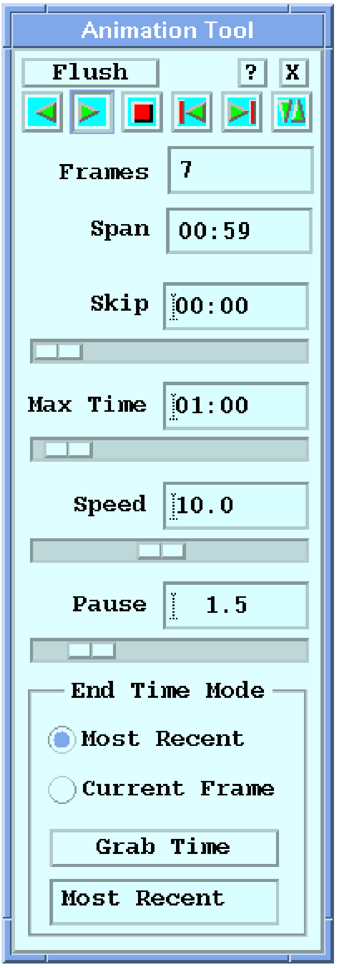
6.10 Product Overlay Tool — Quick Look Window

The **Product Overlay** tool allows you to overlay multiple products, warning centroids and echo tracks, along with adjusting the product overlay opacity. Click the icon to display the tool.



Selecting the Product Type and Product Name

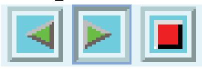
6.11 Animation or Loop Tool



Overview

Animation is one of the best ways for forecasters to observe the motion, growth and decay of radar echoes. In real time applications, many IRIS users leave a loop running constantly. Additionally, the **Slide Show** tool (see Slide Show Tool on page 253) can be used to automate the display of different products from different times. The **Animation** or **Loop** tool provides control of the animation sequence. In addition, loop/browse control buttons are also provided in the **Legend** area so that they are always hand for image manipulation. This section describes the various animation features in IRIS.

Loop Start and Stop Buttons



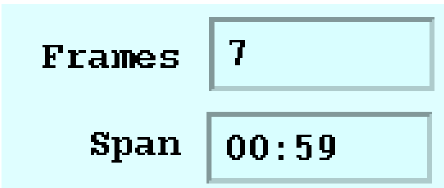
These buttons are available in the Loop tool and in the Legend area. The functions are:

- Right arrow to start the loop in forward play mode.
- Left arrow to start the loop in reverse play mode.
- Left and right arrow to start the loop in swing mode (forward then backward).
- Red square button to stop, although clicking on a depressed button loop button or on the single step or toggle buttons will also stop the loop.

NOTE	Keyboard Tip: SPACE BAR will stop a loop or start it in the forward play direction. The cursor must be in the image area of the loop for this to work.

NOTE	Automatic Site Filtering: When a loop is started, the Site filter will automatically be set to match the loop so that only images from the site (for which the loop was started) will be displayed.

Loop Loading and Status



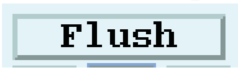
When a loop is loading, it will show haw many frames have been loaded and how many total frames are available (29/30 in the example). The loop will start playing immediately, even while it is loading so that for very long loops of say 100 frames, you do not have to wait for the loop to be fully loaded before it is playing at loop speed. This "looping while loading" slows down the load process a little, but for long loops it is much better for the user.

After the loading is complete, a single number, in the example it would be 30, indicates the number of frames in the loop. The time span of the loop is also shown. This is the *actual* span of the frames in the loop as opposed to the Max Time that is requested.

There are several factors that determine the number of frames in a loop:

- **Device Movie Length** and default window size as configured in setup/output. If your window size is the same as the setup/output default size this is the maximum number of frames you will ever expect to see. If you reset your window size to be smaller than the default size, then you will get more frames, since the same amount of memory is allocated for movies. Likewise, if you set you window size to be larger than the default, you will get fewer frames.
- **Max Time** (see below) determines the maximum possible span of the movie. This will limit the number of frames.
- The number of frames that are available on disk. This is easy to check by looking at the **Time** icon.

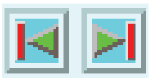
Flush the Loop Buffer



The loops are "sticky"– the frames are all kept in a loop buffer so the loop does not have to reload if it is stopped and restarted. This is a great convenience when you are working with long loops.

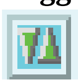
If you make a change to the window such as the color scale or the Display Options, the buffer will automatically "flush" so that the loop will be forced to reload with your changes. SIGMET has tried to anticipate every action that might require a loop to be flushed and reloaded, but in case we haven't or your loop buffer somehow becomes corrupted, you can use the manual Flush button to refresh the buffer. The loop will then reload the next time that it is started.

Previous/Next



These buttons allow you single step forward and back through the loop. This is nearly identical to clicking in the **Time Slider** or using the left/right arrow keys on the keyboard (with your cursor in the image area).

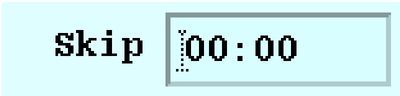
Toggle Button



The Toggle button swaps between the current image and the previous image on the display, regardless of the image type or time. Sometimes this is useful for comparing two different products (e.g., TOPS and VIL). Display both products, then use the Toggle icon to alternately display one, then the other.

NOTE	Hint: It is very convenient that when the cursor is used, the position will be displayed correctly in the two toggle frames, even if their scales are radically different.

Skip Time

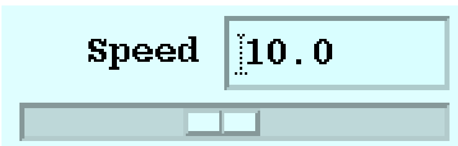


If you want to loop a long time series of data, say 24 hours, it is usually necessary to skip some frames so that you can display the entire 24-hour span without exceeding your **Device Movie Length** for the maximum number of frames. Specify the time skip in HH:MM. If you specify 01:00 (one hour) then a 24 hour movie will have 24 frames. The skipping algorithm will attempt to show the frames that are exactly on or as close as possible to intervals of the skip time. In the case of a one hour skip time, the frames would be on or as close as possible to just after the hour.

Max Time

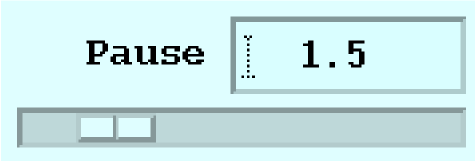
This is the maximum time span that will be allowed. You may not be able to achieve this since there may not be sufficient frames on the disk or you may be limited by the Device Movie Length frame/memory limit as configured in **setup/output**. The actual time span that you achieve will be displayed in the **Span** field.

Speed



This is the requested speed in frames per second. Faster is to the right, slower is to the left. Whether you will be able to achieve a speed will depend on the speed of your CPU, the amount of memory that you have and the size of image that you are looping.

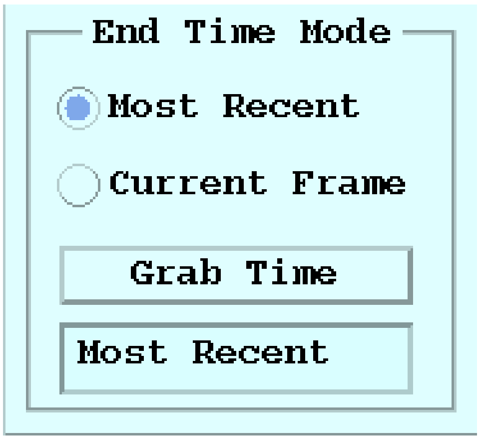
Pause



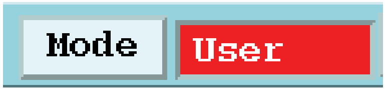
This is the pause in seconds between successive loops. Aside from marking the end of a loop, Pause gives the computer a chance to rest and do other things. For example, setting a very short pause of 0.0 sec will run the loop continuously, but the computer will be busier. Other tasks such as loading the loop will take longer, so use common sense. If your computer seems too busy, then lengthen the pause. The 1.5 second default value is a good compromise.

CAUTION	Caution: High-speed loops of large images place a greater demand on both CPU and memory. By running several large format loops at high speed with no pause, you can use near 100% of your CPU and memory depending on your system hardware configuration. So be careful and consider the other things that you may be asking IRIS to do on your system such as product generation and data acquisition from the radar. The default values for Speed and Pause are reasonable starting points.

Setting the Loop End Time



Usually the last frame in the loop is set to be the **Most Recent** picture. In this case, new data are added automatically to the loop. This allows you to leave a loop running on a display so that you can always see the current situation. Note that when the loop end time is set to most recent (the default), the Mode Indicator at the top will show:



The green background behind "User" indicates that the display will automatically update with new images.

The **Current Frame** and **Grab Time** options allow you to fix the end time for occasions when you want to create loops that do not end with the most recent image, e.g., for analysis of archive data from last year.

Current Frame mode sets the loop end time to be the time of the image that is currently in the window when the loop is started. Simply browse through the images until you decide what frame should be the last frame and then start the loop. The loop will end on the frame that you selected. This is very handy for analysis. Remember that, as you start and stop loops in this mode, the end time is not fixed- it will be readjusted every time that the loop is restarted.

Grab Time allows you to select a specific time for the end of the loop. Simply brows through the images until you find the image that you want to be the last frame and click **Grab Time** to latch this time. Even if you change product types, any loops started will use this as the end time.

For **Current Frame** and **Grab Time** the loops will not update automatically so avoid leaving the displays in these modes since it could confuse other users. To indicate that the loop does not reflect the most recent data, the Mode will show a red indicator background color.

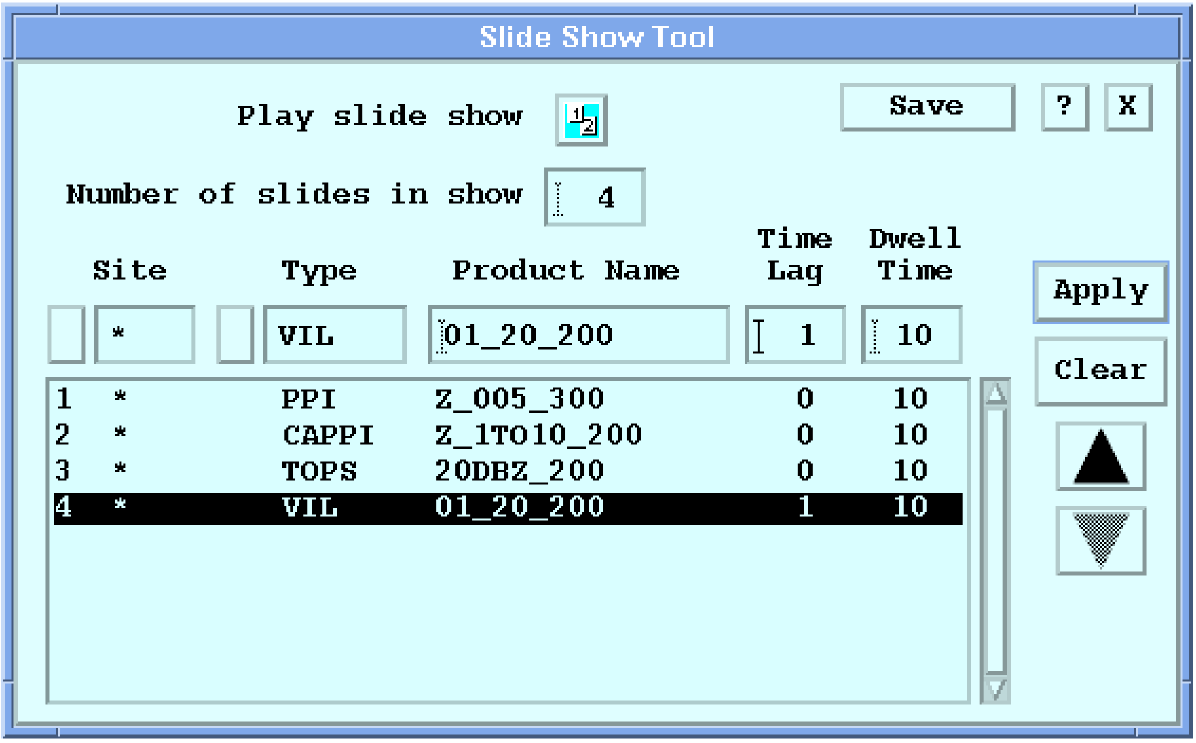
6.12 Slide Show Tool

Overview

The Slide Show Tool provides another method for forecasters to observe the motion, growth, and decay of radar echoes. The slide show tool is capable of displaying different products from different times, while the animation tool is limited to a linear time sequence of one product. For example, in the following screen shot, different 4 slides of different products will be shown in the QLW for 10 seconds. Additionally, multiple windows can be configured and coordinated so that images in different windows change at the same time.

NOTE	Tip: For multiple window presentations it is convenient to use setup/output to configure the start-up window location, window size, and legend on/off.

The **Slide Show Tool** defines the characteristics of a slide show. Click on the slide show icon to display the tool.



First, enter the number of slides in the "Number of slides in show" field. IRIS will then insert the specified number of blank rows into the slide list. At this point, each slide (1–4) must be populated with information about the product that it will display. The user specifies the data for each slide by clicking the slide number (or row), specifying the desired information (site, type, product name, time lag, dwell time), and then clicking apply. Incorrect slide information can be cleared by selecting the slide number (or row) and clicking the clear button. Additionally, slides can be moved up or down by selecting the slide number (or row) and clicking the up or down arrows. Once the slide configurations are complete, click save and then click the "Play slide show" button to start the show. The following section describes the slide show tool options in detail.

Play slide show

A slide show can be started in two ways. The operator can either choose to click play slide show button from within the slide show tool or by clicking the slide show button in the **Legend** area.

Number of slides in show

This field determines the number of slides in a show. The largest number of slides in a show is 16.

Select Product Type and Name

These pop-up menus allow you to select among products that are actually on the disk. If there is no product of the type that you want (perhaps it hasn't been made yet), then you can select the blank product name "———" and simply type-in the name you want. Once the product is transferred to your disk, it will be displayed in the slide show.

Time Lag

This field specifies the version of the product according to the following rules:

- 0 The current (most recent) version of the product.
- 1 The previous version of the product, i.e., the second most recent.
- 2 Two products prior to the current version, and so on ...

This feature enables the comparison of different versions of products. In a multi-window environment, the newest version of a CAPPI product could be displayed along side a CAPPI product from the pervious hour.

NOTE	Tip: If you want to make a single step time sequence, simply enter the same product type and name for each slide and then specify 0, 1, 2, ... for the lags.

Dwell Time

This field specifies how long the slide is displayed on the screen, before sequencing to the next slide. In the example menu, each slide is displayed for 10 seconds.

Explanation of Dwell Time Algorithm

The dwell time not only defines how long a slide is on the screen, it also defines a precise clock schedule of time slots for displaying the slides, i.e.,

- Slide 1 Displayed at Midnight 00:00:00
- Slide 2 Displayed at 00:00:00 plus the Slide One Dwell Time.
- Slide 3 Displayed at 00:00:00 plus the Slide 1 and Slide 2 Dwell Times
- etc. ...

The schedule simply increments throughout the day. Note that a slide show can be started at any time, but the time slots are defined by the above algorithm. This allows users to configure multi-window slide shows where the images in different windows all change at the same time and in the proper sequence.

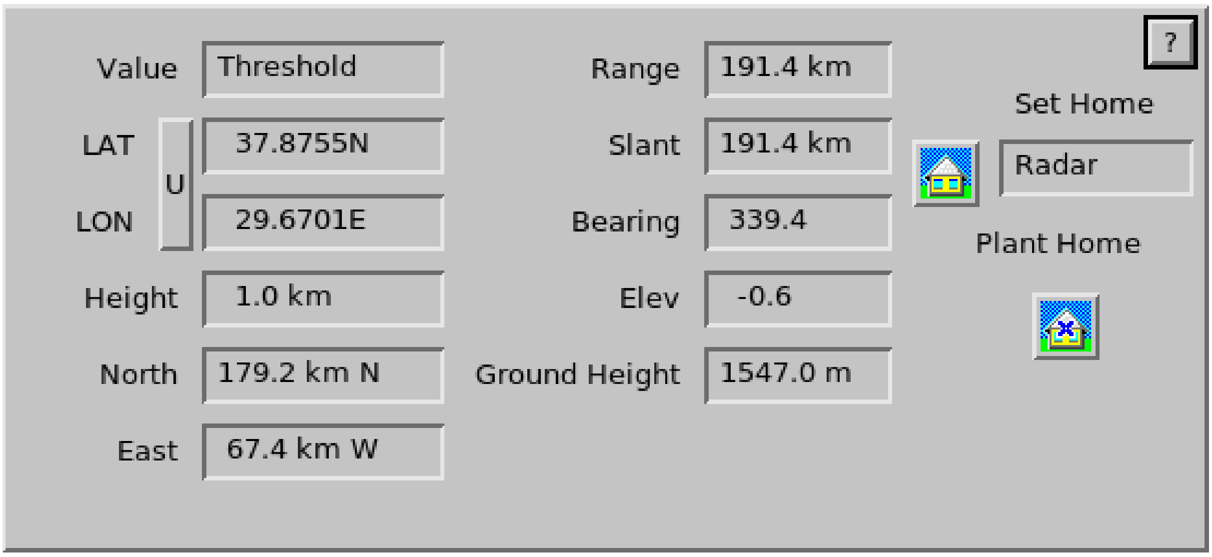
Recommended Uses

A good application is for a weather briefing display for which there is no operator/observer control of the display.

6.13 Cursor Tool

The **Cursor** tool is used to show the value of data at a point and the geographic position of the point. In addition, the position of the cursor relative to another "home" point (range and bearing) are displayed. The "home" point can be selected from a pre-defined list which always includes the radar, or it can be "planted" interactively by the user.

Click the **Cursor** icon to display the tool.



You can now move the cursor in the display by clicking your mouse, or dragging the cursor. The values in the menu will update "live" as you move the cursor.

You can use cursor with other tools such as the Loop tool. However in some cases, Track for example, the mouse is reserved for other functions. You can still get readouts from the cursor tool by displaying it first and then selecting **Track**. The cursor will not be displayed on the screen, but the readouts will properly reflect the values where you are pointing.

Value

This shows the value at the current position. The units are the same as those displayed in the image.

Latitude and Longitude

These fields show the latitude and longitude of the position to the nearest tenth of a minute. The "U" toggles the units between decimal degrees and degrees and decimal minutes.

Height

This field shows the height above the curved surface of the earth at the cursor position. The units are either km or thousands of feet depending on the setting of "Units" in the **Display Options** tool in Display Options Tool — IRIS Product Output Menu on page 238.

Not all displays have a height– VIL for example. In these cases a value of "0.0" is displayed for height.

North

This field shows the north– south distance from the "home" point to the cursor position. The units are either km or nm depending on the setting of "Units" in the **Display Options** tool in Display Options Tool — IRIS Product Output Menu on page 238.

East

This field shows the east– west distance from the "home" point to the cursor position. The units are either km or nm depending on the setting of "Units" in the **Display Options** tool in Display Options Tool — IRIS Product Output Menu on page 238.

Range and Slant Range

Range shows the range along the curved earth's surface relative to the "home" point. This is usually set to be the radar. Slant Range shows the range along the radar beam. The units ar either km or nautical miles depending on the setting of "Units" in the Display Options tool in Display Options Tool — IRIS Product Output Menu on page 238.

Similar to the Height field, not all displays have a slant range associated with them since there may be no elevation angle associated with the product. Again, VIL is a good example. In these cases, slant range is displayed as 0.0.

Bearing

This is the bearing in degrees from the Home point to the cursor as measured clockwise from true north.

Elevation

For products that have an elevation associated with them, this displays the elevation angle from the home point to the cursor. Any product that has a "height" will also have an elevation (e.g., PPI and CAPPI).

If the Home point is relative to the radar than the elevation is really the elevation angle of the radar. If the Home point is not the radar, the elevation is not the elevation angle of the radar, but rather the elevation angle that an observer at that point would observe to see the cursor at its height.

Ground Height

This displays the height of the ground above sea level at the location of the cursor.

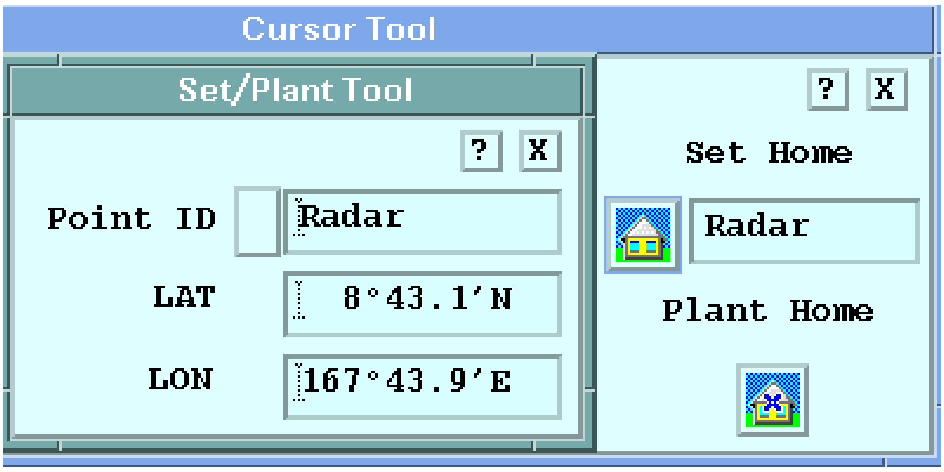
To use this feature Digital Elevation Model (DEM) data in GeoTiff format should be added in the */usr/sigmet/dt* directory with a filename of *dem.tif*. The DEM data should be made to cover the geographical domain scanned by radars within the network. A suggested location to obtain good quality DEM data in GeoTiff format is: http://srtm.csi.cgiar.org.

Selecting and Planting Home Points

The ability to define home points allows you to easily measure the position of a weather radar feature relative to a selected location. For example, "Thunderstorm located 120 km at 260 degrees from the airport."

There are two ways to define home points while in the Cursor tool:

- **Plant a Home point**- Use your mouse to position the cursor and then click the "Plant Home" icon. The Home point, indicated by the "X" symbol will move to the cursor.
- **Select a pre-defined Home point**- Click on the "Set Home" icon to display the Set/Plant tool as shown below. Click on "Point ID" and then select the Home point from the list of available names.



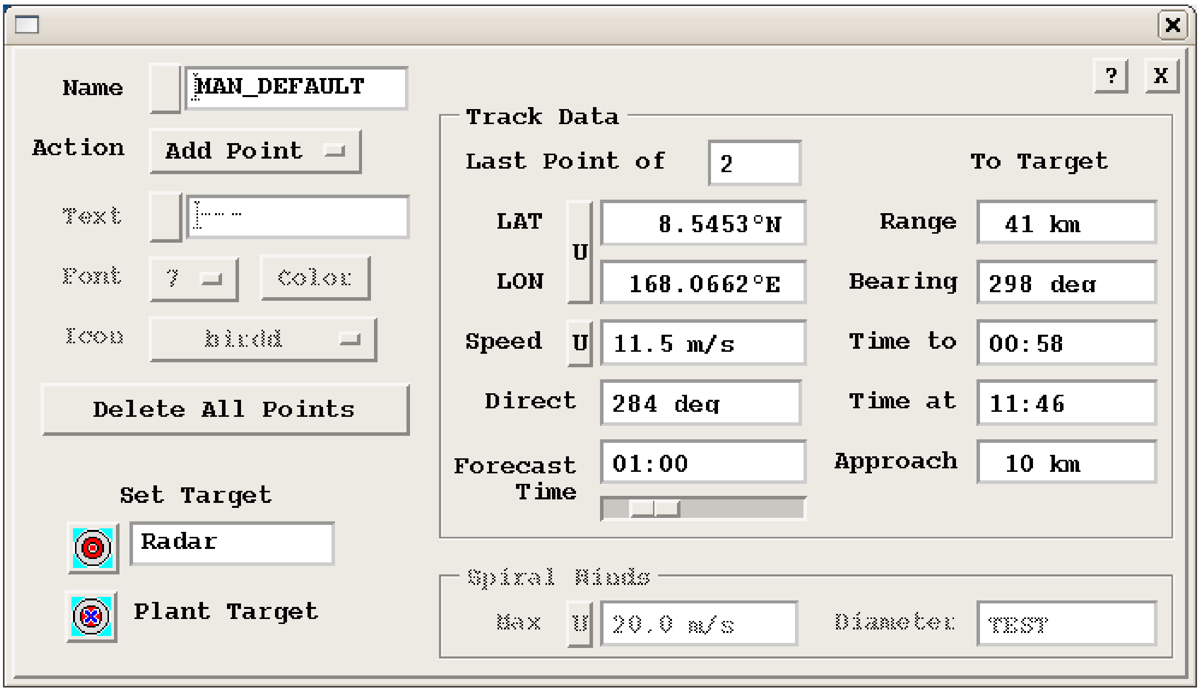
Creating Named Home Points (Operators only)

If you have operator privilege in the window (**File->Set Privilege to**), you can use the Set/Plant tool to make new named points for key locations. There are two ways to do this. First enter the Set/Plant Tool by clicking the "Home" icon.

- **Type-in Method**- Enter the LAT/LON of the home point and the name of the home point. Then click the Point ID button and select Save. You can type-in the LAT/LON using either degrees and minutes or decimal degrees.
- **Cursor Plant Method**- Position your cursor where you want to place the home point and then click the Plant Home icon. Now click the Set Home icon and the LAT/LON will be filled-in for you. Simply replace the text "Plant" with the name that you want, click the Point ID button and select Save.

To delete a home point name, first select the point (using **Point ID**) and then select "Delete" in the **Point ID** menu. The Radar will be used as the home point until you select another one.

6.14 Track/Annotate Tool



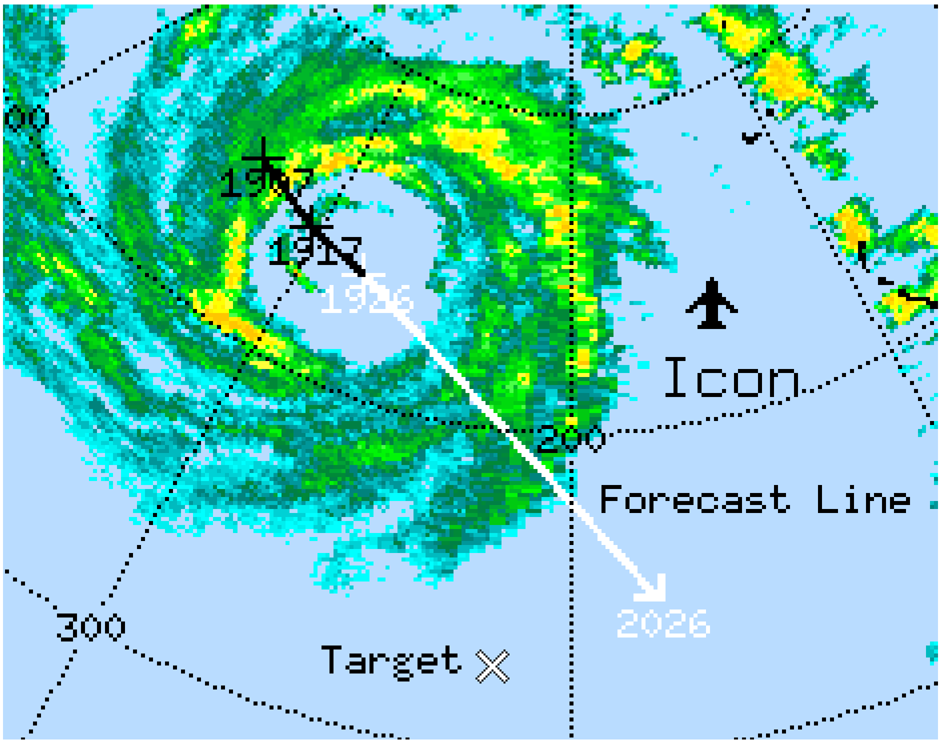
The Track/Annotate tool makes it easy for forecasters manually to:

- Make and edit interactive storm tracks.
- Determine time of arrival, time to arrival and distance of closest approach to a selectable "target" point (similar to a home point in the cursor mode).
- Add annotation text in various font sizes and colors.
- Add bit-map icons of various types and colors.
- Determine the center of a typhoon spiral

The general layout is shown above. The menu is divided into two basic sections:

- The left side contains the control of the next "Action" of the cursor. The selection of the forecast target point is also made here.
- The right side contains the track and forecast information, such as the position of the most recent track point and the distance, bearing and time of arrival from the most recent track point to the selected target point.

These are described in detail below.



Example of Track Points, Icons and Annotation

The elements of a track are shown in the example above.

- **Track Points** are indicated by the "+" with the time displayed beneath each one. Note that the latest track point at 1926 is highlighted since this corresponds to the frame that is currently displayed.
- **Forecast Line** or arrow shows the expected position of the echo, in this case, in 1 hour. This line is also displayed in the highlight color to distinguish it from the track line.
- **Icon** in this case is an airport symbol.
- **Annotation** examples are the text "Icon", "Target" and "Forecast Line".
- **Target** for the forecast is indicated by the "X" symbol. This is used for forecasting the time of arrival at a position.

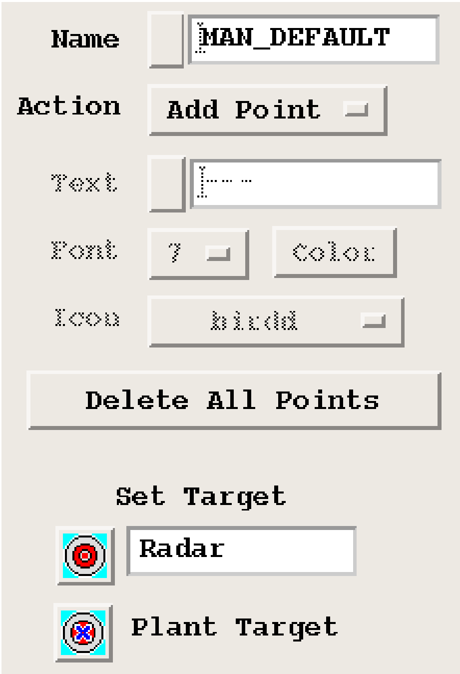
Naming a Manual Track

The Track Name field shows the name of a manual TRACK product. The names are always preceded by **MAN_** to indicate that these are manual tracks rather than automatic TRACK products that are created by IRIS.

To select an existing track name, click on the button next to the name field and select from the list of pre-defined names. There will always be a track with the name MAN_DEFAULT.

To create a new name replace the text in the name field. It is not necessary to type the "MAN_"– IRIS will add this automatically. The name will also be converted to upper case.

To delete a name, first select the name you want to delete, then click the selection button again and choose "Delete". The name will be deleted from the list and the MAN_DEFAULT will be inserted as the active track.



Starting a New Track

- Select an existing track Name or type in a new name.
- Press the "Delete All Points" to start a fresh track. After you do this, the menu will show "Last Point of 0" to indicate that all points have been removed and the Action will show "Add Point".

Adding Points to a New Track

- First select a product for tracking. For example, if you want to track the most severe thunderstorms you might choose VIL since it is a good indicator of storm severity and tends to be persistent.
- Browse through the images to select a feature and then click the cursor on the feature. A track point will appear along with text to indicate the time of the point. The color of the track point will be in a special highlight color to indicate that it corresponds to the image that is being displayed.

- If you do not like the position of the track point, just click again and it will be moved to the new cursor position. You can drag the point to where you want it, and release to commit.
- Continue to browse through the images and add track points.

NOTE	Hint: To avoid crowding the track points, skip a few images. You do not always need a point for every image.

NOTE	Hint: The left/right arrow keys are very useful for browsing when you are in track mode, since you are using the mouse for adding track points.

Moving Track Points

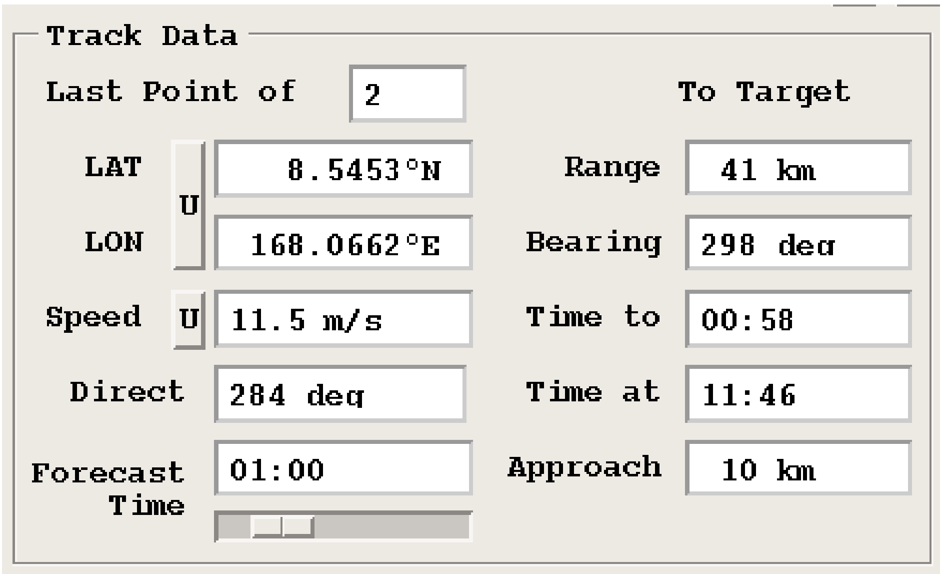
- If you want to change the position of a track point, browse through the images to select the time of the track point that you want to move (it will be shown in the highlight color when the image time matches the track point time).
- Click on the new track point position.

Deleting an Individual Track Point

- Select **Action**->**Delete**.
- Click on the track point that you want to remove.

NOTE	Hint: If you keep the mouse button depressed, the point to be deleted will be highlighted. This is helpful when you want to delete a track point that is very close to other track points.

Track/Forecast Information Fields



The center column of the Track tool shows information about the track you are constructing. The information in the example above is taken from the track example displayed at the beginning of this section.

- **Last Point of <N>** — N shows the number of track, annotation and icon points that have been defined.
- **LAT/LON** — shows the latitude and longitude of the last track point, i.e., the most recent data time. The "U" button allows you to toggle the units between decimal degrees and degrees and decimal minutes.
- **Speed and Direction** — shows the speed and direction of the weather feature as computed from the two most recent track points. The "U" button for speed allows you to select among various common units.
- **Forecast Time** — allows you to set the time of the forecast. This controls the length of the forecast arrow.

Target Information

The "Target" is a geographical position that you use for forecasting purposes. For example, the target might by positioned at an airport or urban area. The default target position is at the radar site, but you can select the target from a list or plant a target with your cursor, similar to home points in the cursor menu.

The list of Target points is the same as the list of Home points. These can only be saved or deleted by the operator. Please refer to the Cursor tool section for details (Cursor Tool on page 256).

Once you have set your target, the target information will show:

- **Range and bearing** to target from the most recent track point. In the example, the target bears 118 degrees and 19 km.
- **Time to** (target) is the time to the closest approach of the track to the target.
- **Time at** is the clock time of when the echo will make its closest approach.
- **Approach** is the distance of closest approach as measured from the track line to the target.

Adding and Editing Annotation Text

- Select **Action**->**Add Text**.
- In the text field, either type-in the text that you want or use the button to select an existing text string that has been saved.
- Select the Font and the Color of the text.
- Position the cursor where you want the text to appear and click. The cursor will show you a few preview characters in the selected font and color so you can decide before you click if the text is OK.
- If you need to delete, edit or move a text string, Use **Action**->**Delete** and then click on the text string to delete it. Now you can add the edited text.

Adding and Deleting Icons

To add an icon such as an airport symbol, thunderstorm symbol, etc.,

- Select **Action**->**Add Icon**
- Use the Icon button to select the type of icon. Usually the name will suggest what the icon is.
- Select the icon color using the Color selection button.
- Position the cursor (now shaped like your icon) on the screen and click.

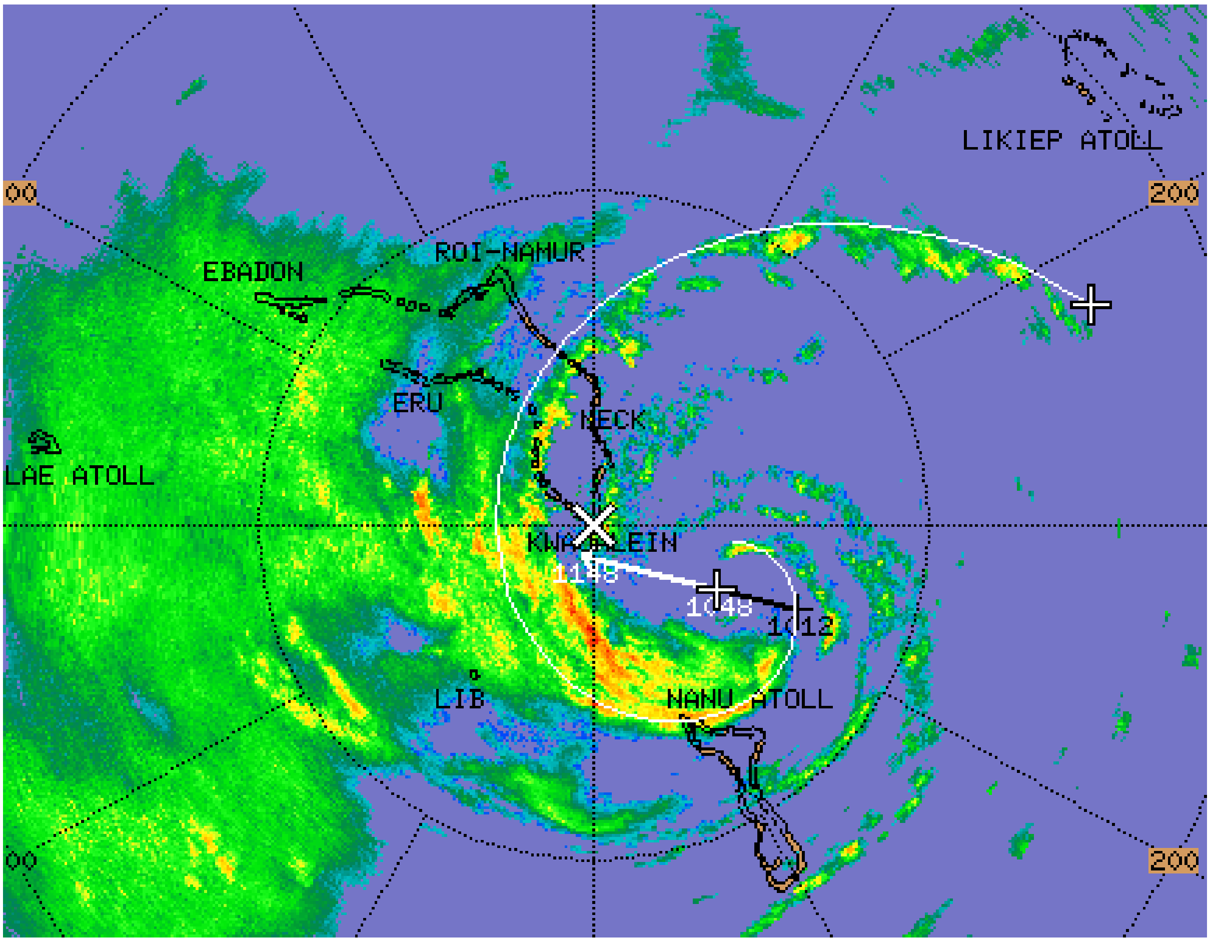
To delete an icon select **Action**->**Delete** and click on the icon to be removed.

Creating New Icons

Icons are .xbm format bit-mapped icons which are stored in the /usr/sigmet/config/overlay directory. You can create your own icons using programs such as paint (on a PC), kiconedit (on a Linux system). To get you started, Vaisala provides several sample icons.

Tracking Typhoons using the Add Spiral option

This mode allows the forecaster to determine the location of a typhoon center, and to calculate the maximum rotational winds. It is possible that the center is out of range of the radar scan, but by lining up the spiral line with the observed data, it might still be possible to determine the center.



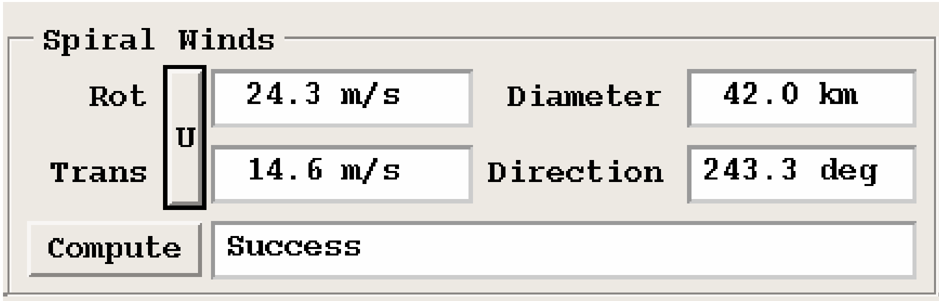
Example of Typhoon Spiral Track

The elements of a typhoon track are shown in the example above.

- **Spiral Band Line** is drawn on the display. You can drag the center point to change the location, or drag the end of the spiral to change the rotation. The goal is to line up the drawn spiral with one of the rain bands.
- **Typhoon Track Points** are indicated by the "+" with the time displayed beneath each one. Note that the latest track point at 1048 is highlighted since this corresponds to the frame that is currently displayed.
- **Forecast Line** or arrow shows the expected position of the eye, in this case, in 1 hour. This line is also displayed in the highlight color to distinguish it from the track line.

- **Target** for the forecast is indicated by the "X" symbol. This is used for forecasting the time of arrival at a position.

Calculating the maximum winds



The IRIS QLW includes a wind model in which it looks at the data, and finds the best fit of a rotation about the center point, plus a mean horizontal translation. In this portion of the Track/Annotate Tool, we display the diameter of maximum wind on the right, and the wind speed at that diameter next to it. Below that we show the average translation speed and direction. This requires a lot of CPU to do, so we only run it when you push the "Compute" button. The text box to the right of the "Compute" button shows the status of this calculation.

It is necessary that you have the polar velocity data on your serving machine for this to work. If you do not, we will desensitize the "Compute" button and display the reason next to it.

Whenever you move the spiral location, the status will display "Repositioning Spiral". This remains until you push the button. In this case, it will display "Fitting winds", and finally "Success". It can take up to a minute to do the fit.

There are a number of possible errors in the fit. One example is if the weather is clear, and there actually are no velocities in the data. In this case, it will display "Error: 0 velocity points". Also, the fit might fail to be solvable. In this case it will display "Error: Bad fit".

If you try to fit a cyclonic motion to a data set which is not rotating, you will get not-very-useful numbers such as a small rotation speed at a large range. Also the radar is not capable of detecting rotation about the radar, so if you place the cursor within a few km of the radar, the numbers will be invalid.

Configuring a Spiral

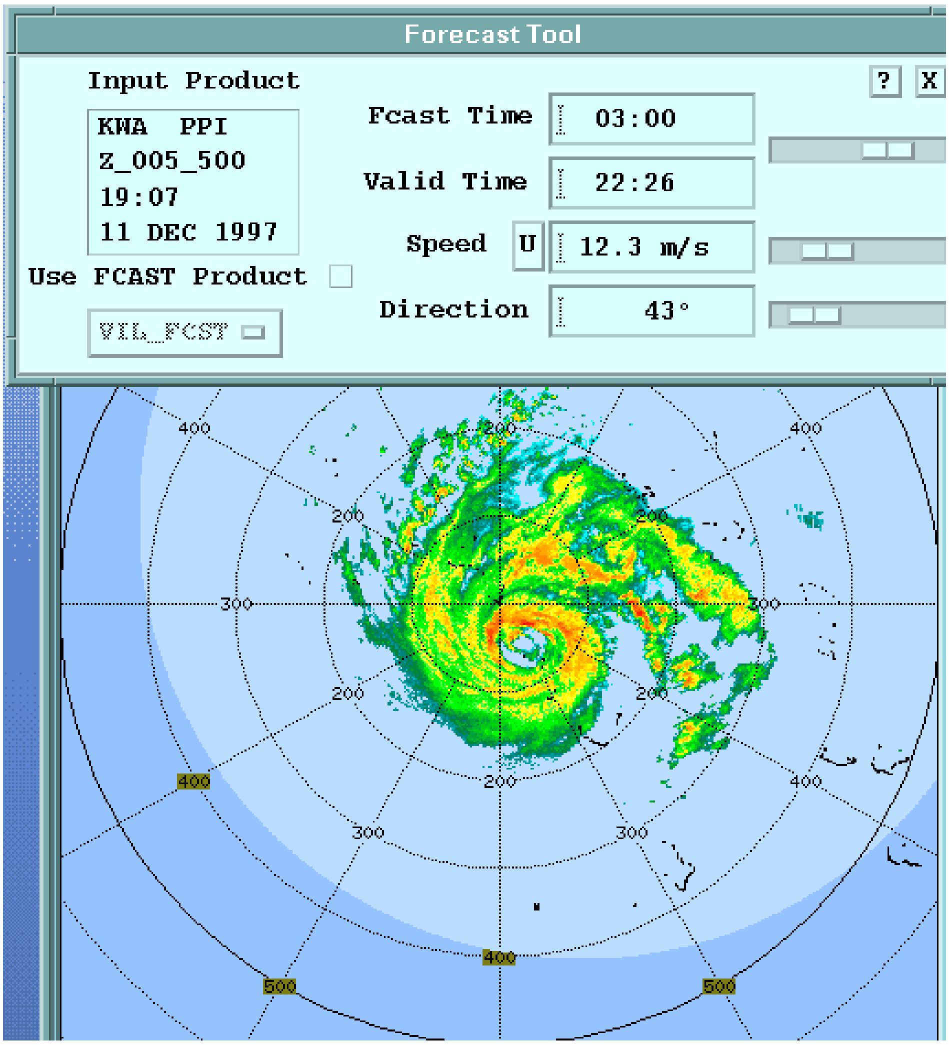
To change the tightness of the spiral line, use the Angle widget, and increment the angle up and down from 5 to 20 degrees. This is the angle in degrees that the logarithmic spiral makes to a circle. So a smaller number makes a tighter spiral.

Set the direction of cyclonic motion at your location to CW or CCW using the Rotate selection widget.

Set the minimum and maximum displayed range of the spiral using the Range type in fields.

6.15 Forecast Tool

This tool is used to shift products "into the future" to see the forecast position of weather features. An example is shown below for the case of a typhoon.



The dark outer region represents the area not scanned, while the inner lighter circle represents the area that was scanned. In the example, the radar image is shifted three hours for an assumed motion of 24 knots at 43 degrees.

There are two ways that the image can be shifted:

- **User Input** - the forecaster inputs a speed and direction as was done in the example.
- **FCAST Product**- an IRIS Forecast product or user Forecast product can be used.

In the case of the user input, the echo is shifted by a constant speed and direction. This is shown in the example above.

If a Forecast product is used, then the echoes can be subjected to both a non-uniform motion field and a non-uniform intensity change field. Forecast products can be produced either by IRIS or by external programs that create forecast products and insert them into IRIS (User Product Insert or UPI).

The IRIS Forecast product computes a uniform wind field based on the average echo motion as calculated from a 2D cross-correlation of the current and previous image. No intensity change is calculated. Check with your system manager to see what Forecast products are available on your system.

User Input Forecast

Suppose that you have obtained a nominal speed and direction from the manual track product. To do a manual forecast projection:

- **"Use FCAST Product"** button should be clicked out.
- **Speed** and **Direction** are set manually by type-in or slide pot.
- **FCAST Time** is set to how far ahead you want to look.
- **Valid Time** displays the time at which the forecast will be valid, i.e., the data time of the display plus the **Forecast Time**

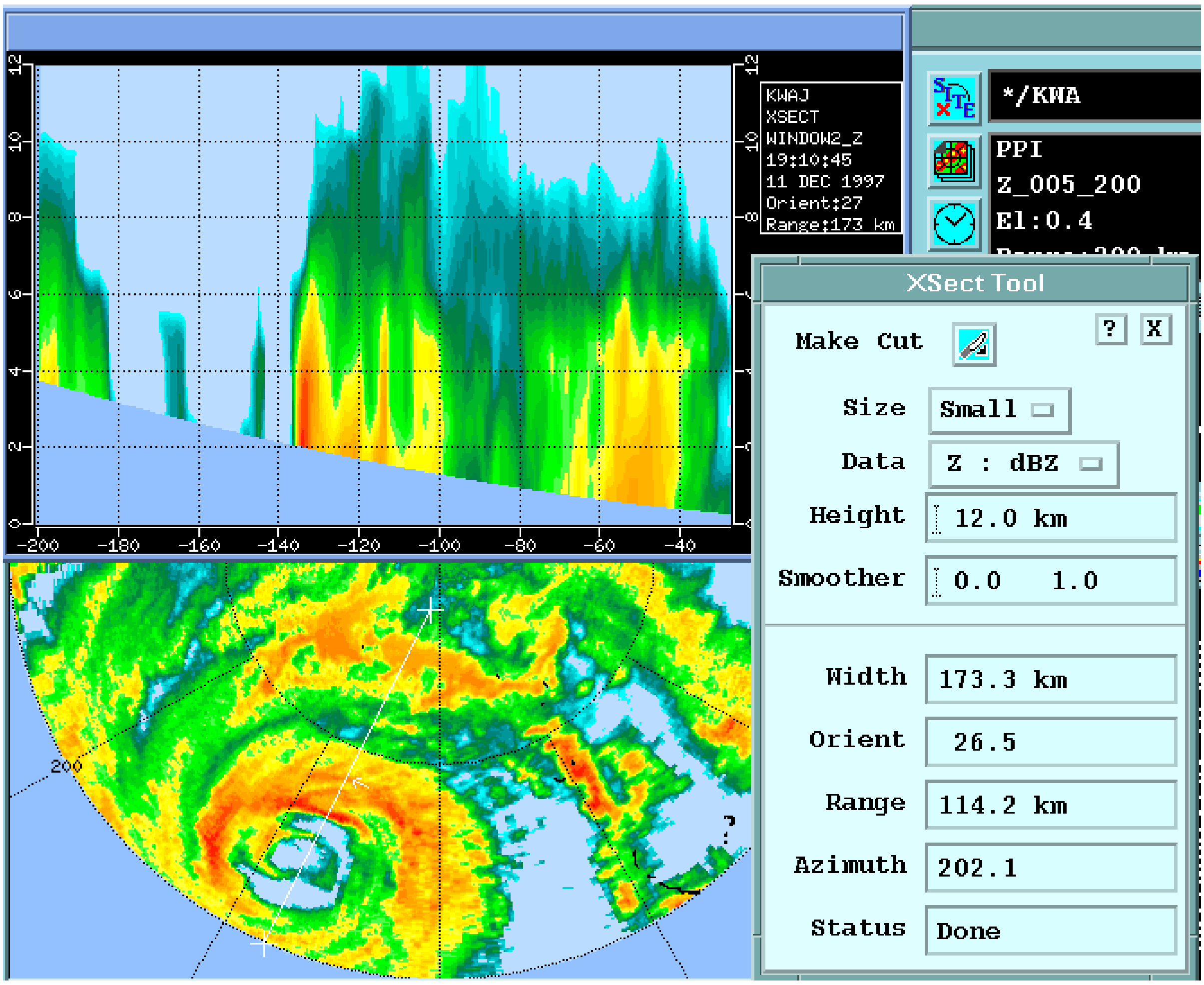
FCAST Product Forecast

- **"Use FCAST Product"** button should be clicked in.
- Select the forecast product, if any are available, from the option widget.

In this case the speed and direction will be taken from the forecast product and the user input fields are desensitized.

6.16 Cross-Section (XSECT) Tool

The interactive cross-section is one of the best ways to see storm structure and echo heights. An example through a typhoon is shown below.



The window at the top left is a small format XSECT window. This appears automatically when you make a cross-section. Note that the radar cannot see all the way to the surface of the earth, hence the curved boundary at the bottom of the cross-section.

The cross-section line is shown on the display. The small arrow at the center of the line shows how your eye will view the cross-section. In this case the cross-section is viewed from the east through the eye of the typhoon.

The XSECT tool is shown at the right of the example. This allows you to configure nearly all aspects of the cross-section.

When you make a cross-section, select an appropriate "base" product. Note that products such as RAIN1 and RAINN cannot be used for a cross-section since they do not represent a specific time.

Click on the XSECT tool (the icon with the cutting knife) and then use the mouse to position the endpoints of the cross-section line. Configure the cross-section menu and then click the XSECT icon in the menu to make the cut. The status of your cross-section progress is shown at the bottom. In a system that is not busy, the cross-section is generated in about 1–3 seconds depending on your particular workstation speed.

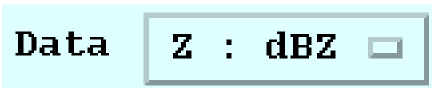
NOTE	Cross-sections are generated by interpolation of the original polar data. Therefore to make a cross-section, you must have ingest files from the signal processor or from RAW data on your system. If the window is exported from another system to your screen then that system will need to have the ingest files.

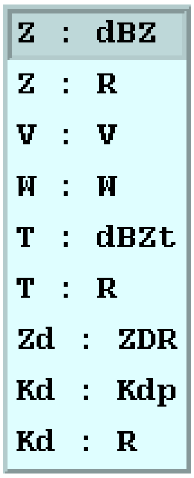
The features of the XSECT tool are described below.

Height

Specify the height of the cross-section in km to the nearest 0.1 km (100m).

Data



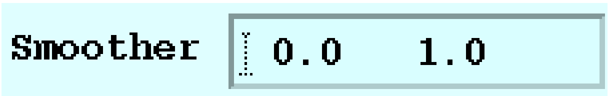


Select the data types from the list. The left variable represents the input data type, the right variable represents what will be displayed. A polarization diversity example is shown here.

Size

Select either a large or a small size window. Small size is usually better since it takes up less screen area and generates more quickly.

Smoother

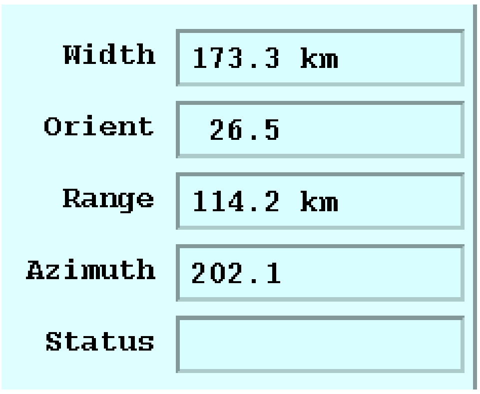


Select the horizontal and vertical smoother length scale in km.

Make Cut

After all is configured, click this icon to make the cross-section. Monitor the progress in the Status field at the bottom of the **XSECT** tool.

Status



The top 4 lines of the status section show the configuration of the cross-section line. Range and azimuth refer to the center point of the line. The bottom line shows the status such as "Setup", "Running" and "Done".

If the Ingest data for the data time that you have requested (i.e., the time of the base product) are not on disk, then the status will show "Error" and a pop-up message will inform you the the ingest files were unavailable. In this case, browse forward in time and try again, or check the Ingest Summary Menu to see what data are available.

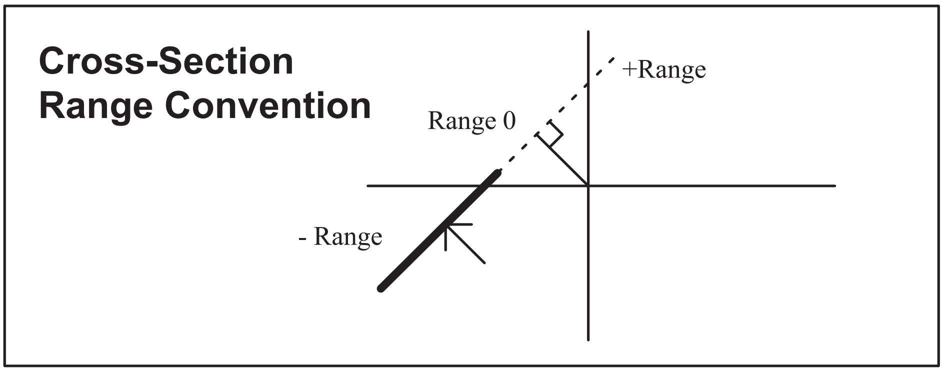
Cross-Section Display Color Scales

The cross-section will use the color scale that is configured in the **Color Scale** tool for the data type that is being displayed. A nice side effect of this is that the cross-section and base product color scales will match if they have the same data type. For example, if you ask for a cross-section of dBZ and the base product is dBZ, the color scale of the cross-section will match the input product.

If you want to change the color scale in the cross-section, use the **Color Scale** tool and select the data type (dBZ, V, etc.). Then re-make the XSECT. The new colors will be applied when the cross-section is re-made.

Cross-Section Range Scale

The height range scale is either km or thousands of feet and the horizontal range scale is either km or nautical miles according to the units selection in the **Display Options** tool. The origin (range zero) corresponds to the point on the line or its extension that is closest to the radar. In other words, the origin is the point where the line or an extension of the line would be at a right angle to a line drawn from the radar. This is shown in the figure below.



Cross-Section Display in Standard Window

The cross-sections that you make can also be displayed in a standard window. Use the product selection features just as you would for any other product. The cross-sections will inherit the name of your window and the data type when they are listed in the product selection tool.

6.17 Product Output Options Tool

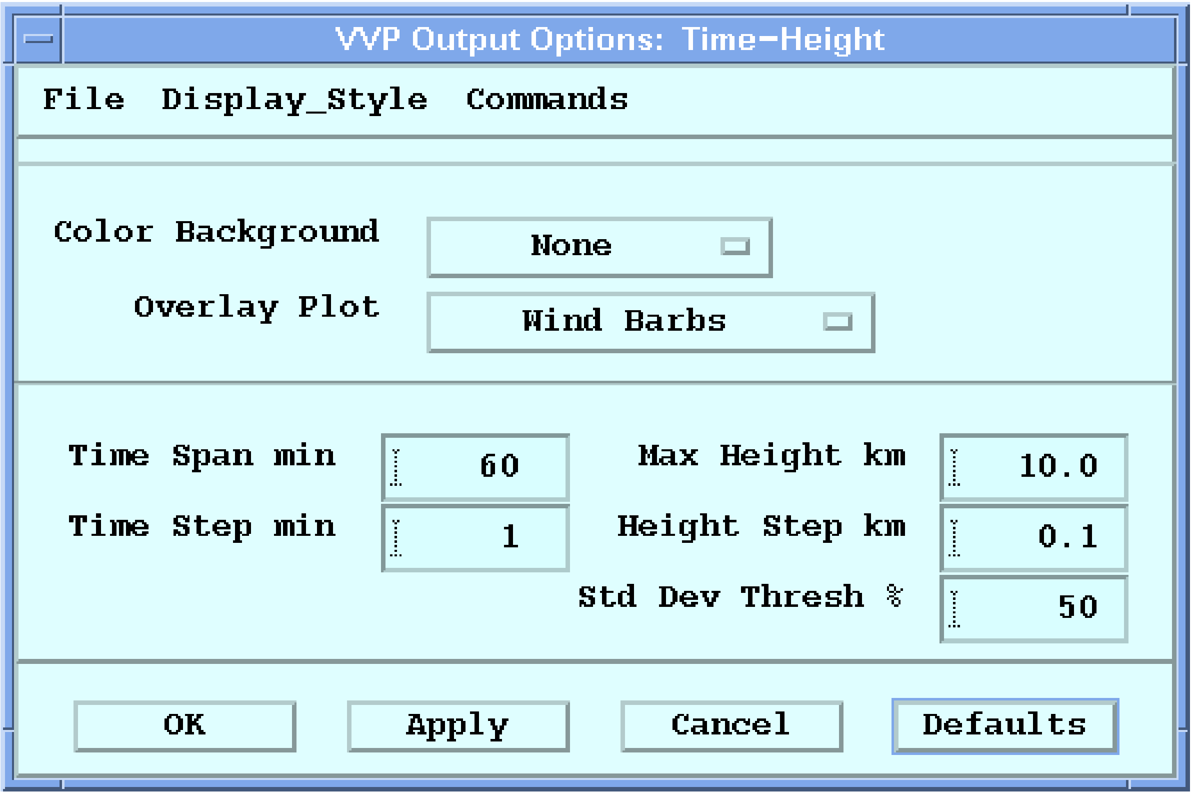
There are several products for which users can specify additional output options. If one of these products is on the screen, then the Output Options tool icon is sensitized. The products are:

VVP (Time-Height)	VVP Output Options: Time-Height on page 276
VVP (Line Graphs)	VVP Output Options: Line Graphs on page 279
WIND and FCAST	WIND and FCAST Output Options on page 281
CAPPI (if multi-level)	CAPPI Height Selection Tool on page 282
NDOP	NDOP Output Options on page 282
WARN	WARN Output Options on page 283

The Output Options tool will allow you to adjust the display of these products for your particular application. You can then do a **File**->**Save** for the VVP, WIND/FCAST and NDOP options so that the configuration for your particular window is saved (it will not effect other windows).

NOTE	Hint: If you are using WIND, FCAST or NDOP products as overlays on other products, it is sometimes convenient to display (for example) the WIND, product and pop-up the options tool for WIND. Then leave the tool up so you can use it if needed when you look at WIND overlaid on another product.

6.17.1 VVP Output Options: Time-Height



The VVP product shows vertical profiles of average Doppler wind properties over the radar such as wind speed, wind direction and divergence. The Output Options menu lets you choose to display wind data in one of the following ways:

- Choose **Display_Style->Graphs** to display a graph of VVP parameters vs. height at a single time; 1, 2 or 3 graphs can be selected. See VVP Output Options: Line Graphs on page 279 for information about the Graphs submenu.

The WIND product plots the horizontal wind speed and direction. For this product type, the Output Options menu lets you choose whether to display all wind measurements or only those winds that deviate from the mean. You can choose either wind barbs or wind strings to represent wind speed and direction, and you can specify a coverage threshold percentage. See WIND and FCAST Output Options on page 281 for information about the WIND Output Options menu.

When VVP is the current product type, you can click on the Options button to pop up the Time-Height Output Options submenu. With this menu, you can display a height vs. time cross-section of VVP parameters with the specified color background and overlay plot.

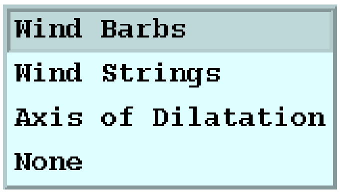
Color Background

Choose the information that you want displayed in the background from the following menu:

See Color Scale Tool on page 234 for information on selecting the color scales for the background display.

Overlay Plot

Choose the type of overlay plot from the following menu:



Wind barbs use the standard meteorological convention of 1/2 barb for 5 knots, 1 barb for 10 knots and triangles for 50 knots.Wind strings point away from the wind direction, with the length of the string indicating the relative wind speed. The maximum length of the wind strings can be set using the **Display Style**->**Graphs** Scale Limit for wind speed.

Axis of dilatation lines show the angle of "stretching". Fronts tend to form parallel to this angle. The length is proportional to the deformation which indicates the strength of the stretching. The maximum length of the dilatation can be set using the **Display Style**->**Graphs** Scale Limit for deformation. Choose "None" if you do not want to display an overlay plot.

Time Span min

This sets the duration of the time (horizontal) axis in minutes.

Time Step min

This sets the minimum time step for plotting data. For example if there is a VVP profile every 5 minutes and this field is set to 10, then every other profile will be plotted. This is useful to avoid collisions of the wind barbs when the data are closely spaced. Type `0.0` to see all the data.

Max Height km9

Type the maximum height (vertical scale) that you want to display. Note that the height of the VVP profile may be less than the height that you display in which case you will see blank background color.

Height Step km

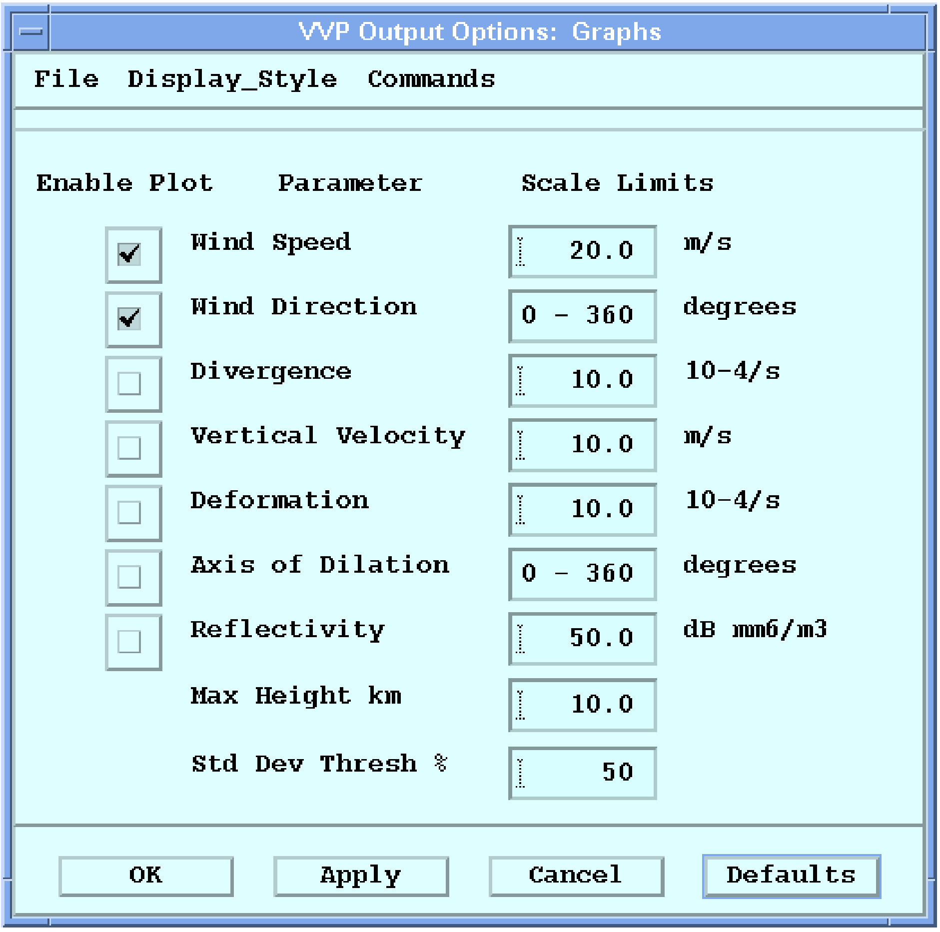
To avoid collision of the wind barbs in height, you may want to specify a minimum height step. Type `0.0` to see all the data.

Std Dev Thresh %

In some cases, the wind estimates will be noisy because of weak signals or poor coverage. This field lets you threshold poor estimates so that they are not displayed. Specify a number between 0 (no thresholding) and 100 (everything thresholded away). Typically a value of 80 is used. Try the Apply button to test your setting. The velocity point is displayed if the following is true:

$$StandardDeviation < -In\left(\frac{threshold}{100}\right) * (1.0 + Velocity/10.0).$$

6.17.2 VVP Output Options: Line Graphs



VVP products can also be displayed in graphical format of VVP wind profile parameters vs height. Either 1, 2 or 3 graphs may be plotted side-by-side.

You can produce a graph of VVP data as follows:

1. Use the **Product Selection** tool to select a VVP product to view.
2. Click on the Options icon to view the Display Options menu. The Product Type should be set to VVP. If not, select VVP.
3. Click on the Options button. This displays the VVP Output Options Menu. Either the Graphs or the Time Height submenu will be shown.
4. If Time-Height is shown, select **Display_Style**->**Graphs** from the menu bar.
5. Make any changes as described below, then click on the Apply button to see your changes take effect on the current VVP display.
6. To save your changes, choose **File**->**Save** from the Display Options menu bar.

The fields in the menu are described below.

Default Button

This provides a reasonable set of default values as a starting point.

Wind Speed

Toggle this button in to chart the wind speed in the graph. Enter a value in the Scale Limits column to specify the maximum wind speed you want to plot.

Wind Direction

Toggle this button in to chart the wind direction. You cannot edit the Scale Limits column for this field.

Divergence

Toggle this button in to chart the wind divergence. Enter a value in the Scale Limits column to specify the maximum divergence you want to plot.

Vertical Velocity

Toggle this button in to chart the vertical velocity. Enter a value in the Scale Limits column to specify the maximum vertical velocity you want to plot.

Deformation

Toggle this button in to chart the horizontal deformation. Enter a value in the Scale Limits column to specify the maximum deformation you want to plot.

Axis of Dilation

Toggle this button in to chart the axis of dilatation. You cannot edit the Scale Limits column for this field.

Reflectivity

Toggle this button in if you want to chart the reflectivity. Enter a value in the Scale Limits column to specify the maximum reflectivity you want to chart.

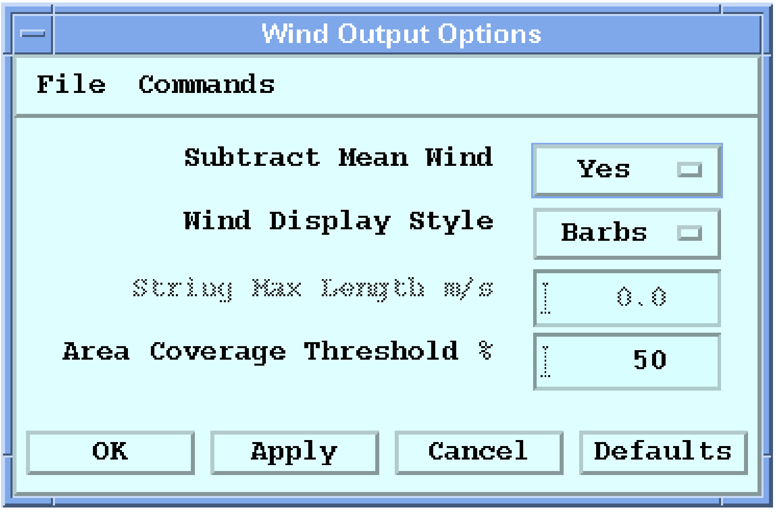
Max Height in km

Enter the maximum height for the data to include in the plot.

Std Dev Thresh %

Enter the standard deviation threshold percent for the data to include in the plot. This is used to threshold poor estimates. The scale goes from 0 (no thresholding) to 100 (total thresholding). 80 is a typical value.

6.17.3 WIND and FCAST Output Options



When either WIND or FCAST is the current product type, you can click on the Options button to pop up the Wind Output Options submenu. With this menu, you can choose display options for plotting the horizontal wind speed and direction. The WIND vectors are estimates of horizontal winds using a uniform wind algorithm in sectors around the radar.

Subtract Mean Wind

When you choose "Yes," IRIS subtracts the mean wind vector from all wind vectors. As a result, it displays the perturbation wind vectors. When you choose "No," the full wind vector is displayed.

Wind Display Style

You can choose to display the WIND product vectors as wind barbs or wind strings. Wind barbs point toward the wind direction, with hatch marks denoting the wind speed following the standard meteorological convention of 1/2 barb for 5 knots, full barb for 10 knots and triangles for 50 knots. Wind strings point away from the wind direction, with the length of the string indicating the relative wind speed (the longer the string, the higher the speed).

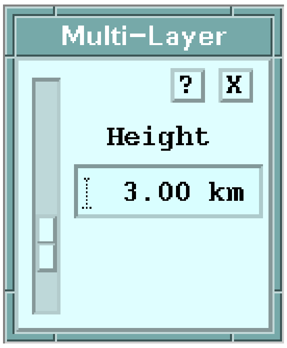
String Max Length

When you choose "Strings" as the wind display style, you can enter the maximum string length in meters/second. Any data point that exceeds this length is displayed at the maximum length.

Area Coverage Threshold %

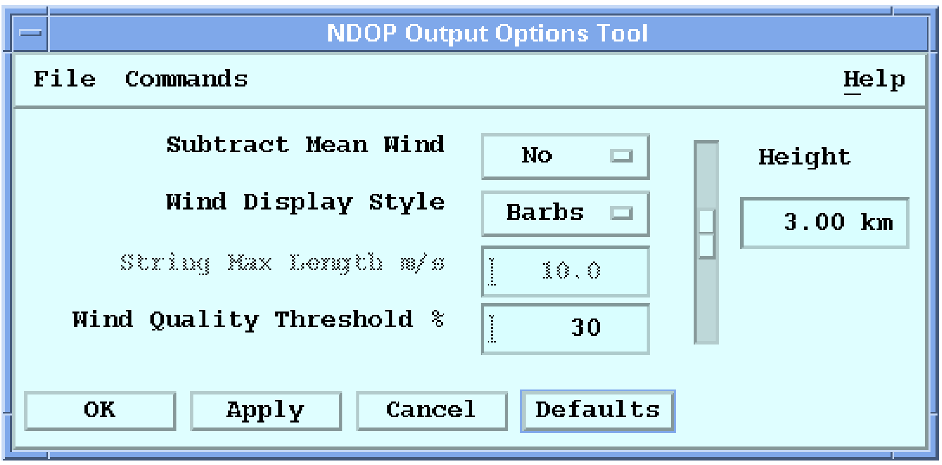
This is used to threshold points for which the aerial coverage of radial velocity data is less than the selected value. A value of 50% would be typical.

6.17.4 CAPPI Height Selection Tool



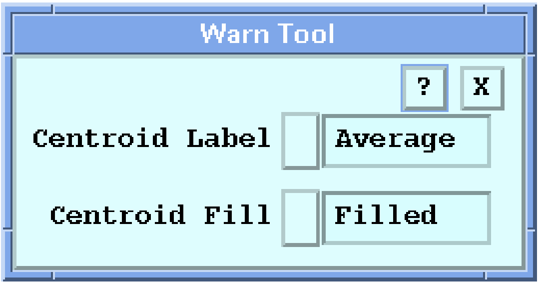
For CAPPI's that have multiple levels (3D CAPPI's) this tool allows you to change heights. You can also use the UP/DOWN arrow keys (your cursor must be in the display portion of the window to use the arrow keys).

6.17.5 NDOP Output Options



The options for the NDOP product are a combination of the Wind Options (WIND and FCAST Output Options on page 281) and the CAPPI height selection (CAPPI Height Selection Tool on page 282). This tool is very convenient to leave on the screen since it will function with WIND, FCAST, NDOP and CAPPI.

6.17.6 WARN Output Options



IRIS WARN centroids are either displayed as an ellipse with a name inside, or as a graphical icon rotated to the direction of motion of the centroid. The Centroid Label options are for a second label line on ellipses, or for a label to the right of the icon. The Centroid Fill options only apply to ellipse style displays, and only when the WARN product is overlaid on other products.

Centroid Label

The WARN centroid has 4 label choices. The data displayed is from the first of the 3 possible inputs to the warning. The units are the same as used by our standard data display, except that wind shear is displayed as knots loss/gain, and height is displayed in kilofeet.

- None – no additional label.
- Maximum – the centroid will be labeled with the maximum value of the data throughout the centroid.
- Average – the centroid will be labeled with the average value of the data throughout the centroid.
- Speed – the centroid will be labeled with the speed of a target. This only applies to systems that have the DWELL product configured for target detection.

Centroid Fill

You can choose the style for the fill effect of the centroid so that it can be clearly identified on your display. The options are described below:

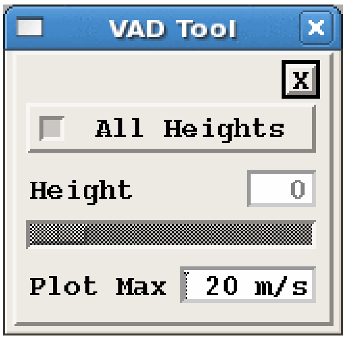
- Open – the centroid area is not filled, but rather simply outlined.
- Hatched – the centroid area is filled with a slanted pattern of lines.

- Filled – the centroid area is filled a solid color.

Operational Use

First configure your Warn Tool options, then choose the desired product to overlay in the Display Options menu. Using the File>Save option in this menu will also save the Warn Tool options.

6.17.7 VAD Output Options



All Heights/1 Height

The IRIS VAD products consist of just a plot of velocity for all azimuths. You can select here if you want to display just one plot of one height, or many plots showing all the heights.

Height

If you have selected 1 height above, then use this slide bar, or the cursor keys to move up and down through the list of heights.

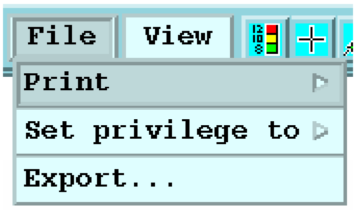
Plot Max

Configure here the maximum velocity to show on the plots.

6.17.8 THICK Output Options

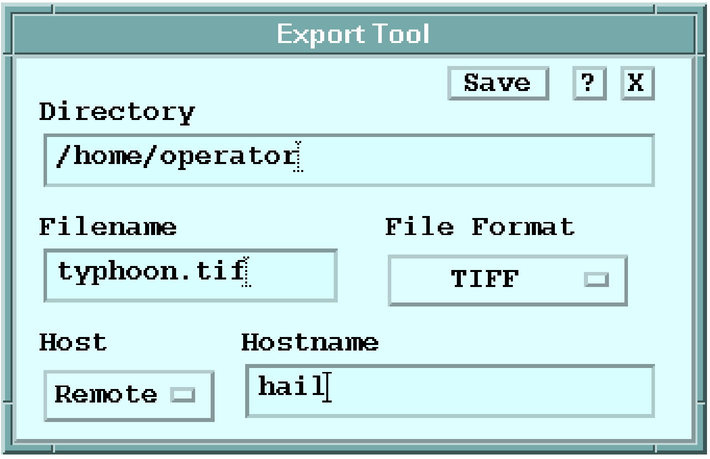
The THICK product shows the difference in height of the lowest and highest instance of any reflectivity contour. The THICK product may also show the average reflectivity value within the same layer. This tool allows you the change which of the two data types is displayed within the THICK product.

6.18 Printing and Exporting Displays



The File button in the upper left of the menu has options for printing displays and for exporting displays in a variety of formats. The postscript setup menu is described in *** 'The Quick Look Window' on page 223 *** of the *IRIS Radar Manual*.

The export tool shown below lets you output to a disk file on your local computer or to a remote computer in a variety of formats.



The supported formats are: GIF (perhaps the most useful), TIF, BMP and Post Script.

NOTE	Automatic printing and exporting is controlled by the Product Output Menu (Sending a Product to a Device on page 295). The formats are controlled by the setup->output utility (see the *IRIS Utilities Manual*).

6.19 Window Keyboard Commands

There are several convenient keyboard commands that are available. These are summarized here.

NOTE	Your cursor must be in the image area of the Quick Look Window for the keyboard commands to function.

Keystroke	Action
↔ LEFT/RIGHT Arrow	Forward/Back in single-step time sequence
SPACE BAR	Toggle loop on/off
↕ UP/DOWN Arrows	Up/Down height step for CAPPI or NDOP

CHAPTER 7
REQUESTING PRODUCT OUTPUT

The product files created by the product generator are stored on disk. From there, they can be sent to displays, printers, storage media, or other computers. The Output process adds any requested overlays, then formats the product for the selected output device. The Product Output menu directs the output to the required destination.

The Product Output menu is available to all users to browse through the available product files and select ones to send to their workstation. Users can also request that all future versions of a particular product be sent automatically to their workstation or selected device. For example, a user might want to see a PPI product every time a particular volume scan TASK runs. In addition, an operator might send a product to a particular destination, such as a remote display, printer or DVD.

To Enter the Product Output Menu:

Choose **Menus**->**Product Output** from the IRIS menu bar or from any of the IRIS menus.

In this chapter:

7.1 Product Output Devices and Files

The Product Output menu can route output to a variety of devices:

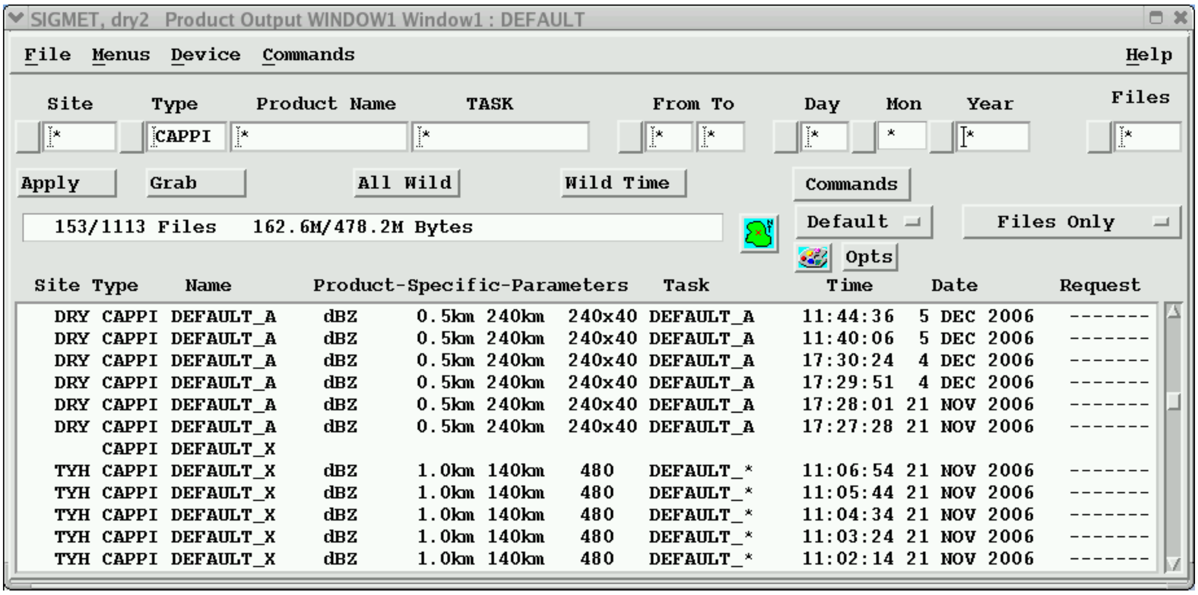
Printer	Postscript printers configured on you system.
Window	A color window on the local workstation. The display is generated by the IRIS host. This window can be exported to appear on a remove workstation.
Network	Sends product files to another system over the network. As a degenerate case, network output can go to a disk file on the system system. The remote system can receive a socket notification of the file. The file format can be converted to any other format using "output pipes".
Archive	A tape drive or MO disk can be used to store data.

The list of output devices known to IRIS are configured in the **setup** utility (See the *IRIS Utilities Manual*, section 9.9). For a list of output pipes which are supplied with the system see section 9.9.4. Customers are encouraged to write their own.

Cartesian products can be displayed in a window using up to 32 data colors, with additional colors available of overlay and annotation. Any product resolution can be displayed. However, the standard IRIS display sizes are:

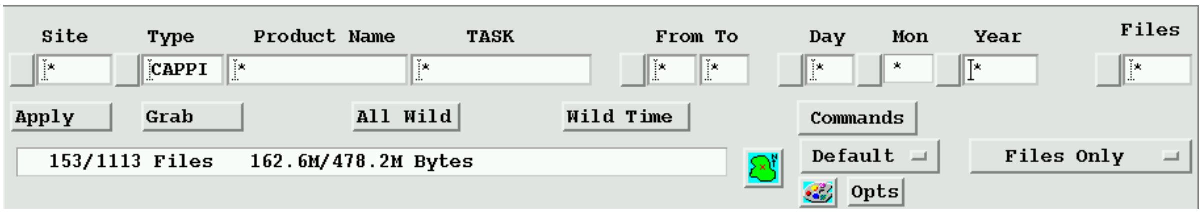
Medium Resolution	For 480 by 480 pixel displays.
High Resolution	For 720 by 720 pixel displays.
X-High Resolution	For 940 by 940 pixel displays.

7.2 Product Output Menu



Filter Menu Filter Section on page 289	Lets you choose the files that appear in the product list.
Product List Product List on page 293	Displays the list of products that you have selected.

7.2.1 Filter Section



When you first enter the Product Output menu, all possible products are listed at the bottom of the menu. This list can be quite large, making it difficult to find the products you need. Use the Filter section to narrow the list down to only those products that are of interest.

Site

Enter a site ID in this field to select data from only one radar site, or enter the wildcard character to select data from all sites. If you click on the Site button, IRIS pops up a list of known sites. This list differs from system to system, depending on the sites that are configured with the **setup** utility.

Type

Enter a product type in this field to select products of only one type, or enter the wildcard character to select products of all types. You can pop up a list of types with data files to choose from.

Product Name

Enter the name of a product to narrow the list down to products having that name. You can include wildcard characters in the product name. A question mark (?) matches any single character; an asterisk (*) matches any sequence of zero or more characters.

TASK

Enter the name of a TASK in this field to narrow the list down to only those products generated by a specific TASK. Again, you can include wildcard characters in the TASK name. For example, entering a product name of *PPI*_? selects all hybrid TASKS that have PPI somewhere in their names.

From, To

Enter a range of hours in these two fields to narrow the list of products by time of day. You can pop up a list of ranges to choose from.

Day, Month, Year

Enter a day, month. or year to narrow the list of products by date. You can pop up a list of values to choose from.

Max

The Max field lets you control how many products to include in the list. "*" means apply no limit, but all IRIS scrolled lists are capped at 1000.

Apply

Click on the Apply button to update the product list, based on your selection criteria.

Grab

If a product is selected, the Grab button inserts the product's site, type, product name, TASK and date information into the filter fields.

All Wild

Click on the "All Wild" button to return all the fields to the wildcard character.

Wild Time

Click on the "Wild Time" button to change only the hours, month, day and year fields to the wildcard character.

Commands

Pops up the following list of operations that you can perform on the product files selected by the Filter menu. These commands apply to products, but not to headers:

Keep — Prevents the Watchdog process from deleting the selected products.

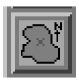
Delete — Marks the selected files for deletion by the Watchdog process.

Reingest — Marks the selected files to be reingested.

Remove Tag — Unflags any selected products that have been tagged.

Send — Sends all selected products to the output device.

Cancel Send — Cancels any send requests for the selected products.

Display Options 

Click on the this icon to specify the output options to be used when your product is sent to a display device. See Display Options Tool — IRIS Product Output Menu on page 238 for information on specifying output options.

Color Scale Configurations 

Click on the this icon to specify the color options to be used when your product is sent to a display device. See Color Scale Tool on page 234 for information on specifying color output options.

Product Specific Output Options Opts

The options button is greyed out unless either the CAPPI, FCAST, NDOP, THICK, VVP, or WIND product type is selected. See Sections VVP Output Options: Time-Height on page 276 to THICK Output Options on page 285 for more information on specifying these options.

Show Headers

There are 4 choices regarding how to show header lines:

Files Only	Show files in the inventory with a header for each file shown.
Headers Only	Show header lines only.
Files + Headers	Show files and all headers.
Headers in Use	Show headers which have automatic send requests configured.

The files only choice also includes "headers in use". The only additional headers seen in "Files + Headers" are for products on disk which you may have recently deleted. "Headers in Use" will show headers with automatic send requests for any output, not just the output device currently selected.

NOTE	You may want to set up your product output assignments based solely on product headers. Select "Headers Only" to do this.

7.2.2 Product List

Site	Type	Name	Product-Specific-Parameters	Task	Time	Date	Request
DRY	CAPPI	DEFAULT_A	dBZ 0.5km 240km 240x40	DEFAULT_A	11:44:36	5 DEC 2006	-------
DRY	CAPPI	DEFAULT_A	dBZ 0.5km 240km 240x40	DEFAULT_A	11:40:06	5 DEC 2006	-------
DRY	CAPPI	DEFAULT_A	dBZ 0.5km 240km 240x40	DEFAULT_A	17:30:24	4 DEC 2006	-------
DRY	CAPPI	DEFAULT_A	dBZ 0.5km 240km 240x40	DEFAULT_A	17:29:51	4 DEC 2006	-------
DRY	CAPPI	DEFAULT_A	dBZ 0.5km 240km 240x40	DEFAULT_A	17:28:01	21 NOV 2006	-------
DRY	CAPPI	DEFAULT_A	dBZ 0.5km 240km 240x40	DEFAULT_A	17:27:28	21 NOV 2006	-------
	CAPPI	DEFAULT_X					
TYH	CAPPI	DEFAULT_X	dBZ 1.0km 140km 480	DEFAULT_*	11:06:54	21 NOV 2006	-------
TYH	CAPPI	DEFAULT_X	dBZ 1.0km 140km 480	DEFAULT_*	11:05:44	21 NOV 2006	-------
TYH	CAPPI	DEFAULT_X	dBZ 1.0km 140km 480	DEFAULT_*	11:04:34	21 NOV 2006	-------
TYH	CAPPI	DEFAULT_X	dBZ 1.0km 140km 480	DEFAULT_*	11:03:24	21 NOV 2006	-------
TYH	CAPPI	DEFAULT_X	dBZ 1.0km 140km 480	DEFAULT_*	11:02:14	21 NOV 2006	-------

The product list is displayed at the bottom of the Product Output menu. Each product name is listed on a header line, followed by the versions of the product that are currently on disk. Each version is identified by the time the data were collected, which is the start time of the associated TASK.

Site and Type

The Site field displays the ID of the radar site where data for the product was collected. The Type field shows the type of the product, such as PPI or RHI. When you position the mouse cursor over either of these fields, with the right button you can pop up the following menu to flag or unflag the selected product:

Keep
Delete
Clutter
Reingest
Remove Tag

Keep — Prevents the Watchdog process from deleting the product.

Delete — Marks the file for deletion by the Watchdog process.

Clutter — Marks this file as a clutter filter.

Reingest — Marks this file as a file to be reingested.

Remove Tag — Unflags the product that has any of the above flags.

Name

The product name for that configuration of this the product type.

Product-Specific-Parameters

The standard product generation parameters shown in Table 6 on page 294 are taken from the product configuration and displayed in this field.

Table 6 Standard Product Generation Parameters

Product Type	Parameter 1	Parameter 2	Parameter 3
BASE	...	dBZ Threshold	Max Range
BEAM	Azimuth Limits	Elevation Limits	...
CAPPI	Data Parameter	Height	Max Range
CATCH	Hours	...	Max Range
FCAST	Speed & Direction	Data Threshold	Max Range
GAGE	Minutes avg	Rain/Disdro	...
IMAGE	...	...	Max Range
MAX	Layer Bottom	Layer Top	Max Range
NDOP	List of Sites	...	Max Range
PPI	Data Parameter	Elevation	Max Range
RAIN1	Input Product	Minutes avg	Max Range
RAINN	Hours	...	Max Range
RAW	Data Parameters	All/One	Max Range
RHI	Data Parameter	Azimuth	Max Range
RTI	Data Parameter	Start Az & El	Max Range
SHEAR	R, A, or E flags	Elevation	Max Range
SLINE	Elevation(s)	...	Max Range
SRI	Melting level	Profile/Convection flags	Max Range
TDWR	CF Wind Speed	CF Wind Dir	CF Gust Speed
TOPS	...	dBZ Threshold	Max Range
TRACK	Inputs Product	Area Threshold	Data Threshold
USER	Data Parameter	...	Max Range
VIL	Min Height	Max Height	Max Range
VVP	Min & Max Height	Number of Steps	Bin Quota
WARN	Symbol & Area	Number of Inputs	Number of hits
WIND	Min & Max Height	...	Max Range
XSECT	Data Parameter	Ctr Point R, AZ	Orientation Angle

Resolution

Included in the product specific parameters for Cartesian products is the horizontal resolution of the product in pixels. For 3-D products, the vertical resolution is also listed, as in "480×10".

The Product Output process always generates a display even if the output resolution does not match your display capabilities. It does this by either skipping pixels or duplicating pixels, as required. For example, if you send a low resolution display to a medium resolution display device, such as a printer, the Product Output process duplicates each pixel to zoom the image on the printer to full size.

TASK

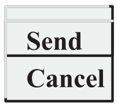
The name of the associated TASK.

Time

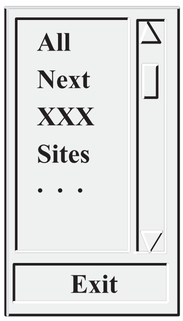
The date and time (local time) when data for the product was collected.

Request

The Request field is used for requesting product output. Position the mouse cursor over an entry in the product list and choose from the pop-up menu. The menu that you see depends on the entry you select in the list.



If you select a product from the list, you can choose to send the product to the output device, or cancel a Send request.



If you select a header line from the list, you can choose to send all or only the next occurrence of the product to the output device. You can also select particular sites that you want to receive the output. Each site you select is marked with an asterisk.

After you issue the Send request, the Request field displays a message indicating the status of the request.

7.3 Sending a Product to a Device

You can send one or more existing products to a display device, or one or more future versions of a product to a display device at one or more sites.

To Send Existing Products:

1. Choose **Device** from the menu bar and select the device to which you want to send the product.
2. Select the products you want to send. There are several ways to make your selection:
   - Click the left mouse button over an entry in the list to select it, or press Ctrl and click to select more than one entry in the list.
   - Click and drag the mouse to select a group of entries in the list, or press Ctrl, then click and drag the mouse to select multiple groups of entries.
   - Use the Filter menu to produce a list of the products that you want to send.
3. Choose ->**Send** from one of the following pop-up menus:
   - If you selected the entries with the mouse, position the mouse cursor over the product list and click on the right mouse button to pop up the menu.
   - If you selected the entries from the Filter menu, click on the Commands button to pop up the menu.

Send	The product is marked to be sent to the selected device and is waiting for the Output Formatter to send it.
Sending	The Output Formatter is working on your request.
Done	The product has been sent to the selected display device.
----	There is currently no request.
Error	An error occurred. Check the Radar Status menu.

Keep in mind that if the selection contains both headers and products, the command applies only to the products. To perform an operation on headers, you must select only headers.

To send one or more future versions of a product:

Select the header for the type of product you want to send, and choose ->**All** or ->**Next** from the pop-up menu. You may also select any number of sites that are known to your system. They will receive all or the next version of the product.

When you choose ->**All** or ->**Next** from the header line, a Send request is issued automatically whenever a new version of the product is added to the disk, and a Send status message appears in the Request column.

To Cancel a Send Request:

You can cancel a Send request at any time by positioning the mouse cursor over the Request column and choosing ->**Cancel** from the pop-up menu. If you have selected a single product, you cancel only the Send request for that product. If you have selected the header line, you cancel the All or Next request.

7.4 Flagging a Product

Normally, the Watchdog process removes product files as the disk space fills by deleting the oldest product files. The first column of the product list allows you to signal the Watchdog with either a Keep or a Delete flag.

To set or unset a flag, select the product or products that you want to tag:

- Click the left mouse button over an entry in the list to select it, or press Ctrl and click to select more than one entry in the list.
- Click and drag the mouse to select a group of entries in the list, or press Ctrl, then click and drag the mouse to select multiple groups of entries.
- Use the Filter menu to narrow the list down to the entries you want to flag.

When you are satisfied with your selection, flag the entries using one of the following commands:

->**Keep**	Prevents the Watchdog from deleting a file. This is useful if you have files that you want to save for several days. Note that the best way to make a record of a file is to send it to tape.
->**Delete**	Signals the Watchdog to delete a file immediately. This is useful if you want to restore a RAW file from tape so that it is automatically reingested. This cannot be done if the RAW product file already exists on disk; it must be deleted first.
->**Clutter**	Available only for the RAIN1 product. This flags the file that serves as the clutter map for the RAIN1 product. If more than one file of the same product name is tagged, the most recent version is used. Clutter maps are not deleted by the Watchdog.
->**Remove Tag**	Removes a flag.

If you have selected the entries with the mouse, these commands are available on a pop-up menu within the product list. They are on the Commands pop-up menu if you have selected the files with the Filter menu.

CHAPTER 8
PERFORMING ARCHIVE OPERATIONS

One of the important features of IRIS is the ability to archive and retrieve radar data. If a RAW product (polar coordinate data) is retrieved from archive, IRIS can generate products from the retrieved data as if the data were collected in real time. Picture products can be retrieved from archive and then displayed. IRIS supports three types of archive devices. Note that these are configured in the Setup/Archive utility.

- Tape such as DAT.
- Optical Disk drives such as re-writable magneto optical drives.
- Large Disk Archives (LDA's)
- DVD+RW systems (e.g., SONY DRU–500AX (internal), SONY DRX–500ULX (external on Firewire or USB 2.0). Currently supported on Linux systems.

Optical disks are more expensive than tape, but last longer and are much more convenient to use because of their random access capability. Recording to tape is convenient, but retrieval can be slow if the file that you want is at the end. The LDA allows users to take advantage of low-cost mass storage systems that are now available. DVD's offer low cost for both the drive and the media while providing approximately 5 GB of storage. These are the most cost effective.

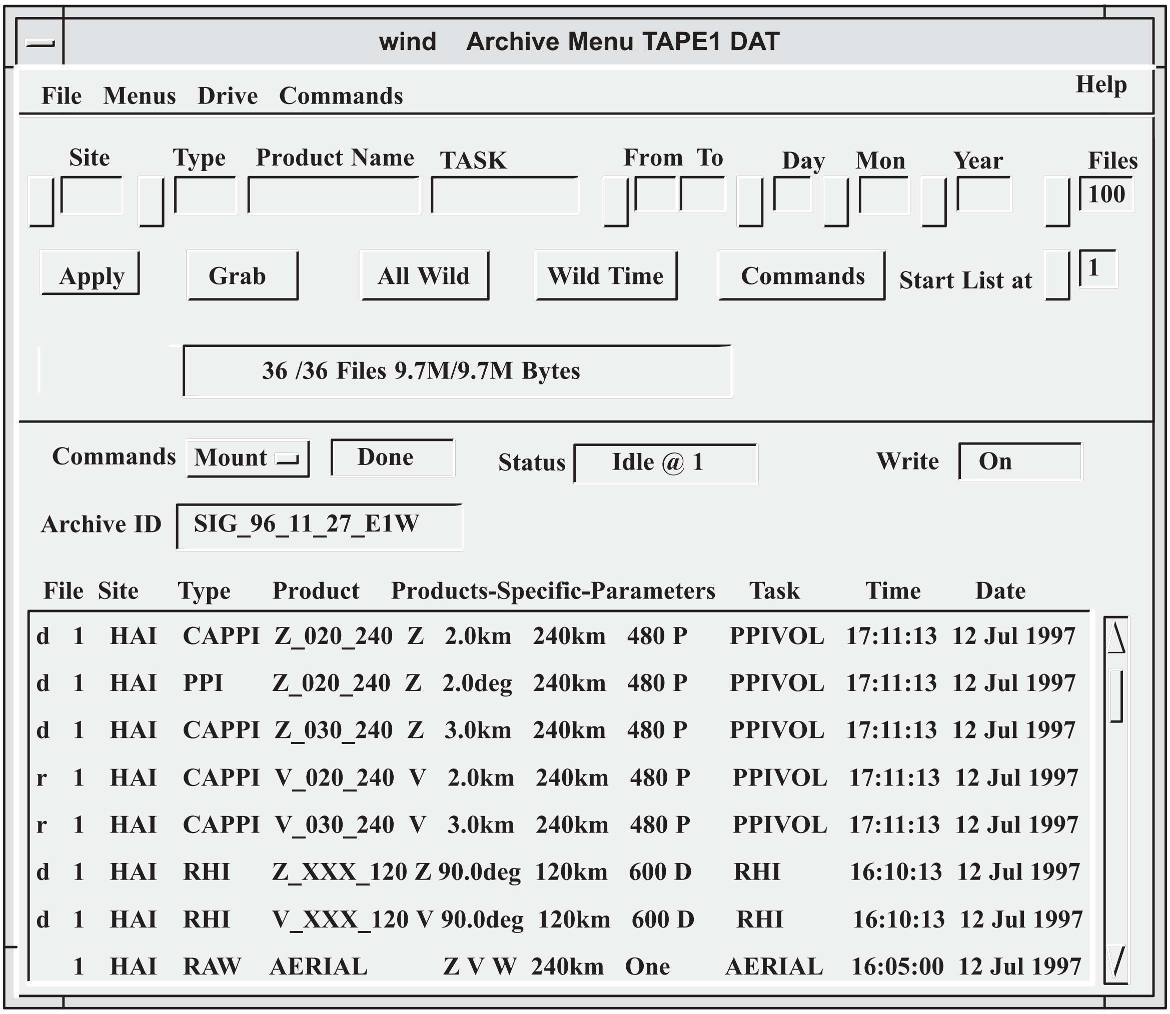
The Archive menu controls the host archive devices. Initially, you make Send requests in the Product Output menu to direct output to the archive device. Then you use the Archive menu to mount an IRIS tape or disk (archive media) and start the recording process. The Archive menu also lets you retrieve product files and store them on the system disk.

To enter the Archive menu choose **Menus** -> **Archive menu** from the IRIS menu bar or from any of the IRIS menus.

In this chapter:

8.1 Archive Menu

NOTE	Note: The sigbru utility has archive/retrieve capabilities that are useful for manual or automatic archive and maintenance of LDA's.



Filter Menu You can use the standard filter menu for selecting the products that appear in the Archive Log area.

Archive Control Area The middle of the menu provides commands to control archive operations such as mount or record, and displays status information for the archive device functions.

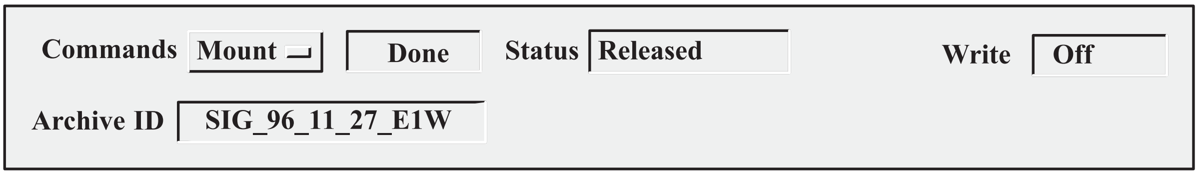
Archive Log Area The bottom of the menu shows what product files, if any, are recorded on the archive that is currently mounted.

All operations are directed to a specific archive device, which you must select.

To select an archive device (tape or optical disk):

Choose **Drive** from the Archive menu and pick a drive from the list. The choices vary, depending on the drives configured with your system. If no archive drives are available, the list contains the entry UNKNOWN.

8.1.1 Archive Control Area



The archive control area of the window lets you select the archive device commands. Status information is also displayed.

Commands

The Commands button pops up the following menu of tape commands:

Mount a disk or tape.

Unmount a disk or tape.

Stop the current operation.

Record a product file to archive.

Retrieve a product file from the archive and copy it to disk.

Inventory the product files on the archive.

Status

The Status field shows the current status of the archive drive and should correspond to the command request. The status entries are:

Rewind (for tape)	The tape is rewinding, for example: - The user issues the Unmount command. - IRIS is positioning the tape for a Retrieve operation. - IRIS has filled a tape during a Record operation.
Writing	The tape or disk is being recorded.
Scanning	The tape is being mounted or an inventory is being created. "Scanning" is also displayed while the tape is positioning for a Retrieve or Record operation.
Reading	The drive is in the process of retrieving a file.
Idle	The drive is not doing anything, that is, the user did not issue a command, or the last command was completed.
Off Line	The specified drive is not on-line. No archive operation can be performed until this problem is corrected. You may need to insert the medium or push a load button. Consult the drive manual.
Unavailable	The drive is being used by someone else, it is broken or not installed.
Released	IRIS is not currently attached to the drive. The drive is free to be used by IRIS or other processes.
Full	The medium is full—an EOT or disk full was encountered during a Record operation. To continue recording, the medium must be unmounted, a new medium mounted and Record must be invoked again.
BOT (tape)	Beginning of tape—a new tape has been inserted into the drive and is ready to be mounted. This status also appears after a Rewind is done.
EOT (tape)	End of Tape—IRIS has encountered the end of tape. Usually IRIS rewinds the tape automatically, so the message is replaced by "Rewind."

Up to three status indicators can appear together in the Status field. For example, if a Record process fills the tape, the tape is rewound and sits idle until the operator changes tapes or issues another command, the Status field indicates the following:

```
Idle BOT Full
```

If the tape is being scanned to create an inventory, the status field displays the following:

```
Scanning
```

When a Record process currently has nothing to do, the status displays:.

```
Idle
```

If new product files tagged for archive (in the Product Output menu) become available, they are recorded automatically.

When the Mount command is completed and the tape is at the beginning awaiting commands, the Status field displays:

```
Idle BOT
```

Archive ID

Identifies the unique name assigned to the tape or disk when it was initialized. The first three characters are the IRIS site ID for the site where the medium was initialized, followed by the date on which the medium was initialized. The final three characters are a random code to assure uniqueness. For information on initializing media refer to Initializing a Tape or Disk for Recording on page 307.

Write

The Write field shows whether the write protection for the tape or disk is set. "On" means that IRIS can write on the medium. "Off" means that IRIS cannot write on the medium. The message appears after a Mount command is issued.

Click on the Wild Time button to change only the hours, month, day and year fields to the wildcard character.

Filter Menu Commands

The Filter Menu functions are identical to that described in Filter Section on page 289 for the Product Output Menu. However, the Commands button pops-up the following list of special operations that you can perform on the files selected by the Filter menu:

Retrieve
Cancel

Retrieve marks all selected files for retrieval.

Cancel unmarks all selected files.

Filter Menu Start List At

This command is located at the base of the filter menu. Because the Archive log listing can contain several hundred files, the Start List At field lets you start the list at a selected file. You can pick a starting number from a pop-up menu or enter a number directly into the field. This is especially convenient for tapes that are in chronological order.

8.1.2 Archive Log Area

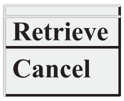
File	Site	Type	Product	Product-Specific-Parameters	Task	Time	Date
d 1	HAI	CAPPI	Z_020_240	Z 2.0km 240km 480 P	PPIVOL	17:11:13	12 Jul 1997
d 1	HAI	PPI	Z_020_240	Z 2.0deg 240km 480 P	PPIVOL	17:11:13	12 Jul 1997
d 1	HAI	CAPPI	Z_030_240	Z 3.0km 240km 480 P	PPIVOL	17:11:13	12 Jul 1997
r 1	HAI	CAPPI	V_020_240	V 2.0km 240km 480 P	PPIVOL	17:11:13	12 Jul 1997
r 1	HAI	CAPPI	V_030_240	V 3.0km 240km 480 P	PPIVOL	17:11:13	12 Jul 1997
d 1	HAI	RHI	Z_XXX_120	Z 90.0deg 120km 600 D	RHI	16:10:13	12 Jul 1997
d 1	HAI	RHI	V_XXX_120	V 90.0deg 120km 600 D	RHI	16:10:13	12 Jul 1997
1	HAI	RAW	AERIAL	Z V W 240km One	AERIAL	16:05:00	12 Jul 1997

At the bottom of the menu is a list of files that are on the archive. This list is used for specifying files for a Retrieve operation or verifying the progress of a Record operation. For tape, the order of the list is the same as the order of the files on the tape. Usually, they are in chronological order. For optical disk, the files appear in the same order as in the Product Output menu.

Archive logs are maintained on disk as ASCII text files. In the case when a tape is mounted, IRIS checks to see if there is a corresponding tape log (see the Mount command in Mounting a Tape or Disk on page 308). If the tape is a valid IRIS tape, then the list is displayed. In the case of optical disk, a new log is generated whenever a disk is mounted.

File Column Pop-Up Menu

When you position the mouse cursor over the File column in the Archive Log, you can pop up the following menu:



Retrieve marks a file for retrieval.

Cancel unmarks the file.

This column also contains status information about the file. The first column displays the sequential tape file number (1, 2, ...) and the second column contains one the following symbols:

r	The file has been tagged for a Retrieve operation.
d	The file is on disk as well as on tape. In this case, a Retrieve is not permitted.
"blank"	The file is on tape only and has not been tagged for Retrieve.

Site and Type

The Site field displays the ID of the radar site where data for the product was collected. The Type field shows the type of the product, such as PPI or RHI.

Name

This field gives the product name for the most recent generation of the product type. It is a display-only field.

Product-Specific-Parameters

Shows the same additional information about the product as seen in the product output menu, for details see *** 'The standard product generation parameters shown in Table 6 on page 294 are taken from the product configuration and displayed in this field.' on page 294 ***.

TASK

This display-only field shows the name of the associated TASK.

Time

This display-only field shows the date and time (local time) when data for the product was collected.

8.2 Initializing a Tape or Disk for Recording

IRIS can mount only valid IRIS tapes or disks that have been initialized by a separate utility program. If you try to mount a non-initialized medium, the Status field shows:

```
NonIris
```

The medium initialization utility should be used in the following situations:

- To initialize a blank tape or disk.
- To overwrite a tape or disk that contains non-IRIS data.
- To overwrite an IRIS tape or disk.

In the cases where you are overwriting an IRIS or other type of medium, you should be very sure that you are not destroying valuable data or software (backup or delivery tapes). To help defend against this, only operators are permitted to use the tape initialization utility.

CAUTION	Caution: Do not initialize an existing tape or disk if you want to record additional data or retrieve IRIS data. Initializing an existing IRIS tape or disk destroys the data already on the medium.

To initialize a tape or disk:

1. Make sure the drive is free. Any IRIS tape or disk must be unmounted and removed.
2. Insert the medium into the drive and set the drive on line. Be sure that the medium is write enabled.
3. If IRIS is running, check the Archive menu and, if necessary unmount the media that you want to initialize.
4. From the operating system prompt, invoke the init_iris command appropriate for your device. Here are some examples:

```
$ init_iris_tape    (for drive unit 1 tape)
$ init_iris_mo      (for drive unit 1 disk)
$ init_iris_mo -u2  (specifies the 2nd drive unit)
$ init_iris_dvd -h  (to get help on usage)
$ init_iris_lda -h  (to get help on usage)
```

Be sure to type the underscore (_) characters as shown. The command name is intentionally long so that it is unlikely that someone would type it accidentally. The "-u2" is used to specify the second drive if there is more than one. The "-h" argument does not execute the command, rather it prints the usage options.

The unit will be checked and you will be prompted to confirm the initialization. The drive goes through several initialization steps that are displayed on the screen. If you have forgotten to write enable the tape, you get a write protect error when IRIS attempts to write the header information. Simply write enable the tape and retype the command.

At the end of the initialization, IRIS displays a unique tape number that is used in the future to refer to the disk inventories maintained for the tape.

WARNING	Important: Write the name of the medium that IRIS assigns on the tape or disk label. This will let others know that the tape or disk has been initialized.

The tape name is based on the first 3 characters of the Site ID, the year, month, day and a random number to make the tape unique.

8.3 Mounting a Tape or Disk

The Mount command is used for mounting initialized media, as follows:

1. Insert the tape or disk into the drive and set it on line. (This differs depending on the drive, so check the manufacturer's documentation.)
2. Choose **Commands**->**Mount**.

When the Mount command is invoked, IRIS scans the medium to determine what kind of medium has been mounted, and checks the system disk to see whether there is a corresponding tape log. The Status field reports "Scanning" during the Mount operation. IRIS then reports its findings in the Filter Summary field as one of:

40*/250 Files 11M/ 202M Bytes	For example, this indicates that the medium is a valid IRIS archive medium with a complete log. The log list shows the first few product files that are on the medium (if any). In this example, there are 250 files and 202 MB on the medium. The log list is currently displaying 40 files that occupy 11MB (* means there are more that could be displayed).

Incomplete Log	This indicates a valid IRIS tape but an invalid or incomplete tape log on disk. The tape log shows the first few files on the tape to the best of its ability. You may want to perform an inventory if a Retrieve operation is to be done.

After a successful Mount operation, IRIS displays the archive ID, which should be checked against the label on the medium.

In the event that a medium of unknown format or a blank tape or disk is detected during Mount, IRIS does not mount the medium and the Status field shows "NonIris." The medium cannot be used by IRIS unless it is first initialized (see Initializing a Tape or Disk for Recording on page 307).

8.4 Recording Data

The Record command starts the recording process. Output requests made from the Product Output menu for the selected archive drive are written at the beginning of a blank tape or added to the end of an IRIS tape. The archive medium can be left mounted so that new files can be automatically written to the archive without having to enter the Archive menu. This continues until the medium is full.

Retrieve, Unmount, and Inventory commands can be issued during the Record operation without first issuing the Stop command. A side effect of recording on an IRIS tape is that a new tape log is created when IRIS scans to find the last tape file. If you record on a tape that has an "Incomplete Tape Log," a new tape log is generated. There is no need to perform an inventory in this case.

To record data:

1. Enter the Product Output menu and select which product files to send to the archive drive. Be sure to specify the correct drive when you do this. You can make either individual send requests or use the header line commands to specify that all future products be sent to the archive.
2. Put a partially filled or a freshly initialized medium into the appropriate archive drive. Make sure that the medium is write-enabled.
3. Enter the Archive menu and select the appropriate archive drive. The Status field should indicate "Idle" or "Released."
4. Choose **Commands->Mount**.

5. Check the Filter Summary to make sure the medium was mounted successfully, and double-check the Archive ID field and log list to be sure that this is indeed the medium that you want to write.
6. Choose **Commands**->**Record**.

Recording continues until one of the following happens:

- There is nothing left to record, in which case the Commands field shows "Record Done" and the Status field shows "Idle." The log now contains entries for the new files that have been added. Further commands can be issued at this point (such as Unmount), but often the medium is left in this state so that future requests for archive from the Product Output menu are fulfilled automatically. This provides hands-off recording of products.
- You choose **Commands**->**Stop**. IRIS simply waits for the next command, which could be to resume the Record process. The log reflects the new files that were added before the Stop command was issued.
- The medium is full. At that time, the tape rewinds to BOT and the system-wide message "TAPE FULL ON DRIVE (drive id)" is flashed. The following steps should be taken:

1. Enter the Archive menu and unmount the tape.
2. Mount a new tape.
3. Choose **Commands**->**Record** to restart the recording operation where it left off.

Products will be queued to be sent to the drive and will be sent as soon as you select the record command on the fresh media. Thus if the media before these queued files are deleted by the normal watchdog process, then there will be no loss of data on the archive. The time depends on the size of your IRIS system disk but is typically several hours.

8.5 Creating and Printing a Log

NOTE	Note: Disk file inventories are not created for LDA devices. The inventory for these is made "on-the-fly".

The Inventory command is invoked when there is no tape log or when the tape log becomes damaged. If the latter case, the Archive ID field displays "Incomplete Log." Note, for optical disks, logs are created automatically whenever a disk is mounted.

Printing is done on a text printer rather than a color printer, depending on how the system manager has configured your system. A tape does not need to be mounted to print the tape log.

To create a tape log:

1. Select **Commands->Inventory**.

   When this command is invoked, IRIS scans through the entire tape and generate a new log. Because this can take some time, you may want to leave the menu and do something else until the operation is completed. Note that when IRIS appends files to an existing IRIS tape, a new tape log is automatically generated.
2. After a tape has been filled, print a hardcopy tape log and store it in a notebook or file near where the tapes are stored. (You should also set the write protect.) This makes it easier to determine what product files are on a tape when data are retrieved.

To print a log (tape or disk):

1. From the operating system prompt, change directories to the location of the logs:

   ```
   $ cd $IRIS_INV_TAPE
   ```
2. You can see a list of the available tape logs in this directory by typing:

   ```
   $ ls
   ```

   A separate file is listed for each archive log, identified by the archive ID corresponding to the label on the tape or disk.
3. Turn on the default printer for your system, then type (for example):

   ```
   $ lp SIG_88_03_08_S9C.LIS
   ```

   where the archive ID "SIG_88_03_08_S9C" is used as an example.

8.6 Retrieving Product Files from Archive

The Archive menu makes it easy to retrieve product files from tape and put them back on disk where they are available for display or, in the case of the RAW product, for subsequent product generation.

The Retrieve command takes product files from archive and stores them on the system disk. Retrieve requires that you first tag all files to be retrieved. Files can be tagged even while Retrieve or other operations are in progress.

Because Retrieve relies heavily on the log, IRIS tapes with incomplete logs should first be inventoried before the Retrieve command is issued. (See Creating and Printing a Log on page 310.) Note that Retrieve works if an inventory is not done, but only those files that are listed in the tape log can be retrieved.

To retrieve a file from archive:

1. Determine which tape or disk has the data that you want. The best way to do this is to maintain a book of printed logs. Because IRIS media can contain a wide variety of products, a simple label is not usually sufficient to describe what is on the medium.
2. Load the medium into the drive and set the drive on line.

CAUTION	Caution: Set the write protection on to avoid accidentally writing to the tape by yourself or another operator.

3. Enter the Archive menu and choose **Commands**->**Mount**. Check the information in the log to make sure it is consistent with what you thought was on the medium.

   Now you are ready to tag files for retrieving.
4. Select the files that you want to tag. There are several ways to make your selection:
   - Click the left mouse button over an entry in the log to select it, or press Ctrl and click to select more than one entry.
   - Click and drag the mouse to select a group of entries in the log, or press Ctrl, then click and drag the mouse to select multiple groups of entries.
   - Use the Filter menu to produce a list of the files that you want to retrieve.
5. Choose ->**Retrieve** from one of the following pop-up menus:
   - If you selected the entries with the mouse, position the mouse cursor over the tape log and click on the right mouse button to pop up the menu.
   - If you selected the entries from the Filter menu, click on the Commands button to pop up the menu.

   If you change your mind, untag the file using the ->**Cancel** menu choice.

   When a product is selected for Retrieve, an "r" appears next to its file number. After a file is successfully retrieved, or if it is on disk already, a "d" is displayed next to the corresponding file number. Note that files that are already on disk cannot be tagged for Retrieve.
6. After you have finished tagging the files that you want retrieved, choose **Commands**->**Retrieve**. IRIS positions the tape and copies the

tagged files to the disk. A "d" appears next to a file after it is copied to disk.

You can still tag or untag files even while Retrieve is operating, so don't worry about changing your mind. You may also leave the Archive menu, and the Retrieve process continues its job. For example, you may want to go to the Product Output menu and request output from some of the products that you have restored to disk.

8.7 Stopping an Archive Operation

Use **Commands**->**Stop** to stop the current archive operation. Issuing a Stop command during a Record or Retrieve operation will not damage any files.

The Stop command has different effects depending on the operation being stopped, as follows:

During Record	Stop allows the file currently being written to be completed. If Record is issued again, IRIS resumes recording at the end of the last file.
During Retrieve	Stop finishes retrieving the last file, then stops retrieving. If Retrieve is issued again, the retrieve process continues where it left off.
During Inventory	Stop causes the inventory to halt. The resulting log is incomplete and the Filter Summary shows "Incomplete Log." Retrieve operations that are limited to the part of the log that was completed can still be done. If the Inventory command is reissued, the inventory is started from the beginning of the tape.
During Mount	Stop cancels the Mount operation and rewinds the tape.
During Unmount	Stop has no effect.

8.8 Unmounting a Tape or Disk

The Unmount command causes IRIS to rewind a tape and take the tape or optical disk drive off line. The log information is cleared from the screen. This command must be invoked before a new tape can be mounted.

1. Choose **Commands**->**Unmount**.
2. Wait for the tape to completely rewind, then remove it from the tape drive.

If the media is a DVD, the contents of the temporary buffer used for writing the DVD are flushed to the DVD, i.e., you do not loose the data in the buffer. This may delay the unmounting step by a 20 seconds. If you inadvertently quit IRIS (qiris) without unmounting the DVD, the buffer is flushed in an identical manner (delaying the qiris).

CHAPTER 9
MANAGING INGEST FILES

Ingest files are the data collected from the signal processor each time a TASK runs. An ingest file is not the same as a RAW data product, which stores ingest data in a compressed format. Ingest files are cataloged by their associated TASKS and stored on disk in an ingest summary file. The Ingest Summary menu accesses this file to provide you with a list of all of the ingest files currently on disk.

IRIS uses an automatic Watchdog process to delete old ingest files. The Ingest Summary menu allows you to tag files with a Keep flag so they are not deleted by the Watchdog. This is necessary if you want to save ingest files, including those that have been restored from tape, for non-real time product generation in an analysis mode. For example, you might want to make a product tomorrow from today's ingest data.

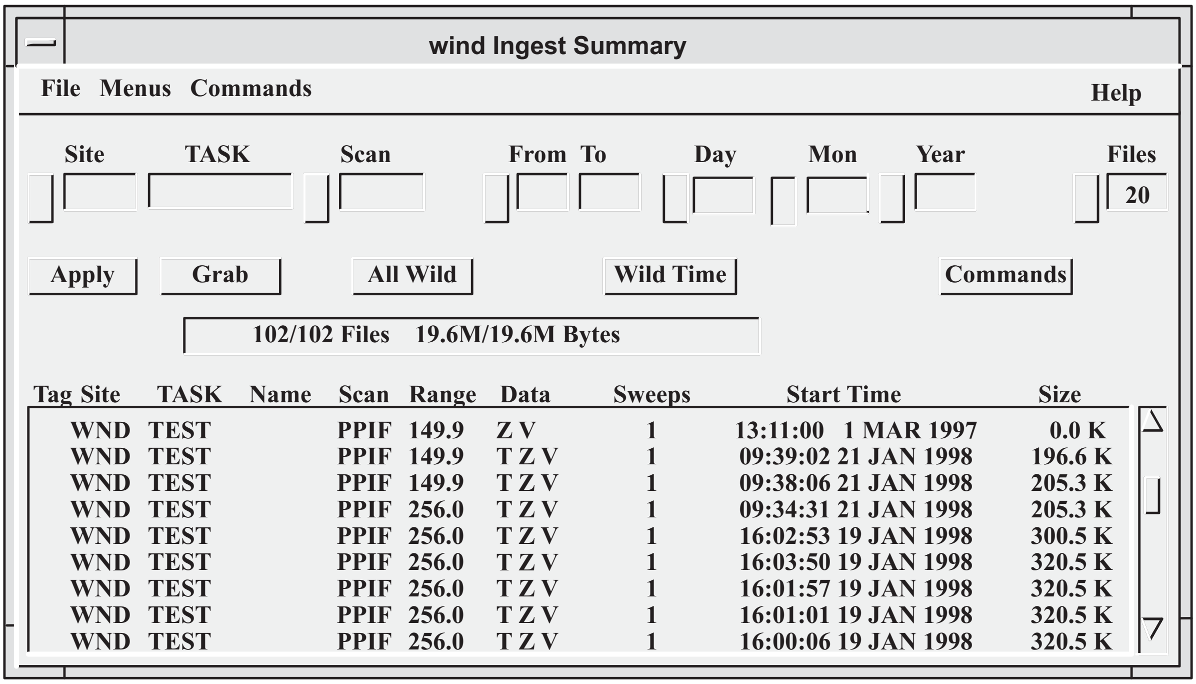
The menu also allows you to delete unwanted files, such as those that were previously tagged as Keep, to free more disk space for new ingest files. Again, the Watchdog normally does this automatically, but tagging files lets you make the decisions as to which files the Watchdog should keep and delete. This is especially convenient when ingest files are restored from tape.

To enter the Ingest Summary menu:

Choose **Menus**->**Ingest Summary** from the IRIS menu bar or from any of the IRIS menus.

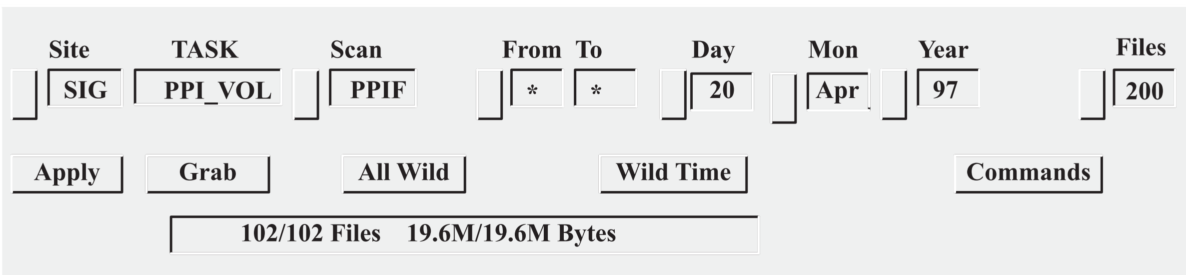
In this chapter:

9.1 Ingest Summary Menu



Filter Menu Filter Menu on page 316	The top part of the menu lets you choose the files that you want to display.
Ingest File List	The bottom of the menu contains the list of ingest files.

9.1.1 Filter Menu



When you first enter the Ingest Summary menu, all possible ingest files are listed at the bottom of the menu. This list can be quite large, making it difficult to find the ones you need. You can use the Filter menu to narrow the list down to only those files that are of interest. By entering values in the filter fields, you can narrow the list by site, TASK, or scan. You can request only those files created within a range of hours, or on a specific month, day or year.

Site

Enter a site ID in this field to select data from only one radar site, or enter the wildcard character to select data from all sites. If you click on the Site button, IRIS pops up a list of known sites. This list differs from system to system, depending on the sites that are configured with the Setup utility.

TASK

Enter the name of a TASK in this field to narrow the list down to only those products generated by a specific TASK. You can include wildcard characters in the TASK name. A question mark (?) matches any single character; an asterisk (*) matches any sequence of zero or more characters. For example, entering a TASK name of *PPI*_? selects all hybrid TASKS that have PPI somewhere in their names.

Scan

Enter a scan type in this field to select products of only one type, or enter the wildcard character to select products of all types. You can pop up a list of types to choose from.

From To

Enter a range of hours in these two fields to narrow the list of files by time of day. You can pop up a list or ranges to choose from.

Day, Month, Year

Enter a day, month. or year to narrow the list of files by date. You can pop up a list of values to choose from.

Files

The Files field lets you control how many files to include in the list.

Apply

Click on the Apply button to update the product list, based on your selection criteria. The Apply button is enabled only if the Filter button is pushed in. If the Apply button is grayed out, click on the Filter button.

Grab

If a product is selected, the Grab button inserts the product's site, type, product name, TASK and date information into the filter fields.

All Wild

Click on the All Wild button to return all the fields to the wildcard character.

Wild Time

Click on the Wild Time button to change only the hours, month, day and year fields to the wildcard character.

Commands

Pops up the following list of operations that you can perform on the ingest files selected by the Filter menu:

Keep
Clutter
Un–Tag
Delete

Keep tags all selected files with the keep flag.

Clutter tags a selected file as a clutter map.

Un-Tag removes delete or keep flags from the selected files.

Delete tags all selected files with the delete flag.

9.1.2 Ingest File List

102/102 Files   19.6M/19.6M Bytes

Tag	Site	TASK	Name	Scan	Range	Data	Sweeps	Start Time	Size
	WND	TEST		PPIF	149.9	Z V	1	13:11:00 1 MAR 1997	0.0 K
	WND	TEST		PPIF	149.9	T Z V	1	09:39:02 21 JAN 1998	196.6 K
	WND	TEST		PPIF	149.9	T Z V	1	09:38:06 21 JAN 1998	205.3 K
	WND	TEST		PPIF	256.0	T Z V	1	09:34:31 21 JAN 1998	205.3 K
	WND	TEST		PPIF	256.0	T Z V	1	16:02:53 19 JAN 1998	300.5 K
	WND	TEST		PPIF	256.0	T Z V	1	16:03:50 19 JAN 1998	320.5 K
	WND	TEST		PPIF	256.0	T Z V	1	16:01:57 19 JAN 1998	320.5 K
	WND	TEST		PPIF	256.0	T Z V	1	16:01:01 19 JAN 1998	320.5 K
	WND	TEST		PPIF	256.0	T Z V	1	16:00:06 19 JAN 1998	320.5 K

The Ingest Summary list is sorted by time, with the newest files listed first.

Tag

This field displays "k" for Keep, "d" for Delete, or blank if no flag is set.

Site

The Site field shows the site ID for the radar site from which data were gathered.

TASK

The TASK field contains the name of the TASK.

Scan

The Scan field contains type of scan used to collect the data, such as RHI or PPI.

Range

This field contains the value of the Max Range field, taken from the TASK configuration.

Data

The Data field lists the data parameters — Z, T, V, W — for the TASK.

Sweeps

The sweeps field shows the number of sweeps that were collected by the TASK. If the scan was halted prematurely, this column displays the partially completed TASK as N/M, even if the TASK was halted partway through the final sweep.

Start Time

The Start Time field shows the time that the TASK started to collect data.

Size

The Size field shows the total amount of disk space occupied by the ingest files for this run of the TASK.

Pop-up Menu

You can select an entry in the list, position the mouse cursor over any of the fields, and pop up the following menu of commands:

Keep tags all selected files with the keep flag.

Clutter tags a selected file as a clutter map.

Un-Tag removes delete or keep flags from the selected files.

Delete tags all selected files with the delete flag.

9.2 Tagging and Untagging Files

CAUTION	Caution: Deleting files may interfere with subsequent product generation. Be sure that a file is not required for product generation before you delete it. The only circumstance that may require manual deletion is when you need to make room when restoring a RAW file from tape.

1. Select one or more files from the list. There are several ways to make your selection:
   - Click the left mouse button over an entry in the list to select it, or press Ctrl and click to select more than one entry in the list.
   - Click and drag the mouse to select a group of entries in the list, or press Ctrl, then click and drag the mouse to select multiple groups of entries.
   - Use the Filter menu to produce a list of the ingest files that you want to tag.

2. Choose ->**Keep**, ->**Delete**, or ->**Un-Tag** from one of the following pop-up menus:

   - If you selected the entries with the mouse, position the mouse cursor over the ingest file list and click on the right mouse button to pop up the menu.
   - If you selected the entries from the Filter menu, click on the Commands button to pop up the menu.

   The files are then marked with a "k" for keeping, a "d" for deleting, or the tags are removed, depending on the command you chose.

CHAPTER 10
CHOOSING OVERLAY FILES

An overlay is a display, such as a geopolitical map or latitude/longitude grid. It is displayed on top of a radar product, such as a TRACK or CAPPI product, to give it more visual appeal and meaning.

Overlays are text files containing the coordinates of the lines in the map or grid, possible icons and text such as city names. They are created by operators or system managers and stored in a central location on the IRIS system. Each overlay is associated with a particular radar site, and there can be many overlays for any one site. The Overlay menu lets you pick which overlay to use when displaying products from the various sites connected to your system.

When displaying a product with an overlay, IRIS can make adjustments for changes in the radar location up to 1000 km. For instance, if a radar is located on a ship at sea, IRIS can shift the overlay to match the ship's movement.

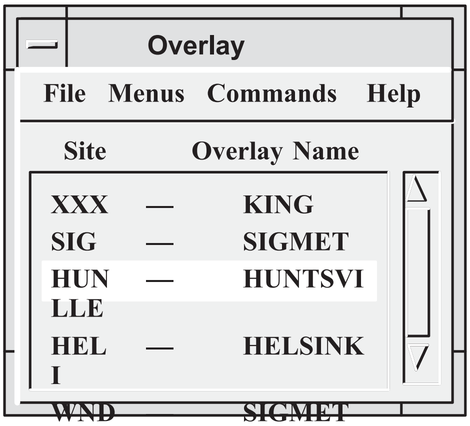
To enter the Overlay menu:

Choose **Menus**->**Overlay Menu** from the IRIS menu bar or from any of the IRIS menus.

In this chapter:

For information on creating overlay files, and where to store them for system-wide use, see the **overlay** utility chapter of the *IRIS Utilities Manual*.

10.1 Overlay Menu



Each entry in the Overlay menu contains the ID of a radar site and the name of an overlay file used when displaying information from that site. The list of sites and overlays differs from system to system, depending on the radar sites connected to the system.

Site ID

A site ID is a three-letter abbreviation for a radar site. It is assigned by the system manager using the Setup utility. The XXX site ID is present on all IRIS systems. It is the ID for unknown sites.

NOTE	Hint: Set the XXX overlay to the default overlay for your radar site, or the site from which radar data are most likely to come.

Overlay Name

An overlay name is the name of the text file containing the map or grid. These files are stored in a central location on your system and maintained by the system manager.

10.2 Assigning an Overlay to a Radar Site

The IRIS system manager associates a default overlay file for each site connected to the system. You may assign a different overlay to the site, as follows:

1. In the Overlay Menu, highlight the site that you want to change and pop up a list of overlays available on the system. on page 323 shows

a pop-up menu containing two overlays for the HEL site — HELSINKI and KARTTA.

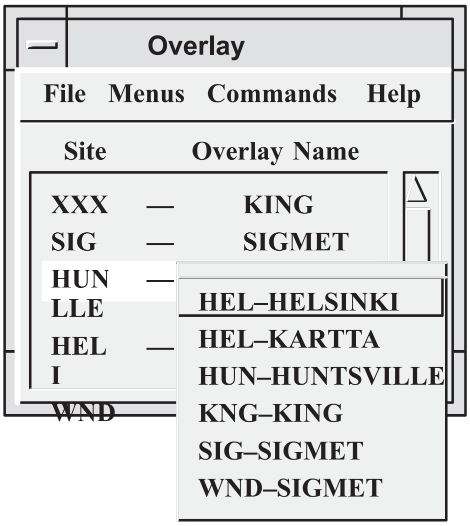


Figure 27Overlay Menu with Pop-Up Menu

2. Choose an overlay from the list.

   There is nothing to prevent you from choosing an overlay that is invalid for a radar site. Therefore, the pop-up menu also shows the site IDs for which the overlay is valid. If you try to display a product with an invalid overlay, IRIS displays the message, "Overlay origin more than 1000 km from radar location." If you should get this message, check that the correct overlay is assigned to the radar site.

APPENDIX A
BASIC RADAR METEOROLOGY

These notes are intended to help you to brush up radar meteorology and to introduce you to English terminology used in IRIS manuals.

A.1 Introduction

A weather radar sends pulses of microwaves and measures, how much is reflected by targets in the atmosphere. "Targets" are mainly raindrops, hail, snow.

A radar antenna focuses the microwaves to a beam of 1 degree. The beam grows wider in distance: at distance of 200 km it is already 4 km wide !

Microwaves travel at the speed of light. Measuring the time when the reflection comes back to antenna, we can count how far the target is.

When a microwave pulse meets some raindrops, very small amount is reflected (scattered) and most of the waves go on. This is because typically raindrops are size of 1 mm distance of 10 cm from each other. This means we can see "rain behind the rain". This also means a radar has to be very sensitive: we send about 250 kW and receive 10^{-13} W.

We can move the antenna up and down (elevation) and round in horizontal plane (azimuth). Typically, in a measurement task, we take a low elevation and measure in all azimuths, then increase the elevation a little, and measure in all azimuths again, and so on, so we get data from all directions at different ranges. This pack of data is called a polar volume, "polar" because it is measured in polar coordinates the center being the antenna.

The radar alternates between sending and receiving at "pulse repetition frequency", (PRF). That is typically between 100 and 1000 times a second. When the antenna is moving in azimuth direction all the time, each pulse is sent in slightly different direction. In signal processing, we process the data from same distance from different pulses. These are called samples. Slices in distance which are processed are called bins. In the image in next page, value of each bin is processed from four samples. The distance between samples is determined by antenna speed and PRF. To get reasonable values, usually some 32–128 samples are processed together.

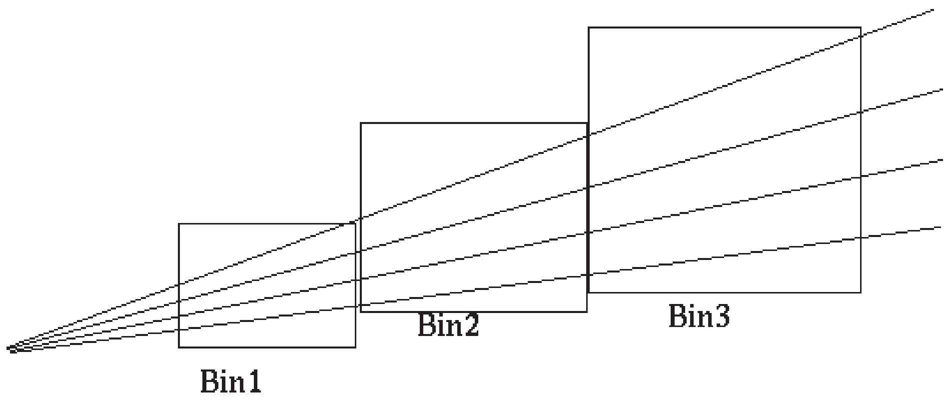


Figure 28 Range Bin Geometry

A.2 Reflectivity

It is convenient to say things in atmosphere reflect the radiation, but backscattering is the accurate physical term. It is measured in Z (radar reflectivity factor) and often expressed in dBZ (radar reflectivity).

The famous radar equation from classical optics says

$$Z = \frac{\mathrm{Pr}^2}{LCK} \quad \text{where}$$

- P is the measured average power (in Watts) of several samples at the radar
- r is the range to the bin
- L is attenuation
- C is radar (hardware) constant
- K is the refractive index and depends on the dielectric properties of the particle

So for meteorologists

$$Reflectivity = \frac{(Watts\_Received * Distance\_Squared)}{(Attenuation * Hardware\_Constant * Rain\_or\_Snow\_Constant)}$$

For cloud physics, Z is a sum $\sum N_i D^6_i$ where N_i is the number of particles with diameter D_i per unit volume in the atmosphere. That means, that one droplet with diameter 4 mm gives 4096 times as much energy as a 1 mm droplet. And that we can't know if there is one droplet of 2 mm or 64 droplets of 1 mm.

Z varies between 0.001 and 10 000 000. To get understandable numbers, we use decibel scale:

$$dBZ = 10 \log \frac{(Z\ mm^6 m^{-3})}{(1\ mm^6 m^{-3})}$$

Typical values for various phenomena in the atmosphere are shown in figure below. You can see that reflectivity strength alone is not enough for target identification !

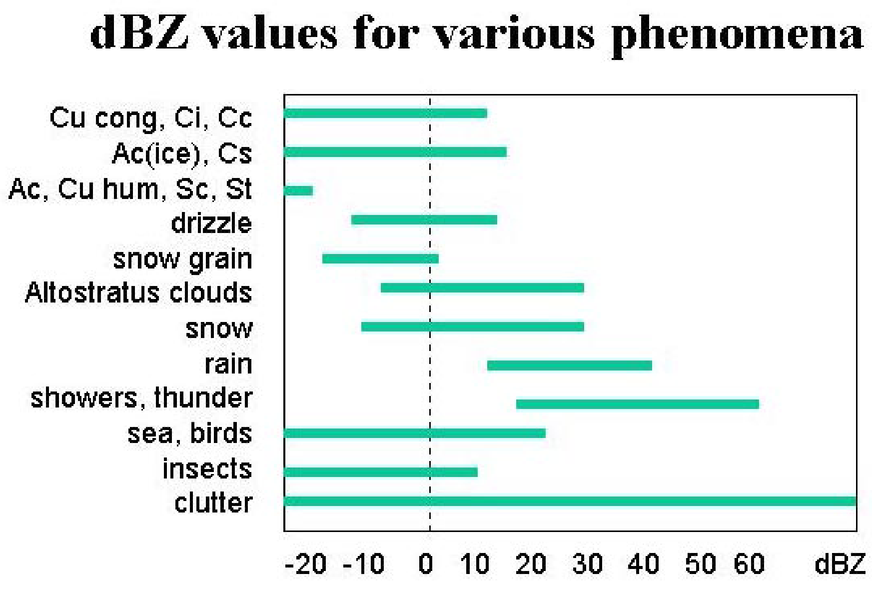


Figure 29 dBZ Values for Various Phenomena

For hydrology, we need an equation to combine radar reflectivity to rainfall rate. All of these equations are empirical and approximate, since Z is proportional to D6 and precipitation rate R (mm/h) is proportional to D3.7. Also, we have to assume something about drop sizes. For 64 drops of diameter 1 mm or one drop, diameter 2 mm, Z is same, R is not ! Good first guess is the classical Marshall Palmer equation

$$Z = 200R^{1.6} \text{ which equals to } R=(Z/200)^{0.625}$$

A.3 Geometry

Earth is spherical. Microwaves do not follow the surface. Because of the atmospheric optics, they usually bend down a bit, at a radius of 4/3 the earths. In the picture below is shown the height of some radar beams as function of distance from radar at different elevations.

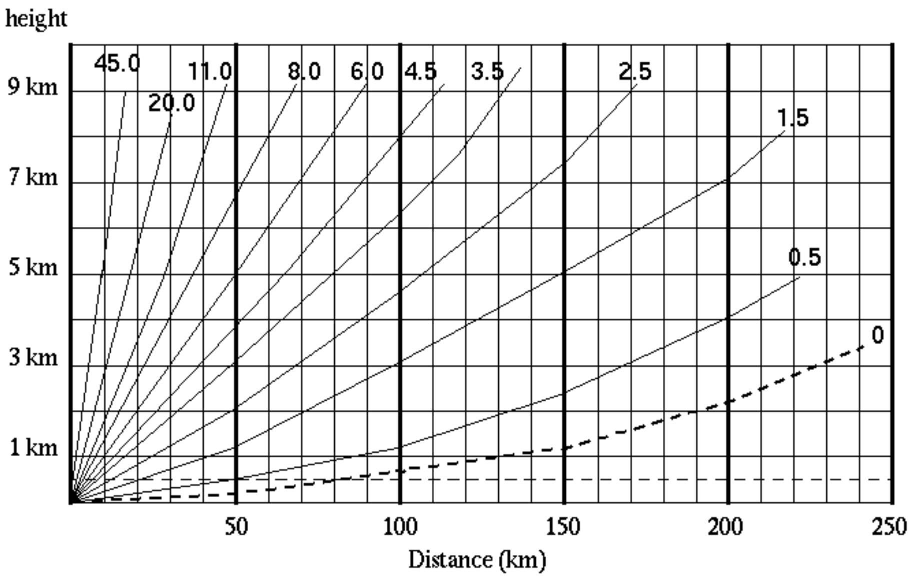


Figure 30 Beam Height vs. Range

Though nominal beam width is 1 degree, some energy is spread to other angles, too. These are sidelobes.

A.4 Problems in interpretation of radar images

Echoes not related to rain

- Reflection of microwaves from ground or water surface, radar mirage
- Birds, insects, chaff from aeroplanes
- Solid targets such as masts and buildings
- Other microwave sources such as the sun and other radars
- Second trip echoes

Echo intensity differences not related to differences in precipitation intensity

- Calibration issues: nowadays electrical calibration can effect 2–3 dB.
- Beam blocking: Near antenna buildings can shade partially or totally echoes from certain direction
- Attenuation in rain: echoes behind heavy rain can disappear especially if wavelength is small. Attenuation correction can compensate if echo is too weak but can not help if there is no echo.
- Water phase: ice, melting ice and water scatter microwaves differently. Bright Band can be 7 dBZ
- Drop size: especially melting hail. 2 mm droplet = 64 of 1 mm droplets

Even if the measurement is OK, there isn't a 100% correlation with a gauge

- Far from antenna the beam is rather high. It can overshoot a precipitating cloud. Or the rain can evaporate below the measurement height. Orographical enhancement can take place. In cold winter winter, difference can be 10 dB between measurement height and surface. Vertical reflectivity profile correction can help to fix quantitative errors, but if there is no measurement the correction does not help.

A.5 Doppler wind measurements

Doppler radar has two advantages to a non-Doppler radar: clutter cancellation and wind products.

A Doppler radar measures speed of the reflector like a policeman's traffic radar. More specifically, it studies the phase how the phase of microwaves compared to the sent pulse is changing between samples (see page 1). (To get good Doppler measurements, we need plenty of samples processed together (64 is good). This sets limits to antenna speed.)

- A non-moving target has no phase shift.
- A target whose movement has no component in direction of the radar beam, has no phase shift.
- A phase shift of exactly 2p looks like no phase shift.
- A phase shift of 2p+d looks like phase shift d.
- A phase shift of n*2p+d looks like phase shift d. This is called aliasing.

The maximum speed which can be measured unambiguously is

$$V_{\max} = \frac{PRF * \lambda}{4}$$

where λ (lambda) notes wave length.

Typical PRFs in weather radars are between 250 and 1200 Hz. Why doesn't everybody just use 1200 Hz and get nice winds ? Because PRF also determines the maximum unambiguous range.

$$R_{\max} = \frac{c}{2 * PRF} = \frac{SpeedOfLight}{2 * PulseRepetitionFrequency}$$

This leads us to the Doppler dilemma: we can measure either high speeds or far away from radar - and we want both. That is why there is Dual PRF techniques, some single PRF algorithms and hybrid tasks employing different PRF for different elevations.

A.6 Clutter cancellation

We can define *clutter* as echoes from hills, buildings, masts, sea, and *noise* as marks in the image caused by electronics of the equipment. Goal of clutter cancellation is to remove clutter without distroying rain data

To illustrate a Doppler filter we study speed spectra of a bin. That is, Doppler speed of each sample (see page 1), horizontal axis being speed (towards or away from radar, zero in the middle). If all samples indicate no speed we know the target is not moving. However, even antenna movements gives some speed. And there is cases when it's raining at the hills.

The next image shows a Doppler spectra from a bin, which contains clutter (speed near zero) and rain moving toward the radar (big hump on the left) as well as some noise (small humps everywhere, seen alone on the right). To find the right settings for the Doppler filter, we can move the red lines closer to each other (less rain data is destroyed) or further from each other (more clutter is cancelled).

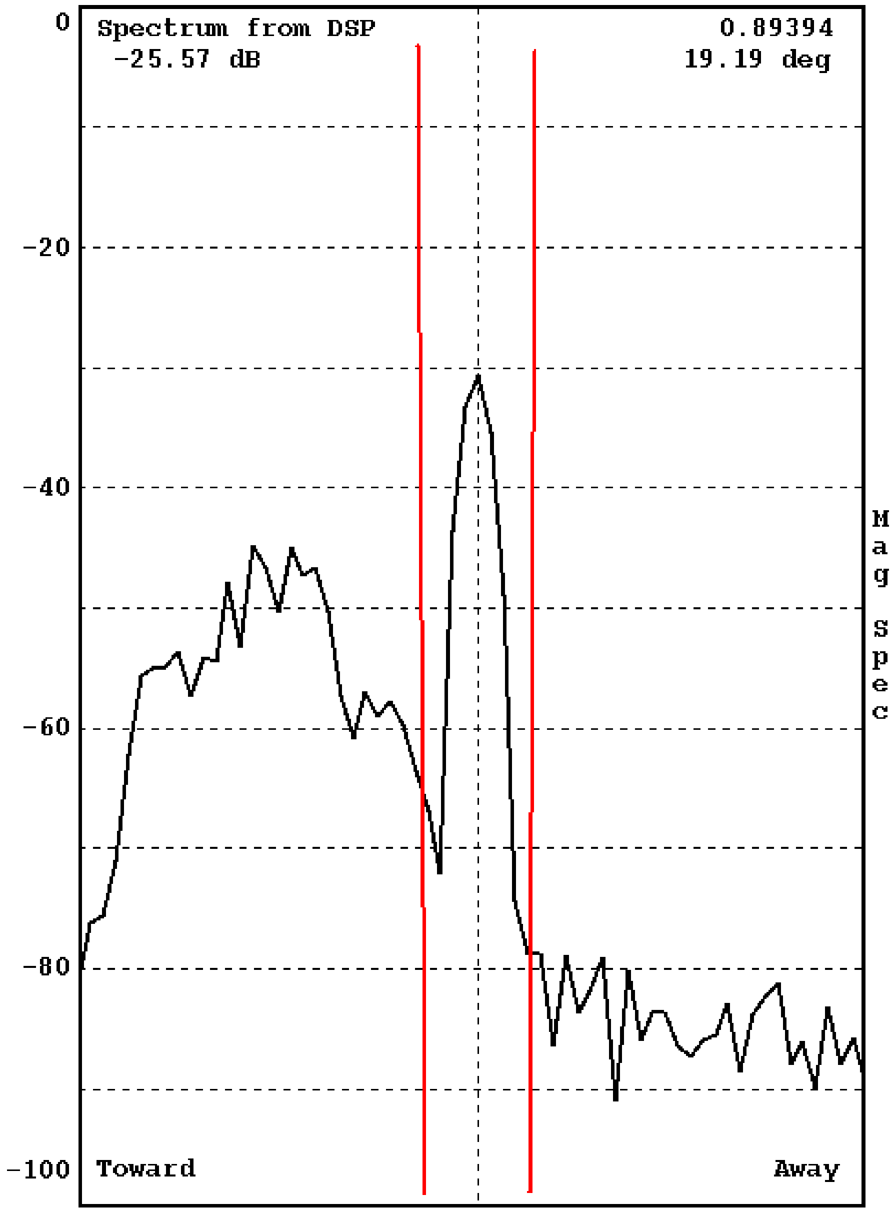


Figure 31 Typical Spectrum Plot

APPENDIX B
PRODUCT CONFIGURATION EXAMPLE

This appendix provides two examples of a set of operational parameters for IRIS, and convenient naming conventions for TASKS and products. The intention is to provide you with a starting point for defining the standard operational mode that is best for your particular application.

IRIS is a flexible system that lets you configure a variety of scan geometries and products. The IRIS configuration in the Radar Status menu provides a convenient mechanism for creating and saving entire sets of IRIS operating parameters. There are two operating modes illustrated here:

Weather Monitoring This is an IRIS configuration named MONITOR, optimized for general weather monitoring and product generation.

Wind Shear Alert Configured for each active runway of an air terminal. These shall be referred to as Terminal Doppler Weather Radar (TDWR) modes. They are optimized for the timely and accurate detection of wind shear events (requires optional SHEAR product).

Each of these modes of operation has a separate IRIS configuration and is described separately.

For installations whose primary responsibility is wind shear detection, you must switch between modes of IRIS operation by changing the IRIS configuration name in the Radar Status menu. For example, if there is no significant weather in the immediate area, the IRIS configuration is set to MONITOR. If there is weather in the wind shear detection zone, the IRIS configuration is set to a TDWR mode. An automatic Warning product in the MONITOR configuration (called SEVERE) signals when to switch into TDWR mode. After weather departs the terminal area, you manually reset the IRIS configuration back to the MONITOR mode in the Radar Status menu.

Note that to change the IRIS configuration, you must first turn off the Radar Process and Product Generator to deactivate IRIS. The various IRIS configurations are presented in the following sections.

In this appendix:

B.1 Summary of Configuration Examples

Table 7 MONITOR MENUS

Menu	Name
Radar Status	MONITOR (or DEFAULT)
TASK Scheduler	MONITOR
Product Scheduler	MONITOR
Product Output	MONITOR

Table 8 MONITOR Products

Product Type	Product Name	Associated TASK	Display Parameter	Configuration Parameter	Range
CAPPI	Z_010_120	PPI_VOL	Z	1.0 km Height	120
	Z_020_240	PPI_VOL	Z	2.0 km Height	240
	Z_030_240	PPI_VOL	Z	3.0 km Height	240
	Z_050_240	PPI_VOL	Z	5.0 km Height	240
	Z_100_240	PPI_VOL	Z	10.0 km Height	240
	Z_150_240	PPI_VOL	Z	15.0 km Height	240
MAX	Z_0_16_240	PPI_VOL	Z max	0 – 16 km Height	240
PPI	Z_005_300	SURVEILLANCE	mm liquid	0.5 Elevation	300
RAIN1	HOURLY	PPI_VOL	mm liquid	1 km CAPPI	240
RAINN	03_HOUR	PPI_VOL	mm liquid	3 hour rain	240
	06_HOUR	PPI_VOL	mm liquid	6 hour rain	240
	12_HOUR	PPI_VOL	mm liquid	12 hour rain	240
	24_HOUR	PPI_VOL	mm liquid	24 hour rain	240
RHI	Z_XXX_100	RHI	Z	Selectable AZ	100
TOPS	10_DBZ_240	PPI_VOL	height	10 dBZ Contour	240
TRACK	TRACK1	-NA-	-NA-	-NA-	-NA-
	TRACK2	-NA-	-NA-	-NA-	-NA-
VIL	010_180_240	PPI_VOL	mm liquid	1 to 18 km layer	240
VVP	VVP	VVP	wind	10 km height	60
WARN	SEVERE	PPI_VOL	message	3 km dBZ>30	240
XSECT	Z_SECTION	PPI_VOL	Z	Selectable Location	
	V_SECTION	PPI_VOL	V	Selectable Location	

Table 9 TD_RWY_09 Menu Configuration Names

Menu	Name
Radar Status	TD_RWY_09
TASK Scheduler	TDWR
Product Scheduler	TD_RWY_09

Table 9 TD_RWY_09 Menu Configuration Names (Continued)

Product Output	TDWR

Table 10 TD_RWY_09 TASKS

TASK Name	Purpose
TDWR	Sector scanning over runway 09/27 at elevations .09 and 1.0

Table 11 TD_RWY_09 MONITOR Products

Product Type	Product Name	Associated TASK	Display Parameter	Configuration Parameter	Range
PPI	010_RWY_09	TDWR	Z	EL 1.0 degrees	30
SHEAR	009_RWY_09	TDWR	Shear	EL 0.9 degrees	30
	010_RWY_09	TDWR	Shear	EL 1.0 degrees	30
WARN	RWY09	TDWR	Shear >10 m/s/km for both		30
			0.9 and 1.0 EL angles. 3km^2 area.		

B.2 Setting Up the Weather MONITOR Mode

Step 1. Configure the Monitor TASKS

See the IRIS Radar Manual for instructions on this.

Step 2. Configure the MONITOR Products

The product mix for the MONITOR mode is summarized in Table 8 on page 335. This table also illustrates convenient naming conventions for products. For example Z_05_300 denotes a reflectivity PPI at elevation 0.5 degrees out to 300 km. Note that the name of the radar and the type of product, such as CAPPI, is given in menu and filename so it's not necessary to include them in product name. A special CAPPI product called Ground is made to be used as input for RAIN1 (just one height near the ground level) so it's an exception to the general naming convention. These conventions make it easier to identify the product by name. The Product Configuration menus for each product are shown in on page 337 through on page 349. Note that configurations for the two TRACK products are not discussed explicitly, because they require only the name of the product — TRACK1 and TRACK2.

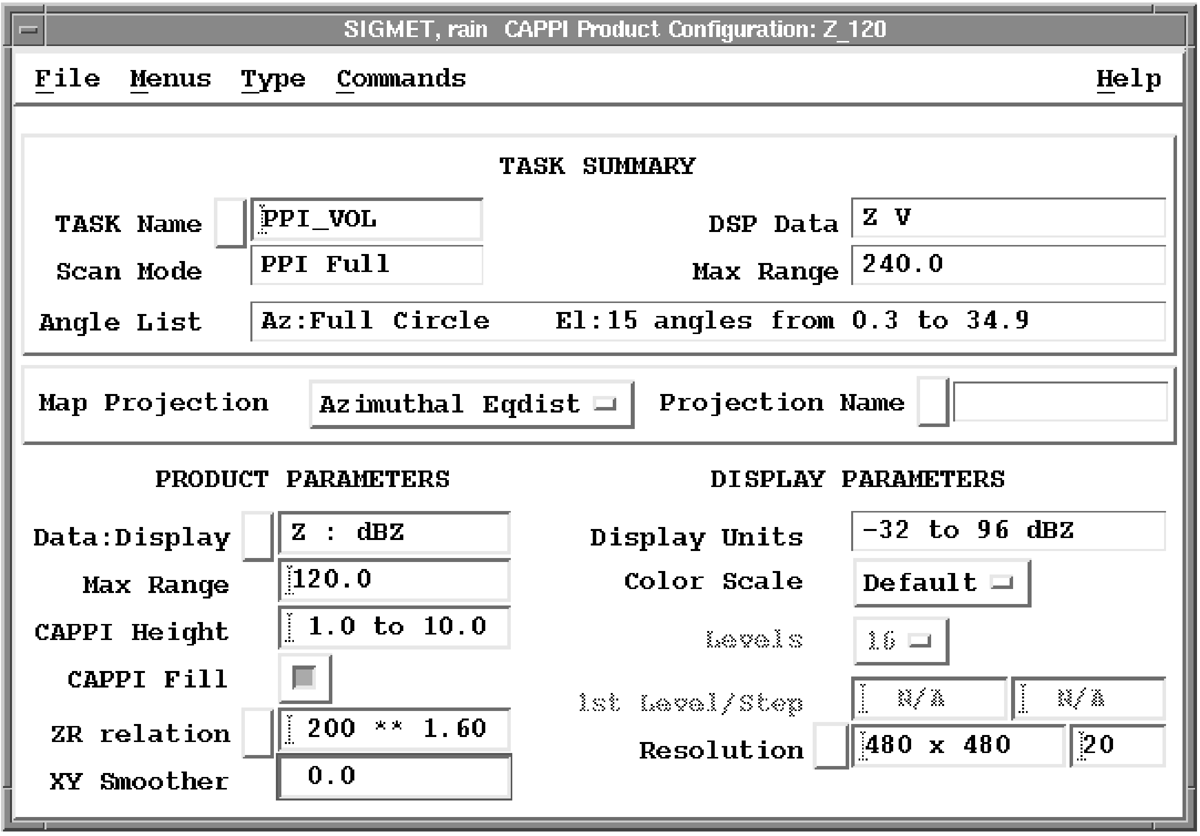


Figure 32 Z_120 CAPPI Product Configuration

This CAPPI is intended to be input for the RAIN1 product. Last number in resolution is 1 indicating that here is only one CAPPI Height.

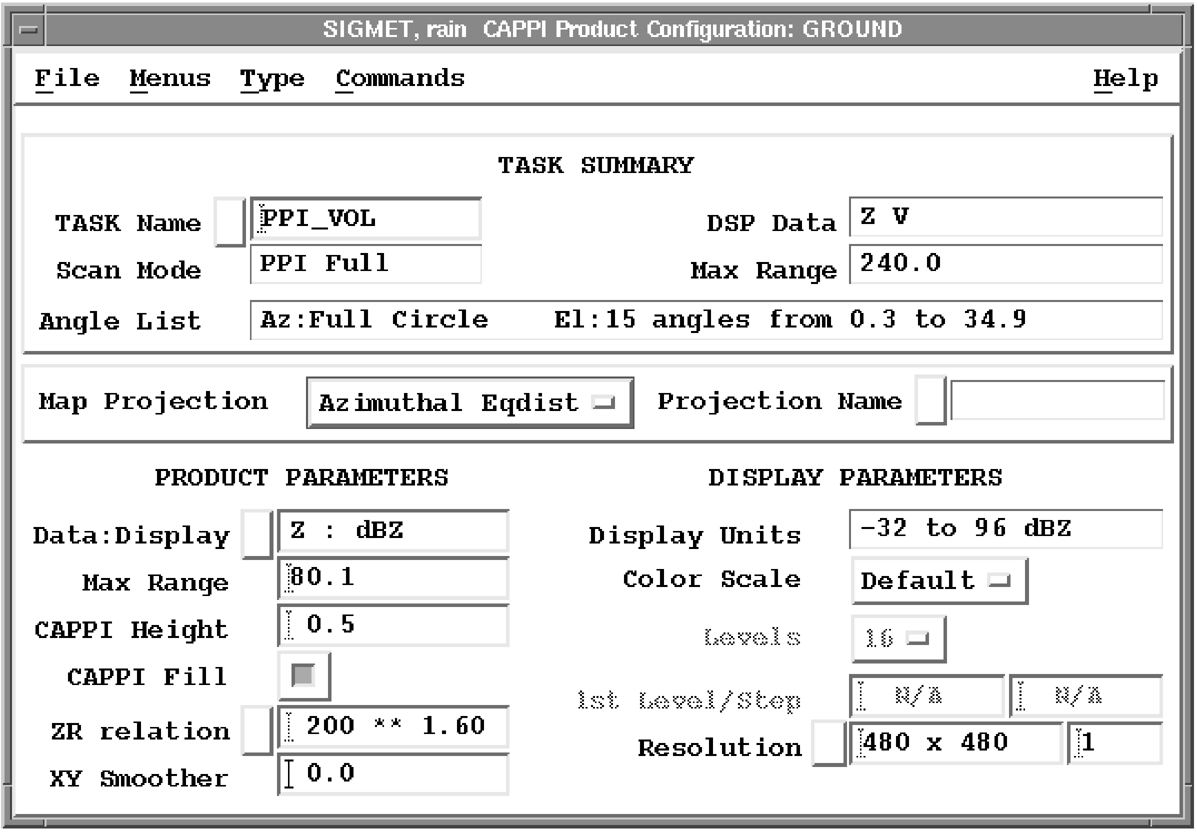


Figure 33 GROUND CAPPI Product Configuration

In MAX, the last number of resolution sets the height of the side panels.

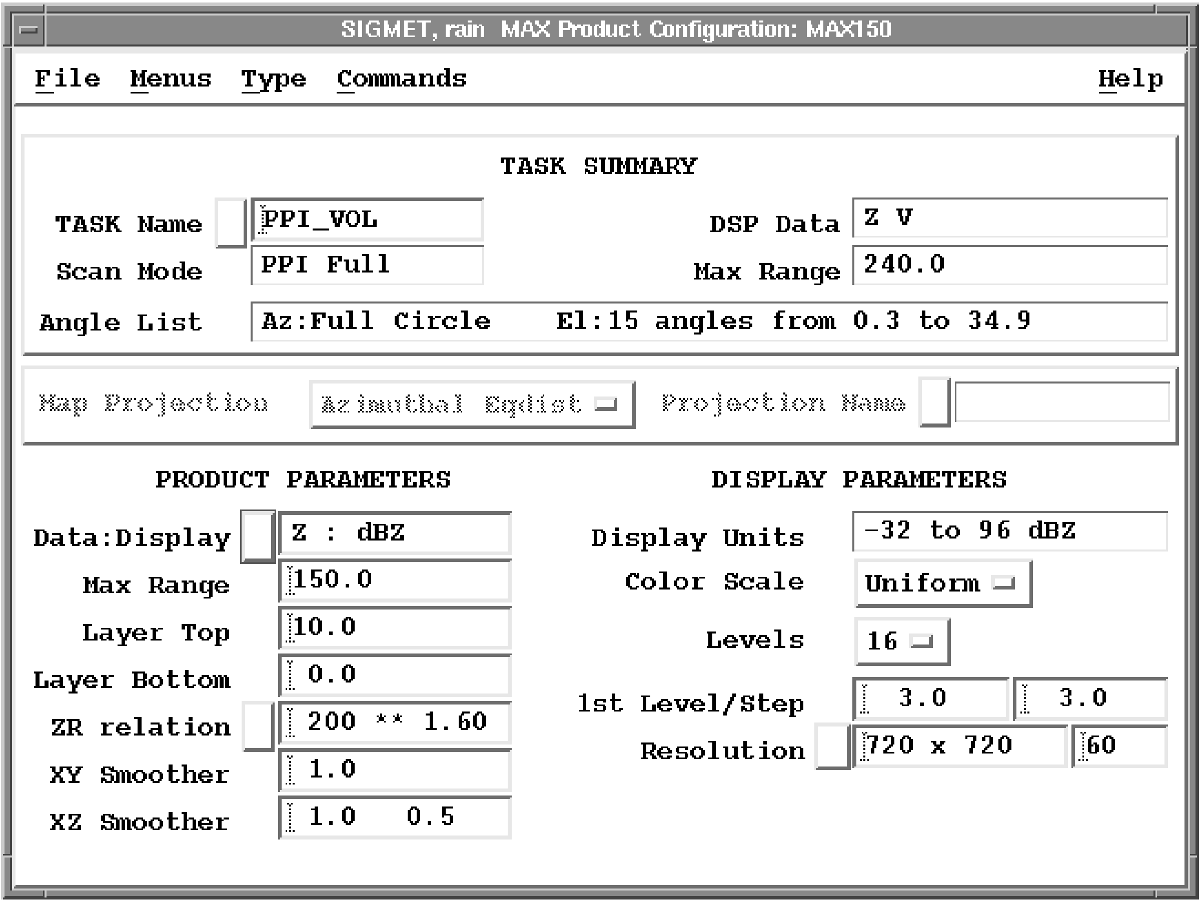


Figure 34 MAX150 MAX Product Configuration

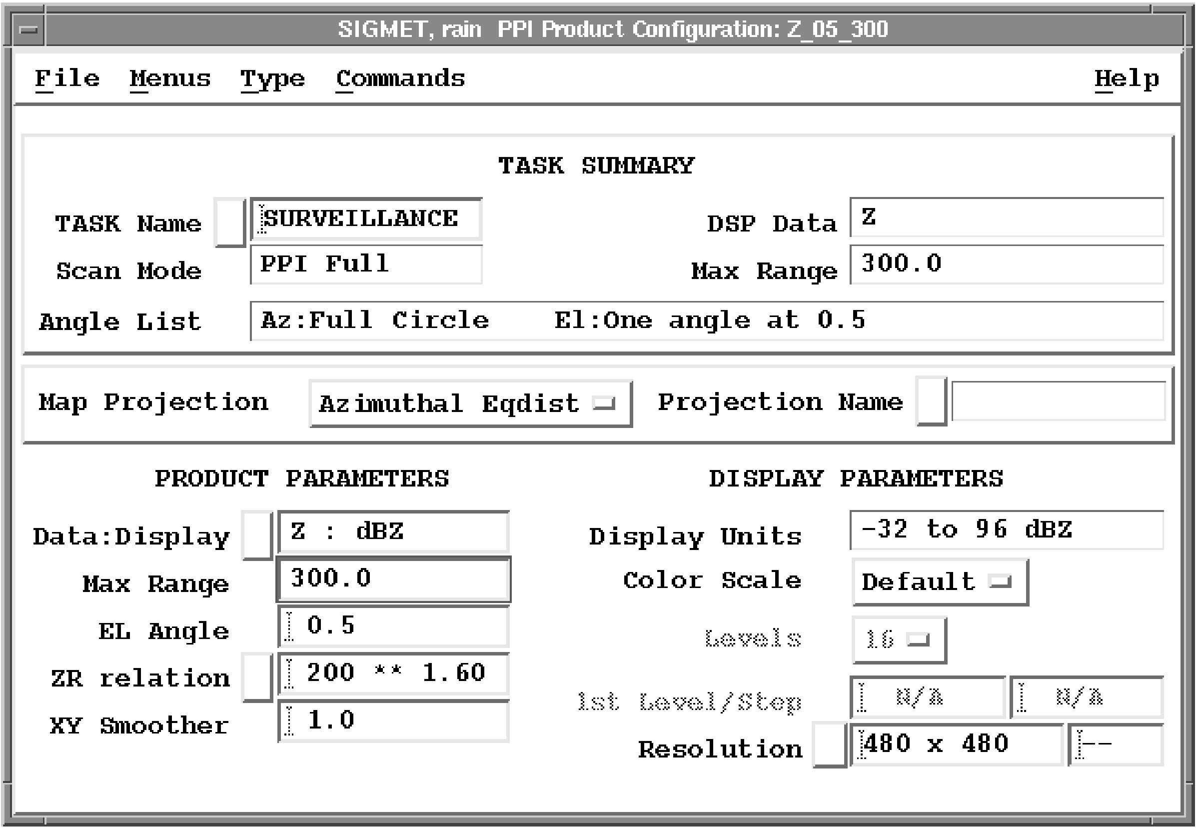


Figure 35 Z_005_300 PPI Product Configuration

Note that you have to schedule and run the GROUND CAPPI product at least once before you can configure this one.

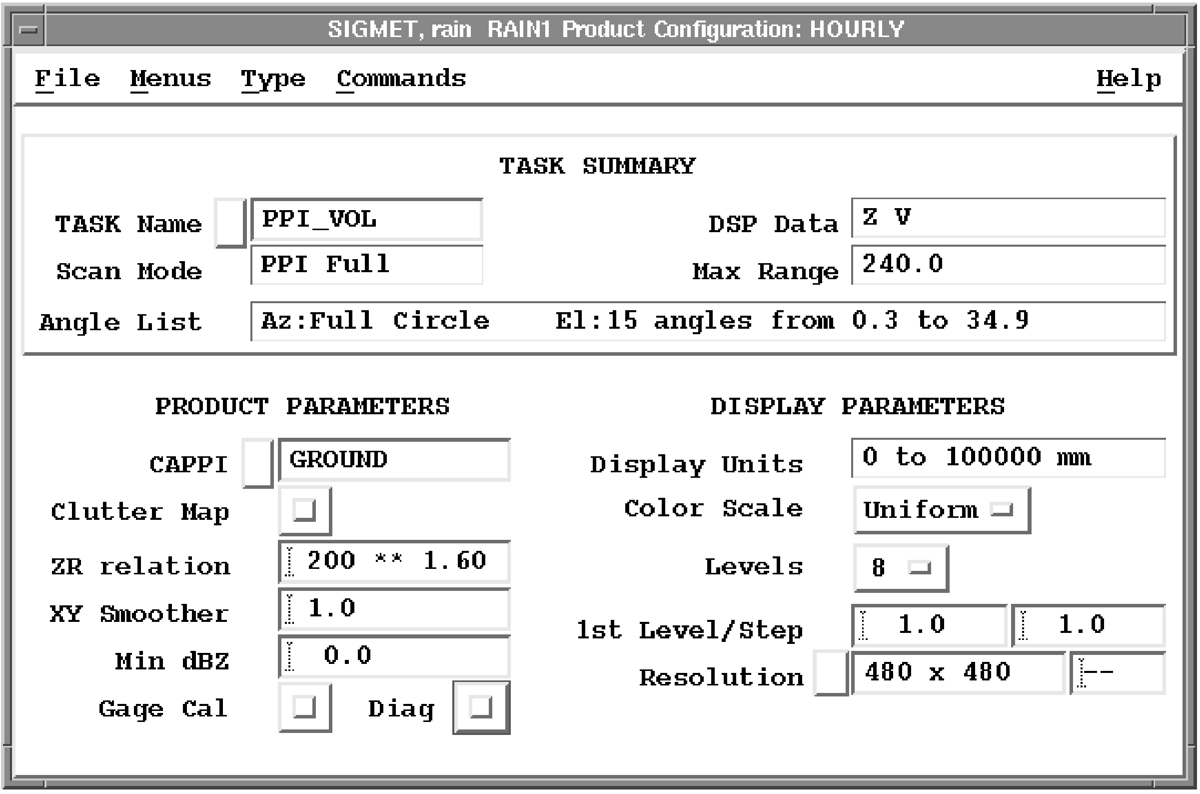


Figure 36 HOURLY RAIN1 Product Configuration

Note that you have to schedule and run the HOURLY RAIN1 product at least once before you can configure this one.

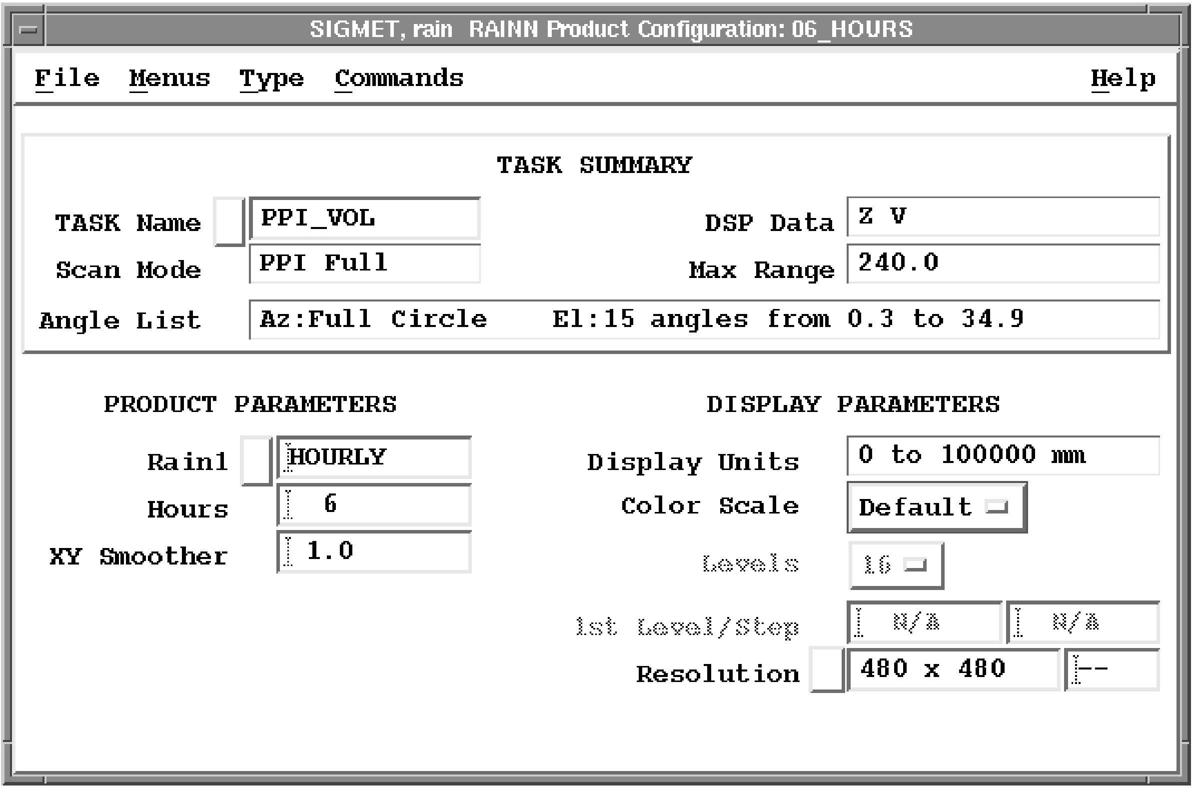


Figure 37 06_HOURS RAINN Product Configuration

Configuration of the other RAINN Products is similar except for the time.

- 03_HOUR
- 12_HOUR
- 24_HOUR

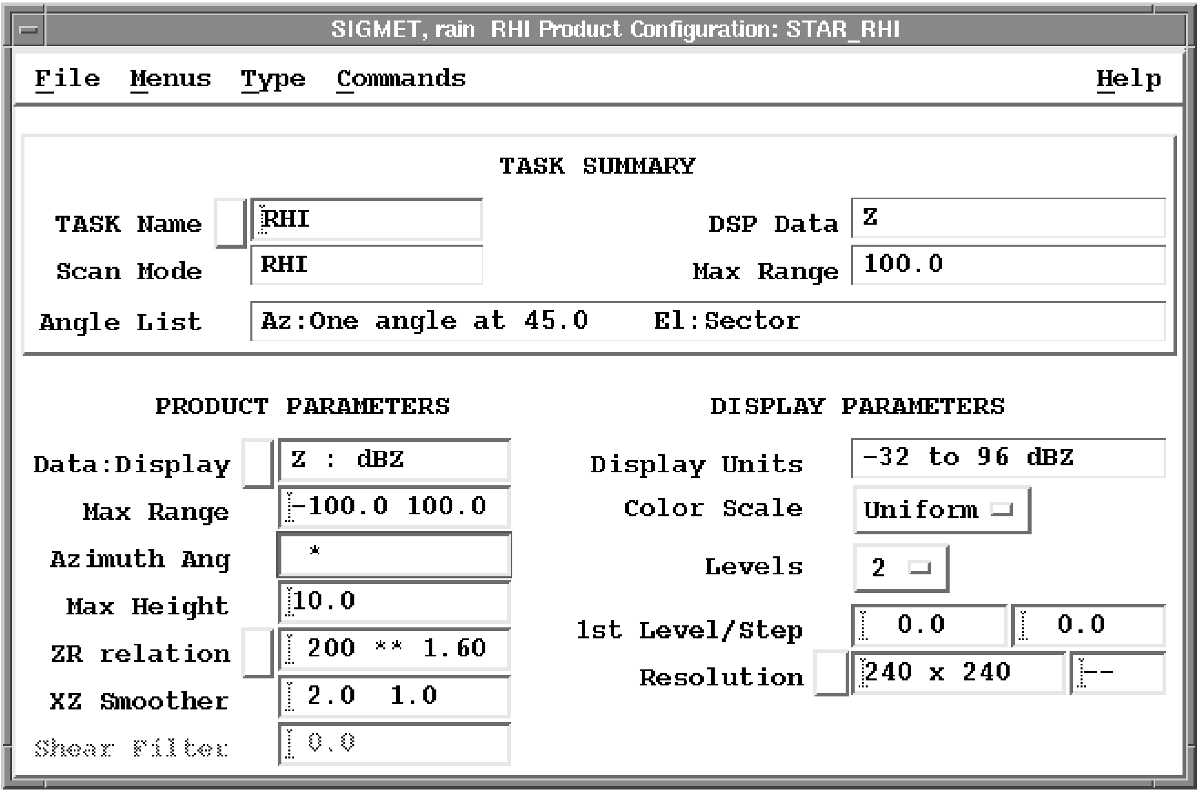


Figure 38 STAR_RHI RHI Product Configuration

When azimuth angle is not specified but marked with an asterisk, IRIS will make a product for each of the scanned azimuths. Negative start range indicates "behind my back" or the other side of antenna, and lets you include two elevations (with distance of about 180 degrees) in the same picture.

Here the dBZ contour is selected to 10 dBZ to determine the top of precipitation.

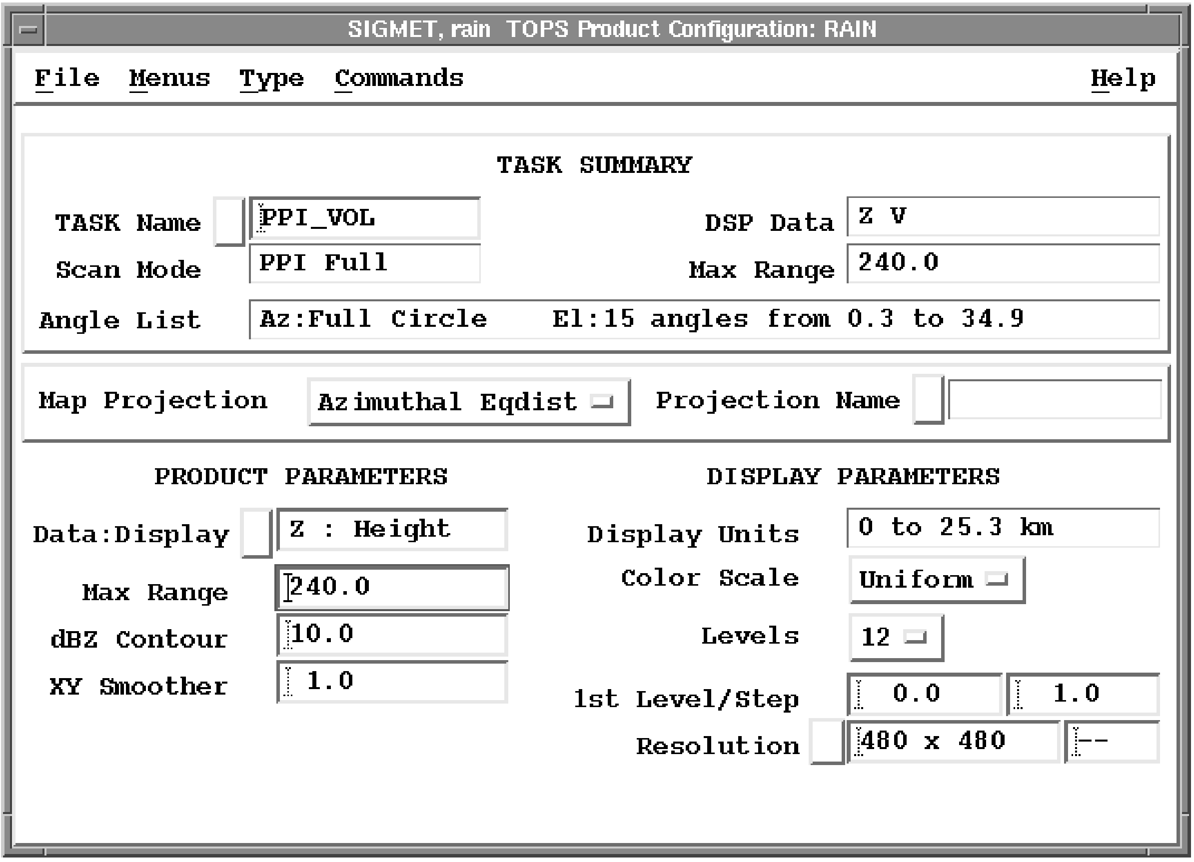


Figure 39 RAIN TOPS Product Configuration

Here the contour is set to -10 dBZ to detect the tops of any clouds near the radar. Note that this might go below the smallest detectable signal at far ranges.

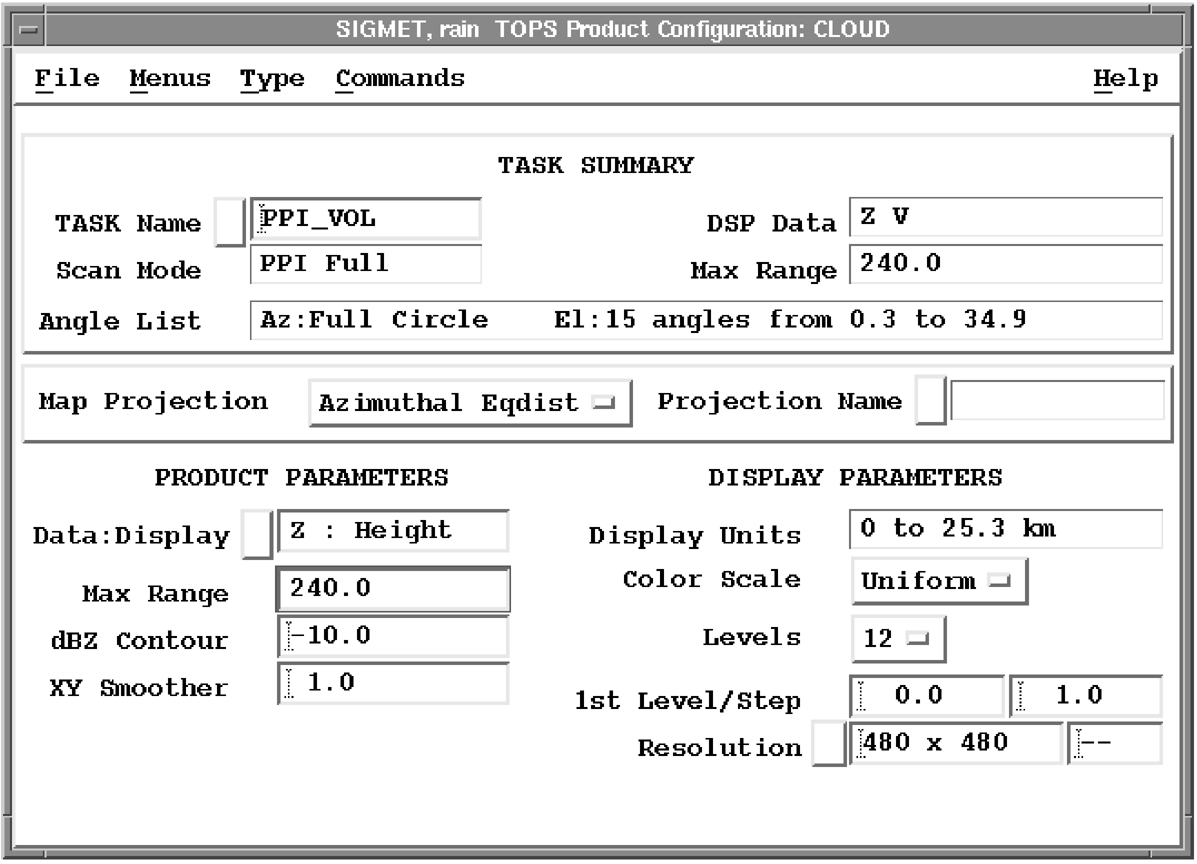


Figure 40 CLOUD TOP Product Configuration

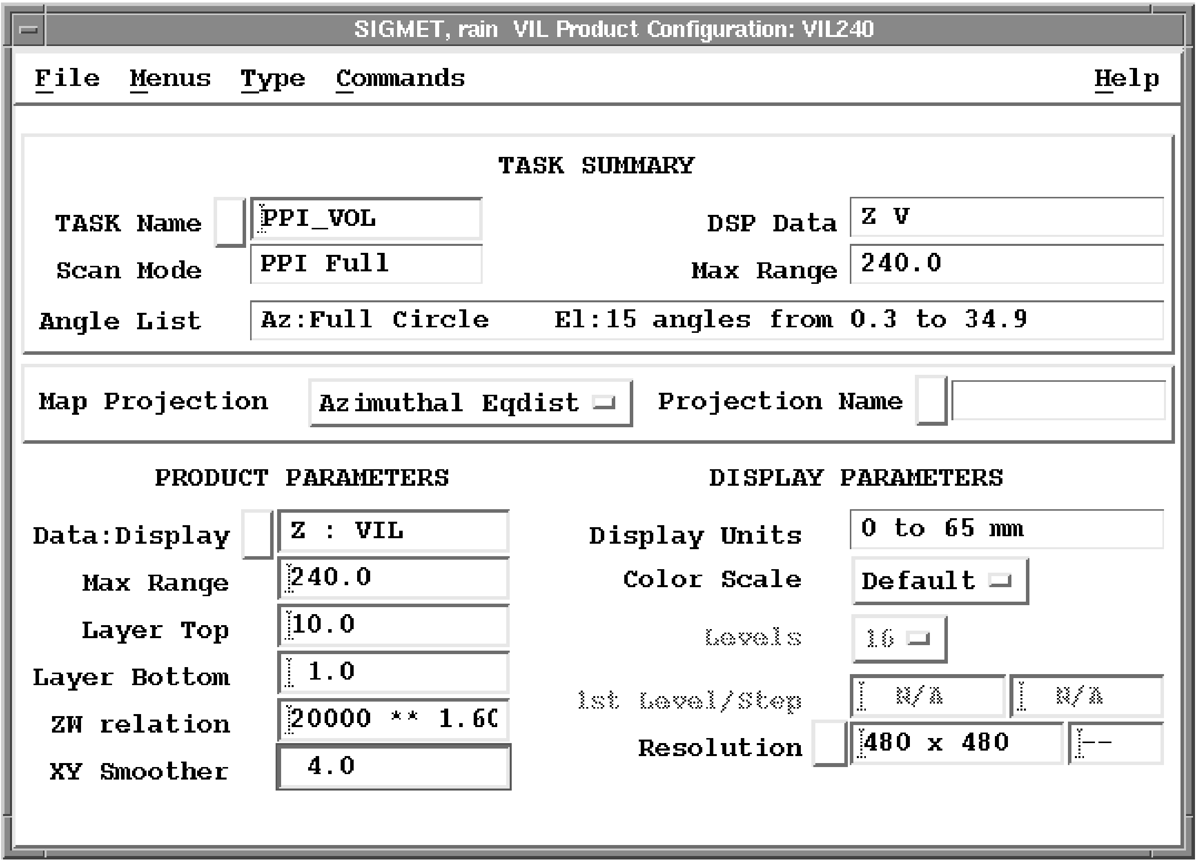


Figure 41 VIL240 VIL Product Configuration

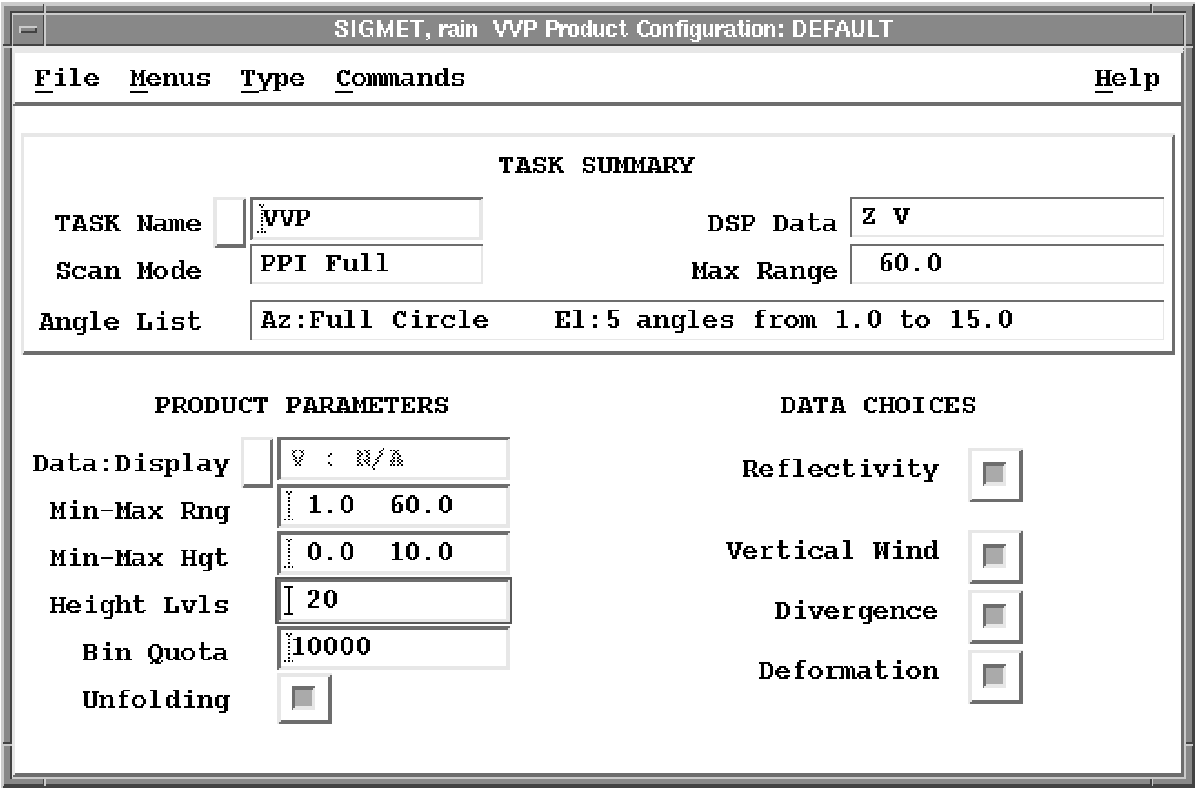


Figure 42 VVP Product Configuration

Even though most cross sections are made interactively in the Quick Look window, it may be useful to have a standard cross section along or crossing a line of interest, such as a runway.

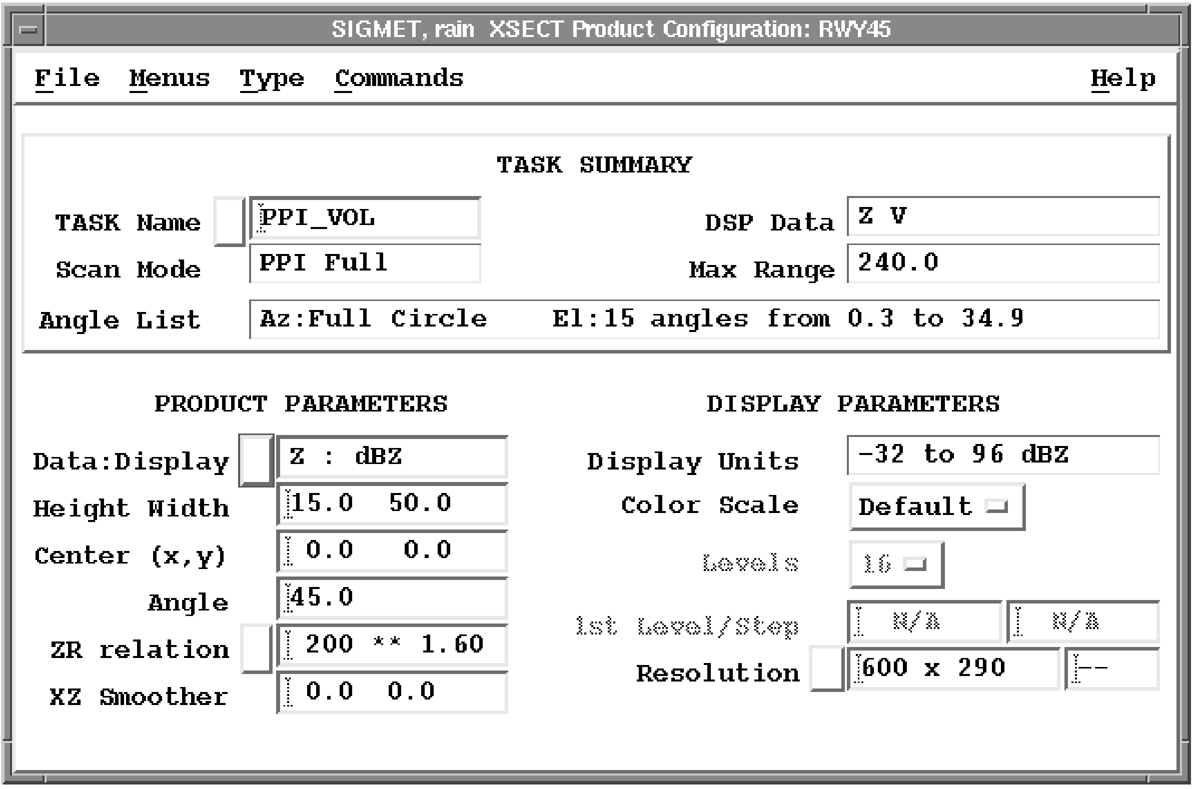


Figure 43 RWY_45 XSECT Product Configuration

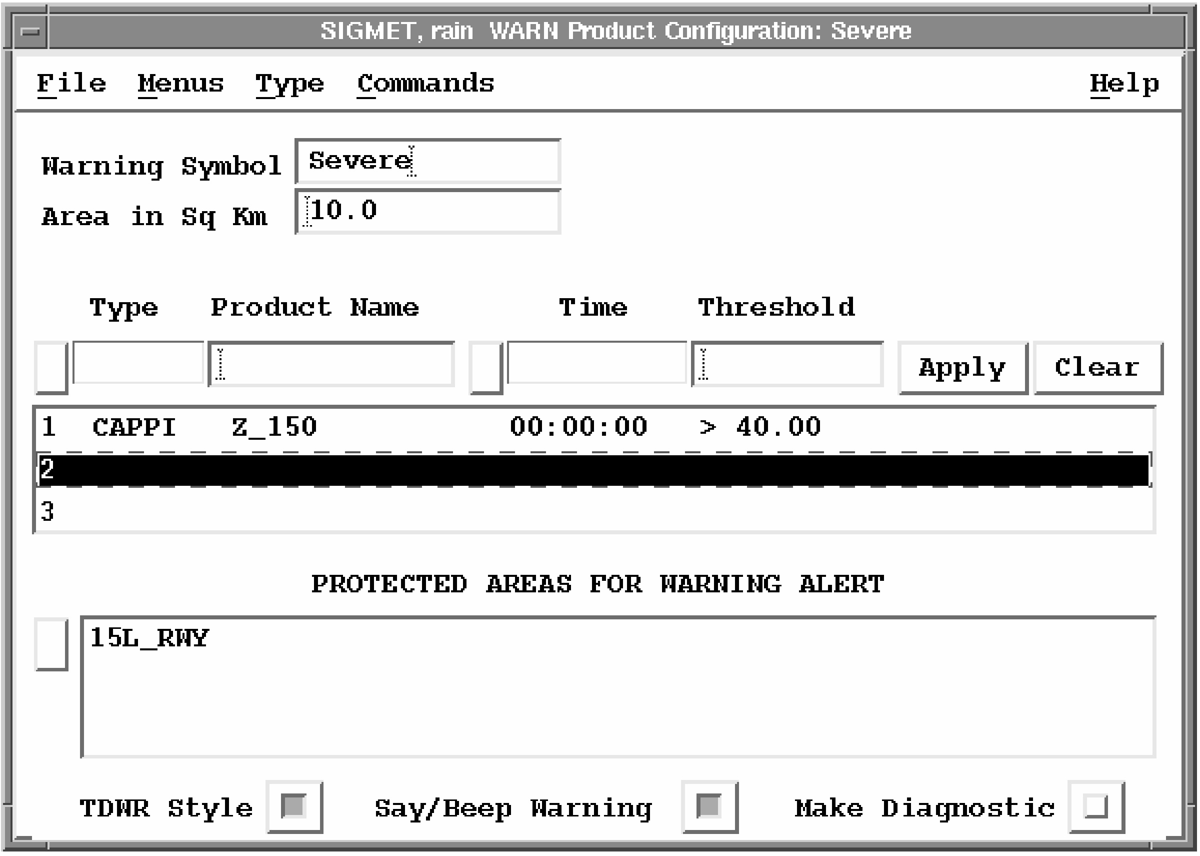


Figure 44 SEVERE WARN Product Configuration

Step 3. Configure the Product Scheduler for the MONITOR Mode

The Product Scheduler configuration is shown in on page 350. Note that you may need to scroll the menu to see the entire configuration.

wind Product Scheduler: MONITOR

File Menus Commands Help

Display KI8 19/19 Products Add for KI8 Site Group 1

Site	Product		Data	TASK	Next–Data–Time	Skip	Rqst	Status	Runs
	CAPPI	—Products—							
KI8	CAPPI	Z_010_120	Z	PPI_VOL	09:00 5 Jun 90	00:00	All	Wait	200
KI8	CAPPI	Z_020_240	Z	PPI_VOL	09:00 5 Jun 90	00:00	All	Wait	200
KI8	CAPPI	Z_030_240	Z	PPI_VOL	09:00 5 Jun 90	00:00	All	Wait	200
KI8	CAPPI	Z_050_240	Z	PPI_VOL	09:00 5 Jun 90	00:00	All	Wait	200
KI8	CAPPI	Z_100_240	Z	PPI_VOL	09:00 5 Jun 90	00:00	All	Wait	200
KI8	CAPPI	Z_150_240	Z	PPI_VOL	09:00 5 Jun 90	00:00	All	Wait	200
	MAX	—Products—							
KI8	MAX	Z_0_16_240	Z	PPI_VOL	09:00 5 Jun 90	00:00	All	Wait	200
	PPI	—Products—							
KI8	PPI	Z_005_300	Z	SURVEIL	09:08 5 Jun 90	00:00	All	Wait	200
	RAIN1	—Products—							
KI8	RAIN1	HOURLY	Liq	PPI_VOL	09:00 5 Jun 90	00:00	All	Wait	200
	RAINN	—Products– –							
KI8	RAINN	03_HOUR	Liq	PPI_VOL	09:00 5 Jun 90	00:00	All	Wait	200
KI8	RAINN	06_HOUR	Liq	PPI_VOL	09:00 5 Jun 90	00:00	All	Wait	200
KI8	RAINN	12_HOUR	Liq	PPI_VOL	09:00 5 Jun 90	00:00	All	Wait	200
KI8	RAINN	24_HOUR	Liq	PPI_VOL	09:00 5 Jun 90	00:00	All	Wait	200
	RAW	—Products—							
	RHI	—Products—							
KI8	RHI	Z_XXX_100	Z	RHI	07:14 5 Jun 90	00:00	All	Wait	10
	TOPS	—Products—							
KI8	TOPS	10_DBZ_240	Tops	PPI_VOL	09:00 5 Jun 90	00:00	All	Wait	200
	VIL	—Products—							
KI8	VIL	010_180_240	VIL	PPI_VOL	09:00 5 Jun 90	00:00	All	Wait	200
	VVP	—Products—							
KI8	VVP	VVP	Wind	VVP	09:10 5 Jun 90	00:00	All	Wait	200
	WARN	—Products—							
KI8	WARN	SEVERE	X		09:10 5 Jun 90	00:00	All	Running	200
	XSEXT	—Products—							
KI8	XSECT	Z_SECTION	Z	PPI_VOL	07:00 5 Jun 90	00:00	Stop	Wait	200

Figure 45 MONITOR Mode Product Schedule

Step 4. Configure the Radar Status Menu for the MONITOR Mode

The top part of the Radar Status menu should be configured and saved as shown in on page 351.

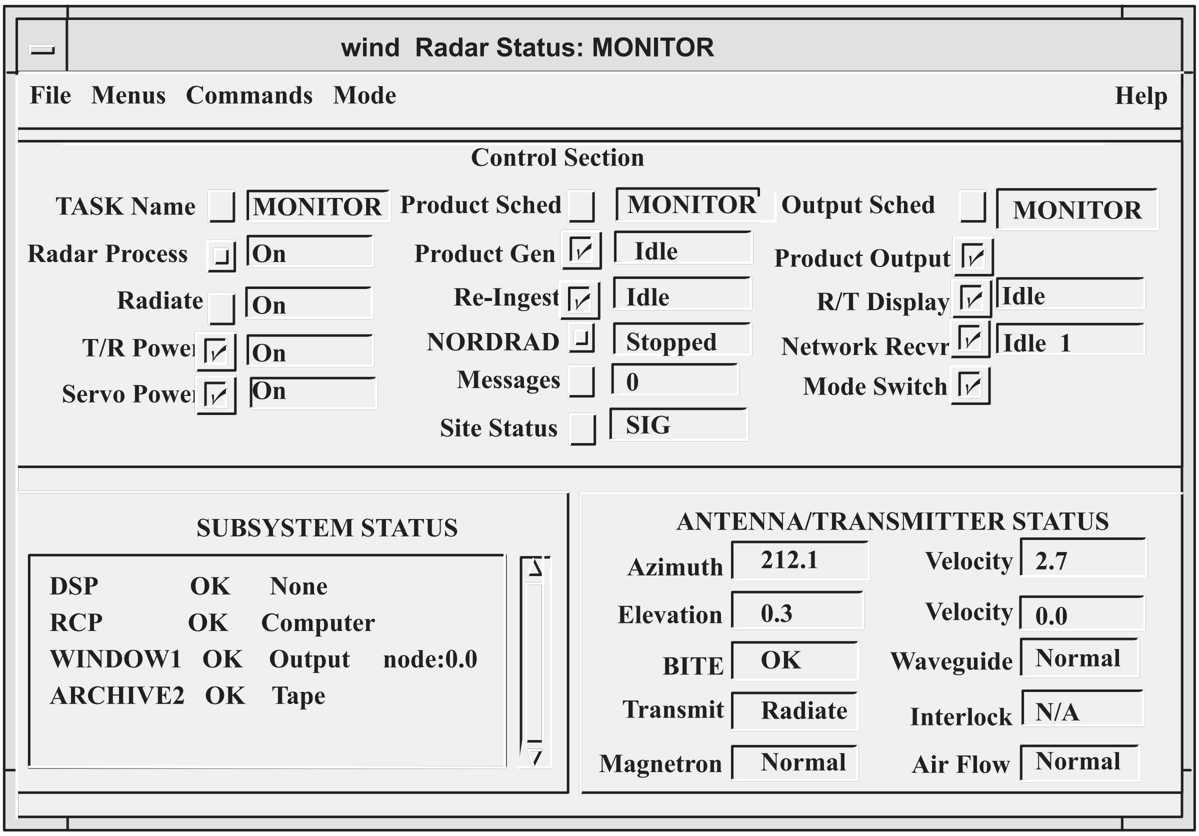


Figure 46 MONITOR Mode Radar Status Menu

Note that there are two options regarding start-up:

- Start-up in standby DEFAULT mode.

  If you want IRIS to start-up in a standby mode, make a separate DEFAULT configuration that has the radar process, product generator, radiate and servo power in the off position. Then switch the IRIS configuration to MONITOR. Note that the radar process and product generator must be set to off before IRIS lets you switch the IRIS configuration to MONITOR.
- Start-up in MONITOR mode

  If you want IRIS to be in MONITOR mode when IRIS starts, name the IRIS configuration DEFAULT.

CAUTION	CAUTION: If the radar antenna motion or radiation could pose a personnel hazard on automatic start-up, do not use this approach.

Step 5. Configure the MONITOR Output Assignments

The output configuration in the Product Output menu varies from system-to-system. Here are some hints for best performance.

- Determine what products to send to the various output devices and network computers on a regular basis. The output from these products should be directed to the corresponding devices and the configuration should be saved as MONITOR in the Product Output menu.
- In this example of the MONITOR configuration, the Warning product called SEVERE is used to signal when there is significant weather in a protected area, called TERMINAL. For wind shear applications, the corresponding warning situation display should be sent to a display so that the location of the warning can be viewed. When this warning product indicates the presence of weather in the terminal area, the IRIS configuration should be switched to the wind shear alert mode (see the TDWR example in Setting Up the Terminal Doppler Modes on page 353).

Step 6. Test the MONITOR Configuration

The configuration should be tested to verify that it is functioning properly, as follows:

- Verify that the TASK schedule can run on schedule without falling behind. Note that RHI's are done only on an *ad hoc* basis through interesting weather. If you fall behind, you should consider eliminating the separate VVP TASK and using the PPI_VOL TASK for VVP products. You can also eliminate the highest angle in PPI_VOL. Other performance trade-off factors are discussed in this manual.
- Verify that the product schedule can run without falling behind. For the example, the products are scheduled on a 15-minute basis. This is verified by checking the Product Scheduler times. Note that the system may temporarily fall behind at the beginning of an hour because there is considerable processing related to the RAIN1 and RAINN products, which occur on the hour.

  If the product schedule consistently falls behind, reduce the number of products set to "All" to those that are used most often. For example, you may not need all the different CAPPI heights. You should also verify that the Product Configuration menu's Smoother field is not set to a large value, or turn the Smoother off (set to 0) in products that require little smoothing.
- View each product to verify that it is being generated properly and that the color scales are appropriate for your season and location. You will probably need to tune the color scales in the Product Configuration menus to match the intensity of precipitation.

- For wind shear detection applications, verify that the SEVERE product (used for indicating when to switch from the MONITOR to the TDWR mode) is appropriate for your application. The suggested product sounds a warning whenever there is an area of 10 sq. km or greater of 30 dBZ or greater echo at 3 km height in a protected area called TERMINAL. TERMINAL should be an area centered about the air terminal (nominally a box 60 km on each side). This product should be tuned by changing the area size and the threshold so that sensitivity is maintained with a low false alarm ratio.

B.3 Setting Up the Terminal Doppler Modes

This IRIS configuration is optimized for the detection of hazardous wind shear. The configuration should be adjusted to match the specific runway configuration as well as the climatology of wind shear events in your location.

NOTE	SIGMET does not warrant that the SHEAR /WARN product will detect all hazardous microburst conditions. Whenever convective storms are in an air terminal area, there is danger of microburst and normal precautions to avoid suspected wind shear should be used, even if the SHEAR/ WARN algorithm does not detect shear. The SHEAR/WARN product is only one of many indicators that such a hazardous condition may exist. SIGMET, Inc. shall not be liable for damages of any kind for failure of the SHEAR/WARN algorithm to detect hazardous wind shear or for false alarms that may occur from use of the SHEAR/WARN algorithm.

It is recommended that you construct a separate IRIS configuration for each active runway configuration. The example presented here for illustration purposes is for a single east/west runway (09/27). The IRIS configurations are named to correspond to the active runway. In this case there are two choices:

- TD_RWY_27
- TD_RWY_09

TD indicates that this is a Terminal Doppler mode configuration.

The operator selects the appropriate configuration for the active runway whenever there is significant weather in the terminal area. An automatic warning product such as SEVERE in the MONITOR mode can be set-up to signal the operator when weather enters the terminal area (for example, within 20 km).

In the example presented here, it is assumed that the radar is sited off the airport to the north. During Terminal Doppler mode, the radar scans in a sector scan over the airport at two elevation angles — 0.9 and 1.0 degrees. The SHEAR product is calculated for each elevation angle. A "two-look" warning product is used to determine if hazardous wind shear is present — hazardous shear must be present at the same location in both elevations and in a protected area before a warning is sounded.

The configuration steps are described below. The TD_RWY_09 case is described first.

Step 1. Configure the Protected Areas

This is done in the **setup** utility. For the case of a single east/west runway, the following areas are suggested (see also on page 354).

Protected Area	Name	Center East of Radar	Center North of Radar	Width E – W	Width N – S	Orientation
1	ALL	0 km	0 km	500 km	500 km	0 degrees
2	TERMINAL	Center on Terminal		40	40	0
3	RWY_09A	See Figure		8	2	0
4	RWY_09D	See Figure		5	2	0
5	RWY_27A	See Figure		8	2	0
6	RWY_27D	See Figure		5	2	0

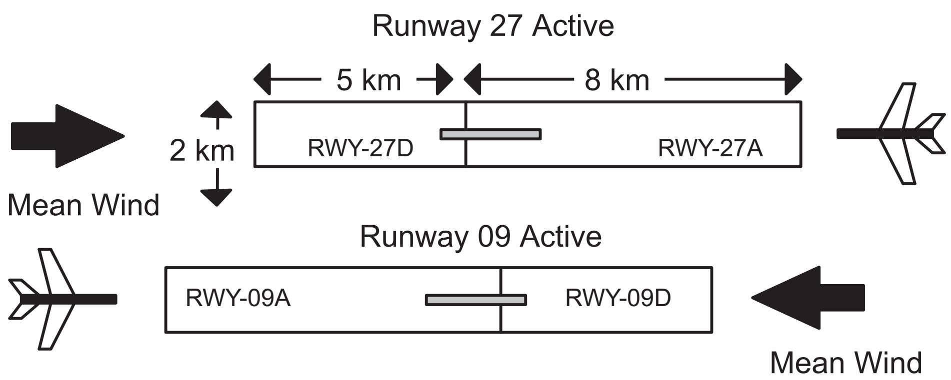


Figure 47 TD_RWY_09 and TD_RWY_27 Protected Areas

The locations of the areas can be checked by making and displaying a warning product with each area.

Step 2. Configure the TDWR TASK

It is assumed here that a single TASK called TDWR is used to cover all runways. It is a sector scan covering 90 to 270 degrees — the region south of the radar. (The radar is located north of the field.) The example in on page 355 is for an RVP5 signal processor.

The elevation angles in the example are 0.9 and 1.0 degrees. These will be used for the "two-look" warning example. The wind shear threshold must be exceeded for the same location on both of these elevation "looks." The specific elevations appropriate for a particular installation vary, depending on the radar siting and clutter characteristics. Wind shear can be a very shallow phenomenon, so the two elevation angles should be as close to the ground as is permitted by the clutter environment. The elevation angles should be separated by 0.1 degrees in the range of values from 0.3 to 1.0.

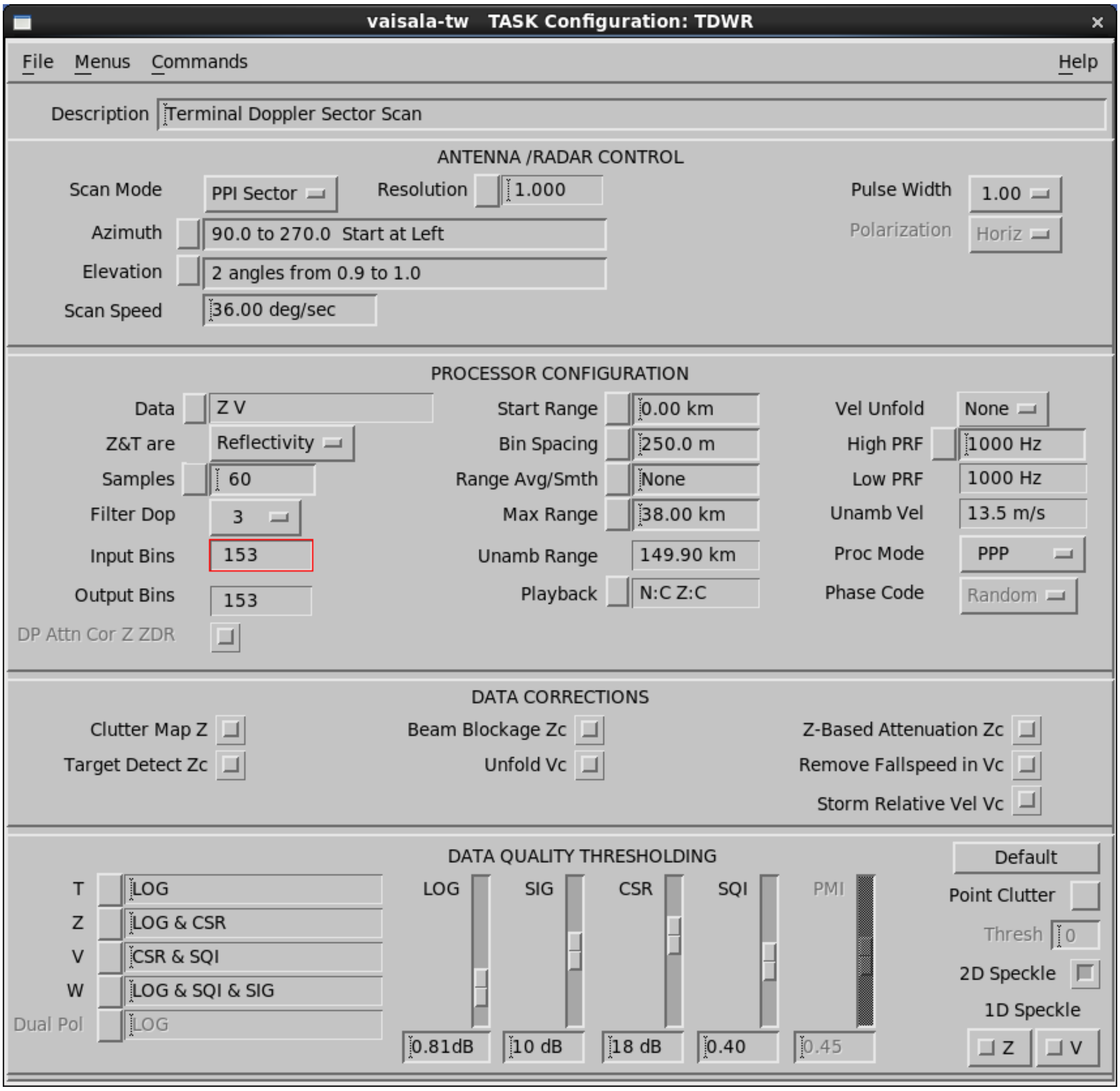


Figure 48 TDWR TASK Configuration

Step 3. Configure the TDWR TASK Schedule

There is only one TASK scheduled in this case. The repeat time may be reduced by trial depending on the load on your system due to networking or multiple users and the specific product mix that you use. Performance is improved slightly if the real time display is turned off.

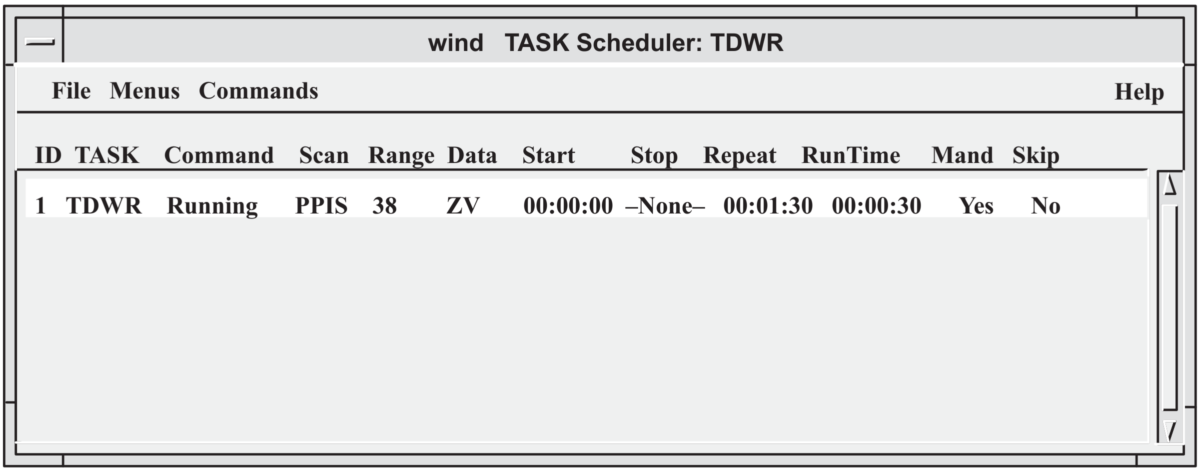


Figure 49 TDWR Task Schedule

Step 4. Configure the TD_RWY_09 Products

There are four products used in this example. Three are required, while one is optional and can be omitted to improve performance:

PPI: Z_010_30 Optional. A PPI of Z for the 1.0 degree elevation scan to 30 km range. This serves as a general purpose display for this mode of operation. The situation display is overlaid on top of this for the RWY09 WARN product.

SHEAR: TD_009_30 A SHEAR product at 0.9 degrees elevation to 30 km range. Used for the RWY09 WARN product.

SHEAR: TD_010_30 A SHEAR product at 1.0 degrees elevation to 30 km range. Used for the RWY09 WARN product.

WARN: RWY09 Requires that shear be detected at both the elevation angles in the same location. This minimizes false alarms while maintaining sensitivity. This TASK uses the runway 09 protected areas.

Recommended product configurations are given in on page 357 through on page 360.

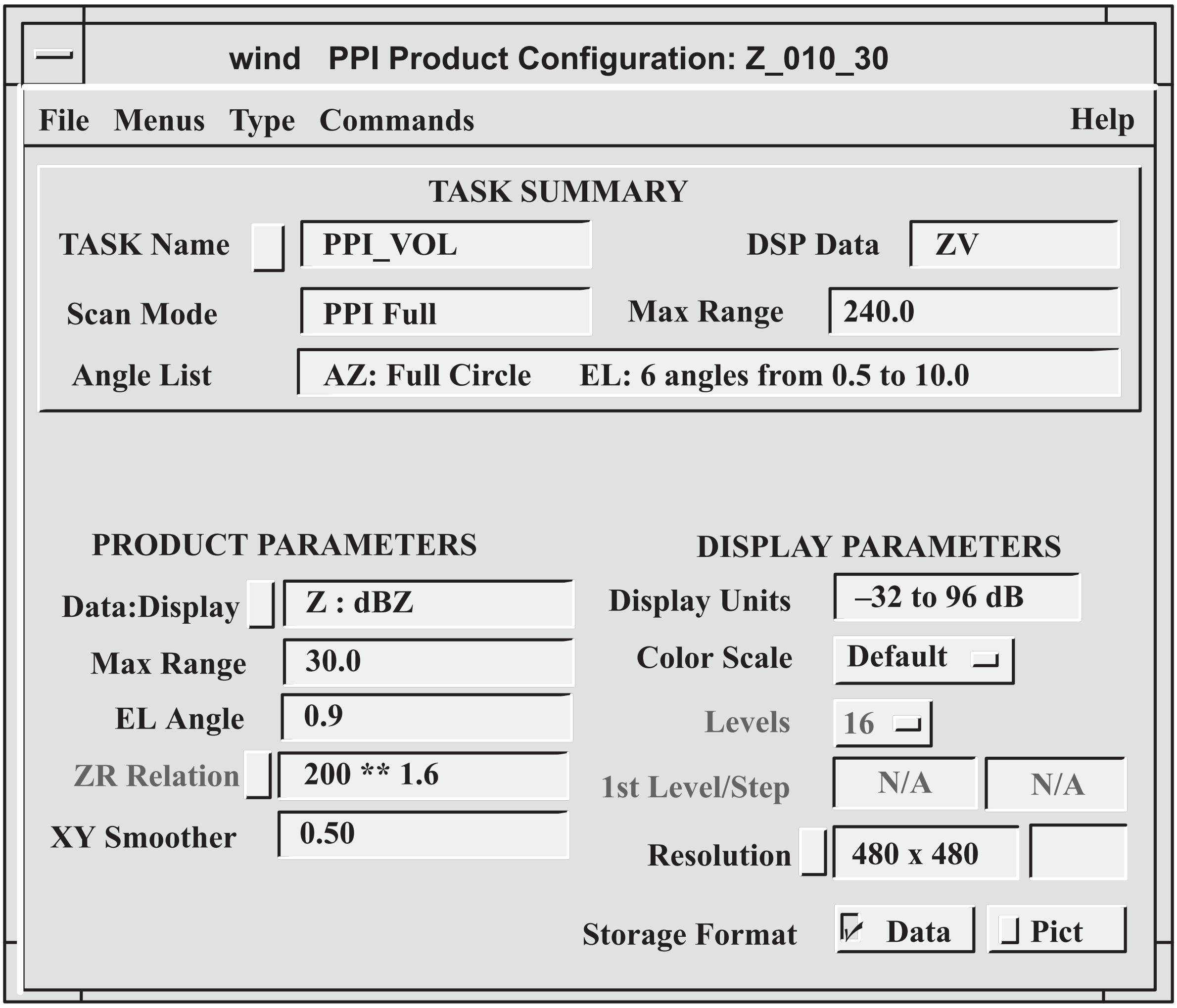


Figure 50 Z_010_30 PPI Product Configuration

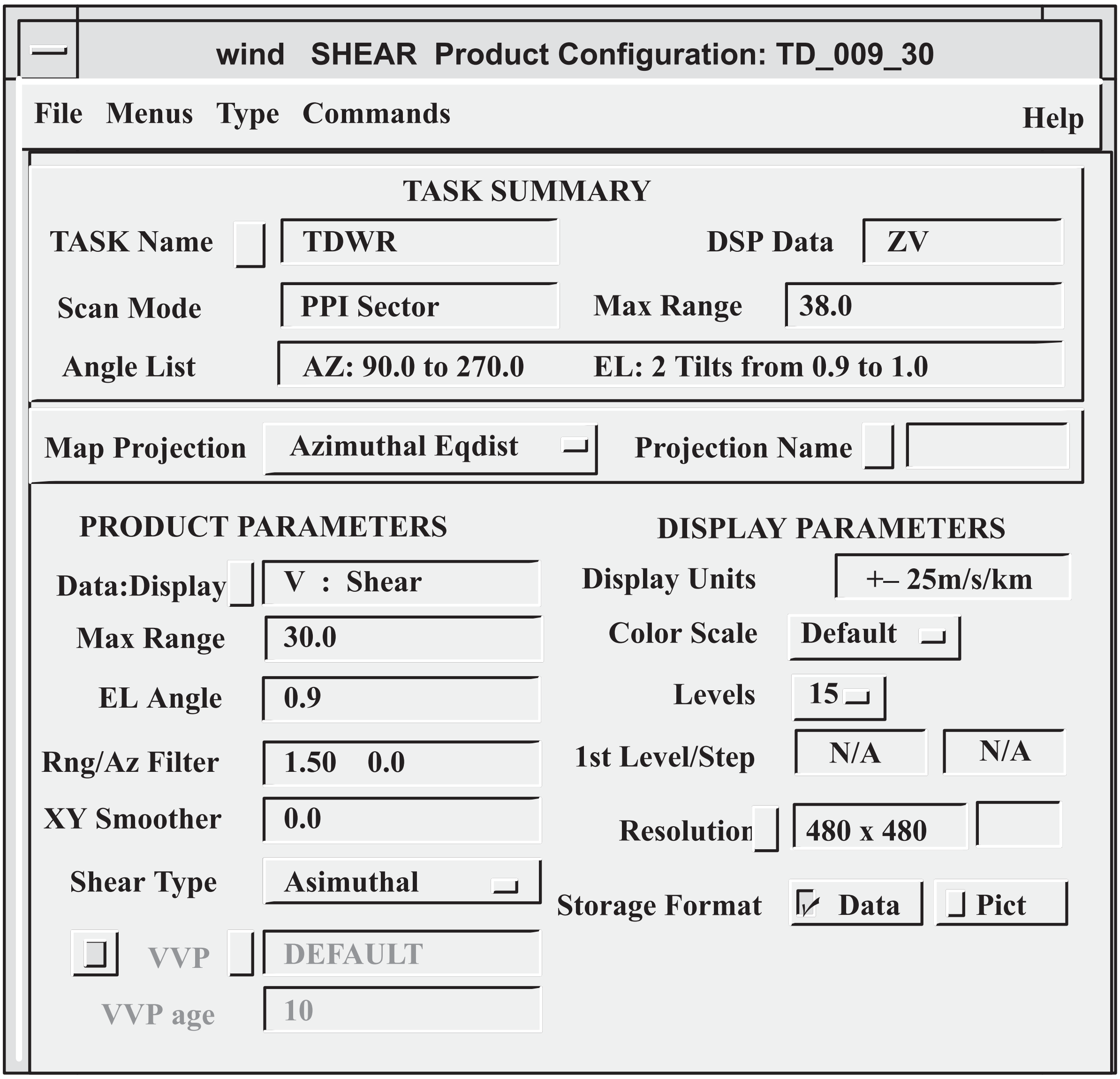


Figure 51 TD_009_30 SHEAR Product Configuration

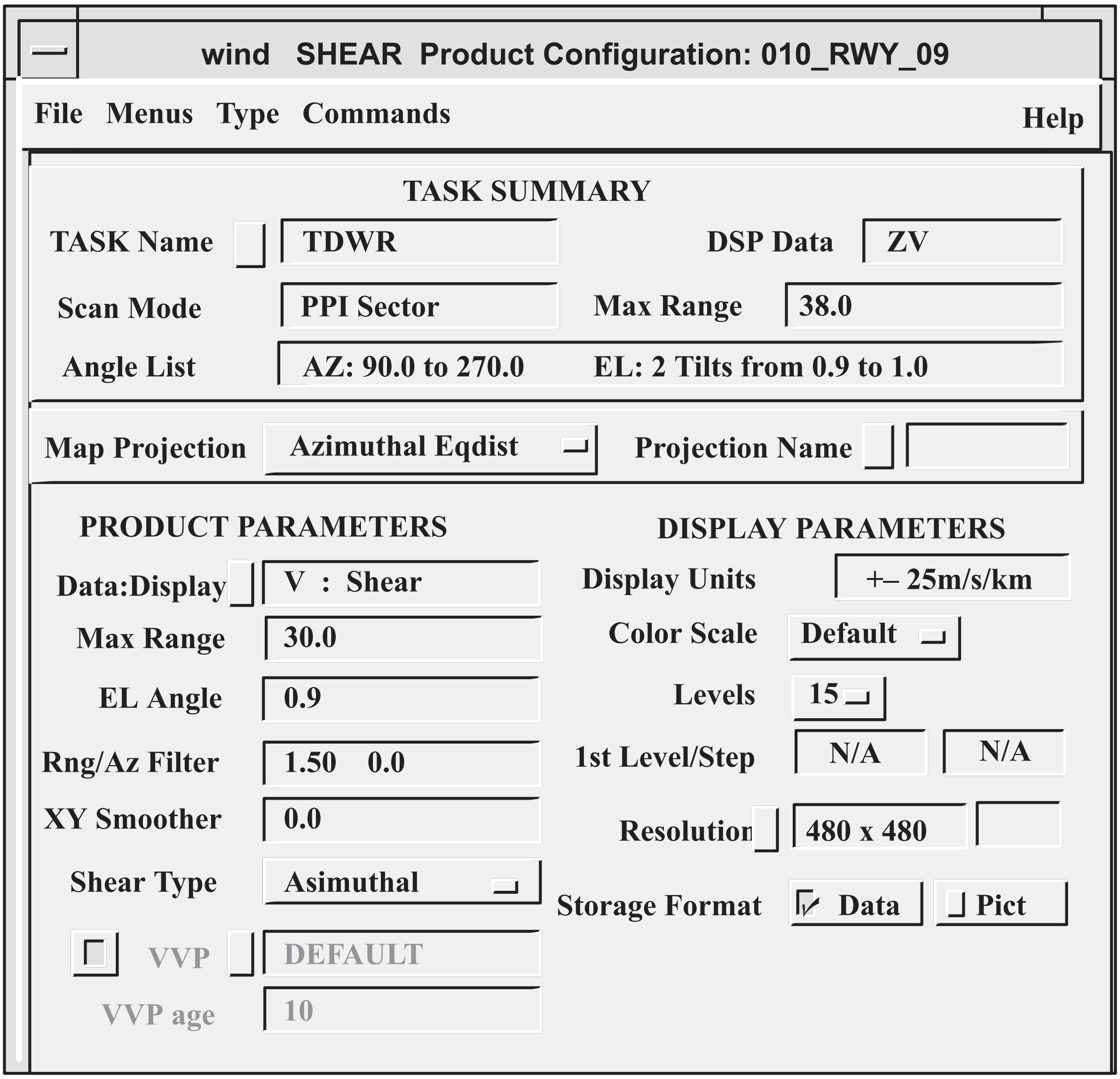


Figure 52 010_RWY_09 SHEAR Product Configuration

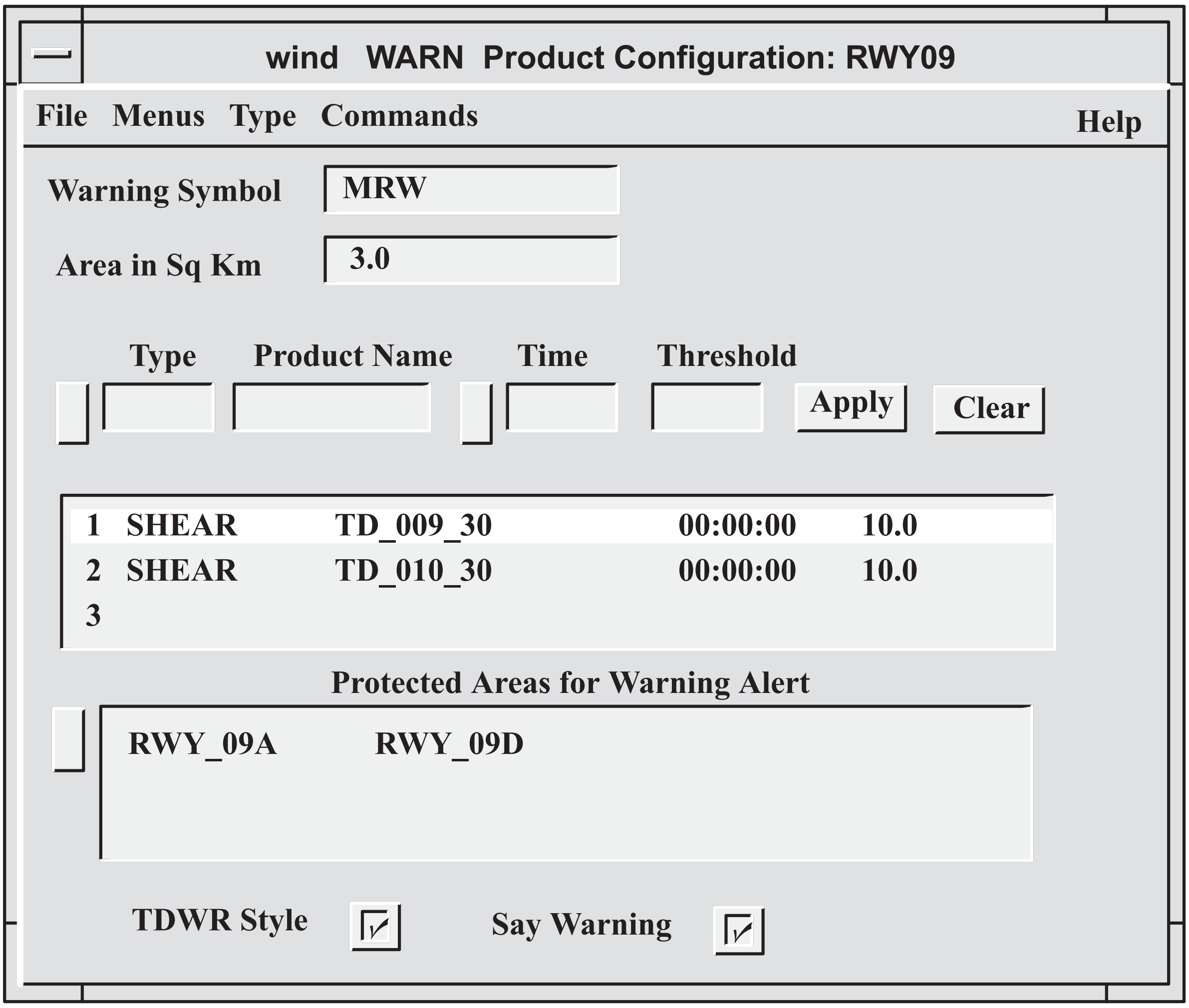


Figure 53 RWY09 WARN Product Configuration

Step 5. Configure the TD_RWY_09 Product Scheduler

The Product Scheduler is shown in on page 361. All products are set to "All." Note that the PPI product is not required for the warnings, so it can be deleted to improve performance. It is useful for depicting the intensity of precipitation over the terminal area.

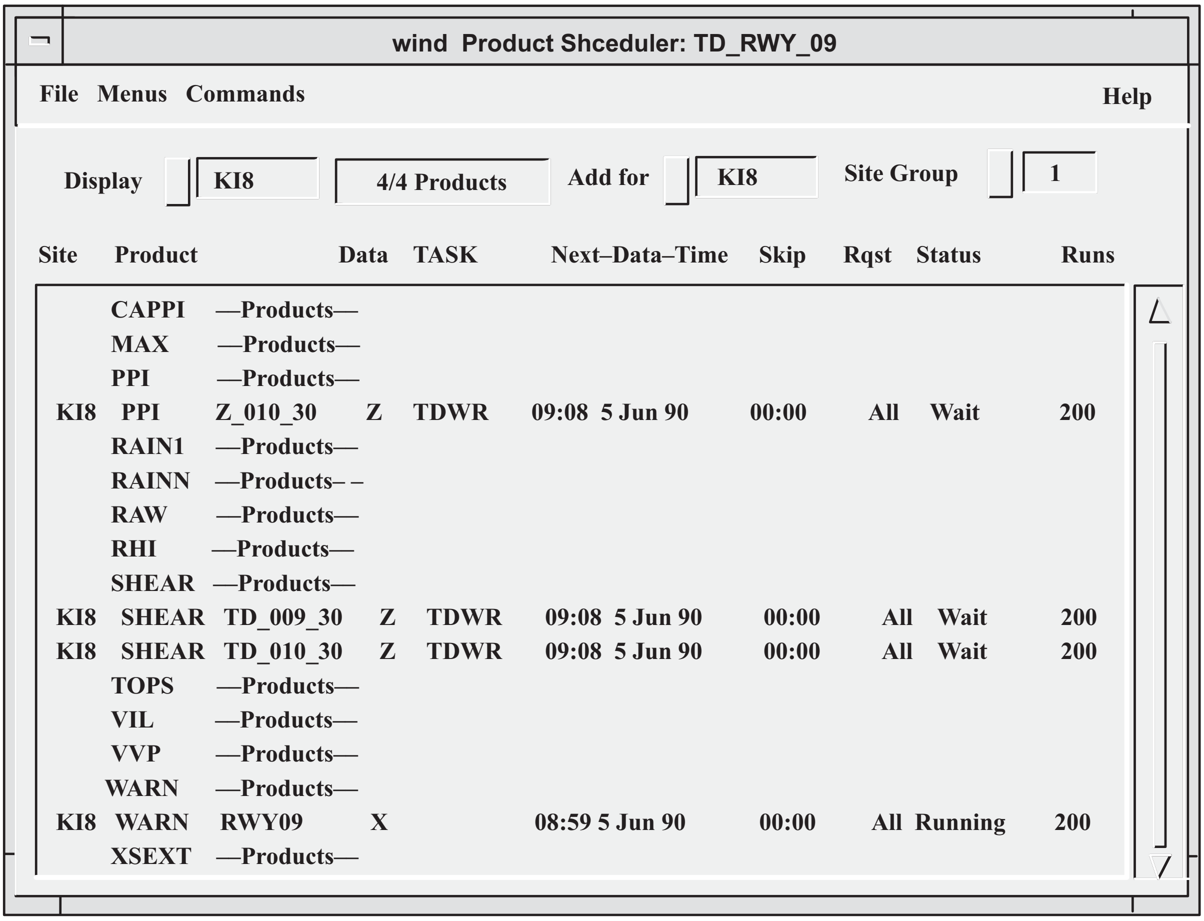


Figure 54 TD_RWY_09 Product Schedule

Step 6. Configure the Product Output Menu

For best performance, product output should be minimized so there is no extra burden from non-essential users. For network use, the RWY09 Warning product can be sent very efficiently and contains a schematic depiction of the location of any microbursts (indicated by MBW) and a text summary of any microbursts detected in a protected area. Here is a recommendation:

- Set all TDWR WARN products (for example, RWY09 and RWY27) to "All" for an output device to be used for warnings. Save the product output configuration as TDWR.
- Optionally, depending on your communications speed and network CPU burdens, set the Z_010_30 PPI to "All." You can also select the appropriate warning overlay (for example, RWY09), but remember to change it when you change runway configurations. If you want to avoid having to remember to make this change, you can save the product output configuration to a distinct name for each runway configuration, such as TD_RWY_09.

Remember that if you send to a networked IRIS system, it must be properly configured to display the products when they arrive. The best way to do this is to make a product output configuration at the receiving IRIS system which automatically displays any of the shear warning products. Tag the output of the shear warning situation displays with "All" and save the product output configuration.

Step 7. Configure the Opposite Runway (runway 27)

In most cases, the opposite runway is configured identically, except that the protected areas receive different names. Having configured runway 09, runway 27 is configured as follows:

IRIS Configuration	In the Radar Status menu, save the configuration under a different name, such as TD_RWY_27.
TASK Schedule	Leave as TDWR.
Product Configuration	Make a WARN product called RWY27, identical to RWY09, except that the protected areas are RWY_27A and RWY_27D. This is easily done using the Save command and modifying the product configuration.
Product Scheduler	Replace the RWY09 WARN product with RWY27 in the Product Scheduler. Save it to a new product schedule named TD_RWY_27.

When you are done, the Radar Status menu should show:

IRIS Configuration	TD_RWY_27
TASK Schedule	TDWR
Prod Schedule	TD_RWY_27
Output Config	TDWR

Step 8. Configure the Other Runways

Configure other runways similar to the examples shown here. The naming conventions here serve as guidelines. For many installations similar to the example presented here, the radar scanning is the same regardless of the active runways. The only difference is the protected areas used in the Warning product so that only the Product Scheduler is different for different runway configurations. In this case, the TASK Schedule remains simply TDWR, and it is used for all configurations (similar to the use of the name TDWR for the product output configuration).

Step 9. Test and Tune the Configurations

The detection of hazardous wind shear is still in the experimental stages in the scientific and engineering community. The approaches used in IRIS have been tested on actual documented cases of hazardous wind shear.

Tuning the system for best results requires some experience and knowledge of both radar and wind shear. IRIS is site adaptable since every location and climate is different. It is recommended that a qualified engineer/scientist make a thorough evaluation of each installation, both before and after the radar is installed. SIGMET can assist with this or recommend independent consultants.

This manual discusses many of the testing and tuning steps. See the sections on TASK Configuration and SHEAR Product Configuration. The system should be tested by running each configuration in actual weather. Some important features to check are summarized below:

Check the protected areas

Run each runway configuration and observe the warning situation display. Are the protected areas shown in the warning situation display correct? If you are uncertain, modify the WARN product to display one at a time.

Check that warnings are generated

Reduce the threshold shear in the warning product configuration from 10 to 5 or 0 when there is weather in the terminal area. This should cause false alarms, which will allow you to test that warnings are being generated. Be sure to reset the threshold back to 10 for both elevation angles.

Check that the velocities are reasonable

With weather in the terminal area, observe the real time display and verify that the velocity pattern provides good coverage of non-zero velocities. If the velocities are all 0, check the TASK configuration. If that is correct, check the coherency of your radar system. (See the *IRIS Utilities Manual, Ascope Utility*)

Check that the selected elevation angles are reasonable for your clutter pattern

Observe the reflectivity pattern on the real time display to verify that the selected elevation angles are appropriate to the clutter pattern of your site. You can experiment with different angles in the range 0.5 to 1.0 degrees to see which give the best results. Clutter performance can be enhanced by increasing the number of samples in the TASK (for example, from 60 to 70), increasing the PRF, using the next wider clutter filter. (See Chapter 4, Optional IRIS Products, on page 121.)

Check the SHEAR Products

The SHEAR products can be displayed and compared against the velocities. You may want to make a PPI velocity product to the same scale to assist with the comparison. Verify that the coverage and values of the SHEAR product are consistent with that of the velocity product.

Tune the WARN Product

The WARN product has two tuning parameters — the threshold area and the SHEAR threshold. Increasing either of these will make the algorithm less sensitive (fewer false alarms). Decreasing either of these will make the algorithms more sensitive. Remember that the shear threshold is quantized to the color bands in the shear product (steps of 5 m/s/km in this example). It is recommended that tuning be done with the area rather than the SHEAR threshold. For more sensitivity, set the area to 2.0 km^2. If false alarms are a problem increase the area from 3.0 to 3.5 then 4.0 km^2.

Several other steps can be taken to tune the WARN product. One is to change the warning criteria. The example here is a "two look" shear approach. However, a single look (one elevation angle) approach can also be used, either alone or perhaps using reflectivity as the second constraint based on the PPI Z product.

Record some test cases

During the first few months of operation, it is a good idea to record some RAW test cases on tape when there is wind shear within range. This allows you to play the events back and make shear products and warnings to evaluate and tune the configurations. Make a RAW product for your terminal Doppler scan and add it to the product schedule. However, set the Request field to "Stop." Then when an alarm sounds, set the RAW next data time back to 5 minutes before the alarm time and set the Request to "All." Finally, go to Product Output menu and Tape menu to direct the output to an IRIS tape. Be aware that the addition of the RAW product may cause your schedule to fall behind. If this is the case, you can temporarily add 15 to 30 seconds to the repeat time in the TASK Scheduler.

Note that microburst warning symbols (without audio alarm) are shown on the situation display when the event is outside of the protected areas. These are excellent opportunities for recording RAW data.

APPENDIX C
RADIAL VELOCITY CORRECTION

The motion of a ship or airborne platform induces a radial velocity error. IRIS corrects for this error by accounting for the platform motion. Ship motion measurements are collected from the antenna controller and the radial velocity correction is optionally applied to the ingest files so that all subsequent products and the real time display are corrected. Note that the radial velocity correction and all of the platform motion parameters are archived as part of the extended ray header.

In this appendix:

C.1 Motion Parameters and Coordinate Transformations

For systems with the Vaisala RCP8, the *RCP8 User's Manual* contains a full theoretical derivation of the stabilization. The basic variables of the ship motion sensing are defined below:

Symbol	Definition
H	Heading measured CW from true north
θ	*H* - π/2
#thetaoverdot#	Rate of change of heading
P	Pitch measured relative to horizo**n** + for bow down
#Poverdot#	Rate of change of pitch
R	Roll measured relative to the horizon + for port side down
#Roverdot#	Rate of change of roll
u	Eastward velocity
v	Northward velocity
w	Upward velocity

Given a vector x in earth coordinates and the corresponding vector x#prime# in ship coordinates,

$x' = Ax$ and $x = A^{-1}x'$

where the transformation matrices are:

$$A = \begin{bmatrix} \cos R \cos H - \sin R \sin P \sin H & -\cos R \sin H - \sin R \sin P \cos H & -\sin R \cos P \\ \cos P \sin H & \cos P \cos H & -\sin P \\ \sin R \cos H + \cos R \sin P \sin H & -\sin R \sin H + \cos R \sin P \cos H & \cos R \cos P \end{bmatrix}$$

$$A^{-1} = \begin{bmatrix} \cos R \cos H - \sin R \sin P \sin H & \cos P \sin H & \sin R \cos H + \cos R \sin P \sin H \\ -\cos R \sin H - \sin R \sin P \cos H & \cos P \cos H & -\sin R \sin H + \cos R \sin P \cos H \\ -\sin R \cos P & -\sin P & \cos R \cos P \end{bmatrix}$$

Note that A^{-1} is the transpose of A. Where the vectors are define as:

$$x = \begin{bmatrix} East \\ North \\ Up \end{bmatrix} \qquad x' = \begin{bmatrix} Towards\ right \\ Towards\ Bow \\ Towards\ Zenith \end{bmatrix}$$

C.2 Radial Velocity Correction

The scalar radial velocity of the scatterers V_R can be expressed as:

$$V_R = V_{R\ meas} - V_{R\ ship}$$

where $V_{R\ meas}$ is the Doppler velocity measured by the signal processor and $V_{R\ ship}$ is the radial velocity correction for ship motion. The radial velocity correction is found by taking the dot product of the antenna vector x in earth coordinates with the velocity of the antenna in earth coordinates y_A , as follows:

$$V_{Rship} = x \cdot \dot{y}_A$$

The antenna vector is a unit vector pointing in the direction of the antenna which depends on the true (earth relative) azimuth and elevation of the antenna, as follows:

$$x = \begin{bmatrix} \sin AZ \quad \cos EL \\ \cos AZ \quad \cos EL \\ \sin EL \end{bmatrix}$$

AZ and EL are earth relative

These are known from the antenna controller. Thus, the problem is to determine the y_A — the velocity of the antenna.

The velocity correction used in IRIS allows for two different types of ship motion sensing:

Inertial Navigation Unit (INU) The INU is typically located close to the antenna. The INU reports pitch, roll and heading, rates of change of these variables, as well as the east, north and vertical motion (*u*, *v*, *w*). In this case, the INU is used as the ship reference point.

Gyro System with GPS The gyros report pitch, roll and heading as well as rates of change of these variables. Mean translational motion of the center of the ship (*u*, *v*, *w*) is obtained from a GPS or other navigational system. In this case the ship center of rotation is used as the ship reference point.

We shall refer to these two cases as the INU Case and the Gyro Case.

In either case, the interface to these devices is the RCP antenna control unit. All of the orientation and navigation information is passed to IRIS via the serial line connection to the antenna controller.

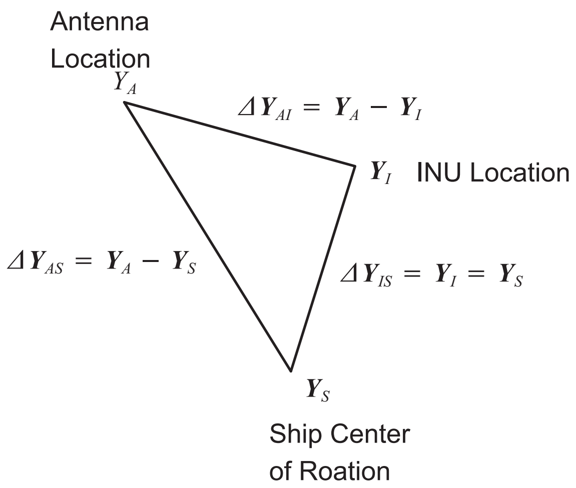


Figure 55 Vectors used for Velocity Correction In Earth Coordinates

In general, the INU is not located at either the ship center of rotation or the antenna. The location vectors are shown in on page 368 in earth coordinates. The position vector of the antenna in earth coordinates can be expressed as:

$y_A = y_I + (y_A - y_I)$ INU Case

$y_A = y_S + (y_A - y_S)$ Gyro Case

so that,

$y_A = y_I + \Delta y_{AI}$ INU Case

$y_A = y_S + \Delta y_{AS}$ Gyro Case

where,

$\Delta y_{AI} = y_{A} - y_I$ and $\Delta y_{AS} = y_{A} - y_S$

Expressing the Δ vectors in terms of the ship relative coordinates yields:

$y_A = y_I + A^{-1} \Delta y'_{AI}$ INU Case

$y_A = y_S + A^{-1} \Delta y'_{AS}$ Gyro Case

Differentiating these two expressions yields the final expressions for the antenna velocity:

$$ _A = \dot{y}_I + \dot{A}^{-1} \Delta y'_A \qquad \text{INU Case} $$

$$ _A = \dot{y}_S + \dot{A}^{-1} \Delta y'_A \qquad \text{Gyro Case} $$

Note that since the INU, antenna and ship center coordinates are not changing relative to the ship coordinates,

$$ \dot{y}'_{AS} = \Delta\dot{y}'_{AI} = ($$

The components of the matrix A^{-1} are as follows:

$$ ^{-1} = \begin{vmatrix} \dot{A}^{-1}_{11} & \dot{A}^{-1}_{12} & \dot{A}^{-}_{1} \\ \dot{A}^{-1}_{21} & \dot{A}^{-1}_{22} & \dot{A}^{-}_{2} \\ \dot{A}^{-1}_{31} & \dot{A}^{-1}_{32} & \dot{A}^{-}_{3} \end{vmatrix} $$

where:

$$ \dot{A}^{-1}_{11} = -\dot{P}\sin P\cos\theta - \dot{\theta}\cos P\sin\theta $$

$$ ^{1}_{1} = +\dot{P}\sin P\sin\theta - \dot{\theta}\cos P \ \text{co} $$

$$ ^{-1}_{31} = -\dot{P}\ \cos $$

$$ \dot{A}^{-1}_{12} = -\dot{R}\sin R\sin\theta + \dot{\theta}\cos R\cos\theta - \dot{R}\cos R\sin P\cos\theta - \dot{P}\sin R\cos P\cos\theta + \dot{\theta}\sin R\sin P\sin\theta $$

$$ \dot{A}^{-1}_{22} = -\dot{R}\sin R\cos\theta - \dot{\theta}\cos R\sin\theta + \dot{R}\cos R\sin P\sin\theta + \dot{P}\sin R\cos P\sin\theta + \dot{\theta}\sin R\sin P\cos\theta $$

$$ \dot{A}^{-1}_{32} = -\dot{R}\cos R\cos P + \dot{P}\sin R\sin P $$

$$ \dot{A}^{-1}_{13} = +\dot{R}\cos R\sin\theta + \dot{\theta}\sin R\cos\theta - \dot{R}\sin R\sin P\cos\theta + \dot{P}\cos R\cos P\cos\theta - \dot{\theta}\cos R\sin P\sin\theta $$

$$\dot{A}^{-1}_{23} = +\dot{R}\cos R\cos\theta - \dot{\theta}\sin R\sin\theta + \dot{R}\sin R\sin P\sin\theta - \dot{P}\cos R\cos P\sin\theta - \dot{\theta}\cos R\sin P\cos\theta$$

$$\dot{A}^{-1}_{33} = -\dot{R}\sin R\cos P - \dot{P}\cos R\sin P$$

These equations show that the motion of the antenna can be expressed as a translational motion of a reference point (either at the INU or at the ship center of rotation), plus a rotational motion about a moment arm from the reference point to the antenna.

The translational motion of the reference point is:

$$\dot{y}_I = \begin{bmatrix} u \\ v \\ w \end{bmatrix}$$ as sensed by the INU for the INU case

$$\dot{y}_S = \begin{bmatrix} u \\ v \\ w \end{bmatrix}$$ as sensed by the GPS for the Gyro Case

As a special case, if the INU and antenna are located at precisely the same position, then,

$\Delta y'_{AI} = 0$ so that $\dot{y}_A = \dot{y}_I$ INU Case

In this case, the antenna velocity is equal to the INU velocity since the moment arm is zero length.

C.3 Aircraft Tail Radars

For aircraft tail radars, the math for the velocity correction is different. First of all the definition of azimuth and elevation is different. This is because the axis of primary rotation is horizontal. We define elevation to be the angle of rotation about the axis of aircraft motion, with zero pointing out towards the left wing, and positive going up from there. Azimuth is defined to be the angle relative to a perpendicular scan. Thus zero means scanning in a plane, positive means scanning a cone faced forwards, and negative means scanning in a cone faced backwards.

Secondly, it does not make sense to correct the angles to earth relative before recording, so the recorded angles are aircraft relative, and all angle syncing is done aircraft relative.

Third, the definition of roll and pitch has the reversed sign on airplanes vs. ships. So the computation of the A matrices defined above have the reversed sign. Note that since no other interpretation of the roll and pitch is done, this can otherwise be ignored.

Thus the antenna vector relative to the aircraft is as follows:

$$= \left| \begin{array}{c} -\cos EL \ \cos AZ \\ \sin AZ \\ \sin EL \ \cos AZ \end{array} \right.$$

AZ and EL are aircraft relative

Before computing the velocity correction dot product, we first must convert to earth relative, using the equation above:

$$x = A^{-1} x$$

After that, everything is the same.

C.4 Configuration

Measure and Input the Moment Arm Vector Components. The moment arm vector components are input via the **setup** utility. These are, for the two cases:

INU Case $\Delta y'_{AI!}$:

$\Delta y'_{AI1}$	Antenna distance forward of INU in deck plane.
$\Delta y'_{AI2}$	Antenna distance to port of INU in deck plane.
$\Delta y'_{AI3}$	Antenna distance upward from INU normal to deck plane.

Gyro Case $\Delta y'_{AS}$:

$\Delta y'_{AS1}$	Antenna distance forward of ship center in deck plane.
$\Delta y'_{AS2}$	Antenna distance to port of center line in deck plane.
$\Delta y'_{AS3}$	Antenna distance upward from ship center normal to deck plane.

The three measurements should be made to the antenna feed horn. The signs of the components must be strictly observed The units are meters. Note that the questions in **setup** refer to the INU case. If you have the Gyro Case, enter the corresponding moment arms relative to the ship center of rotation.

Setup has an additional question regarding the height offset of the INU. This is a fixed number which is added to the height reported by the INU. Since most INU's accurately report the height, this number should be set to zero. The value of this number does not effect the velocity correction.

- Specify the proper antenna format in **setup** RCP section.
- Specify the Extended Ray Header in **setup**, ingest section.
- If you have a Vaisala RCP8, configure as described in the *RCP8 User's Manual*.
- Use the TASK Configuration menu to turn on and off the velocity correction for each TASK.

C.5 Testing

Vaisala provides several programs for testing the velocity correction feature.

C.5.1 The Antenna Utility

The primary utility is the **antenna** utility as described in the *IRIS/RDA Utilities Manual*. This utility displays all of the navigation information that is reported back from the antenna controller as well as the velocity of the antenna Δy_A and the velocity correction. The antenna utility should be used to verify the following:

- The signs of all angles (pitch, roll, heading).
- The signs of angular velocities (pitch, roll, heading).
- The signs of the translational velocities (u, v, w).
- That the velocity corrections are reasonable and free of glitches caused by unreliable input data.

C.5.2 The Rays Utility

The **rays** utility allows ingest data to be examined. In addition, because RAW products can be brought back from archive to create regenerated ingest files, the data recording can be checked. Using the **rays** utility values, the velocity correction algorithm can be verified from an independent calculation.

C.6 In Situ Testing Suggestions

The final testing must be done at sea. This is an uncontrolled environment for testing, however, there is a useful total system test of the velocity correction — fixed ground targets should have zero corrected velocity as observed from the moving platform. Do not use buoys with radar reflectors. They are excellent targets, but they are generally not stationary.

This can be tested by cruising offshore of a coast at ~10 km and observing fixed ground targets while collecting IRIS data. You may want to use a sector scan for this at low elevation. You should verify the following:

- The real time color display should show ground targets at zero velocity.
- The Rays utility should show targets at zero velocity.
- PPI velocity products with a fine resolution velocity scale can be constructed to verify the velocity correction.

If the corrected velocity of ground targets is not zero, you must isolate the problem. If the antenna is properly stabilized, it is likely that both the INU (or Gyro system) and the antenna controller are functioning properly. Therefore, the error is most likely due to alignment:

- The INU or Gyro system vertical and the antenna vertical must be co-aligned.
- The INU or Gyro system azimuths must be co-aligned.
- The moment arms must be properly measured.

The INU or Gyro/Antenna alignment can be checked with the sun tracking feature of the Antenna utility. The moment arm measurement can be checked dynamically as described below.

C.6.1 Dynamic Adjustment of Moment Arms

Measuring moment arms or extracting them from the ship's drawing may be difficult to do. The athwartship component of the moment arm is usually the easiest measure and, in most cases, the antenna is centered across the ship. This leaves the vertical and the for/aft moments. By observing ground targets in special ship/antenna configurations, it is possible to check these moments dynamically.

The vertical component of the moment arm can be isolated by scanning over the beam of the ship while looking at on-shore clutter targets. In this case, the velocity correction is dominated by the roll of the ship and the vertical moment arm. The athwartship position error of the antenna moment arm has the same effect. In this configuration, the vertical moment arm can be adjusted in Antsetup until the observed velocity of ground targets is zero. The ship must be rolling during this test.

After this is done, the antenna can be pointed fore or aft to observe clutter targets. The fore/aft component of the moment arm can be adjusted to remove any remaining velocity error. The ship must be pitching during this test.

C.7 Summary of Velocity Correction Algorithm: INU Example

1. $_R = V_R - V_R\, shi$
2. $_{Rship} = x \cdot \dot{y}$
3. $_A = \dot{y}_I + \dot{A}^{-1} \Delta\, y'$
4.

$$\dot{y}_I = \begin{vmatrix} SpeedEast \\ SpeedNorth \\ SpeedUp \end{vmatrix}$$

as measured by the INU.

5.

$$\dot{y}_I = \begin{vmatrix} SpeedEast \\ SpeedNorth \\ SpeedUp \end{vmatrix}$$

as measured by the INU.

$$\Delta y_{AI} = antenna\ position \begin{vmatrix} forword \\ port \\ over \end{vmatrix}$$

the INU position

$$6. \quad {}^{-1} = \begin{vmatrix} \dot{A}_{11}^{-1} & \dot{A}_{12}^{-1} & \dot{A}_{1}^{-} \\ \dot{A}_{21}^{-1} & \dot{A}_{22}^{-1} & \dot{A}_{2}^{-} \\ \dot{A}_{31}^{-1} & \dot{A}_{32}^{-1} & \dot{A}_{3}^{-} \end{vmatrix}$$

$$\dot{A}_{11}^{-1} = -\dot{P}\sin P\cos\theta - \dot{\theta}\cos P\sin\theta$$

$$\dot{A}_{21}^{-1} = +\dot{P}\sin P\sin\theta - \dot{\theta}\cos P\cos\theta$$

$$\dot{A}_{31}^{-1} = -\dot{P}\cos P$$

$$\dot{A}_{12}^{-1} = -\dot{R}\sin R\sin\theta + \dot{\theta}\cos R\cos\theta - \dot{R}\cos R\sin P\cos\theta - \dot{P}\sin R\cos P\cos\theta + \dot{\theta}\sin R\sin P\sin\theta$$

$$\dot{A}_{22}^{-1} = -\dot{R}\sin R\cos\theta - \dot{\theta}\cos R\sin\theta + \dot{R}\cos R\sin P\sin\theta + \dot{P}\sin R\cos P\sin\theta + \dot{\theta}\sin R\sin P\cos\theta$$

$$\dot{A}_{32}^{-1} = -\dot{R}\cos R\cos P + \dot{P}\sin R\sin P$$

$$\dot{A}_{13}^{-1} = +\dot{R}\cos R\sin\theta + \dot{\theta}\sin R\cos\theta - \dot{R}\sin R\sin P\cos\theta + \dot{P}\cos R\cos P\cos\theta - \dot{\theta}\cos R\sin P\sin\theta$$

$$\dot{A}_{23}^{-1} = +\dot{R}\cos R\cos\theta - \dot{\theta}\sin R\sin\theta + \dot{R}\sin R\sin P\sin\theta - \dot{P}\cos R\cos P\sin\theta - \dot{\theta}\cos R\sin P\cos\theta$$

$$\dot{A}_{33}^{-1} = -\dot{R}\sin R\cos P - \dot{P}\cos R\sin P$$

Definition of terms in matrix A-1

HEAD	Heading measured CW from true north
θ	*HEAD* - $\pi/2$
$\dot{\theta}$	Rate of change of heading
P	Pitch measured relative to horizon + for bow down
$\dot{P}$	Rate of change of pitch

R	Roll measured relative to the horizon + for port side down
$\dot{R}$	Rate of change of roll

APPENDIX D
IRIS 3DVIEW

D.1 Overview

The IRIS 3DView software is a separately licensed software package available from Vaisala that renders 3D visualizations of IRIS format radar data. The radar data can be rendered using surface or volume rendering over a detailed 3D terrain map of the land and water underneath the weather echoes. Alternatively, the 3D visualization can be rendered over a 2D radar product.

IRIS 3DView allows the rendered scene to be rotated, panned, and zoomed in. Additional detail layers such as radar range rings, latitude-longitude grid, and landmark labels can be added to the view for easy navigation. The user can also store preferred view angles and display states for later use.

The user can view the desired data files (Archive Mode) or configure IRIS 3DView to monitor a data file directory for viewing of the latest radar data (Live Mode). The input radar data may be data collected from a single weather radar, or from an IRIS composite of multiple radars.

The user can export bitmap images of the 3D visualization, and run a background process that automatically renders bitmap images of the incoming radar data.

In this appendix:

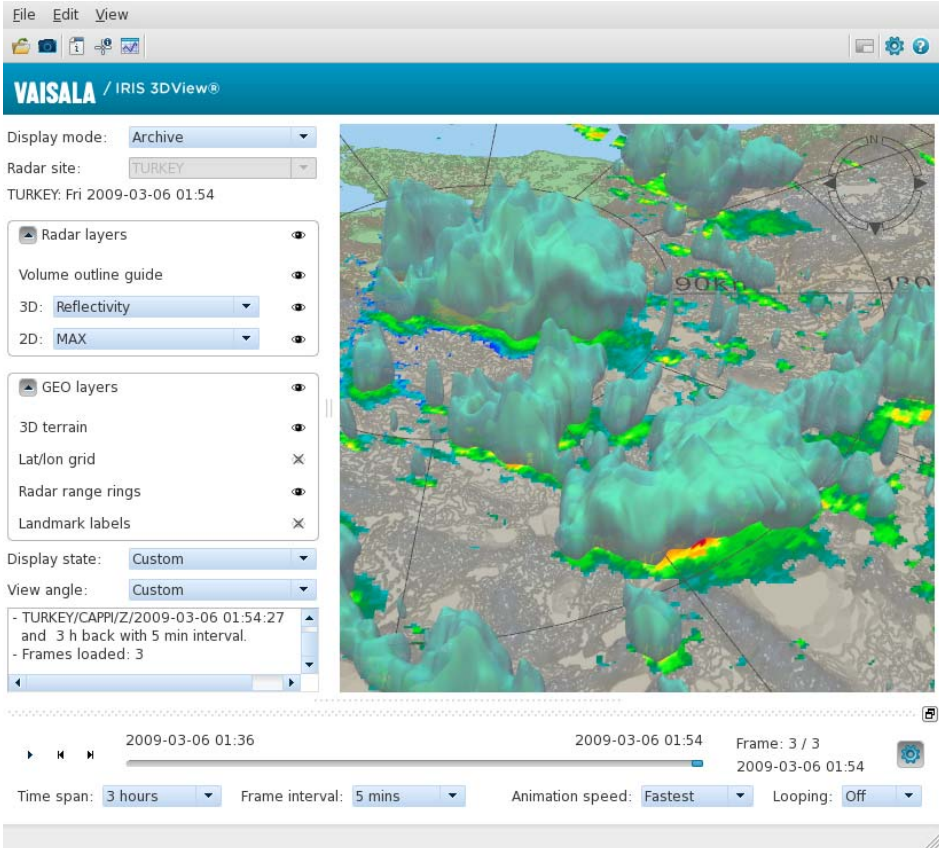


Figure 56 IRIS 3DView User Interface

D.1.1 IRIS 3DView in System Architecture

The IRIS 3DView package fits into the overall architecture of an IRIS system as shown in Figure 57 on page 379. Generally, there is an IRIS/Radar package running the IRIS software at a remote radar site (or perhaps there are multiple remote radar sites). Raw radar base data are fed from the radar sites to a central server computer running IRIS/Analysis software generating many 2D radar products. These products may be viewed directly on this central server computer, or re-distributed to other client computers running the IRIS/Display software package. For 3D functions, the central server computer outputs radar products over the network to the IRIS 3DView workstation. The IRIS 3DView PC receives these data and displays it in the 3D rendering window.

At the 3D rendering window, the operator may manipulate the data by rotating, panning, zooming, etc. During manipulation, the images are viewed in true 3D form. Any 3D image viewed on the IRIS 3DView computer can then be sent back to the central server computer for viewing and distribution to other client computers on the network running IRIS/Display. So in summary the 3D functions (rotation, etc.) are only available at the IRIS 3DView workstation. However 2D versions of the 3D renderings can be made available to any IRIS workstation on the network.

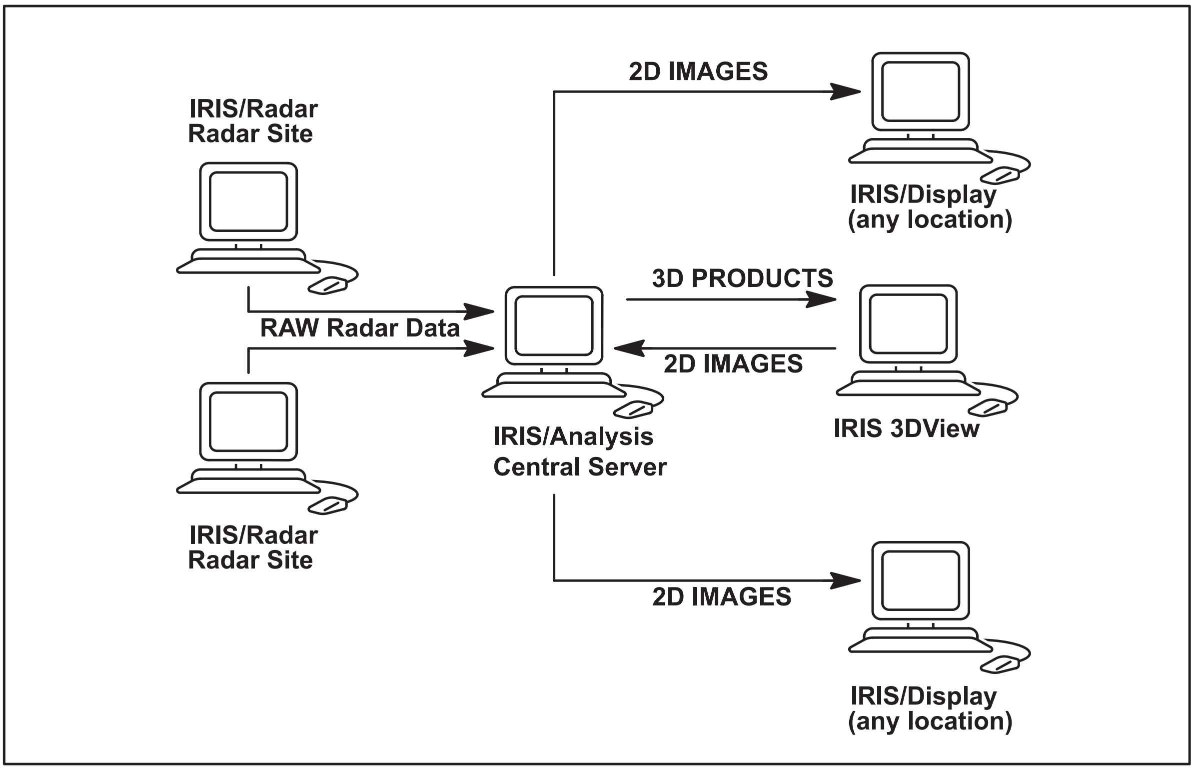


Figure 57 IRIS 3DView Data Flow

D.1.2 System Requirements

IRIS 3DView requires a Linux operating system. The recommended linux distribution is Red Hat Enterprise Linux 5.4. The installation files are delivered in RPM (Red Hat Package Management) format.

IRIS 3DView runs on standard PC hardware. IRIS 3DView must be run on a dedicated computer, since it requires full use of the processor, memory, and graphics subsystems.

The minimum requirements for the hardware are listed below:

- Processor: Intel Core 2 Duo (3.0 GHz, 6MB L2 cache, 1333 MHz FSB)
- Memory: 2GB DDR2 800 MHz
- Graphics card: nVidia GeForce 9600 or equivalent

D.2 Installing IRIS 3DView

This section describes the steps to install and configure the IRIS 3D View application on a Red Hat Enterprise Linux Version 6 or CentOS Version 6 system. You need to log in as a root user to perform this installation.

D.2.1 Prerequisite

It is not necessary for the IRIS software to be installed on the system. If you chose to have the IRIS software on the same system, it is recommended that you install the IRIS software first, before installing the IRIS 3D View.

Obtain the following RPMs (install them on your system before you install IRIS 3D View):

- `libogg-devel-1.1.4-2.1.el6.i686.rpm`
- `libtheora-devel-1.1.0-2.el6.i686.rpm`
- `qtwebkit-2.1.1-1.el6.i686.rpm`
- `qt-mobility-1.1.3-2.el6.i686.rpm`
- `gl2ps-1.3.5-1.el6.i686.rpm`
- `gl2ps-devel-1.3.5-1.el6.i686.rpm`
- `compat-expat1-1.95.8-8.el6.i686.rpm`
- `expat-2.0.1-9.1.el6.i686.rpm`
- `expat-devel-2.0.1-9.1.el6.i686.rpm`
- `xorg-x11-apps-7.4-10.el6.i686.rpm`
- `xorg-x11-server-common.1.7.7-29.el6.i686.rpm`
- `xorg-x11-server-Xvfb-1.7.7-29.el6.i686.rpm`
- `vtk-5.8.0-6.el6.i686.rpm`
- `vtk-devel-5.8.0-6.el6.i686.rpm`
- `vtk-java-5.8.0-6.el6.i686.rpm`
- `vtk-python-5.8.0-6.el6.i686.rpm`
- `vtk-qt-5.8.0-6.el6.i686.rpm`
- `vtk-tcl-5.8.0-6.el6.i686.rpm`
- `acroread-9.4.0-1.el6.i686.rpm`
- `acroread-plugin-9.4.0-1.el6.i686.rpm`

Install the above RPMs in the following order:

1. `#rpm -Uvh libogg-devel-1.1.4-2.1.el6.i686.rpm`
2. `#rpm -Uvh libtheora-devel-1.1.0-2.el6.i686.rpm`
3. `#rpm -Uvh qtwebkit-2.1.1-1.el6.i686.rpm`
4. `#rpm -Uvh qt-mobility-1.1.3-2.el6.i686.rpm`
5. `#rpm -Uvh gl2ps-1.3*`
6. `#rpm -Uvh compat-expat1-1.95.8-8.el6.i686.rpm`
7. `#rpm -Uvh expat-2*`
8. `#rpm -Uvh xorg-x11*`
9. `#rpm -Uvh vtk*`
10. `#rpm -Uvh acroread-9*`

D.2.2 Installing IRIS 3DView

The IRIS 3D View application is in the rpm package called `iris3dview-1.0.2-1.i686.rpm`. Install it using the rpm installation tool (you must be logged in as a root user to run the rpm installation tool):

```
# rpm -Uvh iris3dview-1.0.2-1.i686.rpm
```

NOTE	It is recommended that you do not run the IRIS 3D View application while logged in as a root user. If you have the IRIS software installed on your system, log in as radarop user. If the IRIS software is not installed, create a user on your system.

To create a new user, use the GNOME window GUI tool from **System** > **Administration** > **Users and Groups** and follow the online steps.

D.2.3 Post Installation

1. Log in as normal user and check .config/Vaisala directory for the following files:
   - IRIS3D.conf
   - IRIS3DColors.conf
   - IRIS3DLandmarks.conf
   - IRIS3DVisStyles.conf

2. Do one of the following:
   - If you have the IRIS software installed, create the following directories:

```
/usr/iris_data/data/geo     # for geo data
/usr/iris_data/data/2d      # for 2d data
/usr/iris_data/data/3d      # for 3d data
/usr/iris_data/data/background_output # for
background images processing results
```

The permissions and ownership for these directories are:

```
drwxrwsr-x. 2 operator users 4096 Dec 11 13:14 2d
drwxrwsr-x. 2 operator users 4096 Dec 11 13:15 3d
drwxrwsrwx. 2 operator users 4096 Dec 11 13:15
                                  background_output
drwxrwsr-x. 2 operator users 4096 Dec 11 13:14 geo
```

- If you do not have the IRIS software installed, you can put your data directory anywhere you want, but make sure that you set the directories' permissions to read/write access.

3. Run IRIS 3D View visualization:

   ```
   /usr/bin/iris3dview &
   ```

   When you first start IRIS 3DView, it runs a license wizard. Follow the online steps.

4. If your system has an IRIS or RDA system already installed, the **IRIS 3D View License** dialog box displays the **Sitename** for your system. In that case, leave it unchanged; otherwise, enter a unique **Sitename** (16 characters or less) and then click **Next**.

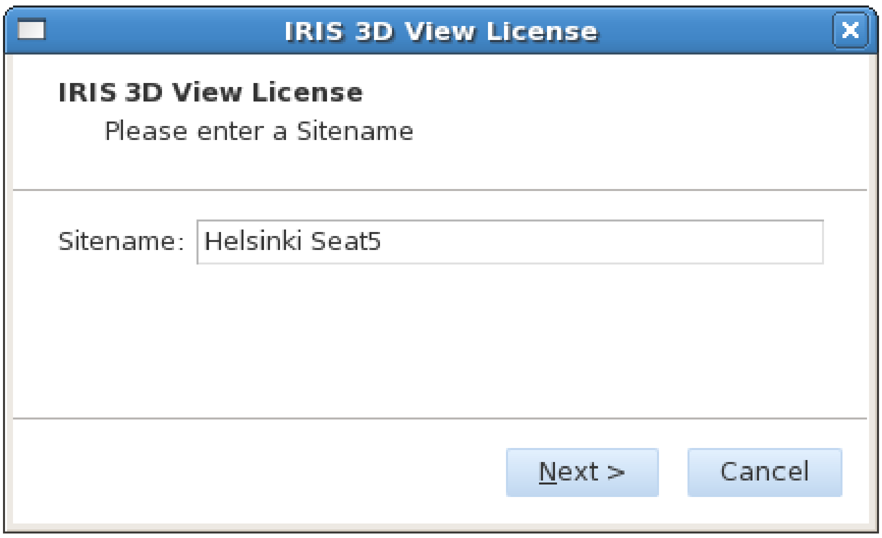


Figure 58 Site Selection During Licence Installation

The **IRIS 3D View License** dialog box now displays the site code and check code.

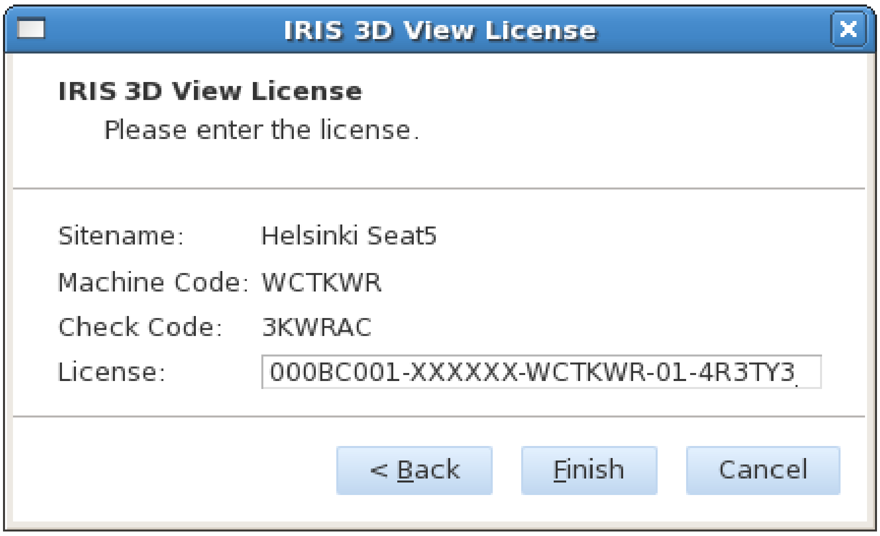


Figure 59 License String Entered

5. Send all the information shown in Figure 59 to Vaisala and we will send you a license string.
6. Enter the license string in the **License** field and click **Finish**.
7. Once the **IRIS 3D View** window opens, click the setup icon in the upper right hand corner to open the **Settings Window** dialog box.

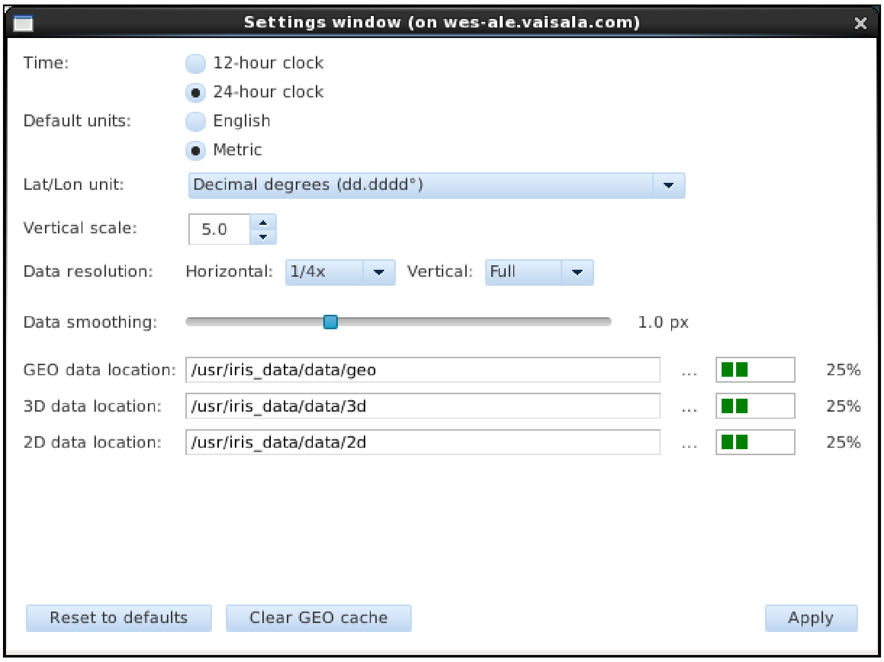


Figure 60 Settings Window

Here you configure the data directory to point to the directories that were created in step 1, according to your data type.

8. Configure background processing. Background processing is run by the iris3d user; however, the user who runs the iris3d visualization needs to copy the configuration files to the .config directory of the iris3d user:

    1. To make it easy, set permissions for everybody to be able to read and write by running:

       `#chmod -R 777 /home/iris3d/ as root user`

    2. From the visualization window, click on **File** > **Export tool**.

    3. From the export window, click the **Background output** tab and follow the online instructions to finish the setup.

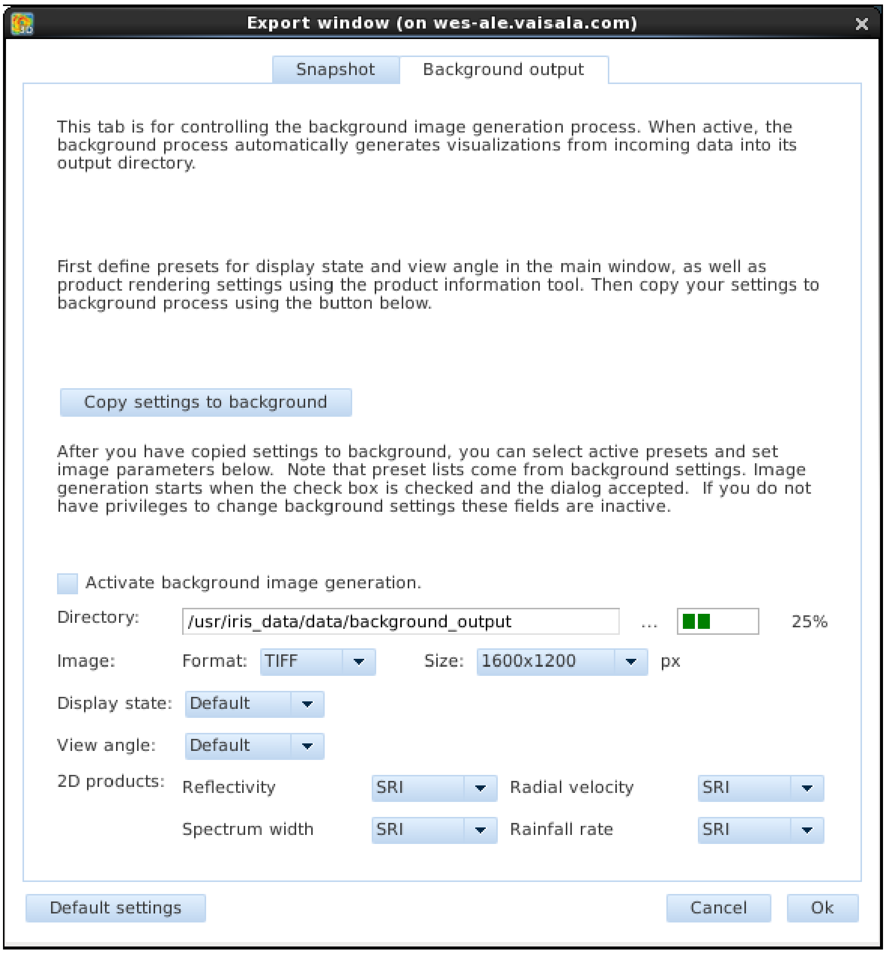


Figure 61 Background Output Tab

D.2.4 Checking Daemon

After installing the IRIS 3D View, the background processing daemon automatically starts. You can check the daemon by running the `ps -ef` command. For example:

```
ps -ef | grep iris
```

and you should get the printout similar to:

```
iris3d    3432     1  0 13:24 ?       00:00:00 dbus-launch --
autolaunch 841d3b9bca80c846219d29fc00000022 --binary-syntax
--close-stderr
iris3d    3433     1  0 13:24 ?        00:00:00 /bin/dbus-
daemon --fork --print-pid 5 --print-address 7 --session
iris3d    3435     1  0 13:24 ?        00:00:00 /usr/bin/
iris3dviewd --loglevel=2 --daemon
```

If you need to restart the daemon, change to the root user by typing:

```
su root
```

You are prompted for the password.

The stop and start the daemon by typing the following:

#/sbin/service iris3dviewd stop
#/sbin/service iris3dviewd start

D.2.5 Testing Background Processing

1. Make sure the background processing daemon is running.
2. Copy 3d data to the 3d directory that you configured.
3. Wait for a second and check the output file in output directory that you configured.

D.2.6 Modifying the Logging Level

You can set logging level to more details, like level 6, by editing the `/etc/sysconfig/iris3dviewd` and changing the `loglevel=2` to `OPTIONS="--loglevel=6 --daemon"`. After modifying the logging level, you need to restart daemon.

To check the logging, go to `/home/iris3d/` and open the `iris3dviewd.log` file. To view real-time logging messages while you are running background processing, run `tail -f iris3dviewd.log`.

D.3 Basic Operation

D.3.1 Starting IRIS 3DView

To start the IRIS 3DView software, simply click the icon for IRIS 3DView on your IRIS 3DView PC. Alternatively, you can type `iris3dview` in a shell session.

When the software starts, the main window is loaded. The main window is shown in Figure 62 on page 387. The 3D view takes up most of the window area, with controls for the view on the left. A compass ring is always shown in the top right corner. When the mouse pointer is moved to the right corner, the current view heading and zoom level are also shown.

The File Toolbar and the Dialog Toolbar are placed on top of the window. The bottom of the window is reserved for the Animation toolbar.

The File, Edit, and View menus on the menu bar support standard keyboard shortcuts. On the File menu you can open and close data files, open the export tool, or quit the IRIS 3DView. The Edit menu can be used to access the settings window. The View menu can be used to hide the File, Dialog, and Animation Toolbars.

The IRIS 3DView software is primarily controlled by using the mouse. For a description of the controls in the 3D view, see Navigating the 3D View on page 388.

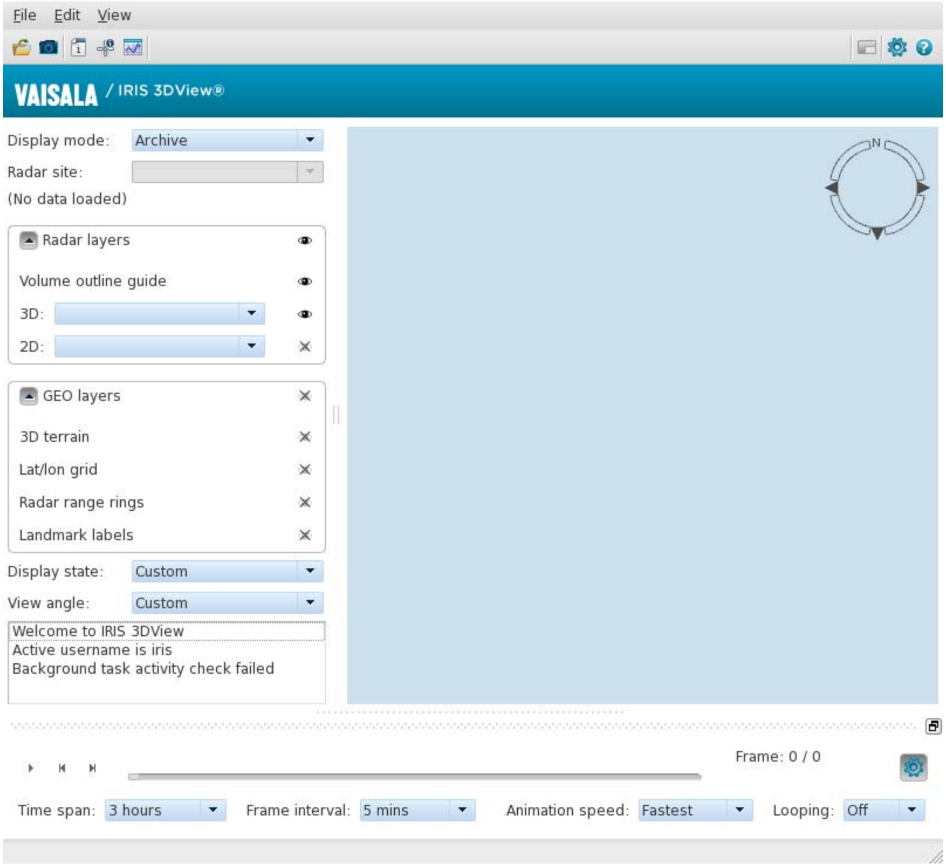


Figure 62 IRIS 3DView Starting View

D.3.2 Opening Data Files

There are two ways to open data files on the IRIS 3DView:

- Click the  button on the File Toolbar or select **Open 3D data** in the File menu. This opens the 3D data selector where you can select the desired data file.
- Select the **Live** mode in the **Display mode** selection drop-down list below the Vaisala logo, on the left side of the main window. In the Live mode, IRIS 3DView automatically opens the latest data file from the radar site that is selected in the **Radar site** drop-down list.

CAUTION	IRIS 3DView cannot find any data files unless their location is configured in the Settings menu. See Settings on page 398.

D.3.3 Navigating the 3D View

The view that is always presented when the software starts is a direct downward view. You can think of viewing the data as if looking through a camera. The location of the camera is controlled by the user. At startup, the camera is high in the sky looking straight down on the earth. The volume outline guide (dark lines) are drawn around the rendered area.

The mouse controls in the 3D view are as follows:

- Hold the left mouse button and drag the mouse to move the camera position about the center of the picture. The camera remains aiming at the center, so this effectively rotates the data. Dragging the mouse horizontally rotates the camera about the center. Dragging the mouse vertically moves the camera vertically about the center.
- Hold the right mouse button and drag the mouse to move the camera location. The camera pointing angle remains the same so this pans the data. Holding the left button and shift key does the same.
- Hold the middle mouse button and drag the mouse to move the camera closer or farther from the center. This effectively zooms the data. Rotating the mouse wheel does the same.

NOTE	You can always return to the starting view by selecting the **Default** view angle preset. Use the view angle preset manager to save your own view angle presets.

D.3.4 Rendering Modes

Rendering mode determines the visualization approach that IRIS 3DView takes when creating the 3D model of the radar data. There are two rendering modes, **surface rendering** and **volume rendering**. The choice of rendering mode and the mode-specific options are set in the Settings window. See Settings on page 398.

IRIS 3DView uses a full spectrum color scale when rendering the radar data. Blues represent the weakest echoes, building up to greens, yellows, oranges and finally reds. The color scale is NOT absolute, but instead relative. The reflectivity legend on the product information tool window shows the current relationship of colors and reflectivity in decibels (dBZ).

D.3.4.1 Surface Rendering

Surface rendering mode uses what in 3D terminology are called iso-surfaces. In other words, for example, if the threshold of the first isosurface is set at 30 dBZ, all of the echo that is less than 30 dBZ is removed from the picture and what you see is a shape that represents the outer boundary of the 30 dBZ echo.

IRIS 3DView allows up to four of these iso-surfaces to be drawn in the same 3D visualization. The threshold value, color and opacity of each surface is user configurable. This allows a very flexible representation of the radar data.

Proper opacity control of the surfaces is important for good visualization. The more opaque a surface is (higher opacity value), the more difficult it is to see through. The less opaque, the more transparent the surface becomes and it is easier to see through it.

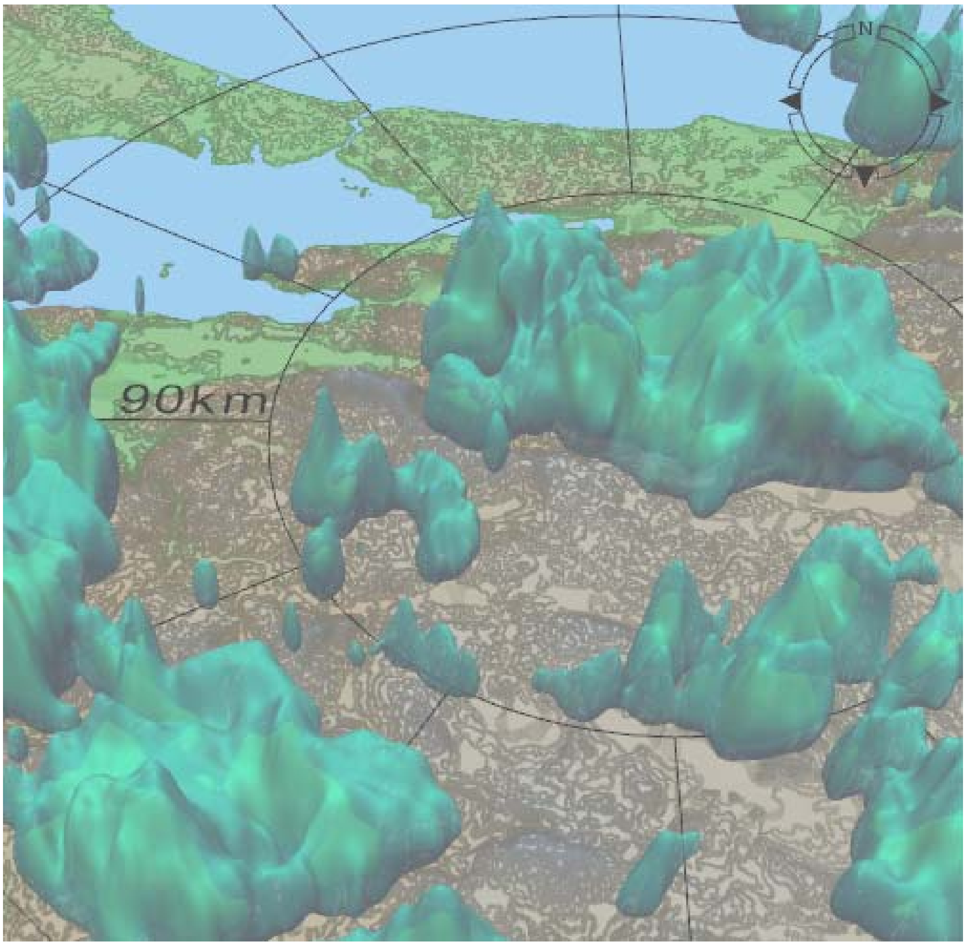


Figure 63 Example of Surface Rendering

D.3.4.2 Volume Rendering

In volume rendering mode, IRIS 3DView renders a 3D visualization of the data that is between the minimum and maximum values. All other data outside this range is filtered out and not displayed. Instead of using distinct surfaces, the area is rendered so that it gradually changes from the color and opacity at the minimum value to the color and opacity at the maximum value.

The minimum and maximum values, as well as the color and opacity at the ends of this range, are user configurable.

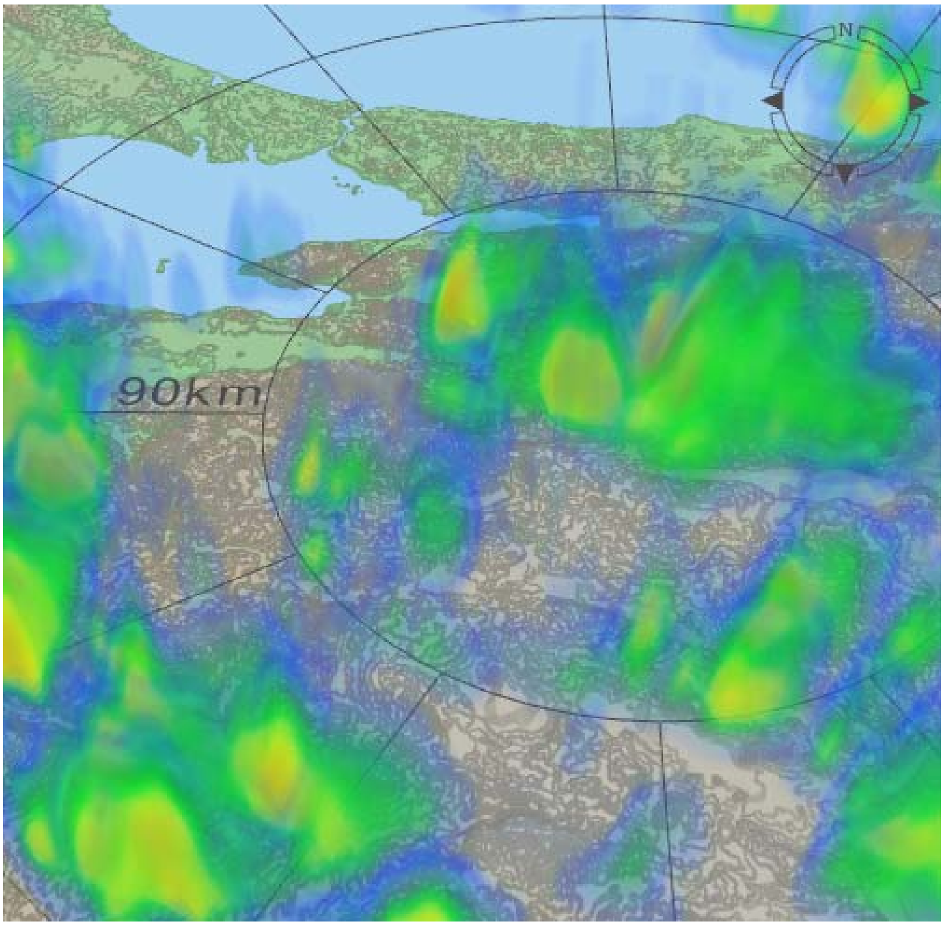


Figure 64 Example of Volume Rendering

D.4 Display State Controls

The controls on the left side of the main window determine what is rendered in the 3D view. There is a text window at the bottom of the controls, which displays a running log of the configuration changes. The right side of the control area has a handle that can be dragged to expand the control area. See Figure 65 on page 392 for a picture of the display controls. Many of the controls have "eye" icons that can be clicked to toggle the visibility of the controlled visual element or layer.

Display Mode

Selects between the Archive Mode and the Live Mode. See Archive Mode and Live Mode on page 392.

Radar Site

Drop-down list for selecting the monitored radar site. Only selectable in the Live Mode. The radar site and timestamp of the currently loaded data file are shown below this control.

Radar Layers

Here you can toggle the **Volume outline guide** on or off (the dark lines around the rendered area), and select the 3D and/or 2D radar products that are rendered.

GEO Layers

Here you can control if the following geographical information layers are shown:

- 3D terrain
- Latitude-longitude grid
- Radar range rings
- Landmark labels

Display State

Select the desired display state preset from the drop-down list, or select **Manage presets** to open the preset manager window. In the preset manager, you can store the current display state options as a preset, and manage existing presets.

View Angle

Select the desired view angle preset from the drop-down list, or select **Manage presets** to open the preset manager window. In the preset manager, you can store the current view angle as a preset, and manage existing presets.

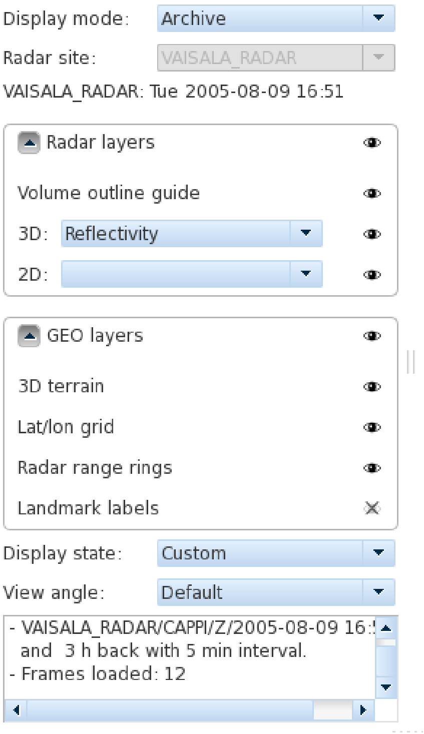


Figure 65 Display State Controls

D.5 Archive Mode and Live Mode

The IRIS 3DView software has two modes of operation: Archive Mode and Live Mode.

D.5.1 Archive Mode

The Archive Mode is a manual mode where the user loads radar data files and creates visualizations without any automatic functions taking place.

D.5.2 Live Mode

In the Live Mode the IRIS 3DView software continuously monitors the input directory. As soon as a new radar data file comes in from the central server computer, IRIS 3DView automatically loads it. If the background process has been configured and enabled, it will render 2D images of the radar data in the background, using preset view angles and display states. The background process requires some setup (i.e., setting of a pre-defined view point, etc.), but no interaction is required at runtime.

D.6 Tools and Toolbars

D.6.1 File Toolbar

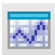
The File Toolbar contains the following icons:

Opens a file selection dialog for selecting a new radar data file. See Opening Data Files on page 387.

Opens the export tool. See Export Tool on page 393.

Opens the product info tool. See Product Information Tool on page 395.

Opens the cursor tool. See Cursor Tool on page 397.



Opens a second 3D window that can be moved, resized, and navigated independently of the main window.

D.6.1.1 Export Tool

The export tool is used to save 3D views as bitmap images. On the **Export** tab, the currently rendered 3D view is shown with a reflectivity legend. Click the **Save a image** button to save the image as a file.

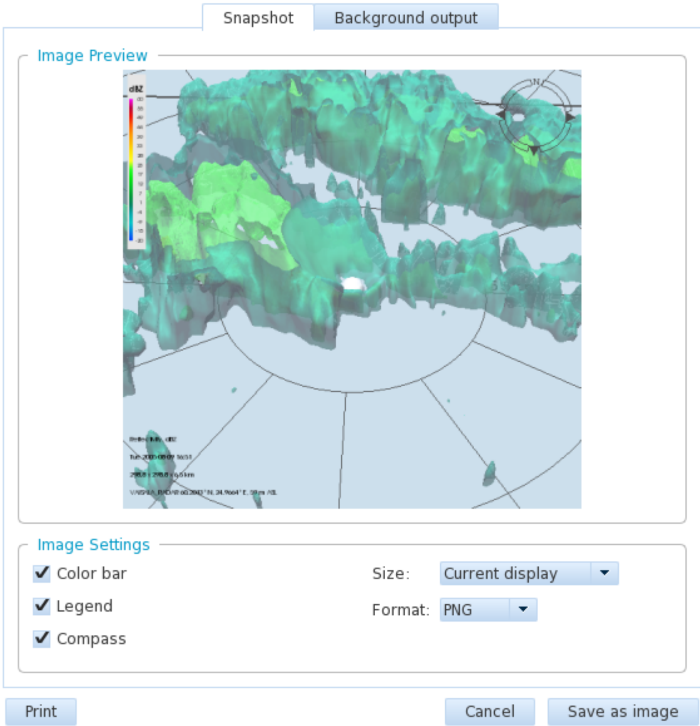


Figure 66 Export Tool

On the **Background output** tab, you can configure the background rendering process which outputs 2D images using pre-defined options. If you want to enable the background rendering, perform the following steps:

1. Using the controls on the main window, create and save a preset for the **display state** that you want to use in the background rendering.
2. Create and save a preset for the desired **view angle**.
3. Open the **export tool** and switch to the **Background output** tab.
4. Click the **Copy settings to background** button to make the presets available for selection.
5. Set the desired output generation options:
   - Output directory
   - File format
   - Display state preset
   - View angle preset
   - Image size
6. Check the **Activate background image generation** checkbox and click the OK button to exit to the main view.

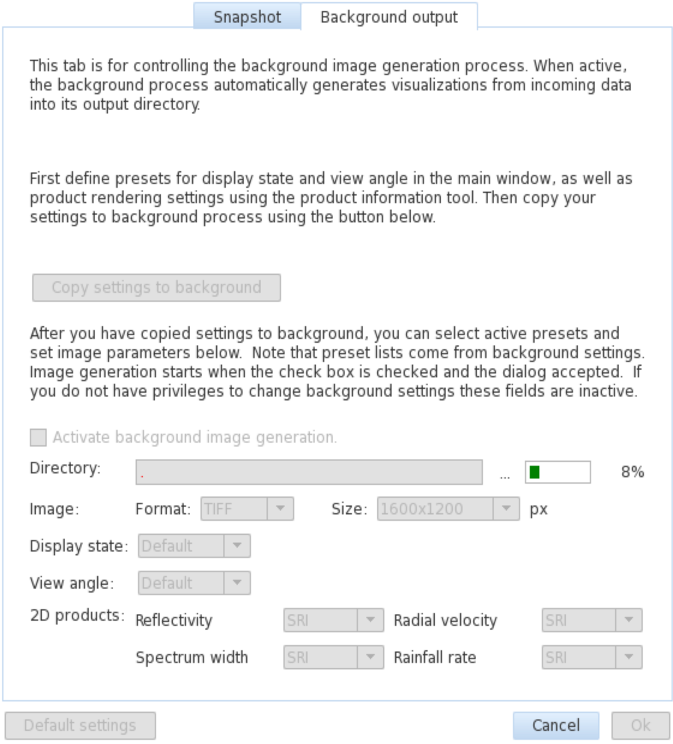


Figure 67 IRIS 3DView Background Output Configuration Window

D.6.1.2 Product Information Tool

The product information tool provides the following information about the currently selected 3D data product:

- **Data**: data type being displayed
- **Time**: timestamp of the data file
- **Volume**: size of the radar data volume
- **Radar**: Name and location of the radar that produced the data file
- Color legend for the 3D view

In addition to the above information, you can set the following options that define how the data product is rendered in the 3D view:

- **Color map**: Allows selection from a short list of pre-configuredcolor scales.
- **Rendering mode**: Rendering mode of the 3D visualization. Options are: Surface rendering and Volume rendering.

- **Isosurface parameters**: These options are visible if surface rendering has been selected as the rendering mode. Using these options you can define the following options for surface rendering:
  - Number of isosurfaces (1...4)
  - Threshold value for each isosurface
  - Opacity of each isosurface
  - Color of each isosurface

- **Volume parameters**: These options are visible if volume rendering has been selected as the rendering mode. Using these options you can define the following options for volume rendering:
  - Low and high value of the rendered range
  - Opacity at the low and high end of the rendered range
  - Color at the low and high end of the rendered range

Click **Apply** to save your changes to the settings, or **Revert to previous** to restore the previous settings. Clicking **Reset to defaults** will select the surface rendering mode with the default isosurface settings.

Click the small arrow below the color legend to minimize the product information tool window. In the minimized form, the product information tool shows only the color legend.

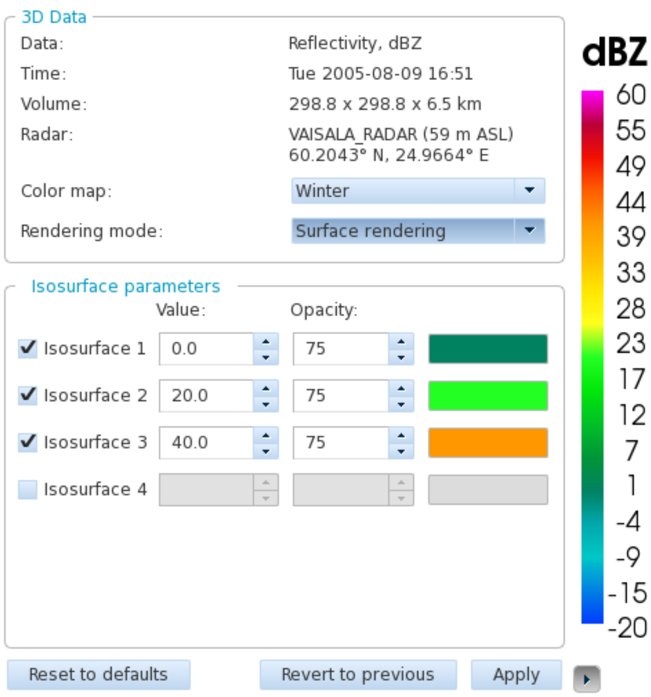


Figure 68 Product Information Tool

D.6.1.3 Cursor Tool

The cursor tool displays information about the current home location, and the current cursor position in relation to the home position. You can also change the current home position by selecting a radar site from the drop-down list, or clicking the **Set home with cursor** button.

When the cursor tool window is open, a round cursor with yellow axis lines appears on the 3D view area. You can move this cursor around the view area by dragging with the mouse: position the mouse pointer above the cursor or one of the axis lines, hold down the left mouse button, and move the mouse. As the cursor moves, the cursor tool window is updated with the location and value information at the cursor position.

NOTE	To move the cursor only on horizontal or vertical axis, hold down the shift key when moving the cursor.

Click the small arrow at the bottom right corner of the cursor tool window to minimize it. In the minimized form, the cursor tool only shows the information for the current cursor position.

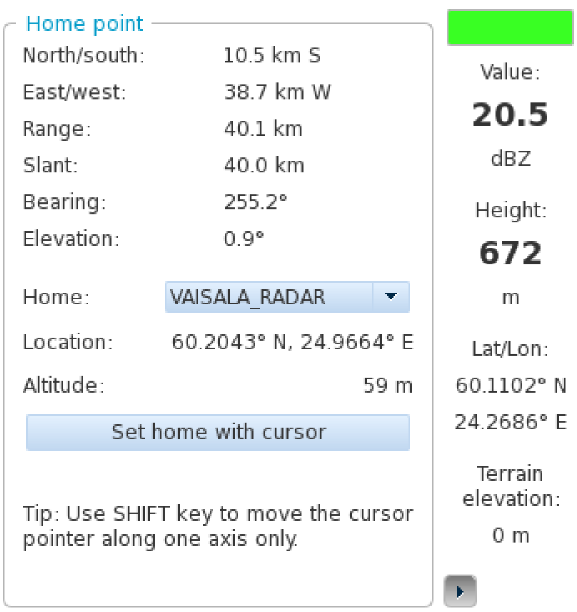


Figure 69 Cursor Tool

D.6.2 Dialog Toolbar

The Dialog Toolbar contains the following icons:

 Toggle between a fullscreen mode and the normal windowed mode.

 Toggle between bright and dark colour schemes.

 Open the settings window. See Settings on page 398.

 Open the IRIS 3DView help.

D.6.2.1 Settings

The settings window contains the general settings for the IRIS 3DView software.

Time

Select 12-hour clock or 24-hour clock.

Default Units

Select English or Metric units.

Lat/Lon unit

Select the units for latitude and longitude. The available options are:

- Decimal degrees (dd.dddd°)
- Degrees, decimal minutes (DD° mm.mmm')
- Degrees, minutes, decimal seconds (DD° MM' ss.s")

Vertical scale

Set the vertical scale of the 3D rendering. A higher value will produce higher peaks, a low value will produce a flater rendering.

Data Resolution

Set the horizontal and vertical resolution that is used for rendering. Lowering the resolution will speed up the generation of the 3D model, but will produce a less detailed rendering.

Options for horizontal resolution:

- Full

- Half
- 1/3x
- 1/4x

Options for vertical resolution:

- Full
- Half

NOTE	Lower the resolution for a smoother playback of animation frames.

Data Smoothing

Increase data smoothing to remove some fine detail from rendered object, creating a smoother model. The smoothing value can be selected using a slider between 0 and 3 data pixels, at increments of 0.1 pixel.

NOTE	Data smoothing is not the same as anti-aliasing of screen pixes. The smoothing is applied to the 3D model, removing some of the model complexity.

Data Location Directories

Set the correct directories for the data files:

- **GEO data location**: the directory where IRIS 3DView looks for 3D terrain data.
- **3D data location**: the directory that IRIS 3DView scans for 3D radar data.
- **2D data location**: the directory that IRIS 3DView scans for 2D radar data.

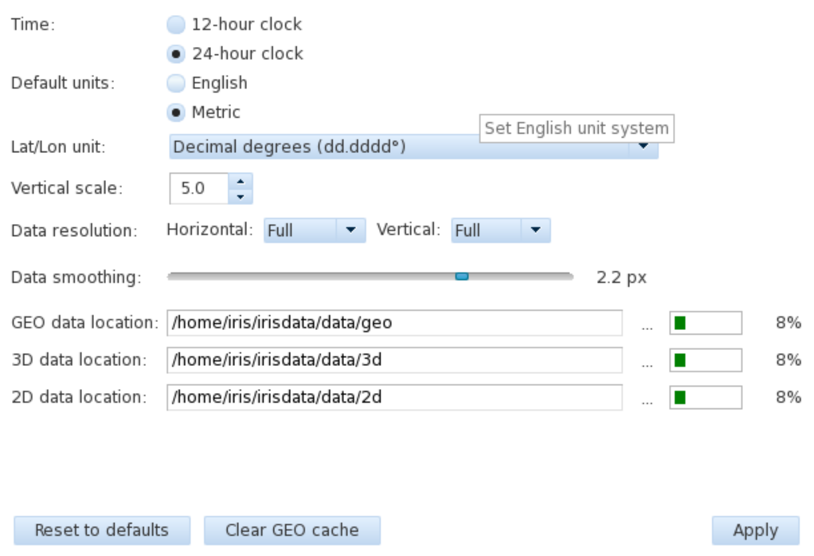


Figure 70 IRIS 3DView Settings Window

D.6.3 Animation Toolbar

The animation toolbar controls the playback of data frames. The top of the toolbar shows the timestamps of the first and last frames of the currently loaded data file, the number of the current frame, and the total number of frames currecty created from the data file. The number of frames is affected by the amount of data in the file, and the animation settings that are active on the toolbar, such as **Time span** and **Frame interval**.

The most prominent feature on the animation toolbar is the slider that selects the currently rendered frame. You can drag the selector using the mouse. The playback controls on the left side of the slider consist of the play button which will play the animation from the current frame to the end, and buttons for jumping to the next and previous frames. The animation toolbar can also be separated from the main window by pressing the icon on the top right corner of the animation toolbar.

The toolbar has the following settings which can be hidden and shown by clicking the settings icon  on the toolbar.

Time Span

This setting determines the maximum time selectable using the animation slider. The options are:

- 3h back
- 6h back

- 12h back
- 24h back

Frame Interval

This setting determines the minimum frame interval. If there are more frequent data files on disk, then some will be skipped to reach this minimum. The larger the frame interval, the faster the animation will proceed through the time span.

- 5 minutes
- 15 minutes
- 30 minutes
- 60 minutes

Animation Speed

Sets an additional delay between displayed frames. Does not affect the rendering time. Options are:

- Fastest (no delay)
- 1 second
- 3 seconds
- 5 seconds
- 10 seconds

Loop mode

This setting determines whether the animation will only **Play once**, or **Loop** endlessly until stopped.

Figure 71 IRIS 3DView Animation Toolbar

NOTE	The typical bottleneck for animation playback is speed is CPU power, i.e. the time it takes for IRIS 3DView to calculate the 3D model of the frame. If the animation playback speed is unsatisfactory, set the **Animation speed** to Fastest, render in a smaller window, and consider lowering the data resolution in the Settings window.

APPENDIX E
IRIS TDWR FEATURES

E.1 Overview

E.1.1 Items provided with the IRIS/TDWR Option

The optional IRIS/SHEAR package includes various features for terminal Doppler weather radar applications. The features and their associated documentation are summarized below:

- SHEAR Product

  The WARN product run on a radial SHEAR product is used for microburst detection.

  IRIS Users Manual SHEAR: Wind Shear on page 182
- SLINE Product

  Detects wind shifts associated with gust fronts and cold fronts. Can use radial, azimuthal or combined radial and azimuthal shear.

  IRIS Users Manual SLINE: Shear Line (Optional) on page 195
- Ribbon Display

  Ribbon display terminals (RBDT's) are large format text-only displays that are used to display and signal alerts to controllers. IRIS supports US FAA-style Dale RBDT's which are serial line hardware devices and Virtual RBDT's (vribbons) which are X-Window displays.

  This appendix Ribbon Displays on page 413
- TDWR/LLWAS Integrator

  Uses the US FAA algorithm to integrate information from IRIS shear warning products and LLWAS (low-level wind shear alert system) to generate TDWR products for output to standard US FAA-style ribbon displays. Note that an LLWAS system is not required.

This appendix TDWR/LLWAS Integrator and Runways Utility on page 426

- Runway Utility

  Graphical utility for selecting the active runways that are in use. The information is used by the TDWR/LLWAS Integrator to select for which runway corridors alerts are issued to the RBDT's.

  This appendix Runways Utility on page 434

These features, combined with all the standard features of IRIS, provide controllers with timely, concise information concerning wind shear and other weather phenomena that can affect air terminal operations.

The TDWR used by the US FAA is based on technology circa 1985. Since this time, computer speeds have increased dramatically. There have also been changes, in algorithms, networking standards and user interface. The goal of the IRIS/TDWR is to take the best elements of the TDWR designs and implement them in the context of todays technology.

SIGMET does not warrant that the IRIS/TDWR option will function in accordance with US FAA Specifications.

E.1.2 IRIS/TDWR Terminology

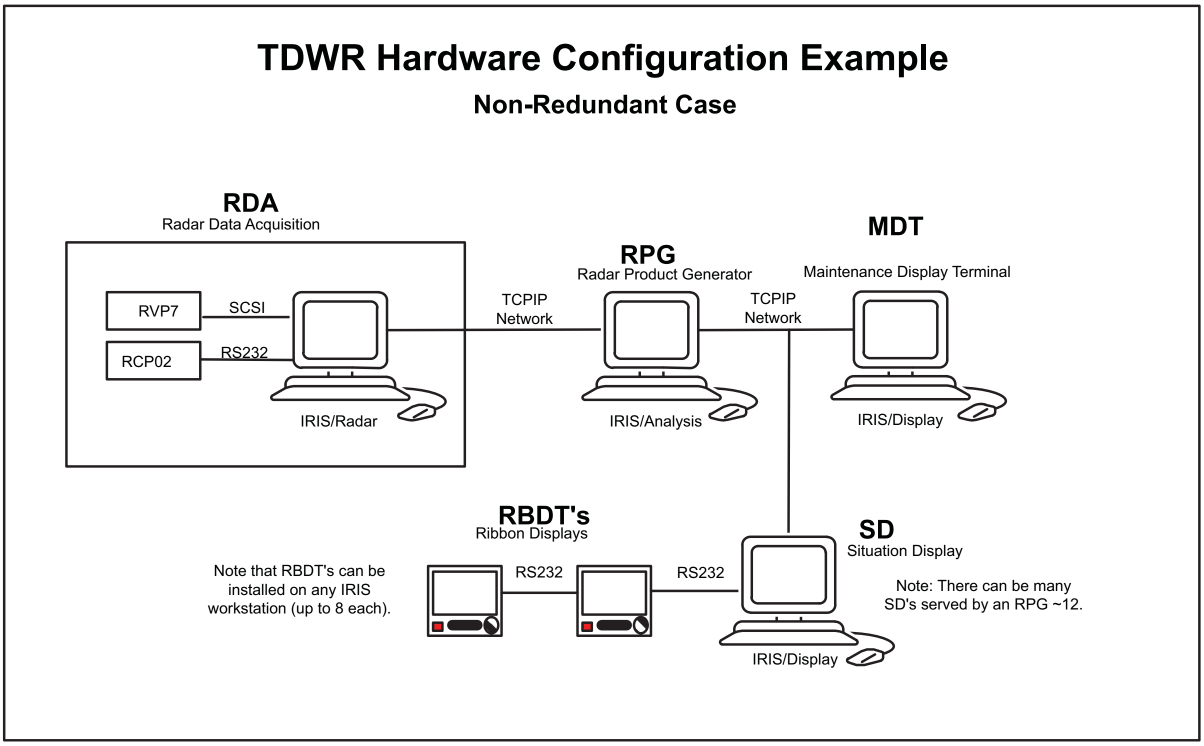
Below is a summary of US FAA TDWR terminology and how it matches-up to IRIS terminology:

- **Radar Data Acquisition System (RDA)**– this is the system that collects data. In IRIS this would consist of the signal processor, radar control processor and a workstation running IRIS/Radar software.
- **Radar Products Generator (RPG)**– in TDWR this is a separate computer that takes in Base Data from the RDA and generates products. The IRIS analog would be a workstation running IRIS/Analysis receiving data from another workstation running IRIS/Radar. In IRIS the RDA and RPG functions can be combined.
- **Maintenance Display Terminal (MDT)**– Used for control and monitoring of the TDWR system. Since IRIS is a networked client-server system, the concept of a dedicated "terminal" for this function does not really apply, since any workstation on the network can provide this function. For management purposes, it is sometimes useful to have an IRIS/Display workstation that is dedicated to the MDT task.

- **Ribbon Display (RBDT)**– this is a text only display intended for controllers. It connects to an IRIS Workstation via a serial line.
- **Situation Display (SD)**– a simplified weather display showing oval shapes to depict microbursts and current and forecast wind shear line positions. In IRIS, this is accomplished by the simultaneous display of WARN and SLINE products.
- **Arena**– in IRIS this is called a protected area. For example runway 33LA_1MF signifies a box (typically 1 miles square) that is centered 1 nautical mile from the approaching end (south end) of runway 33 (nominally approached on a heading of 330 degrees).
- **Corridor**– Each runway has two corridors, an approach corridor and a departure corridor.
- **Base Data**– the basic dBZ, V and W data. In IRIS the compressed version is the RAW product. The un-compressed version is called Ingest Data.
- **Wind Shear Alert (WSA)**– alert of a shear line or gust front based on the SLINE (shear line) product, or a weak microburst based on the WARN product run on radial shear.
- **Microburst Alert (MBA)**– alert of a strong microburst. In IRIS these are based on the WARN product run on a radial SHEAR product.
- **Low Level Wind Shear Alert System (LLWAS)**– based on anemometers that are positioned around the air terminal. LLWAS is not available at all sites. Where it is available, it provides backup to the TDWR in cases where the radar coverage is obscured, or there are no scattering targets.

E.1.3 IRIS/TDWR Hardware Configuration Example

SIGMET supports both single and dual–redundant hardware configurations. Because of the network communications features in IRIS there are many possible hardware configurations that allow different tasks to be performed by various workstations. The example below is for a non–redundant system.



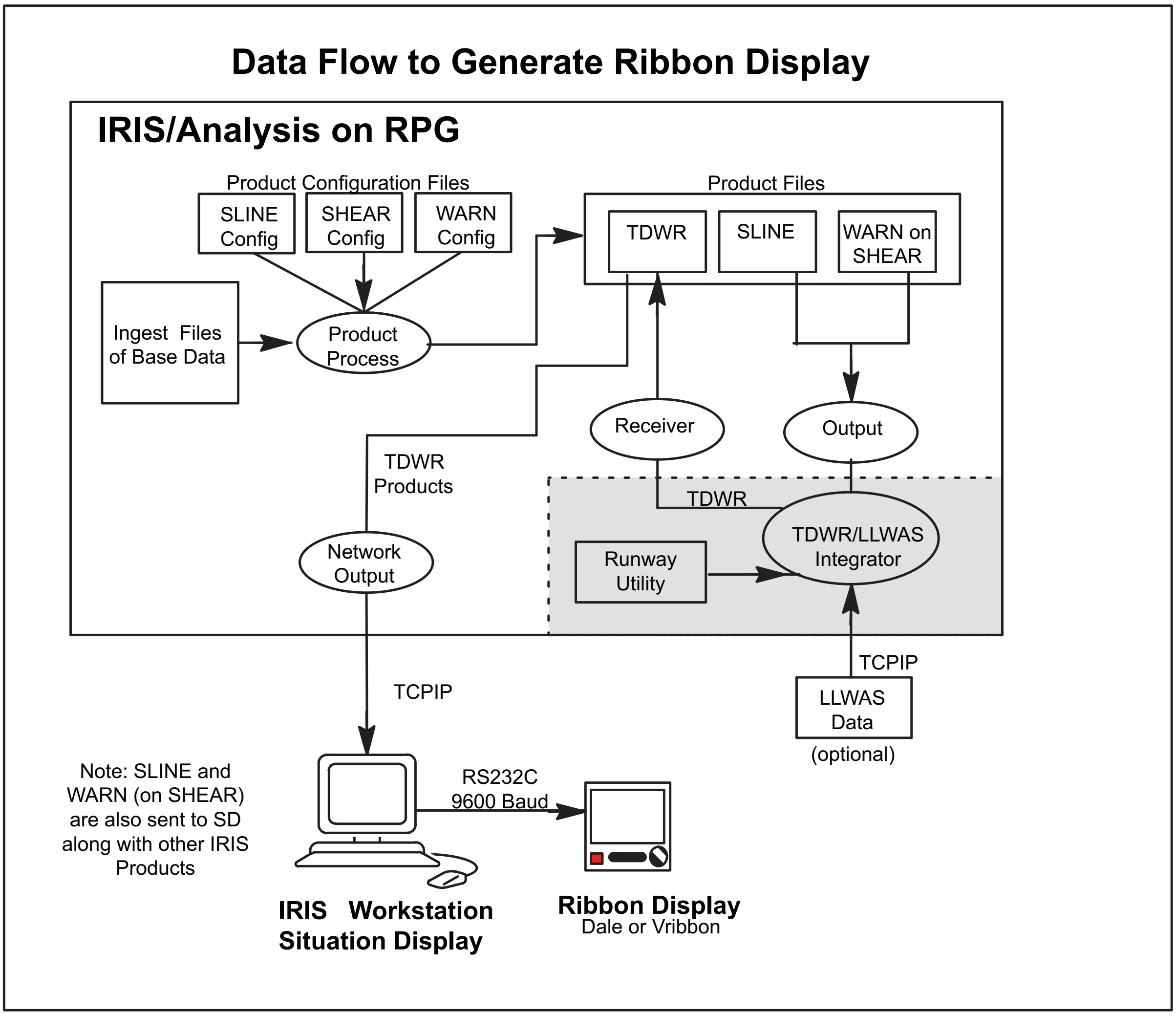
With the IRIS architecture, the RPG and MDT functions could be combined into the RDA workstation. Reducing the amount of hardware increases the system reliability and reduces maintenance. The RDA workstation also has all the features of an SD.

For redundant systems, there are two RDA's and two RPG's. The RDA's have dual network interfaces and the active one outputs base data to both RPG's. This means that all the products are actually made twice. Each SD is configured with three network interfaces — one for each RPG and a separate one for network output to the SD's. Each SD is equipped with two network interfaces — one for each RPG. Thus each SD receives two versions of each product — one from each SD. If one RPG or network fails, the SD's will continue to receive products from the other one.

E.1.4 Data Flow for Ribbon Display Generation

The primary function of the TDWR processing is to output ribbon display messages to controllers (accompanied by audio warning tone). In addition, the standard IRIS output and display features are used to construct images for the Situation Displays (SD's), i.e., simplified displays showing runway warning areas (arenas), alert centroids and shear lines with forecast positions. Since the SD's are normal IRIS displays, any other IRIS product can be displayed as well.

Ribbon displays are generated whenever the local IRIS (the IRIS where the ribbon display is connected) receives a special TDWR product. The data flow to generate these TDWR products is shown below:



The normal IRIS product generation makes SLINE and WARN products for radial shear (microburst warnings). These products will have all possible protected areas turned on, even for inactive runways. The results are sent to a separate TDWR/LLWAS Integrator. The Integrator takes data from LLWAS (if available) and configuration information on the current active runways from the runway utility. The output back to IRIS is a TDWR product that is filtered so that only the information required by the ribbon display is present. The integration algorithm is the FAA/MIT Lincoln Lab algorithm that was developed for the U.S. FAA TDWR.

Usually both IRIS and the Integrator run on the RPG, although it is possible to run the TDWR/LLWAS Integrator on an SD. This would, however, lead to configuration chaos since there are likely to be many SD's.

The RPG then outputs the TDWR product to the SD's and when it is received, it is automatically formatted into a ribbon display message and sent out the SD serial line. The process that outputs the products to the RBDT's has an additional configurable filter, i.e., the controller can specify which corridors will be displayed on an SD. The **ribsetup** utility is used to configure this.

E.1.5 IRIS/TDWR Configuration Summary

The remainder of this appendix covers the theory, installation, configuration and use of the various TDWR components. For convenience, the installation steps are summarized here:

- Configure the IRIS for TDWR operation.

  Protected Area Configuration (Arenas) on page 408 Configure the runway arenas (protected areas)

  IRIS TASK and Product Configuration on page 410 Configure the scan TASKS and the SLINE and SHEAR products

  IRIS Product Output Configuration on page 411 Configure the outputs to the Integrator and the SD's.
- Install and configure the Ribbon Displays.

  Ribbon Displays on page 413 Hardware installation

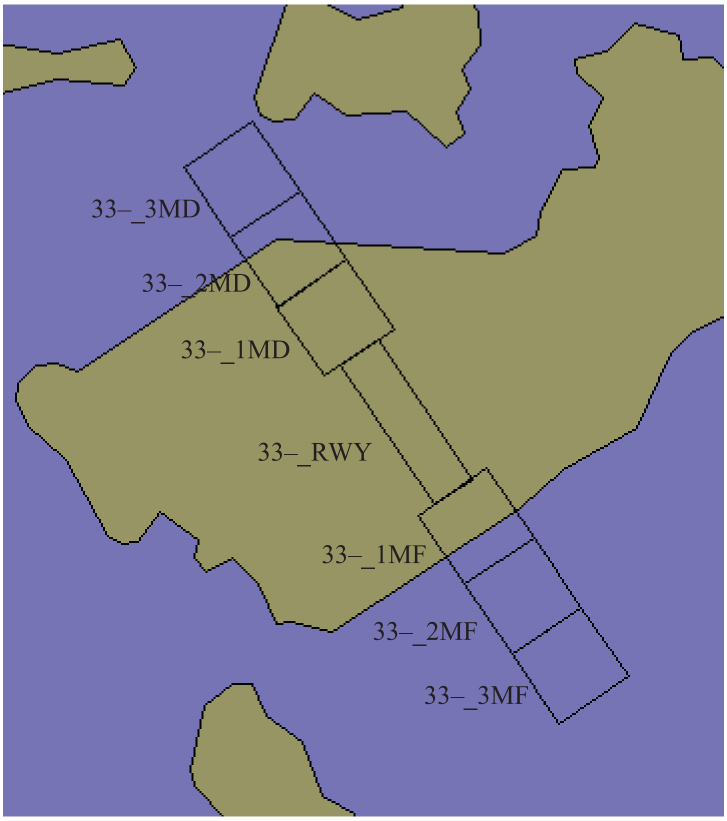
  Ribbon Display Software Configuration on page 418**Ribsetup** utility
- TDWR/LLWAS Integrator and Runways Utility on page 426 Configure the TDWR/LLWAS Integrator (runways.conf).
- Runways Utility on page 434 Use the **runways** utility to set the runway direction.

E.2 IRIS Preparation

The preparation of the IRIS system involves setting-up the protected areas, scan strategy, product generation and output for TDWR operation.

E.2.1 Protected Area Configuration (Arenas)

Protected areas are configured in the IRIS setup/product utility. An example of protected areas configured as arenas for a TDWR system is shown below. This section describes how to configure these areas.



Arena Naming Convention

A special naming convention is used to designate runway corridors and protected areas (also called "arenas"). An example is shown in the figure above.

The naming convention for runways is as follows:

- The first two digits are the runway name, also referred to as the "corridor" name. In the example, this is "33". There is no need to make corresponding names for the reverse direction (runway 15). This will be done automatically. SIGMET recommends that you use the convention of naming the "north bound" direction for a corridor.
- The next position is used if there is a left and right runway. For example, use 33R and 33L to indicate left and right runways. If there is only a single runway, then use a dash as was done in the example, i.e., 33–. Note, if the left and right runways are within approximately 500 m of each other, then it is easier to designate a single corridor for alert purposes rather than have two separate corridors that are almost completely overlapped.
- The next field is an underscore character which serves as a separator.
- The last 3 digits are used to specify the "arena". For example, "1MF" is used to specify a protected area that extends from the end of the

runway to 1 mile from the end of the runway. It is recommended that you use the text RWY to specify the runway itself.

Once you have decided the names for all the runways and arenas, then you should construct the geometry of the protected areas, i.e., the size and orientation information that is required in the IRIS Setup/Product utility. Refer to the *IRIS Utilities Manual* for details. It is tricky to get the areas correct so to help you:

NOTE	SIGMET provides an EXCEL spreadsheet that makes it easy to configure runway protected areas. Please download it from our website www.sigmet.com or email support@sigmet.com for a free copy.

After you have created your protected areas you can test them with the **overlay** utility. This requires that you have already configured the overlay for your system. Refer to the chapter on **overlay** in the *IRIS Utilities Manual*. To see your protected areas on top of your overlay select the *Options* menu and press the button labelled "Protected".

The display will show you the protected areas. Zoom in as needed to see them. The areas will not be labeled. Verify that all the areas are present in the correct locations and that all of the edges are properly aligned. If not, quit **overlay** and then go back to IRIS setup/product to edit and save the protected area information. Retest with **overlay** to see if you got it right.

E.2.2 IRIS TASK and Product Configuration

The configuration of scan TASKS and the SLINE and SHEAR products required for TDWR operation depends on a the specific requirements of the user and the constraints of the site. Therefore each site tends to be different. For example, some customers may require that a complete volume scan information be collected during TDWR operation (to provide general weather monitoring) while others may want to have the scan dedicated to low-level wind shear detection. Most installations will configure the system to switch automatically from a weather monitoring mode to a hazard monitoring mode, whenever there is sever weather near the terminal.

The example configuration provided in Setting Up the Terminal Doppler Modes on page 353 of this manual can be used as a starting point for operation. This example will need to be adjusted to the specific requirements of your site. This is typically done when your system is installed.

E.2.3 IRIS Product Output Configuration

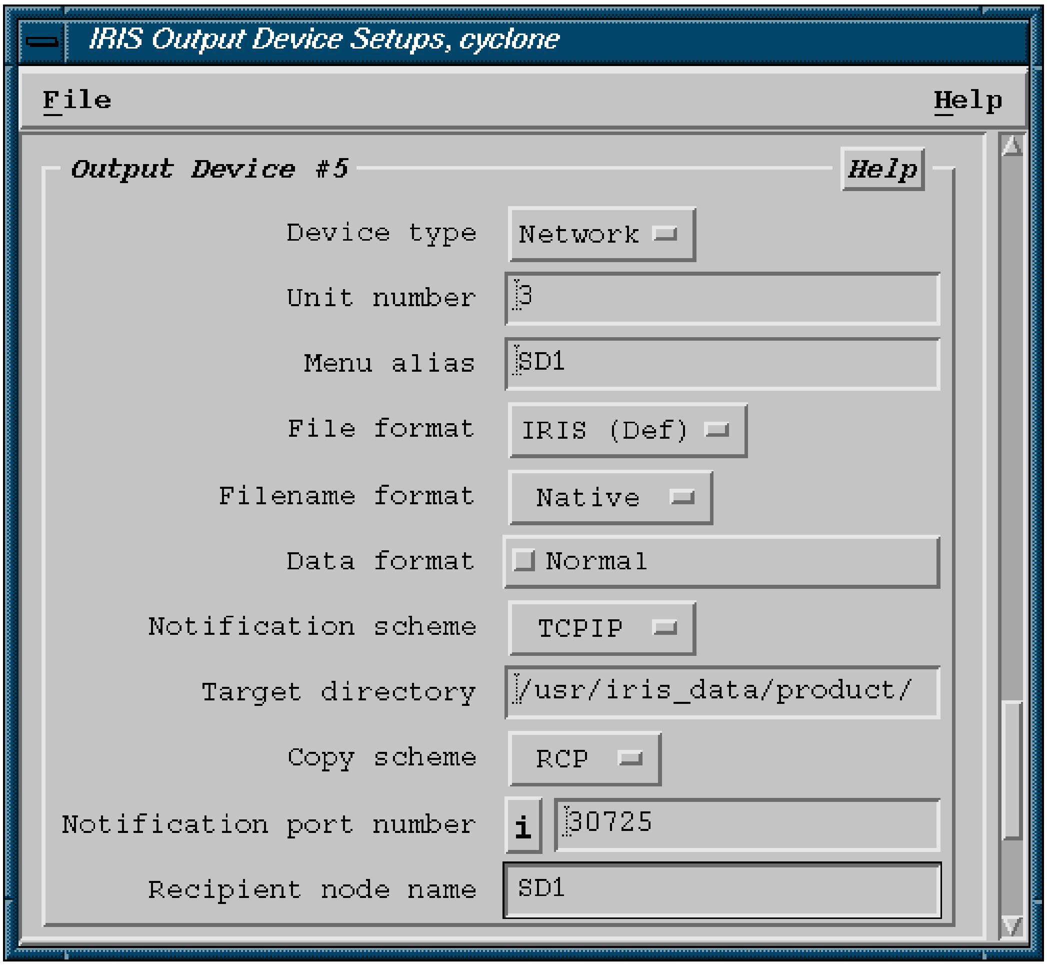
The special IRIS product output configuration for the TDWR consists of:

- Output of TDWR products to the SD's (IRIS/Display Workstations with hardware and/or virtual ribbon displays).
- Output of SHEAR and SLINE products to the TDWR/LLWAS Integrator.

Both of these output configurations are made on the system where the TDWR/IRIS Integrator is running. This is typically an IRIS/Analysis Workstation functioning as an RPG (radar product generator). In the examples below, this node is called "cyclone".

Configuring Output to the SD's

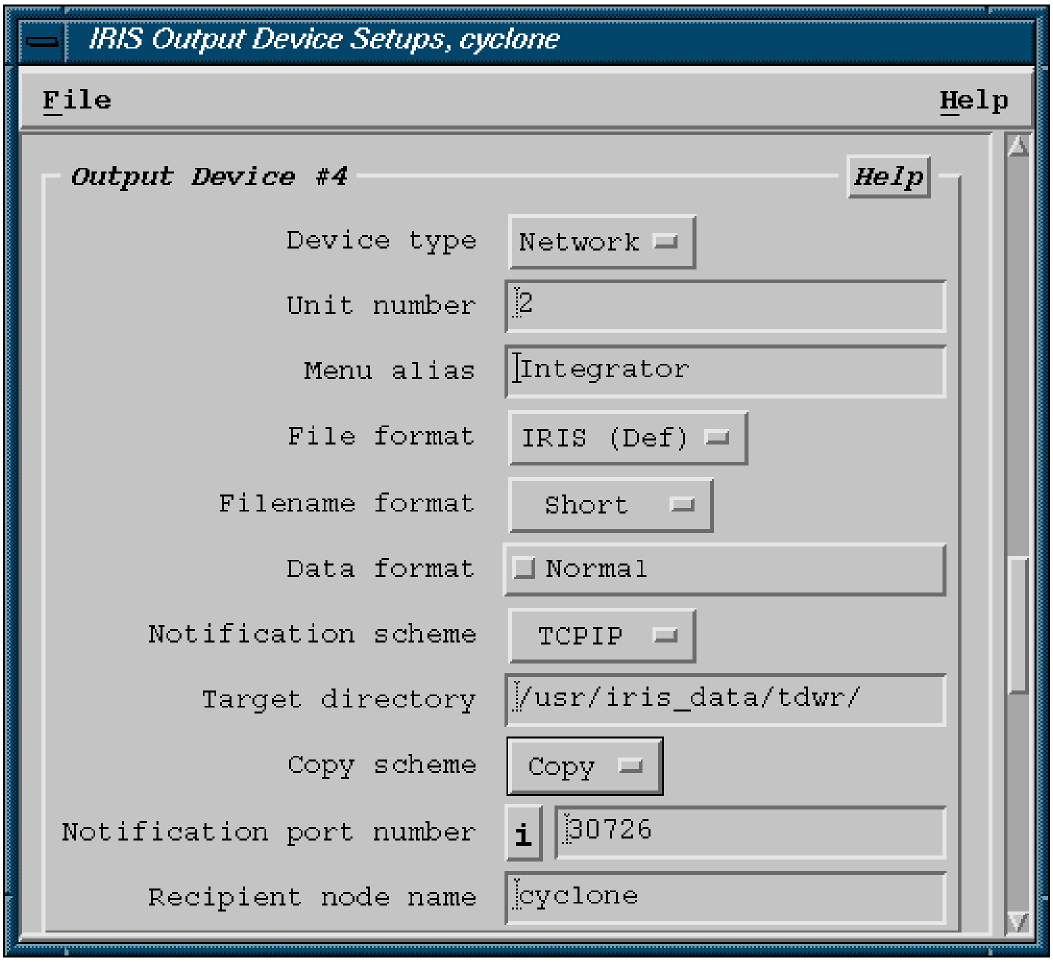
The first step is to set-up the network output devices for the SD's. This is done in the usual manner in IRIS setup/output. An example is shown below for a network output to a workstation that is called SD1. The standard IRIS target directory and TCPIP notification port are used in the example.



Finally, configure the IRIS Product Output Menu to make automatic output of TDWR products to the SD's (refer to Sending a Product to a Device on page 295 of this manual).

Configuring Output to the TDWR/LLWAS Integrator

Next use IRIS setup/output to configure the output to the Integrator. See the example below. Use the "Short" file name format. Since the Integrator will be running on the same machine use "Copy" rather than "RCP" (remote copy). The notification port must match what is configured for the Integrator in the runways.conf file (Configuring the Integrator and Runways Utility- runways.conf on page 428). The recommended port is 30726 as shown in the example.



Finally, configure the IRIS Product Output Menu to make automatic output of SHEAR and SLINE products to the Integrator (refer to Sending a Product to a Device on page 295 of this manual).

E.3 Ribbon Displays

E.3.1 What is a Ribbon Display?

A busy ATC controller does not have time to look at color situation displays and interpret them. Ribbon displays are alphanumeric displays (connected to the Situation Displays) that provide ATC personnel with concise information on the status of various runway corridors with regard to wind shear and microburst events. The display shows simple text messages of the form:

32LA MBA 3MF 40K- 180 14

32LD 190 15

33LA WSA RWY 25K+ 190 17

33LD WSA RWY 25K+ 160 14

The interpretation of these messages is as follows:

- The first line informs the controller of a microburst alert for runway 32 left at 3miles final approach. A 40 knot loss of airspeed can be expected. At the end of the line is the measured surface wind (direction and speed in knots) at the threshold end of the runway or from some other point on the field (depending on the availability of wind information from an LLWAS or other source).
- The second line shows the normal display with no warning message. Only the wind is displayed.
- The third and fourth lines show a wind shear alert (shear line) for runway 33L (approach and departure) with an expected 25 knot gain. The threshold winds are displayed at the end of each line.

In addition to the text messages an audio alert tone is sounded whenever an alert is issued. The controller acknowledges the alert tone by pushing a button on the front of the ribbon display.

E.3.2 Types of Ribbon Displays Supported by IRIS

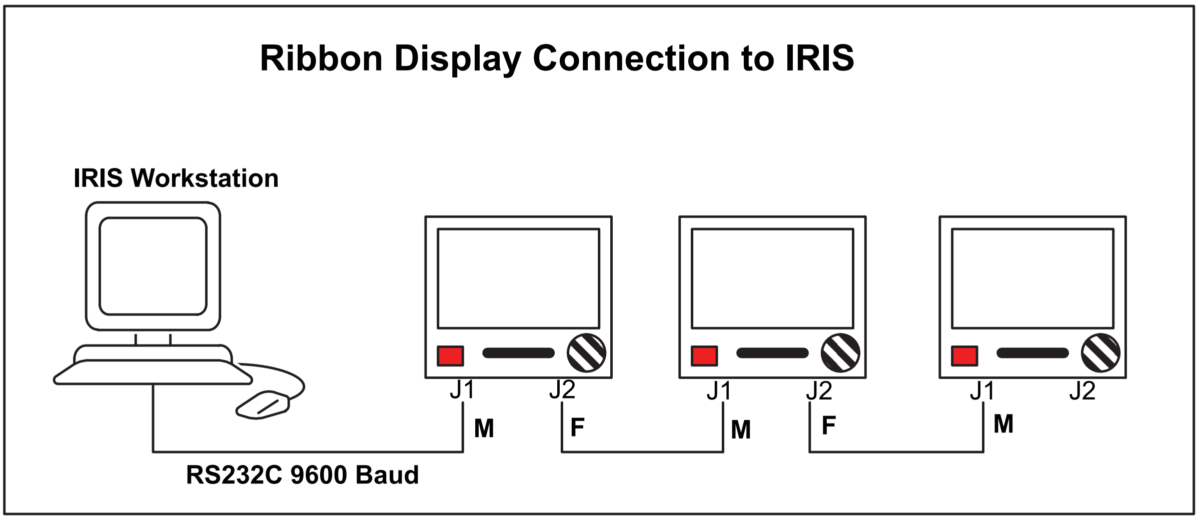
IRIS Supports two types of ribbon displays:

- Dale Electronics, Inc. Model ADP-250M045 (-1 for 220V) Plasma Display Monitor/Alarm System. This is used by the US FAA. Because of its brightness it is well-suited for tower cab environments which have high background light.
- IRIS Virtual Ribbon Displays. This is an X-Window display which can be put on a workstation or PC running X-Windows.

The IRIS Workstation must be licensed for ribbon display support.

E.3.3 Dale Ribbon Display Hardware Installation

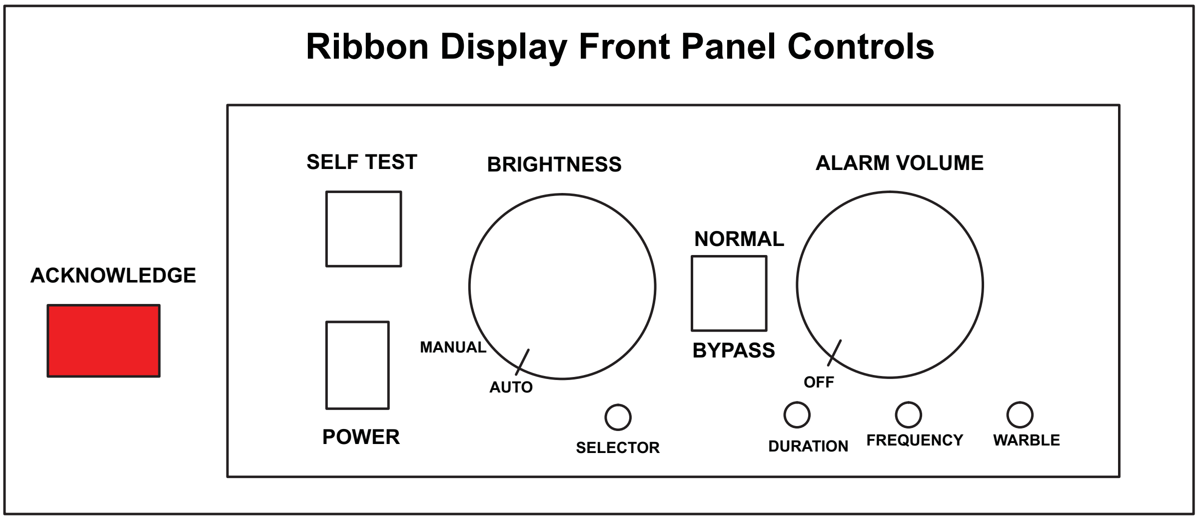
Up to 8 Dale ribbon displays can be "daisy-chained" to an IRIS workstation as shown in the figure. The M and F notation refers to the cable end (DB25M or DB25F).



The pin assignments for the connectors are as follows:

Pin	J2	J1	Signal
	1	1	GND (shield)
	3	2	Receive Data
	2	3	Transmit Data
	7	7	GND

E.3.4 Dale Ribbon Display General Use



The hinged front panel drops down to access the local controls. The controls area is illuminated when the door is open. The features are summarized below.

Self Test

Holding in the SELF TEST push button writes the character set to the display. The monitor's I.D. number, model number, and software version are also shown on the last line of the self test screen. At this time the selector switch can be adjusted to change the I.D. number if required. The audio alarm is also activated which allows the volume and warble to be adjusted to the user's preference. If data is sent to the monitor while SELF TEST is depressed, the monitor will set D6 and D7 (of the status byte) high when the button is released indicating that data sent to the unit was not captured and that the screen should be regenerated.

Brightness

The display brightness can be adjusted manually with the BRIGHTNESS control. Brightness is increased with clockwise rotation. When the control is rotated to its extreme counter-clockwise position (past a switch detent) the brightness is controlled automatically according to the amount of ambient light in the room.

Normal/Bypass

With the switch in the "NORMAL" position, communication between the monitor, host,,and other peripherals is enabled. With the switch in the "BYPASS" position, the RS-232D signals are routed around the monitor. This is a hardware switch which completely isolates the monitor's I/0 circuitry when in the "BYPASS" position.

Selector

The monitor's identification number can be set from 0–7 via the recessed switch. To set the identification number, push and hold the SELF TEST button, and adjust the SELECTOR control until the desired number is displayed on the screen. Note: There are three positions that display zero. All work as I.D. #0.

Alarm Controls and Adjustments

The audible alarm is two tones that are alternately turned on and off to create a "warble" effect. The parameters of the warble can be altered per the users preference with the DURATION, FREQUENCY, and WARBLE adjustments. (These adjustments are recessed to prevent unintended changes.)

Volume

The audible alarm loudness can be adjusted from 60 dBa to 85 dBa with the VOLUME control. Turning the control fully counter clockwise disables the alarm speaker output. Loudness is increased with clockwise rotation and decreased with counter clockwise rotation.

Duration

The DURATION adjustment varies the on/off time (duty cycle) of the two tones.

Frequency

The FREQUENCY adjustment raises or lowers the frequency of the two warble tones.

Warble

The WARBLE adjustment varies the rate at which the two tones are alternated.

Acknowledge

When the host computer sends an alarm, the monitor will activate the audible alarm and illuminate the ACKNOWLEDGE push-switch. Pushing the ACKNOWLEDGE switch signals IRIS that the alarm was acknowledged and silences the alarm.

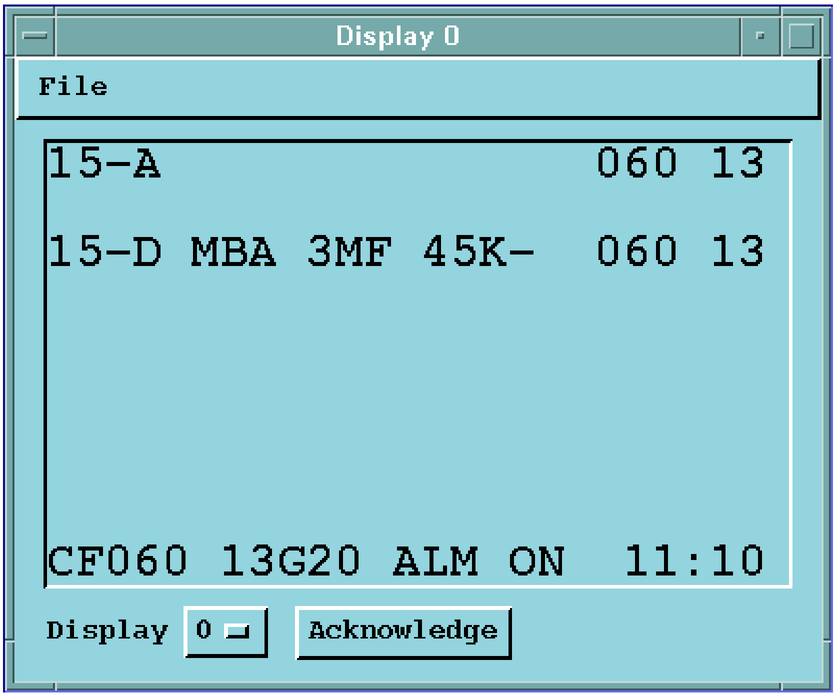
E.3.5 IRIS Virtual Ribbon Display

For systems that do not have the Dale model ribbon display, the IRIS Virtual Ribbon Display (vribbon) can be used. It is also convenient for "eaves dropping" on Dale displays to verify that they are properly configured, i.e., you can look at a virtual version of the Dale display.

Observers, Operators and Controllers can access the vribbon. The vribbon display is run locally on an SD by launching it from IRISnet or opening a terminal and typing:

```
$ vribbon
```

The display will appear as shown below.



The display has 10 lines. The top nine lines are used to display warnings for various approach and departure corridors. In the example, runway 15 departure has a microburst alert with a 45 knot loss. The threshold winds are reported as 060 degrees at 13 knots. The bottom line shows the center field wind data and the status of the alarm signal.

The vribbon can show any of the 8 physical ribbon displays. This is done by selecting the display number (0–7). The vribbon display also has a tone alarm which can be silenced (not disabled) using the Acknowledge button.

The next section describes how to configure the ribbon displays, i.e., what information appears on each line for each of up to 8 displays that may be attached to an IRIS workstation.

E.3.6 Ribbon Display Software Configuration

NOTE	To run the IRIS software for ribbon display support, your system must be licensed for this feature and you must have operator privilege. Please check with your system manager.

Overview

The ribbon display setup utility provides the following functions:

- Runway approach and departure corridors are assigned to each line of the display.
- Up to eight displays can be configured for each IRIS workstation and the lines for each display can be set independently.
- Up to four different configurations can be saved. This is used for installations where different active runway assignments may require different display layouts.

This section covers the use of the ribbon display setup utility.

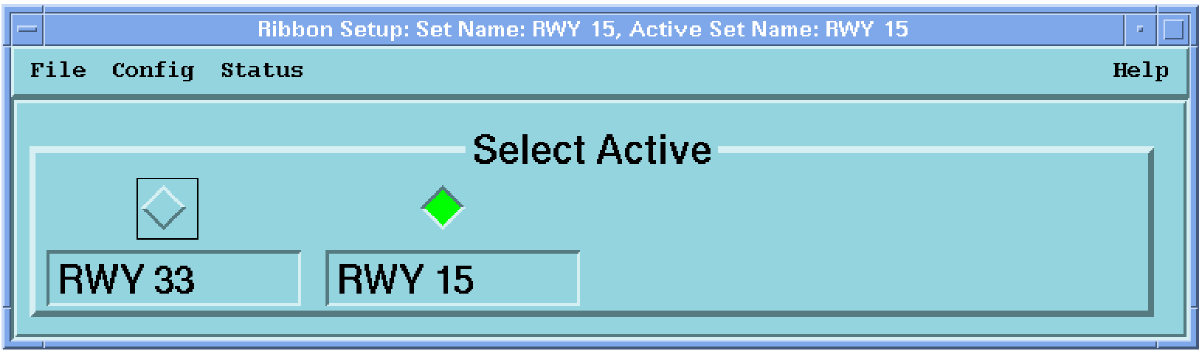
Configure Ribbon Displays Using the ribsetup Utility

After you have defined your protected areas, the **ribsetup** utility is used to define the appearance of the ribbon display, i.e., what runway information is displayed on each line of each ribbon display.

To start the **ribsetup** utility you must be an operator. Use a IRISnet or open a terminal window and type:

```
$ ribsetup &
```

The **ribsetup** utility will appear as shown below:



When the menu first comes up it is in "select" mode. The user can select among up to four different configurations that have been pre-defined. In the example above, two configurations are defined- one for runway 33 and the other for runway 15. The other two configurations are unused.

The configurations should be made to correspond to the actual runways that are typically used together in operation. When the terminal area is reconfigured in response to a new wind direction, this menu is used to select the appropriate ribbon display for the new configuration.

The features of the menu are described in detail below.

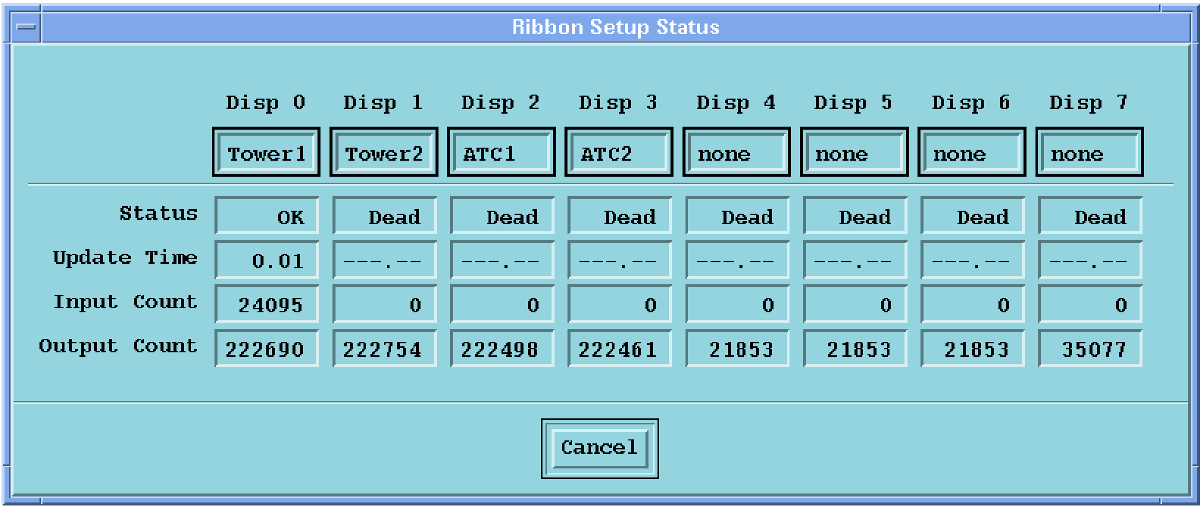
File

This provides the functions

- Load– used to restore the menu from the currently-saved file configuration if you want to "undo" changes.
- Save– saves your changes.
- Print– to print the menu for documentation purposes.
- Exit– to exit the menu. Note that ribbon displays will still be active when you exit.

Status

Select Status to see a submenu of the communication status of each of up to 8 ribbon displays that can be attached to your IRIS workstation.



The top row of the menu shows the ribbon display numbers for 8 displays that could be connected to your IRIS workstation. Note that your system may have fewer than 8 displays. The second row shows the names that have been configured for the displays. The last four names are set to "none" to indicate that these are unused.

The status of each ribbon display is indicated as either "OK" or "Dead". A "Dead" display may have been turned-off or have a cabling problem. Also, the display number set on the display itself may be incorrect (see Dale Ribbon Display General Use on page 415 "Selector").

The update time shows the time in seconds since the last communication between IRIS and the display. Input and output count are shown to indicate the number of bytes input from the display and output to the display. This is sometimes useful for debugging communications problems.

Config

The submenus under config provide the ability to customize the appearance of each ribbon display. These are discussed separately.

Config/Config ... (serial output port)

This selection determines which serial line output port is used for ribbon displays. Only a single port is needed since the displays are daisy-chained together. Type in the device name which will always have the form:

`/dev/ttyXXX`

The XXX depends on your system here are some examples:

- Linux ttyS0 or ttyS1
- HP tty0p0 or tty0p1

Check with your IRIS System Manager if you are unsure.

Number of Active Sets (1, 2, 3, 4)

This determines how many different active sets you want. In the example, there are two active sets. Active sets are named by simply typing in the name that you want and then doing a File->Save.

Display Setup Menu

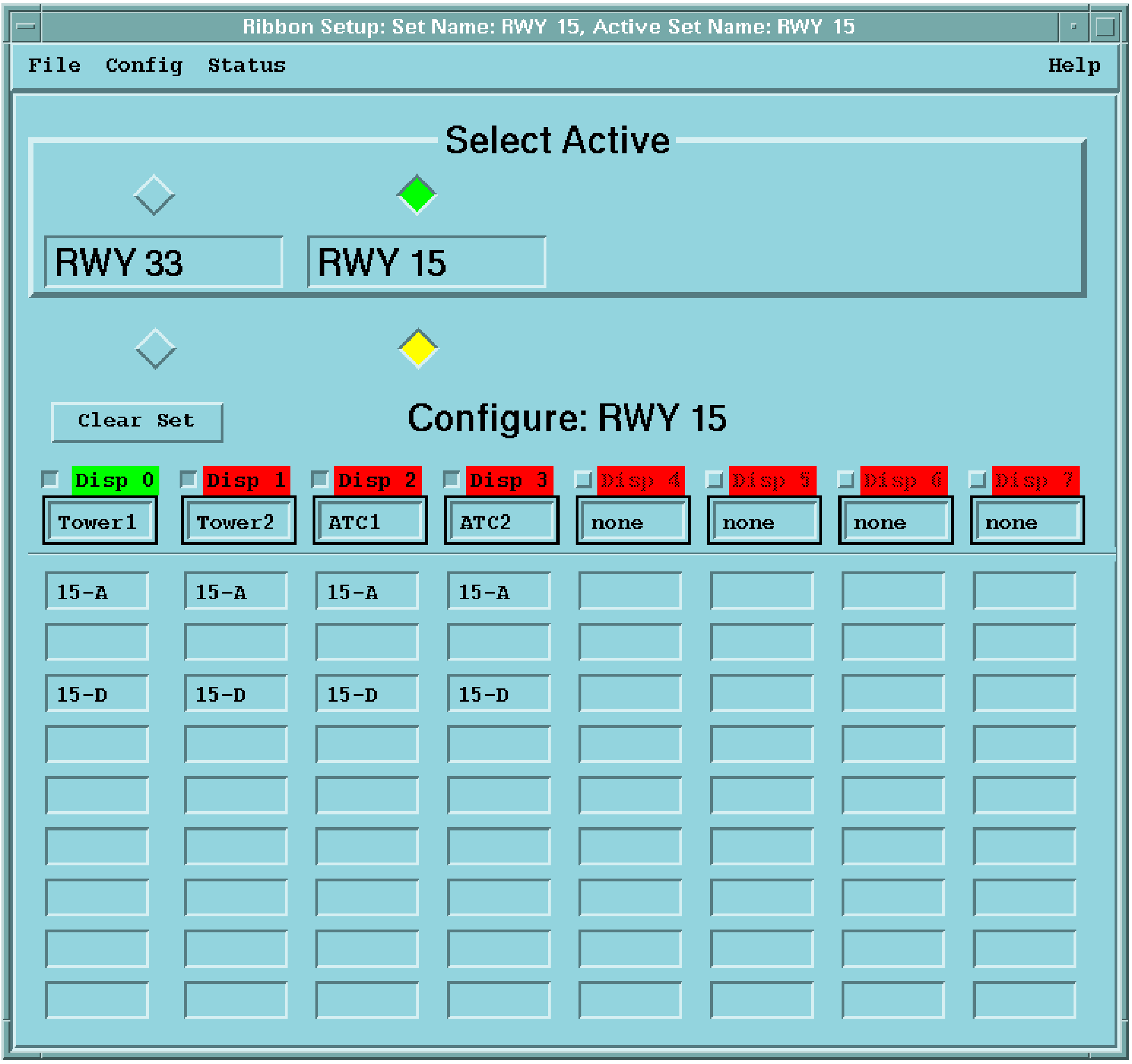
This is to turn-on the setup menu which will appear as shown below. The setup menu is used to configure the ribbon display appearance for each active set.

The display configuration for an active set can be viewed by pushing the button under the active set name. Note that this will not change the active set on the ribbon displays, i.e., it only effects what is displayed and edited in the setup menu. The button turns yellow to indicate which set is being viewed/edited. In the example, the setup menu is set to view RWY 15 (yellow button).

The top of the setup menu shows the display number and is color coded red or green to indicate whether display status is "OK" or "Dead". The display numbers correspond to the "Selector" position (0–7) that is configured on each of the ribbon displays. It is recommended that if, for example, you have four displays, that the selector switches on the displays be set to 0, 1, 2 and 3.

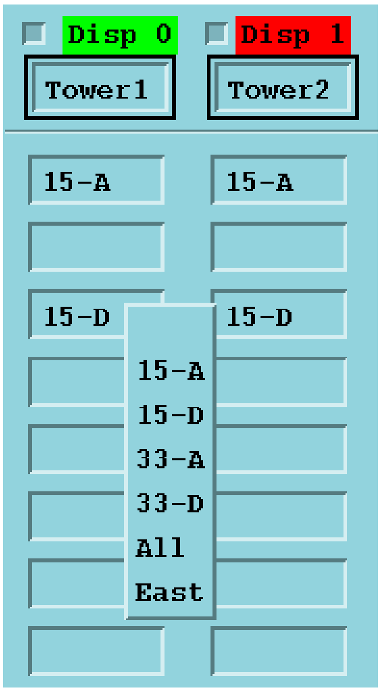
There is also a button next to the Display Number to select whether a display is enabled or not. If a display is installed, the button should be clicked-in. In the example, the first four displays (0–3) are enabled, but displays 1, 2 and 3 are dead (read color) indicating that they are either turned-off or there is a communication problem.

Beneath each display number is a display name (e.g., Tower1). These should be set to indicate the location or function of the particular ribbon display. It is recommended that you use the text "None" or "Unused" to indicate the case when a display is not installed. To change the name, simply type-in the text.



The bottom part of the setup menu has nine entries for each display, corresponding to the nine lines that are available for warnings on a ribbon display. To configure what appears on each line, first highlight the line and then right-click the mouse to get a pop-up list of all possible corridors as shown below.

The corridor names are taken from the IRIS setup/product warning areas that were created (see the beginning of this section). In addition, there is a blank line (to configure blank lines on the display), and there are other arbitrary protected areas that may not be associated with a particular corridor. For example, a single large protected area could be configured to display alerts anywhere within 5 miles of the terminal.



Select the corridor from the submenu for each line of the display. Repeat the procedure for all of the displays.

In the example, each of the four displays that are enabled is configured identically. In general this is good practice since it makes the system easier to maintain. However, if your operation requires it, different displays can have different configurations.

To assist with major changes, use the "Clear All" button. If you make a mistake you can use File->Load to restore the saved values.

After you have configured a set, use File->Save to save your results. You may also want to do a File->Print to document your settings. Then you can click on a different set (yellow button under the set name) and configure the displays for this. Continue until you have configured all of the active sets.

E.3.7 Ribbon Display Testing with tdwr_sim

WARNING	Do not run the tdwr_sim test utility during normal system operation since it may interfere with the signalling of actual warnings.

To test the ribbon display and for training purposes, SIGMET supplies a utility called **tdwr_sim**. The utility outputs a simulated TDWR product with alerts for selected corridors to verify that the ribbon displays are functioning. Note that this does not verify that warnings are properly generated by the IRIS system. To use the utility, start a terminal and type:

```
$ tdwr_sim
```

The utility will prompt you to "Enter Corridor Count". Enter the number of corridors that you have on your system. In the example that has been used in this appendix there would be four (33A, 33D, 15A, 15D). The maximum count supported by the simulator is 16. Next hit <Enter> and the corridor names will be displayed line-by-line. You can type-in arbitrary text to generate a test message. A sample session is shown below:

Enter Corridor Count [4]: 4

Enter Alert type for Corridor 0 (15-A)[ ]:

Enter Alert type for Corridor 1 (15-D)[ ]: MBA

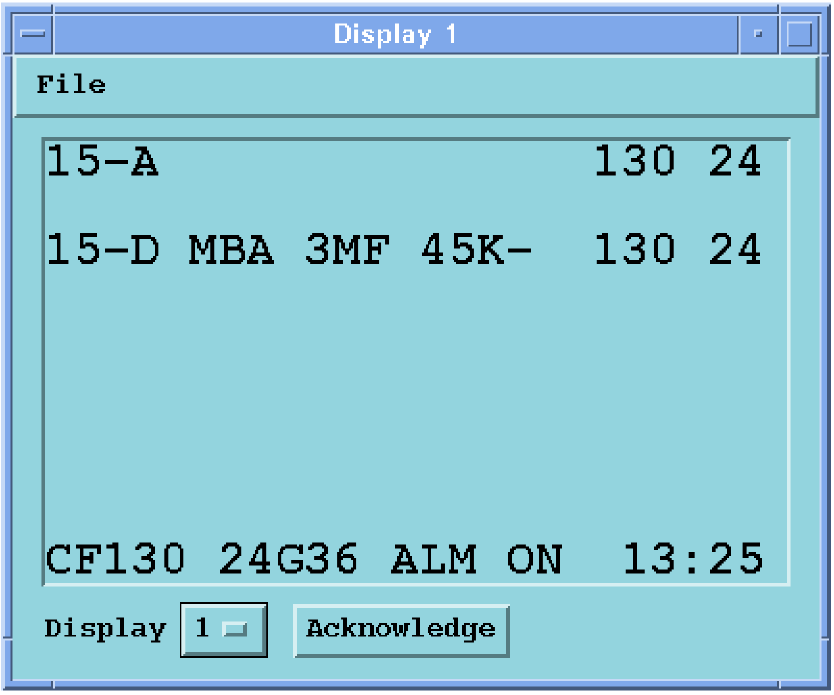
Enter Alert type for Corridor 2 (33-A)[ ]:

Enter Alert type for Corridor 3 (33-D)[ ]:

Sending product to IRIS.

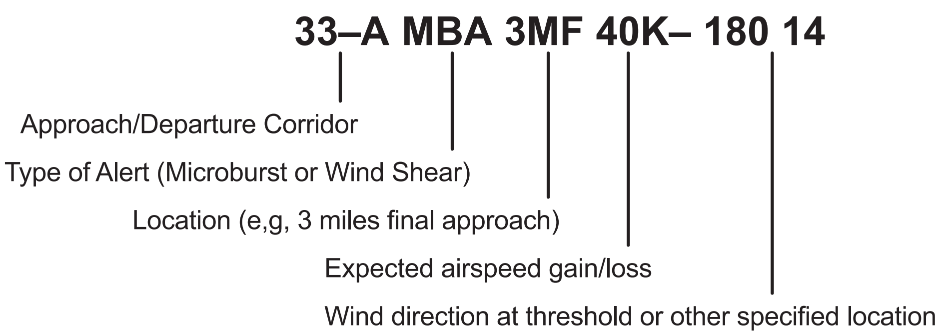
Enter Corridor Count [4]:

At this point, tdwr_sim sends a simulated TDWR product to IRIS, which in turn transmitted to each ribbon display that is configured to show alerts for the selected corridor (in this case 15–D). This causes the ribbon display to have a warning message as shown below (illustrated with virtual ribbon display)



To clear an alert, simply hit <spacebar> to replace the warning with a blank line. If no new message is sent to the ribbon displays for 150 seconds, the text "NO DATA AVAILABLE" will be displayed on all ribbon displays. To stop tdwr_sim, type <Ctrl> c.

E.3.8 Summary of Ribbon Display Alert Messages



E.4 TDWR/LLWAS Integrator and Runways Utility

E.4.1 What is the Integrator

The TDWR/LLWAS Integrator is a separate software process (i.e., not part of the main IRIS software) which combines wind shear alerts from IRIS and an optional LLWAS system to generate TDWR products. The Integrator functions as a filter on the alerts, i.e., the integrator:

- Only passes alerts for runways that are active as specified by the runways utility.
- If an arena has two or more alerts, then the more important alert is passed, e.g., a microburst alert is more important than a wind shear alert.
- Only passes the alert for the arena of first encounter in a corridor. For example, if 33L_3MF and 33L_2MF both have microbursts alerts, then the 33L_3MF is alerted on the ribbon display since an aircraft would encounter this first.
- In the event of failure of a system, will use the alerts from the other system, e.g., if TDWR fails, then only LLWAS data will be used.
- For each arena, the alerts from TDWR and LLWAS are combined as follows: a strong alert (MBA) from either system is passed through, while a weak alert (WSA) requires confirmation from the other system. The thresholds for what is considered strong and weak are tuned for each site.

The TDWR products from the Integrator are sent back to IRIS for distribution to SD's to drive the ribbon displays. Please refer to the data flow diagram in Data Flow for Ribbon Display Generation on page 406 and the more detailed figure on communication on the next page.

The Integrator takes as input the following data:

- SLINE products from IRIS (gust front warning)
- WARN (on radial shear) products from IRIS (microburst warning)
- LLWAS input data (if available, for LLWAS warnings).
- Active runway configuration from the runways utility.

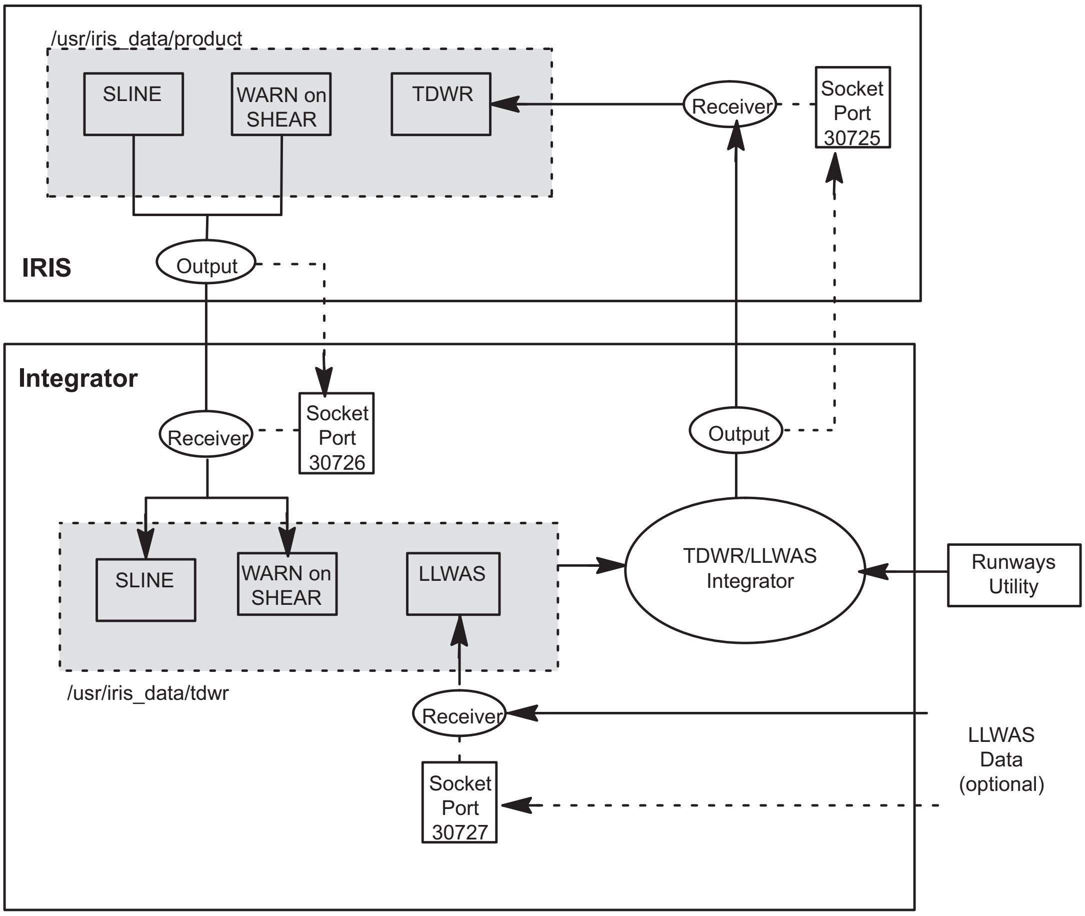
A new TDWR product is made and output to IRIS whenever:

- New input data are received.
- The active runway configuration is changed.

- A maximum time-out has expired (specified time of order 60 seconds).
- The product sitename is the same as the radar sitename.

All of the inputs are used when a TDWR product is made, unless an input is "stale", i.e., it is older than a specified time (of order 120 seconds). For example, if LLWAS fails, the Integrator will continue to use the old LLWAS data until the time limit for "stale" data is reached. If all of the data are "stale", no TDWR product is made at all. In this case, there will be no output to IRIS and the ribbon displays will eventually show "NO DATA AVAILABLE".

IRIS/Integrator Communication



E.4.2 Configuring the Integrator and Runways Utility- runways.conf

The configuration of the Integrator and the runways utility is stored in the **runways.conf** file. This is kept in the IRIS_CONFIG directory which is assumed here to be the standard **/usr/sigmet/config** directory. Refer to the preceding figure for a conceptual picture of the configuration. This section describes the file and how to configure it. The configuration steps are:

- Create the **tdwr** data directory (default location **/usr/iris_data/tdwr)**
- Install the **runways.conf** file (default location **/usr/sigmet/config/ runways.conf)**
- Edit the **runways.conf** file.

Create the directory /usr/iris_data/tdwr

You must have root privilege for this step. The tdwr directory can exist anywhere on the workstation that runs the Integrator. However, we recommend that you put it in the same place that you put the IRIS_PRODUCT product directory. For a standard installation this will be in a directory called **/usr/iris_data.** This may be different on your system. If so, simply substitute the appropriate directory. To see the location of the product directory check **/usr/sigmet/config/profile.**

To make the tdwr directory, login as root or become the super user and then:

```
# cd /usr/iris_data

# mkdir tdwr
```

To complete this step, set the privileges for the directory to match the other directories (do an ls –ll to see how the other directories are set). For a standard installation you will need to type:

```
# chown operator tdwr

# chgrp users tdwr

# chmod 777
```

Install the runways.conf file

The **runways.conf** file is kept in the **/$IRIS_ROOT/config** directory (usually /**usr/sigmet/config)**.

First check to see if the file exists in this directory. Login as operator and type:

```
$ cd /usr/sigmet/config
```

```
$ ls
```

The runways.conf file should be in the list. If it is not, then copy the template as follows:

```
$ cp /usr/sigmet/config_template/init/runways.conf /usr/
sigmet/config
```

Edit the runways.conf file

Now edit the **runways.conf** file (use vi, emacs or your ASCII text editor). The file is shown below:

```
# File: ${IRIS_CONFIG}runways.conf

# Contains configuration information for the TDWR/LLWAS
integration

# algorithm and the runways utility.

# Number of runways to define: COUNT 3

# For each runways: Primary direction, Secondary direction,
default direction.

# The default direction is the direction to use at powerup
until changed

# manually by runways.

RUNWAY 1 33- 15- LLWAS

RUNWAY 2 36R 18L LLWAS

RUNWAY 3 36L 18R LLWAS

# Uncomment this if you want all corridors reported out of
integration.

#DONT_FILTER_RUNWAYS

# Turn logging on, choices are FILE or TERM or BOTH or NONE
LOG BOTH

# Define input related info:
```

```
# Socket port; Directory; Timeout to consider input data
stale

IRIS_IN 30726

IRIS_IN_DIR /usr/iris_data/tdwr/

IRIS_IN_TIME 120

# Define output related info:

# Socket host and port; Directory;

# Timeout to retransmit output even with no changes

IRIS_OUT cyclone 30725

IRIS_OUT_DIR /usr/iris_data/product/

IRIS_OUT_TIME 60

# Define LLWAS input related info:

#LLWAS_IN 30727

# Since the LLWAS input does not contain sitename or lat/lon.
These

# need to be specified to handle the case where IRIS input
is lost.

# For systems with no LLWAS input, it is recommended that you
comment

# this whole section off.

# Specify radar lat and lon in signed degrees. Negative is
south latitude, or

# West longitude.

RADAR_LATLON 43.00 -71.00

# If you want to take the latlon from the IRIS input, if
available, then

# comment out this line.

ALWAYS_SET_LATLON
```

```
# Specify desired radar sitename. Max 16 chars, requires
quotes if you

# have imbedded whitespace.

RADAR_SITENAME "THIS IS A TEST"

# If you want to take the sitename from the IRIS input, if
available, then

# comment out this line.

ALWAYS_SET_SITENAME

# List of users who are allowed to operate the runways
utility.

OPERATORS operator

# End of file
```

The various lines in the file are described in detail below:

- `COUNT 3`

  This is the number of physical runways, i.e., strips of concrete.

- `RUNWAY 2 36R 18L LLWAS`

  For each runway, an arbitrary number is assigned (e.g., 1, 2 and 3). These numbers should be sequential starting from 1. The names for each runway are then specified in the next two fields (e.g., 36L and 18R). The last field is the default active runway when the software is first started. This can be either of the runway names or, if available, LLWAS. In the LLWAS case the runway direction specified in the LLWAS data is used when the Integrator is first started. If there are no LLWAS data, then the runway direction in the first field is used on start-up.

- `# DONT_FILTER_RUNWAYS`

  This line should generally be left commented (the # sign). If it is un-commented (# sign removed), then the integrator will pass-on alerts for all arenas, even if they are not associated with active runways. Filtering can still be performed by the ribbon displays, i.e., ribsetup can be configured to exclude inactive runways (see Ribbon Display Software Configuration on page 418).

- `# Turn logging on, choices are FILE or TERM or BOTH or NONE`

  `LOG BOTH`

If you are starting the integrator from a terminal, then set this to "BOTH". If you are starting the integrator automatically, then set this to "FILE". The log file will be stored in **/usr/iris_data/log.**

- `IRIS_IN 30726`

  `IRIS_IN_DIR /usr/iris_data/tdwr/`

  These entries configure the characteristics of the input from IRIS to the Integrator. IRIS_IN is the socket port that is used by IRIS to notify the Integrator when a new product is sent. This must match the IRIS setup/output network device that has been configured to send products from IRIS to the Integrator. The default port is 30726.

  The IRIS_IN_DIR is the directory where IRIS sends products to the Integrator. This must match the directory configured at the beginning of this section and the directory configured in IRIS setup/output for the TDWR integrator (IRIS Product Output Configuration on page 411)

- `IRIS_OUT cyclone 30725`

  `IRIS_OUT_DIR /usr/iris_data/product/`

  These entries configure the characteristics of the output from the Integrator to IRIS. IRIS_OUT is the nodename (cyclone) and socket port (30725) where IRIS will receive the data. Usually this is the local workstation where the Integrator is running. The socket port should match the IRIS_NETRCV environment variable for the network receiver. This is set in the **/usr/sigmet/config/profile.**

  The IRIS_OUT_DIR is the directory where TDWR products will be sent. This must match the directory configured for IRIS_PRODUCTS- typically **/usr/iris_data/product**. This is set in the **/usr/sigmet/config/profile.**

- `IRIS_IN_TIME 120`

  This is the time in seconds, after which, an input is considered to be "stale". For example, if the LLWAS stops sending data, the Integrator will continue to use the old LLWAS data for a period of 120 seconds (in the example). After 120 seconds, the old LLWAS data will not be used to make new TDWR products.

- `IRIS_OUT_TIME 60`

  This is the maximum time between generation of TDWR products. A new TDWR product is made whenever one of the following happens:

  A new input arrives.

  The active runways configuration changes

  One of the inputs becomes stale (IRIS_IN_TIME times-out)

  IRIS_OUT_TIME from the last TDWR product generation is exceeded.

Thus the IRIS_OUT_TIME assures (in this example) that a TDWR product will be created at least every 60 seconds provided there are valid inputs (data are not stale).

- `LLWAS_IN 30727`

  This is the socket port that is used by LLWAS to notify the Integrator when a new LLWAS data are available. If you do not have and LLWAS, comment this line by adding # to the beginning.

- `<LLWAS Site Information>`

  If you have an LLWAS system, you will need to specify the LAT/LON of the radar and the sitename since these are not in the LLWAS header. This information is needed if the radar fails and the alerts are based on LLWAS alone. If you do not have an LLWAS, then comment all lines of this section.

- `OPERATORS operator controller>`

  This is used to control access to the runways menu to the user ID's in the list. Note that anyone can view the runways menu, but only users in the list can change it.

E.4.3 Starting the Integrator

Manual Integrator Start-up

To start the TDWR/LLWAS Integrator you must be an IRIS Operator. In a terminal window on the workstation where the Integrator is run (typically an RPG IRIS/Analysis system) type:

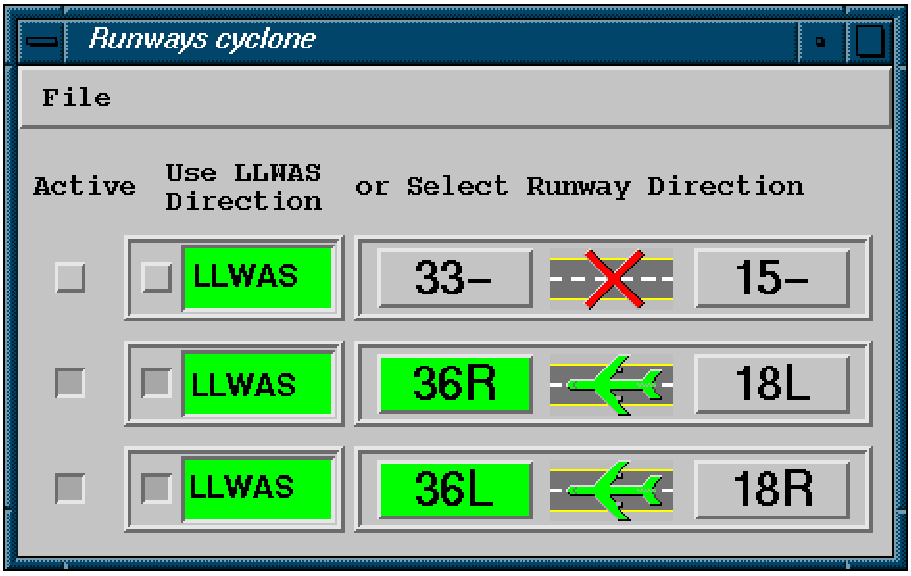
```
$ tdwr_llwas_int
```

This will start the software and log events in the terminal window. Iconify the terminal so that you can read any messages in the log.

Atomatic Integrator Startup

The recommended approach is to start the integrator automatically when the workstation boots-up. This is done by creating a startup file in a manner identical to the automatic "siris" startup. Refer to the *IRIS Installation Manual* Chapter 2, Introduction to IRIS Products, on page 17 for creating automatic startup procedures for your specific platform and operating system.

E.4.4 Runways Utility



Overview

The **runways** utility is used by controllers to specify which runways are active. This information is used by the TDWR/LLWAS Integrator algorithm to filter alerts from inactive arenas. For example, each runway arena has two names, e.g., 33L_3MD is the same physical arena as 15R_3MF. The runway direction specified in the **runways** utility determines which of these names is used to identify the arena. Also, if a runway is not used, the entire runway and all of its associated arenas may be set to inactive.

The **runways** utility must be run on the same IRIS node where the Integrator is run (typically this is the IRIS workstation assigned to generate products), however you can export the **runways** display to another workstation on the network. Thus the **runways** utility can be run from any networked workstation.

Whether you are on a local or remote workstation, you must have privilege to logon to the system. Note that most installations allow Observers to view the runways utility, but only Controllers (and perhaps Operators) can change the runway direction. The "OPERATORS" line in the runways.conf file is used to specify which users can control the **runways** utility (see Configuring the Integrator and Runways Utility- runways.conf on page 428).

Starting the Runways Utility

- The **runways** utility may be configured to start automatically on your system, This is configured by the system manager. Refer to the *IRIS Installation Manual*Chapter 2, Introduction to IRIS Products, on page 17 for creating automatic startup procedures for your specific platform and operating system.
- The easiest way for manual start is to use IRISnet. Click on the node where the Integrator is run. This will pop-up a tools menu. Click the runways icon in the tools menu. If the runways icon is not in IRISnet tools menu, contact your system administrator.
- The other (less easy) way is to use a terminal and type:

```
$ runways &
```

If you are on a different workstation you can use rlogin <nodemame> or sigterm <nodename> to open a terminal on the node where the integrator is run. Note that if you use the rlogin approach, then prior to running runways you will also have to type the following:

```
$ export DISPLAY=<yournodename>:0.0
```

This exports the runways display to your workstation. If the runways display does not appear on your workstation, then you may need to type the following on a terminal on your workstation (not the remote system):

```
$ xhost +
```

This authorizes windows from other workstations to appear on your display. Check with your system manager if you want this automatically enabled.

Stopping the Runways Utility

To exit the runways utility select File->Exit in the upper left. Note that the settings specified in the runways utility will still be used by the Integrator after you exit.

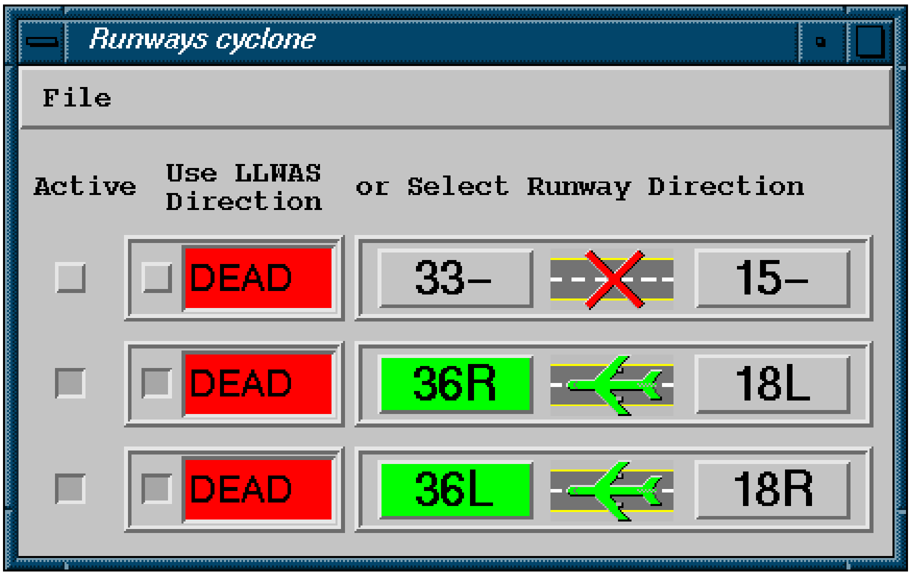
Setting Active/Inactive Runways

Each runway that is configured in runways.conf will have a line in the menu as shown at the beginning of this section. The button in the far left column activates/deactivates the runway. Inactive runways are indicated by the "X" symbol over the runway, as shown in the example for 33/15.

Selecting the Runway Direction

The runway direction is indicated by the green color of the runway name and the direction of the aircraft icon. The runway direction can be selected either manually by clicking the runway name, or automatically by LLWAS (if available). To enable the LLWAS automatic selection, click the button on the LLWAS column for each runway.

LLWAS Status



If LLWAS is available on your system, its communication status with the integrator is displayed in the LLWAS column. The image above shows the display "DEAD" in red background to indicate the LLWAS is not communicating to the Integrator.

APPENDIX F
HYDROMET RAINGAGE CORRECTION

F.1 Overview

IRIS/Hydromet is an optional IRIS package for hydrometeorological applications. The standard IRIS features for hydrometeorological applications include:

- Display of rainfall rate in mm/hr or inches/hour for a Z-R relationship selected in the Product Configuration Menus for PPI, RHI, CAPPI, MAX and XSECT. The units selection is made by the color scale selection.
- RAIN1 — Hourly rainfall accumulation for selectable Z-R relationship. See RAIN1: Hourly Rain Accumulation on page 59 on the RAIN1 product for details.
- RAINN — Multiple-hour rainfall accumulation based on the hourly amounts. See RAINN: N-Hour Rain Accumulation on page 63 on the RAINN product for details.

The additional features provided by the IRIS/Hydromet option are:

- CATCH product to provide precipitation average depth in subcatchment regions for selectable time periods. Subcatchment regions are defined similarly to overlays. CATCH products can be displayed as color-coded regions or as color-coded icons. In the Quick Look Window, you can right-click the mouse on a region or icon to see a bar graph representation of the subcatchment amounts by hour. See CATCH: Subcatchments Precipitation Accumulation on page 121 for details on the CATCH product.
- GAGE product input with raingage calibration. This feature allows the radar RAIN1 hourly accumulations to be calibrated to the actual rain that is measured in gages. The corrected RAIN1 products can then be used by the CATCH and RAINN products. GAGE products may also contain the ZR coefficient and exponent (by site) derived

from disdrometer measurement or other source (see Product Parameters on page 31). You can view a 12-hour history by right-clicking (a pop-up appears).

In this appendix the features of the Hydromet option are discussed:

Raingage correction data flow	Hydromet Data Flow for Raingage Correction on page 438
Input raingage file format	Gage Data File Format on page 441
RAIN1 configuration with gage correction	Configuration of RAIN1 with Raingage Correction on page 443
RAIN1 gage correction algorithm	Algorithm for RAIN1 Gage Calibration on page 447
RAIN1 scheduling with gage correction	RAIN1 Scheduling with Gage Product on page 448

F.2 Hydromet Data Flow for Raingage Correction

on page 440 shows the data flow for the raingage correction which is described below:

- **Input from External Raingage Network**

  Raingage data are supplied by the customer in the form of files that are transferred automatically by the customer over the network to a directory that is defined by the IRIS **setup** utility (Input section). Each file should contain the total accumulation for the previous hour for all gages. The information that is required is described in Gage Data File Format on page 441 which describes the GAGE product data format.
- **Input Pipe for Format Conversion to GAGE Product**

  The "Input Pipe" is a format convertor to reformat the customer data to the GAGE product format. The Input Pipe is specified in the **setup** Input section. It is a software program that will usually be customized for the particular raingage network. Customers can create their own pipes or Vaisala can provide the pipe "AsciiToGage", in which case the pipe source code is also provided so that customers can maintain the pipes in the future.
- **GAGE Product**

This is a product in IRIS that contains the raingage totals for all gages in the network for the last hour. The data format is described in Gage Data File Format on page 441.

- **Input CAPPI's**

  The IRIS RAIN1 hourly rainfall accumulation product uses CAPPI's as input. the CAPPI's can be in dBZ, dBT or the corresponding rainfall rate according to a default Z–R relationship such as $Z=200R^{1.6}$. Usually a "Filled" pseudo CAPPI is used so that at far ranges the lowest elevation angle will be used to fill-in the data.

- **RAIN1 Processing and Raingage Calibration Process**

  Gage correction is activated when the gage correction button is turned on in the RAIN1 product configuration menu. In this case, the IRIS product generator waits for all of the CAPPI's and the GAGE product for the previous hour and then runs the RAIN1 algorithm. RAIN1 Scheduling with Gage Product on page 448 describes the scheduling considerations for the RAIN1 algorithm with GAGE correction, i.e., how to handle the time delay of the arrival of the GAGE product. The RAIN1 algorithm proceeds normally per the description in RAIN1: Hourly Rain Accumulation on page 59. The extra step of the GAGE correction is done by a "Product Pipe" algorithm. Vaisala supplies an algorithm based on Brandes and Wilson (1982). Customers can supply their own product pipe correction algorithm in lieu of the one supplied. Refer to the *IRIS Programmers Manual* for details on Product Pipe algorithms.

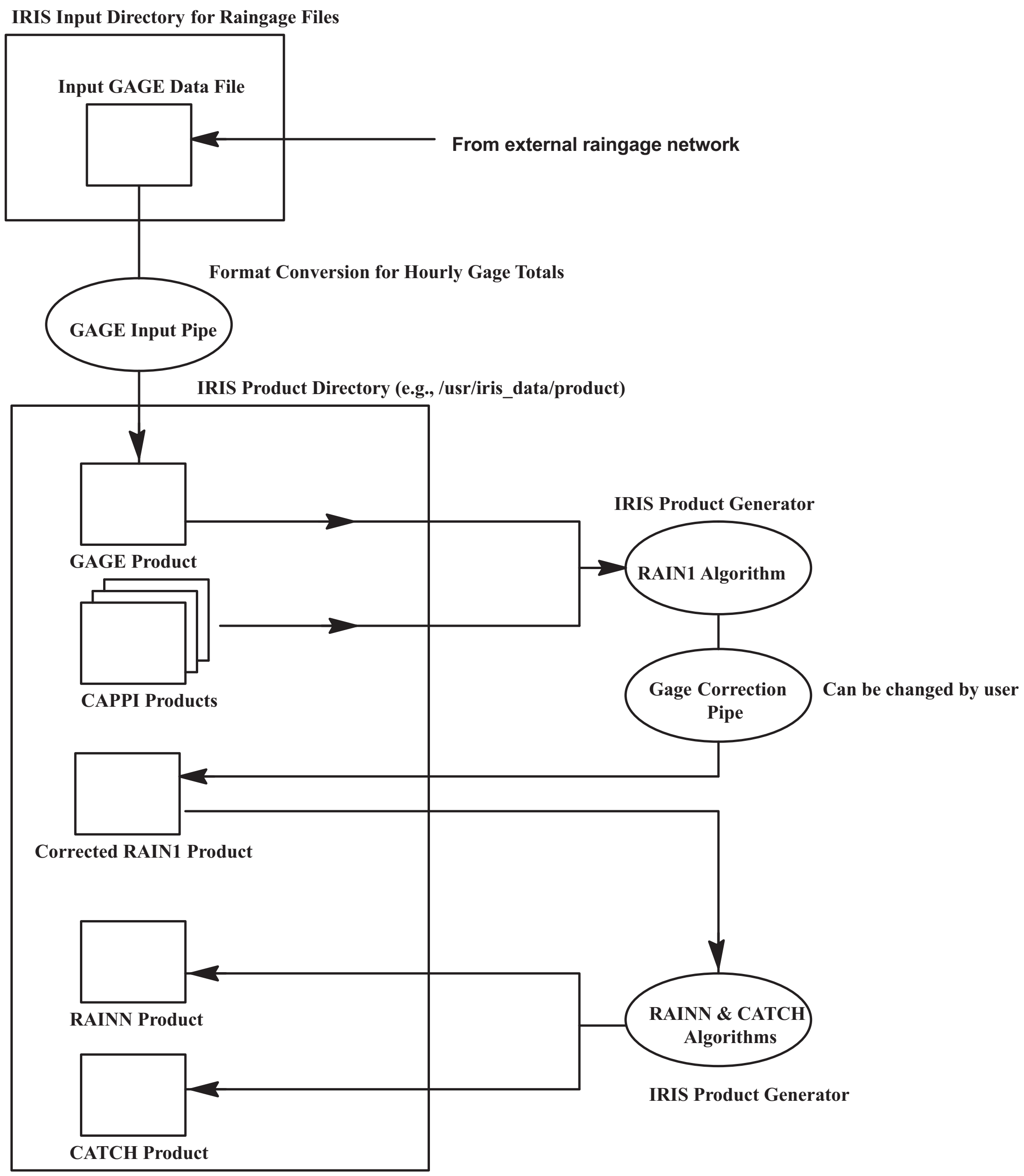
- **Corrected RAIN1 Product**

  The raingage calibration process outputs the final corrected RAIN1 product which will then be used by the RAINN and the CATCH products. Note that an uncorrected RAIN1 product can be made by simply running the RAIN1 product (under a different name) with the gage correction button clicked–off. For example, name the uncorrected product HOURLY and the corrected product HOURLY-GAGE.

- **CATCH and RAINN Products**

  The RAIN1 product then serves as the basis for the RAINN and CATCH products. Also, WARN products can be run on the RAIN1. Thus all subsequent products that rely on RAIN1 for input get the benefit of the correction algorithm.

Figure F–1: RAIN1 Raingage Correction Data Flow



F.3 Gage Data File Format

The customer raingage data files should be sent automatically to a directory specified in IRIS setup/input for the input pipe. Typically, the data can be sent by ftp, rcp or using NFS. The file should contain the hourly gage totals for all of the gages along with other supporting housekeeping information required by the GAGE product such as date and time and raingage location.

The recommended input gage data format is described below. Note that this does not match the format of the GAGE product since the input pipe will reformat the product for IRIS. The basic information needs to be in the file, or in some cases in a separate configuration file for the input pipe. For details on the GAGE product format, refer to the *IRIS Programmer's Manual*. In general, the input pipe must be custom — written either by the customer or by Vaisala. This is the format used by our **AsciiToGage** input pipe. Customers who wish to use another format must write their own custom input pipe.

The input data file format is described below:

- Each file is plain text ASCII, and the overall structure is a collection fields consisting of a keyword followed by one or more data values. This makes the format expandable, since new keywords can easily be added in the future, and each software reader can choose which set of keywords it needs to process.
- White space is used to separate the keywords and data values. Quotation marks may be used around a string value if there is a possibility that the string contains white space. Each line of the file is terminated by a "newline" character.
- Each file represents data from any number of stations, but only one data time will be reported in each file. That time is the ending time of the data, and is reported using the "TIME" and "SPAN" keywords in the first lines of the file. The fundamental time resolution is quantized to one-minute intervals.
- Each rain gage station report consists of a line containing at least the "CODE" and "LONLAT" keywords, plus either the "RRATE" or "RFALL" keyword. The "QUAL" and "REM" keywords are optional.

The keywords are as follows:

 # any comment

Any line beginning with at "#" is ignored, as well as all blank lines.

TIME yyyymmddhhmm

Gives the ending time for all of the stations reported in this file. The string of digits gives the year, month, day, hour, and minute. This keyword should appear only once at the beginning of the file.

SPAN nn

Gives the time span in decimal minutes for all of the data reported in this file. This keyword should appear only once at the beginning of the file. Currently IRIS only supports 60 minute spans.

CODE nnnnnn

Tells the station code for a rain gage. The code is an arbitrary string 15 or less characters long. This field must be present for each reported gage.

LONLAT nn.nnnnn nn.nnnnn

Tells the longitude and latitude of a rain gage. Longitude is a real number from -180 to +180, with positive values representing East longitude. Latitude is a real number from -90 to +90, with positive values representing North latitude. Any number of decimal digits of precision can be used. This field must be present for each reported gage.

RRATE nn.nnn

Tells the rain rate in millimeters/hour for a rain gage. Either the RRATE field or the RFALL field must be present for each reported gage.

RFALL nn.nnn

Tells the rain fall amount in millimeters for a rain gage. Either the RRATE field or the RFALL field must be present for each reported gage.

Z/R ccc.c e.ee

This is an optional field. It is only available from disdrometer type raingages which are capable of calculating a Z/R relationship. The 2 numbers are the constant and exponent in the equation $Z = CR^{E}$. When there is no rain, or the disdrometer is not capable of making a measurement, the values of 0.0 should be sent for both numbers. This will be interpreted as a special flag to indicate that the default values should be used.

QUAL nn

Tells the data quality (0:Useless, 10:Best) for a rain gage report. This field is optional; if omitted the data quality is assumed to be "10" (Best).

REM xxxxxxxxxxx

Allows a comment to be inserted in the file. An arbitrary text field follows. Note that quotes should generally be used around comments if the comment itself might include white space.

The following example file gives rain gage data for five different sites during a 60-minute time span ending at 22:00 on 10 July 2000. Note that the exact columns and the numerical precision are allowed to vary, as are the order of keywords on each line.

```
REM "Example format of an IRIS Rain Gage input file"

TIME 200007102200 SPAN 60

CODE 001213 LONLAT 127.312533 38.172512 RRATE 4.5

CODE 000223 LONLAT 127.2223 38.2155 RRATE 2.2

CODE 000095 LONLAT 127.31 38.2283 RFALL 0.083

LONLAT 127.1214 38.1825 QUAL 0 RRATE 1.2 REM "Gage broken"
CODE 000122

CODE 000109 RRATE 1.1 LONLAT 127.2884 38.1277
```

F.4 Configuration of RAIN1 with Raingage Correction

The configuration steps necessary to generate RAIN1 products with gage correction are detailed below.

1. **Configuration of Input CAPPI Products**

   The RAIN1 algorithm starts with CAPPI products. Please refer to CAPPI: Constant Altitude Plan Position Indicator on page 44 on the CAPPI product configuration for more information. Here are some considerations in how to optimize the CAPPI products for RAIN1 with GAGE correction:

   - **CAPPI data type set to R based on Z**

     The input CAPPI should be made in rainfall rate units. This causes the CAPPI interpolation to be done on rainfall rate rather than on dBZ. Thus the weighting of the interpolation is linear in rainfall rate units. Use the corrected reflectivity factor "Z" (as opposed to the uncorrected reflectivity factor "T") so that you have the benefit of clutter correction and cancelation.

   - **CAPPI resolution of approximately 1 km**

The resolution of the RAIN1 product will be identical to that of the input CAPPI product. We recommend that the maximum range for the CAPPI and the number of pixels be set to yield a resolution of approximately 1 km. For example, for a 240 maximum range, a 480 × 480 product would have 1 km resolution.

- **CAPPI height of approximately 1 km, Fill set to Yes (Pseudo CAPPI)**

  Select a single-level CAPPI height of approximately 1 km depending on the height of the surrounding terrain. Note that CAPPI heights are defined as height above a reference level that is usually set to sea level (in IRIS Setup/RCP). Enable the CAPPI Fill so that the CAPPI will be defined for near and far ranges where it is not possible to interpolate to 1 km.

- **Use default Z-R relationship of $Z=200R^{1.6}$**

  We recommend that the customer initially use a default $Z=200R^{1.6}$ as the default Z-R relationship in the CAPPI product. After some experience, the customer may choose to modify this to match their precipitation more closely. This relationship can be adjusted seasonally as well.

2. **RAIN1 Product Configuration**

   For the RAIN1 product configuration select the input CAPPI's configured above. Use the same Z-R relationship in the RAIN1 product as was used for the CAPPI's. Click the gage correction button to on if you will be using gage correction.

3. **GAGE Correction Configuration File (Rain1GageCor.conf)**

   The raingage correction algorithm uses a configuration file called Rain1GageCor.conf in the /usr/sigmet/config. A template can be found in /usr/sigmet/config_template directory and should be copied to /usr/sigmet/config at installation. An example is shown in Table 12 on page 444.

Table 12 Example of Rain1GageCor.conf file

```
# Rain1GageCor.conf for the Rain1/GAGE correction program
LOG NONE
# OVERRIDE_PRODUCT_NAME JOE
# VERBOSE
MIN_VALID_GAGE 1.00
MIN_VALID_RADAR 1.00
MIN_CORRECTION 0.20
MAX_CORRECTION 5.00
```

The various fields are described here:

- **LOG**

  Configures where logging information goes to. Choices are NONE, TERM, FILE, or BOTH. FILE means place in the ${IRIS_LOG}/Rain1GageCor.log file.

- **MAX_CORRECTION**
- **MIN_CORRECTION**

  The maximum and minimum gage correction factors prevent large, possibly erroneous corrections from contaminating the data. The numbers are entered as factors such as 3 and 0.3 for the max and min respectively. In the event that the limit is exceeded, the algorithm will use the value of the limit, i.e., the correction factors will be saturated at the limit.

- **MIN_VALID_GAGE**

  This is the minimum amount of rainfall hourly accumulation for a gage to be considered as having a valid amount of rainfall. This will depend to some extent on the accuracy of the gages. A value of 3 mm would be typical. Note that this corresponds to approximately a one hour average reflectivity factor of 21 dBZ.

- **MIN_VALID_RADAR**

  This is the minimum RAIN1 accumulation, averaged about a gage that is valid. Radar precipitation accumulations less than this are considered invalid and no gage correction is calculated. This is similar to the Minimum Valid Gage Accumulation, except that in this case it is for the radar. A value of 3 mm would be typical.

- **MIN_VALID_COVERAGE**

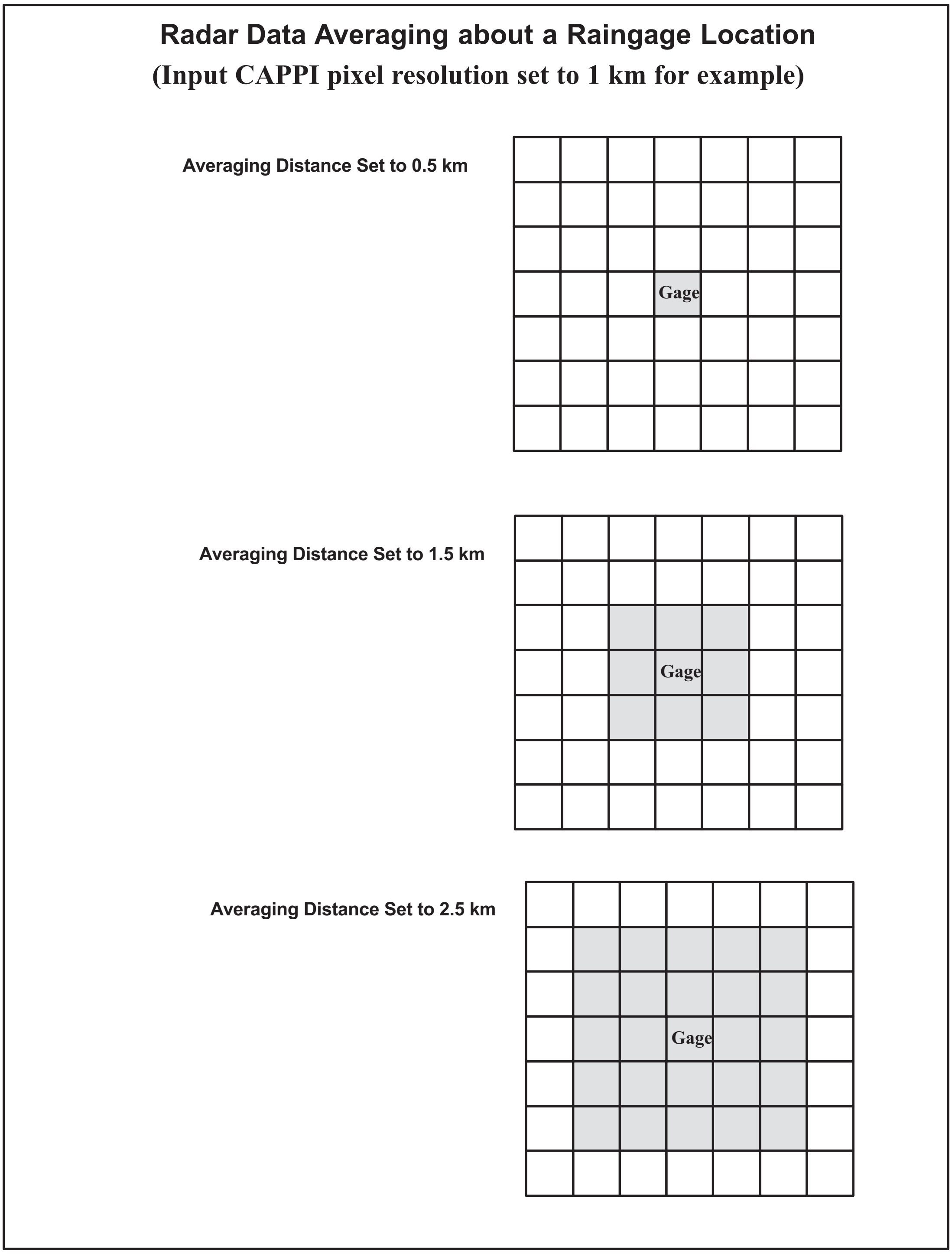
  When the radar RAIN1 pixels about a gage are averaged (1, 9, 25, 49 pixels, etc.) to make a gage correction, not all of the pixels will generally be valid. If the percentage of valid pixels is less than this value, than a gage correction is not calculated. For example, if the Minimum Percentage is set to 50%, and averaging about a gage is over 3 × 3 pixels, then at lease 5 pixels must be valid for a gage correction to be generated.

- **OVERRIDE_PRODUCT_NAME**

  Use this command if you wish to change the product name of the RAIN1 product.

- **RADAR_AVERAGE**

  This is the distance in km around the raingage where the radar reflectivities shall be averaged. In the case where the input CAPPI resolution is 1 km (e.g., maximum range of 240 km and 480 × 480 pixels), setting the Averaging Distance to 1.5 km would result in averaging over 3 × 3 pixels centered about the pixel containing the gage. Examples are shown in on page 446 below.



4. **IRIS Setup Configurations**

- **Setup/Input to Configure the Raingage Input**

Specify the input characteristics of the user raingage files including the directory where the files will arrive and the name of the Input Pipe that will be used to reformat the data into the IRIS GAGE product. Refer to the *IRIS Utilities Manual* section on setup/input for details. Note that depending on your system there may also be a ".conf" file for the Input Pipe. The input pipe will be stored in /usr/sigmet/config/pipes.

- **Setup/Product to Configure Default Z-R Relationship**

  Typically this is set to $Z=200R^{1.6}$ (input 200 and 1.6). However, you can set it differently based on local experience. Note that you can override this in the RAIN1 product configuration.

- **Setup/Product to Configure the GAGE Wait Time**

  This is the time required after the end of the hour for the GAGE product to be generated. The delay will be primarily caused by the delay in the arrival of the user raingage data over the network.

F.5 Algorithm for RAIN1 Gage Calibration

The default raingage correction algorithm provided is modeled after Brandes and Wilson (1982). The algorithm uses a basic time step of one hour, i.e., GAGE totals for each hour are compared to the hourly radar totals (based on a default Z-R relationship) for the same hour. The ratio (1-hour gage accumulation/1-hour radar accumulation) is the correction factor for a gage. The RAIN1 product is then corrected by interpolating the correction factors for all of the gages to each pixel in the RAIN1 product and multiplying the radar pixel value by the correction factor. The basic algorithm steps are described below.

1. **Gage Correction Factor Calculation for Each Gage**

   The gage correction is the ratio of the (1-hour gage accumulation)/(1-hour radar accumulation.

   - The gage accumulation is taken from the GAGE product. It must be greater than the Minimum Valid Gage Accumulation for a gage correction factor to be calculated.
   - The radar accumulation for the gage is calculated by first making an uncorrected RAIN1 product for the hour and then averaging the pixels surrounding the gage (according to the Averaging Distance, see on page 446). The pixels are averaged by summing only the valid (non-thresholded) pixels and then dividing by the number of valid pixels. For a gage correction to be calculated, the average rainfall accumulation must be greater than the Minimum Valid Radar Accumulation, and the number of valid (non-

thresholded) pixels must be greater than the Minimum Percentage Radar RAIN1 Coverage.

- If both the gage and radar 1-hour accumulations are valid, then a gage correction is calculated for the gage. Otherwise, the gage is flagged as invalid.
- The maximum and minimum correction factor limits are then applied.
- This procedure is repeated for each gage.

2. **Gage Correction Interpolation for Each Pixel**

The gage correction factors are then applied to the uncorrected RAIN1 product to yield the final corrected RAIN1 output product. The technique is that the rainfall accumulation value at each pixel in the uncorrected RAIN1 product is multiplied by an average correction factor.

The average correction factor for a pixel is calculated from all gages by weighting the correction factor for each gage inversely with its distance from the pixel, i.e.,

$$\bar{C} + \frac{\sum \frac{C_i}{D_i}}{\sum \frac{1}{D_i}}$$

where $\bar{C}$ is the average gage correction for a pixel, C_i is the correction at a gage and D_i is the distance between the gage and the pixel. Note that the minimum value of D_i is fixed at 1 km.

F.6 RAIN1 Scheduling with Gage Product

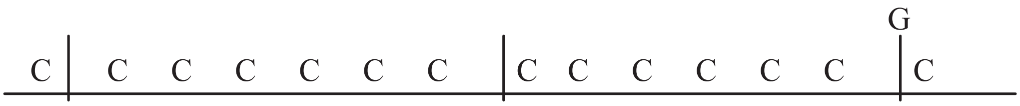
The scheduling algorithm for generation of the RAIN1 product is different from the standard RAIN1 scheduling since the product generator must await the arrival of both the CAPPI's and the GAGE product for the previous hour. To account for the delay in the arrival of the GAGE product, a Gage Wait Time is input into IRIS **setup**/product. In the figures below this is noted as "WaitG".

The notation shows a time line which represents the data time, i.e., in the case of a CAPPI, this is the time that the volume scan was started based on the clock on the radar computer which may be different than the clock on the computer where RAIN1 is being generated. In the case of a GAGE product this is the time exactly on the hour, at the end of the accumulation hour. Vertical bars show even hours.

Case 1A: Normal Case, CAPPI's and GAGE arrive

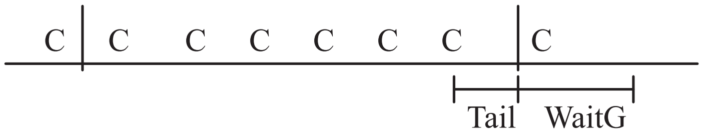
This is the normal case when both the CAPPI and the GAGE products arrive. The GAGE product actually arrives sometime after the hour, but in "Data Time" it is plotted exactly on the hour. The RAIN1 product is run as soon as the GAGE product arrives and the first CAPPI from the next hour arrives.

Case 1B: CAPPI'S arrive, GAGE arrives for a future hour



Here there is a missing hour in the GAGE product stream. The RAIN1 product will run (without GAGE correction). The assumption here is that the GAGE products are arriving in time order, and the missing hour's data will never appear.

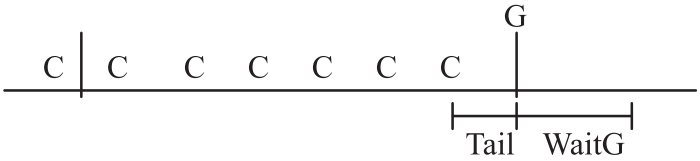
Case 1C: CAPPI'S arrive, but GAGE does not



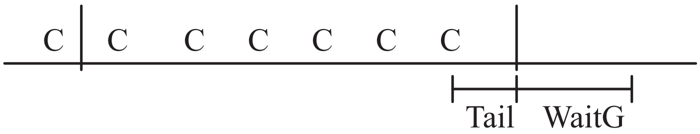
Here the GAGE product does not arrive. The RAIN1 product will run (without GAGE correction) when the local time on the product computer is past the arrival time of the last input CAPPI plus the Tail and WaitG times. The Tail time is difference between the data time of the last input and the next integer hour. The WaitG time is the "Raingage Arrival Wait Time" from **setup**/product.

Note that if the GAGE product eventually arrives, it will be ignored.

Case 2A: GAGE arrives, but the first CAPPI in the next hour does not



This is similar to the previous case. In this case, after the Tail and WaitG times have elapsed, the product runs using the available CAPPI's in the prior hour. There will be a GAGE correction and the RAIN1 algorithm will use all the available CAPPI's.



Case 2B: Neither GAGE nor the first CAPPI in the next hour arrive

This is nearly identical to the Case 2A, i.e., after the Tail and WaitG times have elapsed, the product runs using the available CAPPI's in the prior hour except that there will be no GAGE correction.

Degenerate Case: No CAPPI's ever arrive

In this case, no RAIN1 product is generated.

F.7 References

Brandes, E. A. and J. W. Wilson, 1982: Thunderstorms: A social, Scientific and Technological Documentary; Vol 3: Instruments and Techniques for Thunderstorm Observation and Analysis. E. Kessler, Editor. U.S. Department of Commerce, NOAA Environmental Research Laboratories.

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