M211849EN-C

User Guide

IRIS Focus

Version 3.0

VAISALA

PUBLISHED BY

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1. About This Document

1.1 Version Information

This document provides information for using IRIS Focus software.

Table 1 Document Versions

Document Code	Date	Description
M211849EN-C	February 2016	This document. Third version of this document
M211849EN-B	May 2016	Second version of this document.
M211849EN-A	January 2016	First version of this document.

1.2 Related Documents

Table 2 Related Documents

Document Code	Name
M211850EN	*IRIS Focus Administrator Guide*
M211849EN	*IRIS Focus User Guide*
M211904EN	*IRIS Focus Release Notes*

1.3 Trademarks

HydroClass™ is a trademark of Vaisala Oyj.

IRIS™ is a trademark of Vaisala Oyj.

All other product or company names that may be mentioned in this publication are trade names, trademarks, or registered trademarks of their respective owners.

1.4 Documentation Conventions

WARNING! Warning alerts you to a serious hazard. If you do not read and follow instructions 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 highlights important information on using the product.

Tip gives information for using the product more efficiently.

Lists tools needed to perform the task.

Indicates that you need to take some notes during the task.

2. IRIS Focus Overview

IRIS Focus provides tools for viewing and analyzing weather data received from weather radars through a web browser quickly and easily.

The displayed data consists of radar products, which are raw signal data from a radar receiver processed to provide information about current weather conditions. The radar products measure information such as radar signal reflectivity or rain intensity for analysis by meteorologists.

The weather data is overlaid on a geographical map that is centered on a selected radar site. Data is gathered from a single weather radar or a network of radar sites. All data is stored for 48 hours, and it can be animated on a time line.

Nowcasting performs advection calculations on motion data from radar products to predict weather movement and severity up to, for example, 2 hours in the future.

IRIS Focus provides live and pre-configured radar products, which differ in how they are processed within the IRIS architecture, as well as how they are used by the system end user.

- *Live Radar Products*
  Radar signal data that is processed into radar products and displayed in real-time. Live products allow more control over the weather data presentation in the IRIS Focus UI. For example, you can change the reflectivity threshold of a selected radar product in real-time.
- *Pre-configured Radar Products*
  Preset radar products defined and produced in IRIS Analysis and displayed by IRIS Focus on request.

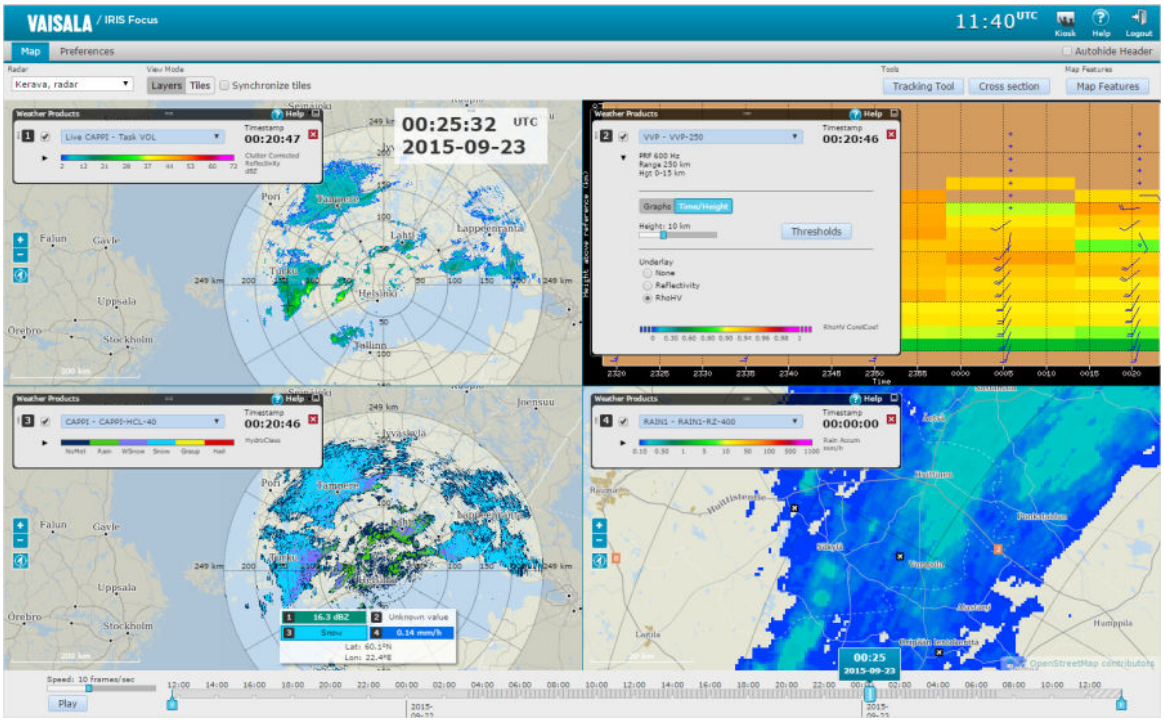


Figure 1 IRIS Focus Main View

More Information

- Live Radar Products (page 45)
- Pre-configured Radar Products (page 65)

2.1 IRIS Product Family

IRIS Focus provides an intuitive user experience for professional users, such as meteorologists and analysts. It is closely integrated with Vaisala weather radar systems, where IRIS Focus forms the visualization front-end and other IRIS components handle radar control, radar product generation, and data distribution. IRIS Focus retains the proven quality of Vaisala IRIS back-end processing software, while adding a modern user interface.

IRIS Focus runs on a web server that users can connect to in an enterprise intranet or from an external location or the Internet. Network connections between the IRIS Focus web UI and the data processing back-end go through a socket server, a custom protocol over TCP/IP that delivers radar data from the IRIS back-end services to IRIS Focus. The IRIS Focus application polls the server for data and displays it on screen.

The following figure shows a setup where IRIS Focus is used as part of a complete Vaisala weather radar network consisting of 2 radar sites.

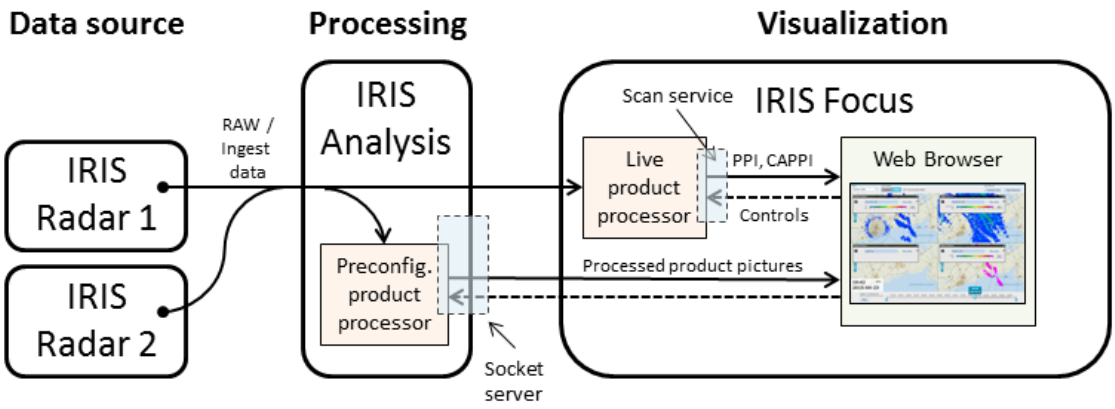


Figure 2 IRIS Focus Data Flow

In this case, IRIS Analysis and IRIS Radar can be considered back-end services for the IRIS Focus front-end interface. IRIS Focus communicates with IRIS Analysis through a secure socket server connection.

The components have the following functions:

- *IRIS Radar* - Operates the radar site and stores data gathered from the radar signals in RAW format.
- *IRIS Analysis* - Receives RAW data from IRIS Radar through secure connection and processes it into displayable radar products.
- *IRIS Focus* - Polls pre-configured radar products from IRIS Analysis and displays them on the web interface and generates live radar products from RAW data.

2.2 Licensing

IRIS Focus requires a software license to run. To activate the license, you need a product key.

Vaisala delivers the product key when you purchase the software. If you have purchased the software and you have not received the product key, please contact Vaisala.

For server deliveries, Vaisala activates the product key in the factory and a Vaisala representative sends you the key for future reference.

The license is mapped to the hardware of your IRIS Focus server. If your hardware configuration changes and you need to re-install IRIS Focus, you must request a replacement license from your Vaisala representative.

License Options

The IRIS Focus license includes the following:

- **IRIS Vision**
  The IRIS Vision license has an unlimited number of seats.
  If the license is missing, users cannot log in while admins can log in but cannot access the map view.

- **IRIS Focus**
  The IRIS Focus license is required to use IRIS Focus features and products.
  IRIS Focus licensing is based on a floating seat pool.
- **Nowcasting**
  The optional nowcasting feature requires a separate license in addition to an IRIS Focus license.

IRIS Focus Seat-based License

IRIS Focus licenses are available in different configurations. To increase your seat count, you must replace the current license with a new one by contacting your Vaisala representative.

The seat count defines how many users can access IRIS Focus at the same time. When a user logs in, they occupy a seat. When a user logs out, the seat is released and the next user can take it. If a user logs in when all the licenses are reserved, the user is shown IRIS Vision until an IRIS Focus license is released.

Nowcasting is only available to users with an IRIS Focus seat.

Seat counts within a workstation are browser-based. For one license reservation, users may view IRIS Focus in as many instances or tabs of one browser, such as Firefox®, as they like. If a user opens IRIS Focus in a different browser, such as Google Chrome™, they reserve one license for each browser.

More Information

- User Management (page 75)
- Licensing Management (page 87)

3. Using IRIS Focus

IRIS Focus combines an intuitive look-and-feel with powerful processing capability to provide a range of views, map tools, animations, and preferences.

3.1 Map View

The IRIS Focus main view displays a scrollable map area centered around the selected radar site. The map around the area is drawn using azimuthal equidistant projection that uses the radar site as a point of origin, which means that all distances and directions measured from the radar site are accurate.

In the map view, you can select multiple simultaneous weather data measurements, and display them on separate tiled windows, or on a combined layer overlay view.

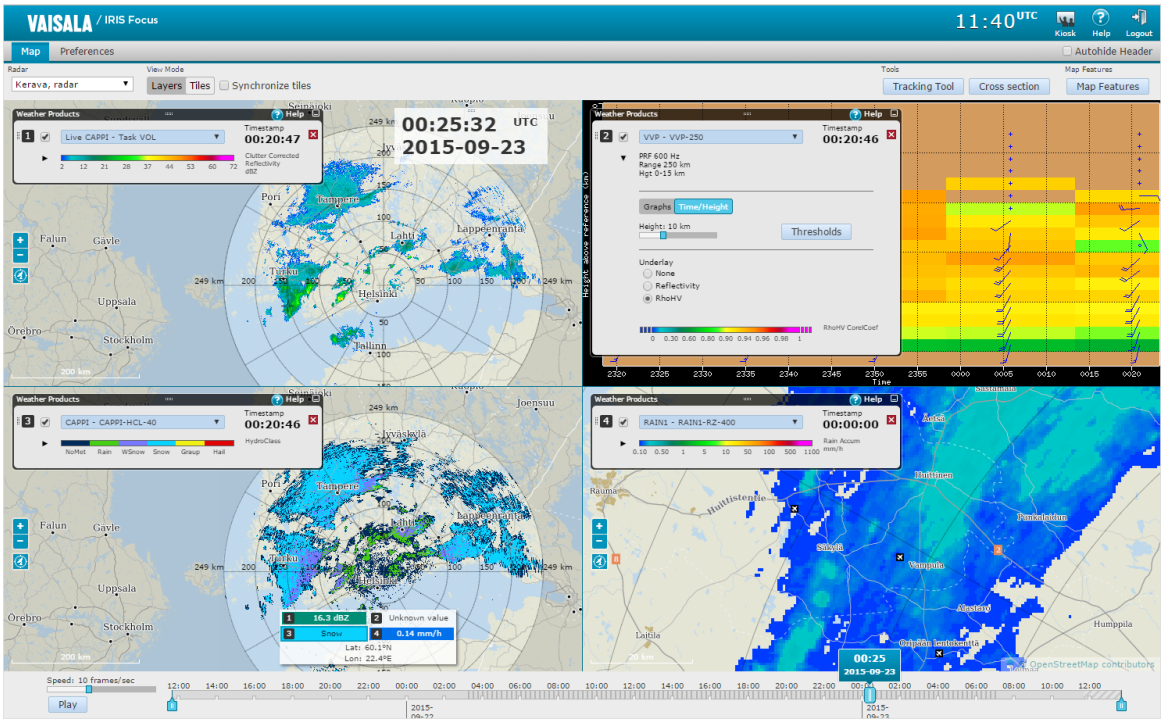


Figure 3 IRIS Focus Map View

The map engine in IRIS Focus runs on the open source GeoServer map server. The map data is gathered from the collaborative OpenStreetMap project, and the JavaScript user interface is built with the OpenLayers library. To improve performance, map data is cached as bitmap tiles with GeoWebCache.

3.1.1 Map Layers

The background map and the weather data visualizations from the radar products are drawn as individual layers and then combined to form an overview of current weather conditions around the radar site.

Base Layers

The background (also known as base) consists of a number of non-interactive layers. At the bottom is a terrain map that can be enhanced with additional layers containing roads, province boundaries, and other similar terrain features.

Radar Product Layers

The interactive radar product layers are drawn on top of the background layers.

3.1.2 Editing Base Layers

To manage map settings such as map style and additional map layers, such as roads, select **Map Features** on top right corner of the UI.

Available **Base Map** styles include:

- **Standard**
  Basic terrain with oceans, lakes, rivers, landmasses and islands. All waters are blue and all land areas gray. Cities and dense settlement areas are brown. This is the default map view.
- **Simplified**
  Same as Standard, without cities.
- **Terrain**
  Same as Standard, with landforms added so mountain ranges and other terrain features are more visible.

Changing from one map style to another takes some time while the new terrain assets are cached.

Table 3 Map Detail Settings

Map Detail	National borders	Province borders	Airports	Roads	Labels
None					
Minimal	x				
Aviation	x		x		
Roads	x			x	
General	x	x			x
Full	x	x	x	x	x

3.1.3 Radar Product Layers

IRIS Focus supports up to 4 simultaneous radar product layers that can be displayed on top of each other (**Layers** mode) or in separate tiles (**Tiles** mode).

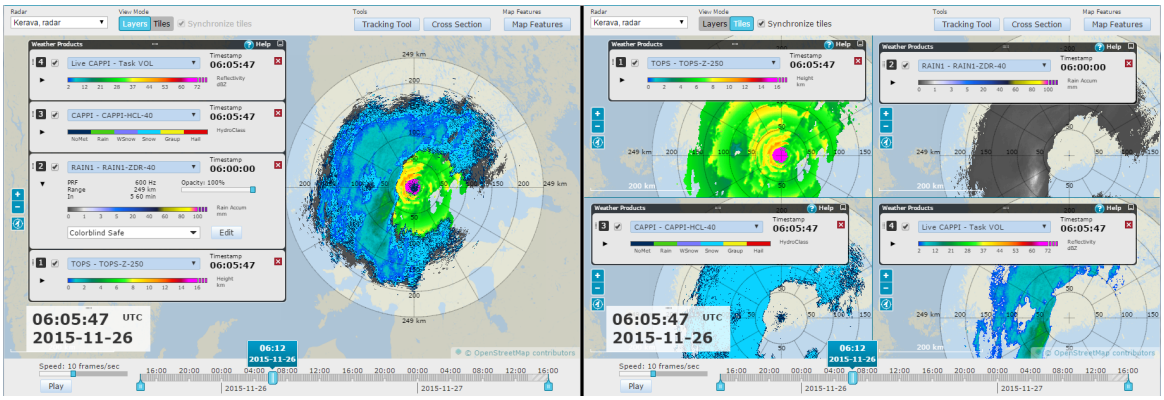


Figure 4 Layered and Tiled view modes

All active radar product layers are listed in the **Weather Products** panel.

Each additional layer requires more processing capacity from the system. To improve performance, avoid having unnecessary background or radar product layers on screen.

Tiles Mode

In **Tiles** mode, the tiles are synchronized by default.

In synchronized mode, all tiles pan and zoom automatically to the same coordinates whenever you move one of the tiles.

To disable the synchronized mode, deselect the **Synchronize tiles** check box.

Layers Mode

In **Layers** mode, the layers are drawn on the screen in the same order as they are listed on the **Weather Products** panel. The topmost layer in the panel is also drawn on top in the map view.

To change the order of the layers, drag them to new positions in the panel. IRIS Focus re-draws the radar products on the map view using the new layer order.

In **Layers** mode, layer number 1 always defines the overall presentation of the map view. For example, the range rings around the radar site are based on layer 1, so if the products on layer 1 and 2 have respective ranges of 100 and 250 km, the range rings on the map view are drawn only up to 100 km, which is the maximum range of the product on layer 1. The weather data from layer 2 is still drawn on the map, even though it "appears" to be outside the radar range. This also affects radar products that include some additional UI elements, such as Maximum Data (**MAX**).

More Information

- Radar Products (page 37)
- Maximum Data (MAX) (page 68)

3.1.4 Radar Product Layer Settings

Each product's **Weather Product** panel includes settings for radar product layers.

The contents of the panel depend on the radar product type:

- *Live radar products* are processed in IRIS Focus application, and offer options to analyze the data in real-time.
  See 4.5 Live Radar Products (page 45).
- *Pre-configured radar products* are configured in the IRIS Analysis back-end, and their full parameters are only accessible on the back end.
  See 4.6 Pre-configured Radar Products (page 65).

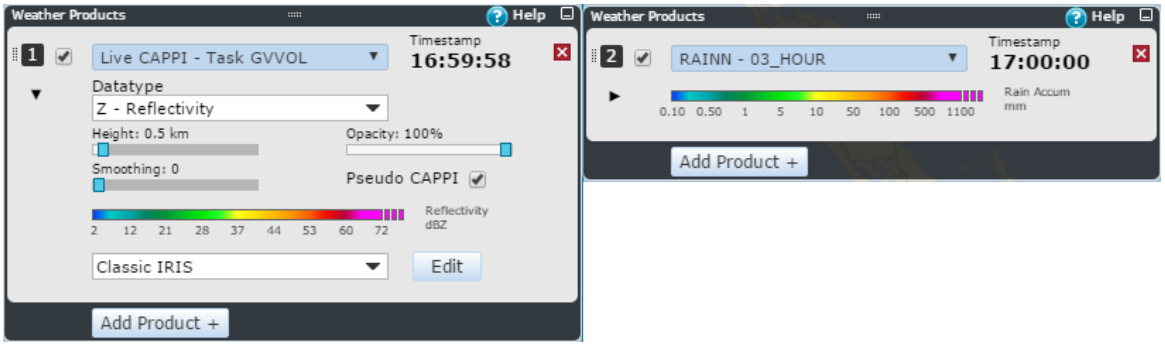


Figure 5 Live and Pre-configured Product Settings

The opacity value, which sets the transparency of a layer, is available for all radar product layers.

Live Attributes

Live product layers include the following additional attributes:

Attribute	Description
Data type	Sets the measured data type. See 4.1.3 Data Types (page 40)
Height (**CAPPI**) Elevation (**PPI**)	Defines the height (measured from sea level) of the horizontal cross section being displayed, or elevation of the current radar beam.
Pseudo **CAPPI**	Toggles Pseudo **CAPPI** on/off. Pseudo **CAPPI** attempts to visualize those parts within the radar range that are not measured with current settings. See 4.5.2.2 Pseudo CAPPI (page 51).

Attribute	Description
Smoothing	Blends adjacent pixels closer together depending on their distance from each other. See 4.3 Radar Product Smoothing (page 42).
Threshold (**BASE**, **TOPS**, **THICK**)	Defines reflectivity threshold (dBZ) for the amount of data displayed in the image. See 4.4 Radar Product Reflectivity Threshold (page 43).

3.1.5 Map Units

IRIS Focus supports the following unit sets. To change them, see 3.6 User Preferences (page 34).

Unit	Metric	Imperial	Aviation
Distance	km	miles	nmi
Velocity	m/s	mph	kt
Angle change	deg/km	deg/mile	deg/nmi
Altitude	km	ft	ft
Rainfall	mm/h	inch/h	inch/h
Vertically Integrated Liquid (VIL)	mm	inch	inch

3.2 Animation Timeline

IRIS visualizes radar data from the last 48 hours and nowcasting data into the future.

You can jump to any point in that time and view the radar products by clicking or dragging the playback slider on the timeline at the bottom of the main view.

Animation

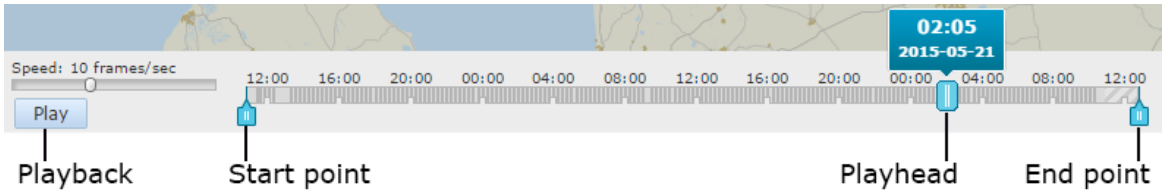


Figure 6 Animation Controls

You can start a looping animation that runs at 1 … 25 frames per second using the playback controls on the lower left part of the main UI. To set only a part of the weather history to be animated, drag the start and end points to the desired positions on the timeline. The animation settings update in real time.

Most radar products have an update interval of 15 minutes, but some are updated every 5 minutes or every 60 minutes. The length of the animation step is defined by the update interval of layer number 1, that is, the bottom layer.

By default, the animation stops for 1 second before looping back to the beginning. You can change this in **Preferences**.

Nowcasting

Nowcasting performs advection calculations on motion data from radar products to predict weather movement and severity up to, for example, 2 hours in the future.

When you drag the playback slider into the future, the timestamp formatting indicates that the display is showing nowcasted data.

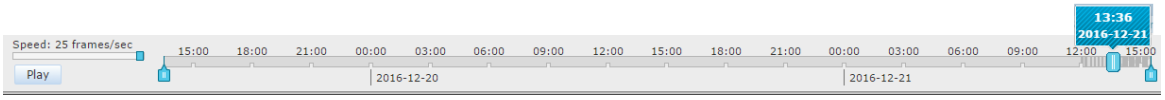


Figure 7 Animation Controls in Nowcasting Mode

More Information

- User Preferences (page 34)
- Nowcasting (page 23)
- User Preferences (page 34)
- Nowcasting (page 23)

3.3 Map Tools

3.3.1 Cursor Tool

When you stop the mouse cursor on the map view, a small overlay box opens next to it. The overlay box contains coordinates and exact radar product values for that location.

If you select are multiple radar products, the cursor tool lists values for each product in the same order they are displayed on the screen.

Figure 8 Values from 4 radar products

The cursor tool works in both layered and tiled modes. In tiled modes, the overlay box displays values for each radar product at the current position, even if the tiles are not synchronized.

3.3.2 Radar Product Colors

All radar product visualizations are drawn on the map using an editable color scale gradient, which illustrates the intensity of the detected weather phenomena or values of the received signal. The default color scales are useful for most conditions, and you can edit them further with the built-in color scale editor.

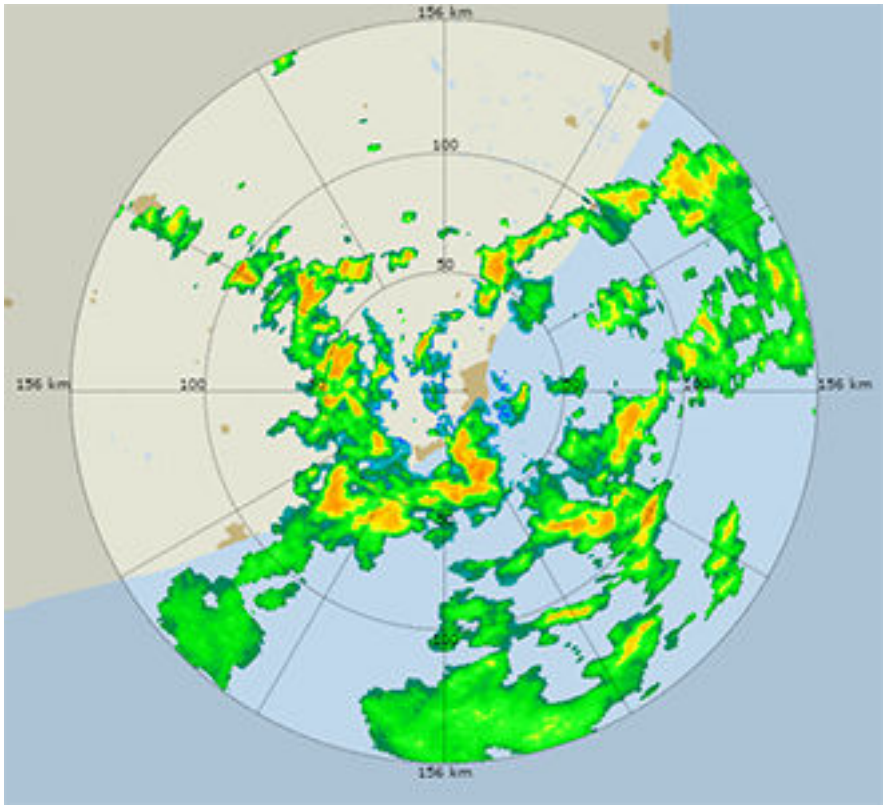


Figure 9 Signal reflectivity in precipitation

3.3.2.1 Color Scale Editor

To access the editor, select **Edit** on a radar product panel.

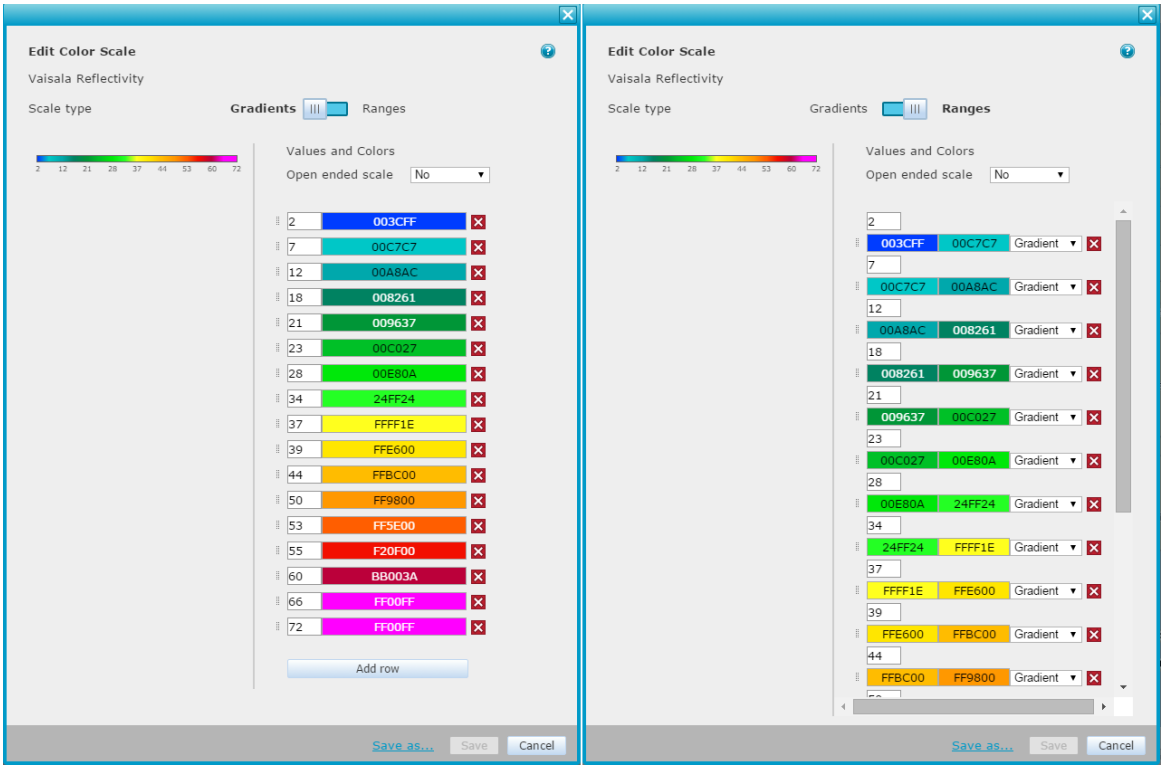


Figure 10 Color Scale Editor Modes

The editor displays the current color scale gradient. On the right side is a list of the keypoints of the color scale. Each keypoint sets the RGB color of a defined value in the radar product, and the values between keypoints are interpolated to make a smooth gradient. By optimizing the keypoints for site-specific conditions, you can make measurement ranges close to each other more distinct, and improve the users' ability to perform visual analysis on the data.

The open-ended scale setting allows you to define how values outside the upper and lower thresholds of the color gradient are displayed on the map. Open-ended scales continue drawing values beyond the thresholds with the same color as the lowest or highest keypoint in the color scale. Non open-ended scales do not draw any values outside the thresholds on the map.

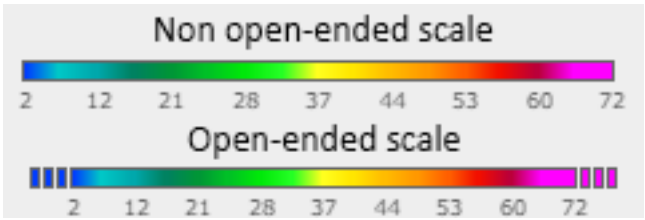


Figure 11 Open and Non-open color scales

Using non-open scales, especially for the low end, is an effective way to remove signal noise or clutter from the radar product layer.

The **Ranges** mode allows more fine-tuned options for editing color scales. On the tab you can set each step between two keypoints on the color scale to be either gradients or single solid color.

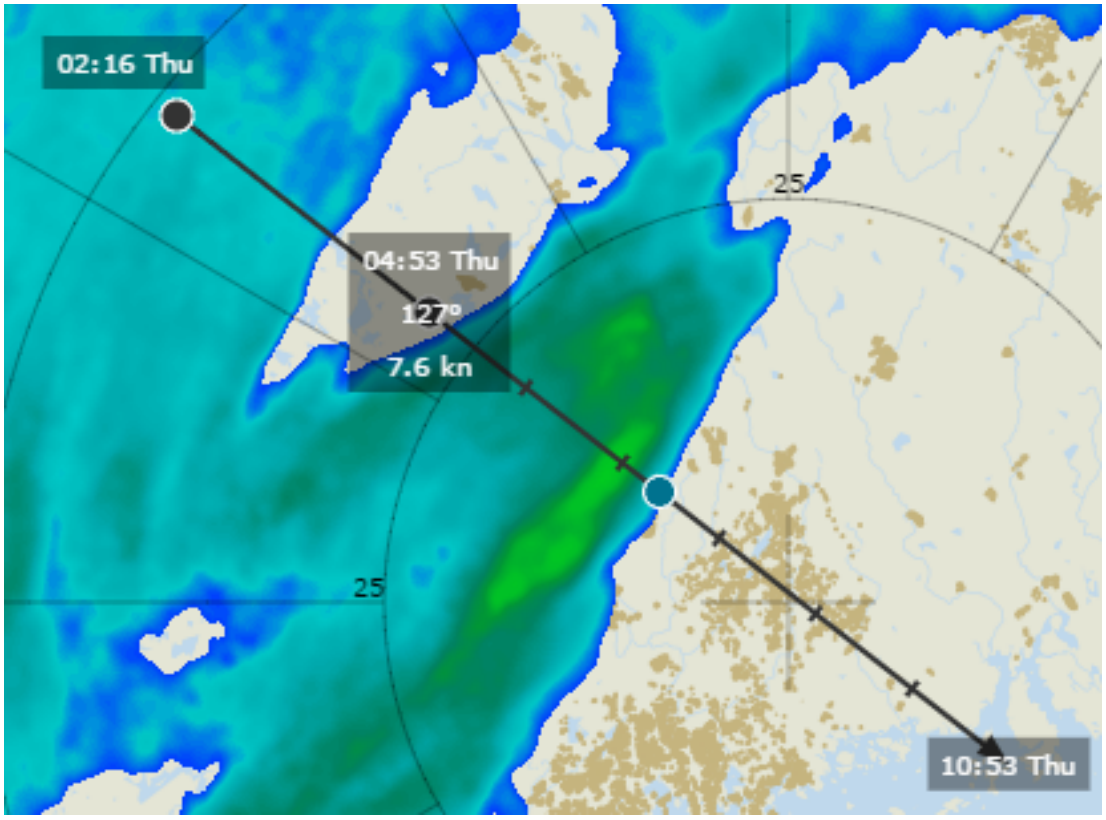
To change a color in a keypoint, click on it and select a new color from the color picker, or enter a new numerical RGB value directly into the color field.

3.3.3 Tracking Tool

Use the **Tracking Tool** to predict the movement of weather fronts or other visible elements in the radar products.

1. On top right corner of the main UI, select **Tracking Tool**.
2. Drag the playback slider to the time where you want start tracking something.
3. Click on the map view in the position you intend to track.
   Usually this is an edge of a weather front or an interesting local weather event.

4. Drag the playback slider forward and add a second tracking point the tracked event appears to have moved.
   The **Tracking Tool** draws a line by continuing with the same path and speed. The first 6 estimated hours are always drawn on the screen, and you can run the tracking point even further if you drag the playback slider onwards.
   In the following image, the black circles are tracking points and blue is a future estimate point based on the tracking points. The floating overlay box next to the tracking points shows a timestamp



5. When you are finished or want to start another tracking event, clear the tracking points by selecting **Tracking Tool > Clear tracking points**.

3.3.4 Cross Section Tool

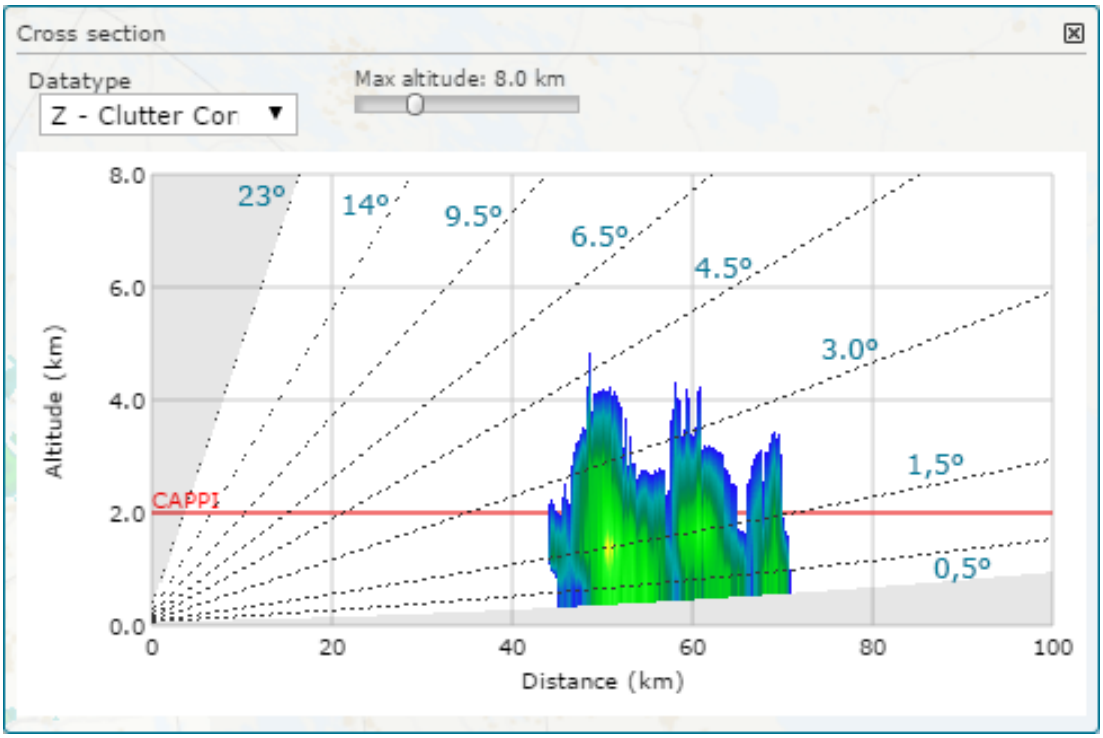
IRIS Focus calculates vertical cross sections from the radar product data for all live radar products.

The cross section window shows a vertical slice of the atmosphere on the selected line. The dotted lines are beam center lines that show the altitudes where the radar signal has passed at a given distance. The weather phenomena are drawn with the same colors as in the main view. The area outside radar range is greyed out.

1. Select **Cross section** on top right corner of the main UI to launch the cross section tool.
2. Select a live radar product.

3. Select points on the map:
   - Straight line – click on two points on the map to create endpoints for a vertical cross section of the radar product.
   - Curved line – click on the map and drag the mouse cursor to draw a freeform curved line. The cross section is calculated along the line when you release the mouse button.

   The cross section is calculated on a line between those endpoints.
   You can move the curve and the endpoints afterwards.



If you are using a live CAPPI product, the selected CAPPI altitude is drawn with a red line.

4. If you wish, change the product data type in the dropdown menu.

More Information

- Live Radar Products (page 45)
- Data Types (page 40)
- Live Constant Altitude Plan Position Indicator (CAPPI) (page 49)

3.4 Nowcasting

Nowcasting performs advection calculations on motion data from radar products to predict weather movement and severity up to, for example, 2 hours in the future.

In this time range IRIS Focus can predict smaller features such as individual showers and thunderstorms with reasonable accuracy using image advection techniques. As part of the techniques, nowcasting extrapolates storm (echo) motion *n* hours into the future.

Nowcasting does not attempt to imply laws of physics into the model, such as performed in numerical weather prediction (NWP). By using advection extrapolation instead of NWP, nowcasting can include details that cannot be solved by NWP models running over longer forecast periods.

Nowcasting can be used by, for example, road, energy, or airport organizations to provide real-time decision making support.

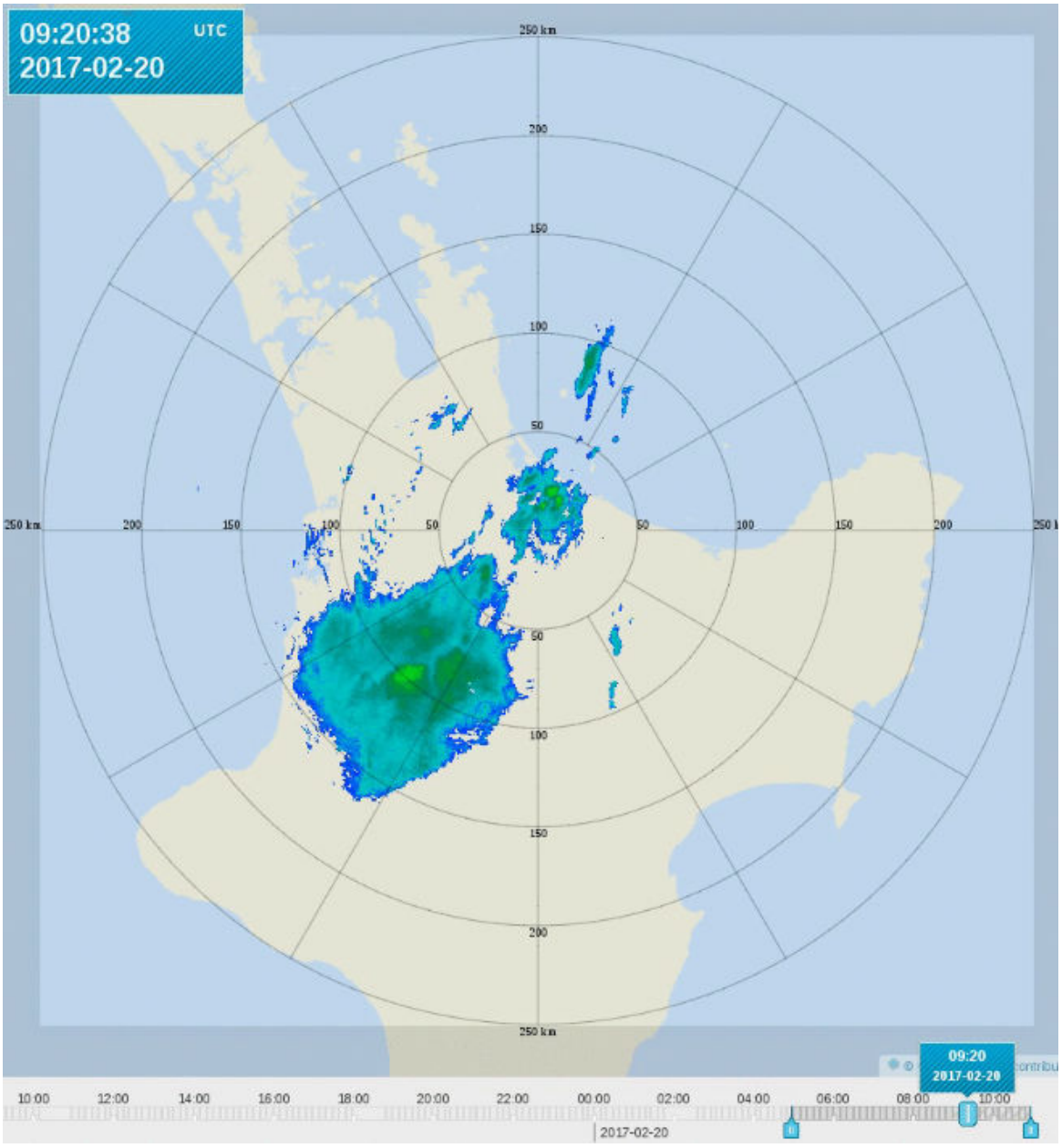


Figure 12 Viewing Nowcasted Data

IRIS Focus nowcasting uses an area-based method in which a motion vector field (MVF) is estimated over the entire observed area to provide insight into many types of precipitation. The IRIS Focus display advects cartesian products into the future.

You can view nowcasted data in IRIS Focus by moving the slider on the animation timeline. When you are in nowcasting mode, the appearance of the timestamps change to indicate that you are viewing nowcasted data.

More Information

- Animation Timeline (page 17)
- Motion Vector Field (MVF) (page 68)
- Configuring Nowcasting (page 88)
- Animation Timeline (page 17)

3.4.1 Calculating Nowcasting Predictions

In nowcasting, a precipitation field is considered a single pattern that can move and change with time. Placing the analyzed area on a grid, the first step in nowcasting is to compute a set of velocity vectors, one for each tile of a fixed size and then use them to predict future movement. Calculations are based on a cross-correlation of patterns.

In IRIS Focus, the motion vector fields (MVFs) calculated to support nowcasting cover the area measured by the radar. Zooming in and out of the display does not change the calculations.

Nowcasting Process

The following process explains how IRIS Focus creates nowcasts of its cartesian products in two steps: first create a motion vector field (MVF) and then use the MVF to advect products into the future.

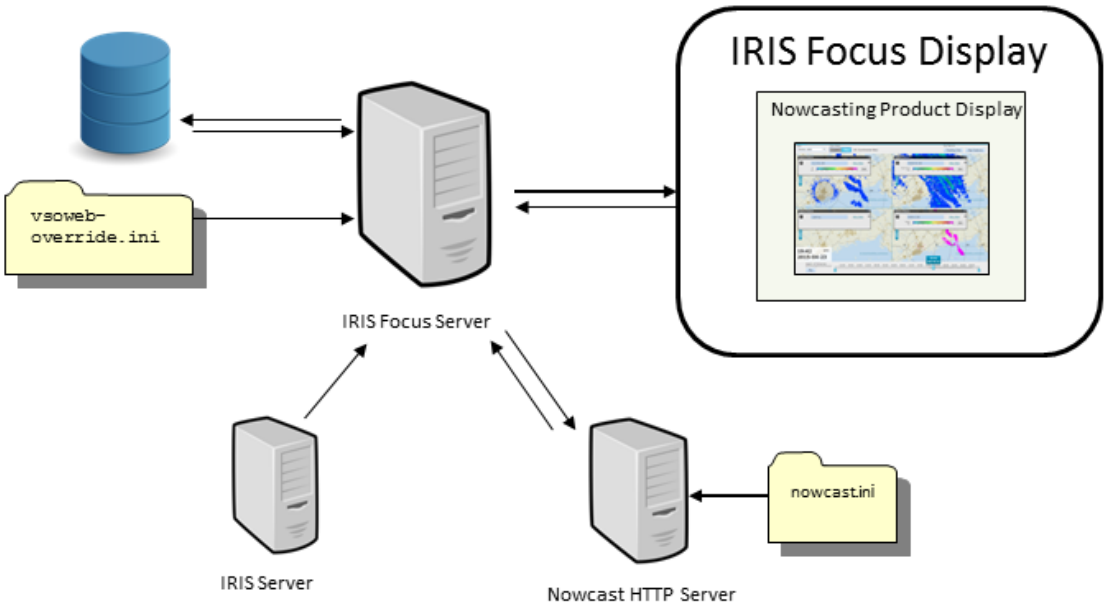


Figure 13 Nowcasting Architecture

1. Read the nowcasting configuration on start-up.
2. Run the radar data sequence.
3. Calculate the current velocity as a motion vector based on configurable settings.
   MVF generation is done in the nowcast server, which by default is installed on the IRIS Focus server. The nowcast server takes requests from the web application and returns MVF products. Advected product generation is done in the web application.
   MVF calculations use the last few products generated of a Cartesian (non-live) product and passes them through the nowcasting algorithms. Note that since the last generated products are used, depending on the product schedule, it is possible that the first advected image is before the current time.
   The MVFs are visible in IRIS Focus as a separate product and are used by IRIS Focus in nowcasting other radar products.
   See 4.6.6 Motion Vector Field (MVF) (page 68).
4. Run the nowcasting advection and velocity calculation algorithms to determine how the precipitation elements in the atmosphere will move in the near future.
   See 3.4.2 Calculating Advected Products (page 26) and 4.6.6.1 Calculating Motion Velocity (page 70).
5. Display nowcasting predictions in IRIS Focus.
   See 3.2 Animation Timeline (page 17).

3.4.2 Calculating Advected Products

When you view nowcasted products by moving the animation slider into the nowcasting region, you see advected products.

IRIS Focus generates advected products using the last motion vector field (MVF) generated for a site along with the last product of the type you are viewing. IRIS Focus generates the advected products on-demand.

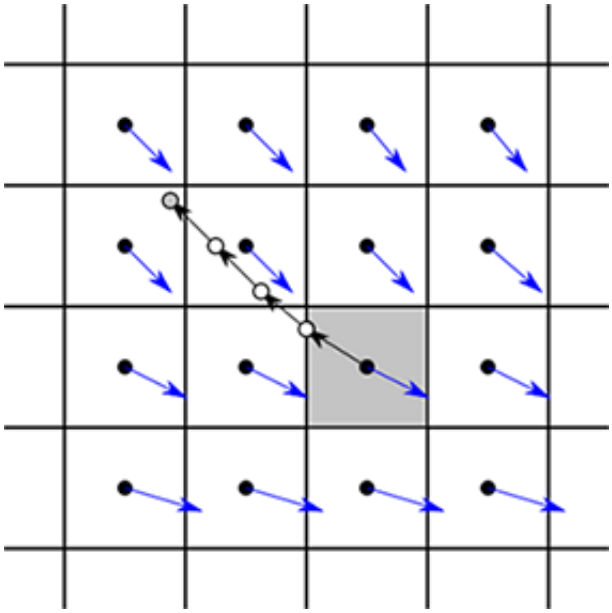


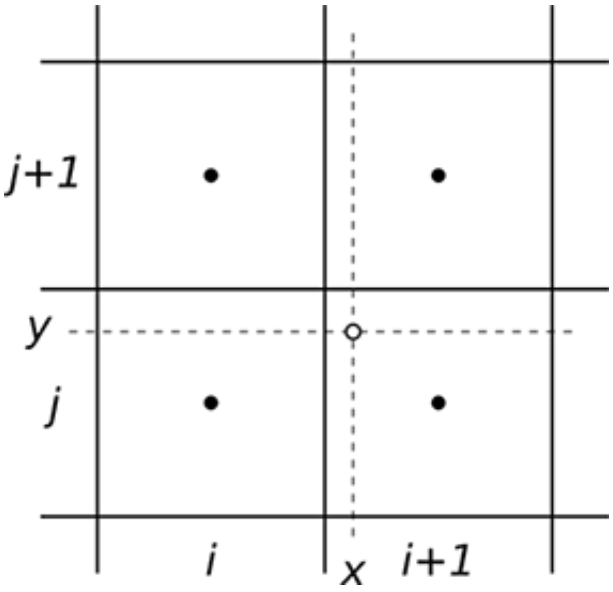
Figure 14 Product Advection

Calculating Advected Products

The advection algorithm back traces each pixel's previous positions. To determine the value of one pixel (shown in gray in the previous image), the algorithm performs the following calculations:

1. Shift the position of the pixel using the MVF point for that pixel, but in the opposite direction.
   The new value is determined by interpolating the raster value at the previous location of the pixel.
2. To determine value in the pixel **N** frames in the future, the algorithm performs the shift **N** times.

3. The algorithm determines the MVF vector components at each intermediate location using the same interpolation procedure as for the raster value at the previous location. The interpolation computes a weighted average of raster values in four surrounding points.



3.5 Alerts for Significant Weather

In IRIS Focus, a weather *event* is an occurance of a pre-configured **WARN** product appearing in the display.

A weather *event* becomes an *alert* when the pre-configured **WARN** product moves into a protected area in the display.

You configure alerts to detect significant weather events in a pre-defined protected area.

To use IRIS Focus alerts, you must define **WARN** products in IRIS Radar and then draw protected areas in IRIS Focus.

When IRIS Focus detects an event icon in a protected area, the icon and the bounding box around the area turn red. You can hover over the area to show more information about the alert.

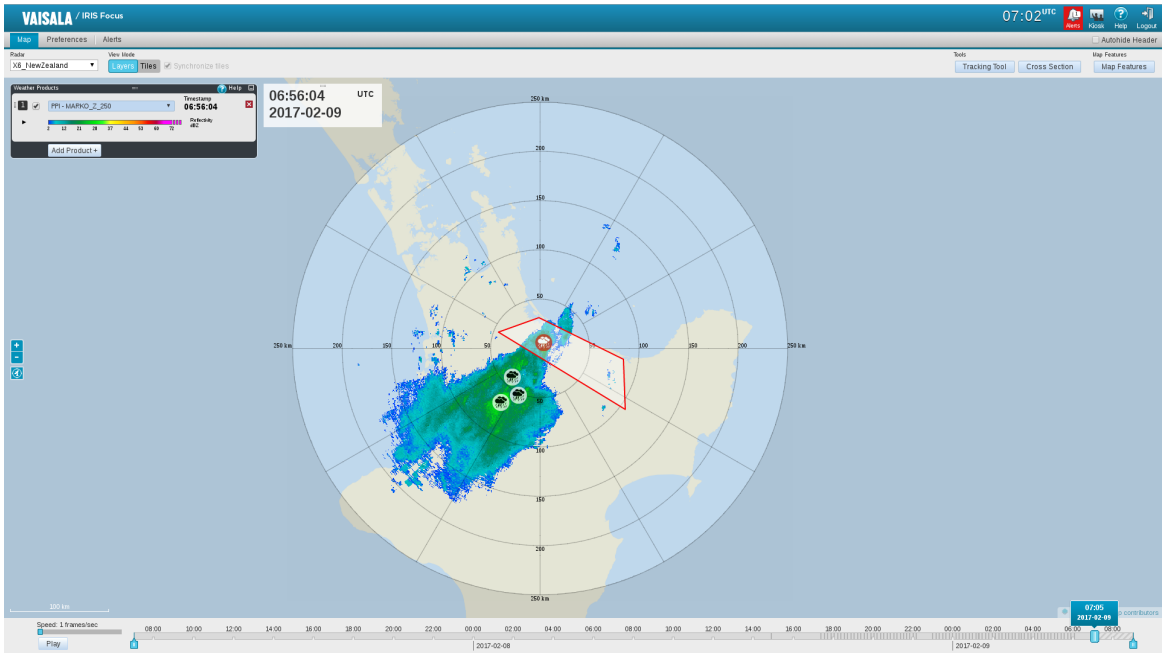


Figure 15 Viewing Events and Alerts

Alerts have a hysteresis period of 20 minutes. If new events of the same type, and in the same protected area, arrive, IRIS Focus keeps the alert active. Once there have been no new events for 20 minutes, the alert is turned off.

IRIS Focus generates alerts for different event types and different protected areas.

Example: Detecting Hail

The occurrence of 45 dBZ at 1.5 km above the freezing level is a good indicator of hail in many mid-latitude locations. Assuming that the freezing level is at 4 km, and you run an echo **TOPS** product for the 45 dBZ contour, your pre-configured warning could check if:

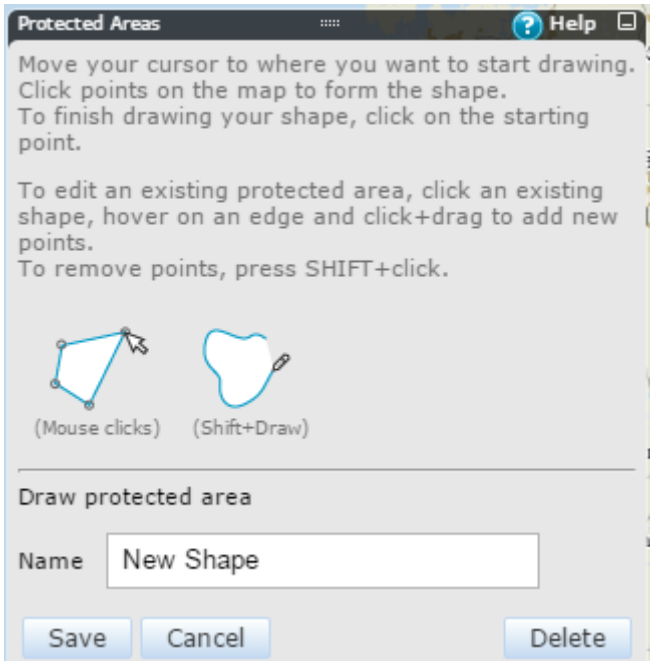
- The **TOPS** product shows 45 dBZ tops at heights greater than 5.5 km. If yes, there is a high probability of hail.
- So you do not issue an alarm based on a single pixel, a "threshold region" parameter checks if the region of hail signature at least 10 km^2 .
- The **VIL** for the same region (1 ... 10 km) is greater than 5 mm (or a value determined from the local climatology of hail).

3.5.1 Drawing Protected Areas

1. Select **Alerts > Protected Areas**.

2. Select **Shape**.

3. Name your protected area.



4. Move your cursor to where you want to start drawing.
5. Click points on the map to form the shape.
6. To draw free-form, press the SHIFT and the mouse button while you drag the cursor.
7. To close your shape, click the starting point.
8. To remove points in a protected area, press SHIFT+click.
9. Select **Save**.

The protected area is now active. IRIS Focus generates an alarm when an event crosses into the protected area.

More Information

- Viewing Protected Areas (page 31)
- Managing Alerts for Significant Weather (page 91)

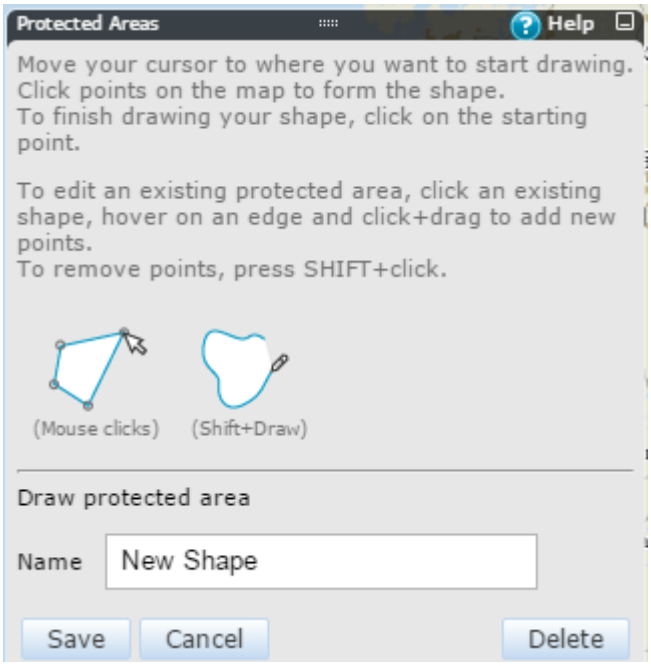
3.5.2 Editing Protected Areas

1. To edit an existing protected area, click an existing shape, hover on an edge and click and drag the mouse to add new points.
2. To move an existing point, hover over it and click and drag the mouse to move it.
3. To remove points in a protected area, press SHIFT+click.
4. Select **Save**.

3.5.3 Removing Protected Areas

CAUTION! Take care when removing protected areas from your map. You cannot undo an action that removes a protected area.

1. Select the protected area you wish to remove.

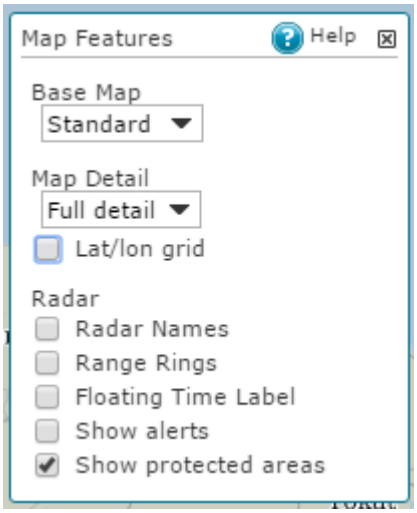


2. Press **DELETE**.
   The protected area is removed from the IRIS Focus display.
   You will no longer be alerted to weather events in this area.

3.5.4 Viewing Protected Areas

1. Select **Map Features**.

2. Select **Show Protected Areas**.



The protected areas drawn for your system are displayed on the map.

More Information

- Map View (page 13)
- Drawing Protected Areas (page 29)

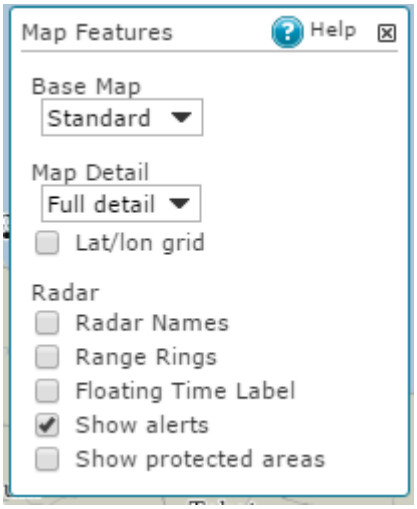
3.5.5 Viewing Active Weather Events and Alerts

You can choose whether to display active weather events and alerts in the IRIS Focus map display.

The alert panel is always active.

1. Select **Map Features**.

2. Select **Show alerts**.



Active weather events and alerts are displayed on the map.

More Information

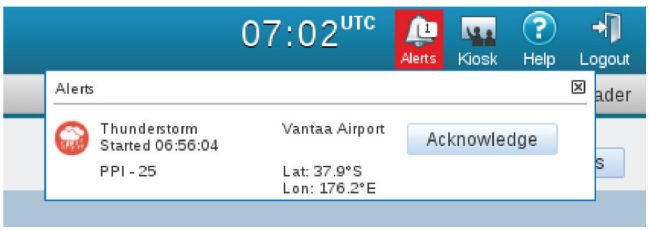
- Map View (page 13)

3.5.6 Acknowledging Alerts

A weather *event* becomes an *alert* when the pre-configured **WARN** product moves into a protected area in the display.

When an alert is in a protected area, both the event icon and the protected area are red and the alarm icon in the menu indicates a new alarm, which you can acknowledge.

1. In the main menu, select **Alerts**.
2. In the **Alerts** panel, acknowledge the alarm.
   The acknowledgement records who has seen the alert and when.
   Acknowledging alerts has no effect on the alert status.



3.5.7 IRIS Focus Warning Symbols and Definitions

Table 4 IRIS Focus Warning Symbols

IRIS Warning Symbol Label	IRIS Focus Event Icon	IRIS Focus Alert Icon
`DOWNBURST`		
`HAIL`		
`THUNDERSTORM`		
`WINDSHEAR`		
Other **Warning Symbol** value		

Weather Events and Alerts

In IRIS Focus, a weather *event* is an occurance of a pre-configured **WARN** product appearing in the display.

A weather *event* becomes an *alert* when the pre-configured **WARN** product moves into a protected area in the display.

Alerts have a hysteresis period of 20 minutes. If new events of the same type, and in the same protected area, arrive, IRIS Focus keeps the alert active. Once there have been no new events for 20 minutes, the alert is turned off.

IRIS Focus generates alerts for different event types and different protected areas.

3.6 User Preferences

To view and change user-specific settings, select **Preferences**.

You can change:

- Your password
- Default animation settings
- Interface language
- Measurement units used in IRIS Focus. See 3.1.5 Map Units (page 17).

Figure 16 User preferences window

3.7 Supported Browsers

IRIS Focus data is available through a secure network connection, and can be displayed on multiple client workstations across your organization.

IRIS Focus supports current Internet Explorer, Mozilla Firefox, and Google Chrome browsers.

4. Radar Products

A weather radar transmits pulse signals outwards to the atmosphere and receives reflected echoes of the signal. As the radar rotates around its vertical and horizontal axes, it gathers raw data by sending and receiving signals.

The raw data can be analyzed for signal properties, such as reflectivity and Doppler velocity, that are affected by the atmospheric conditions in the measured area. For example, a dense precipitation area reflects a stronger echo signal back toward the radar. These signal properties are processed further to create radar products that are useful for meteorological purposes.

IRIS Focus is designed for use with dual polarization Doppler radars that transmit and receive both horizontally and vertically polarized pulses. The combination of differential polarization modes allows for detailed analysis of atmospheric events such as detecting different precipitation types.

IRIS Focus supports:

- *Live radar products* are processed in IRIS Focus, and offer options to analyze the data in real-time. See 4.5 Live Radar Products (page 45).
- *Pre-configured radar products* are configured in the IRIS Analysis back-end, and their full parameters are only accessible on the back end. See 4.6 Pre-configured Radar Products (page 65).

For information on the algorithms used to process raw signal data in IRIS, see IRIS and RDA Dual Polarization Users Manual and RVP900 Users Manual.

More Information

- IRIS Product Family (page 10)
- Live Radar Products (page 45)
- Pre-configured Radar Products (page 65)

4.1 Measuring Radar Data

IRIS Focus uses the data generated by weather radars to detect hydrometeors in the atmosphere such as rain, snow, or hail.

4.1.1 Bins, Sweeps, and Volumes

As the radar rotates around its axis 360° in a sweep, the weather radar transmits microwaves pulses into the atmosphere and receives signals reflected off hydrometeors. After a sweep, the radar usually changes its elevation and starts a new sweep.

The reflection measurements from a pulse are sorted into bins. A bin is a single sample of weather data detected at a known direction, altitude, and distance from the radar site. The radial size of a bin decreases with distance, so bins further from the radar site cover a larger area than nearby bins. Each sweep typically contains the same number of bins independent of the elevation.

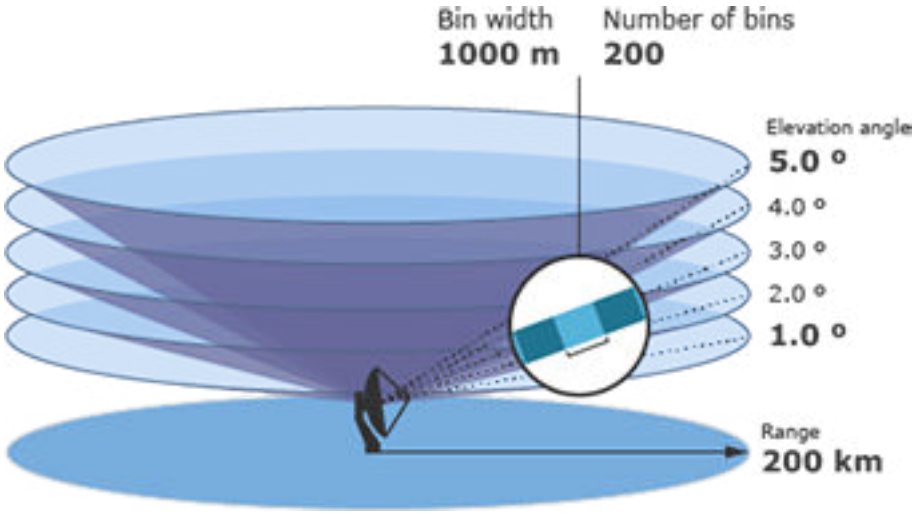


Figure 17 Bins and Sweeps

Volumes, a complete set of raw measurment data collected during sweeps, are used to calculate a model of the atmosphere. The maximum volume is half of a sphere (from 0° elevation upwards), but other shapes are more typical.

4.1.2 Radar Beam

As the distance from the radar site increases, the granularity of the radar beam decreases, which degrades the accuracy of radar products. For example, a 1° wide beam sent at the antenna has a width of 2 km across at 120 km distance. The following image shows how the detected bins grow larger further away from the radar.

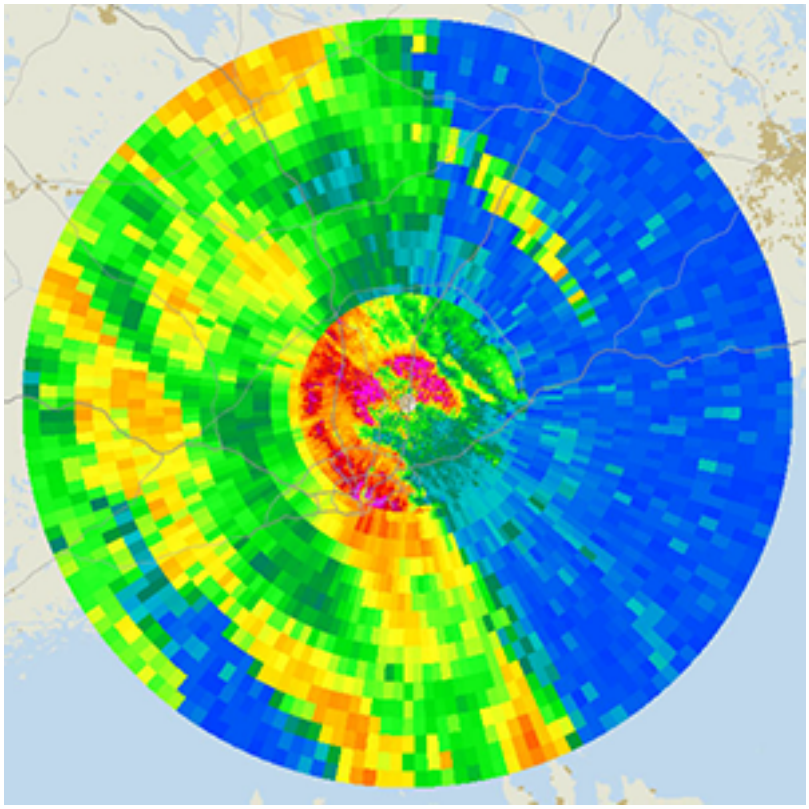


Figure 18 Radar resolution across the detected area

Many radar products are affected by the curvature of the Earth. A radar beam transmitted at a 0° vertical angle from the radar site on a flat environment would be 780 meters above ground at 100 km distance, before accounting for atmospheric refraction. While all IRIS Focus radar products are corrected for curvature and refraction effects, weather phenomena from below the curvature threshold cannot be detected.

The following image shows a vertical cross-section of a typical volume scan action. The image is corrected for earth curvature. Note how the vertical resolution increases with longer horizontal distance. The same applies to horizontal resolution.

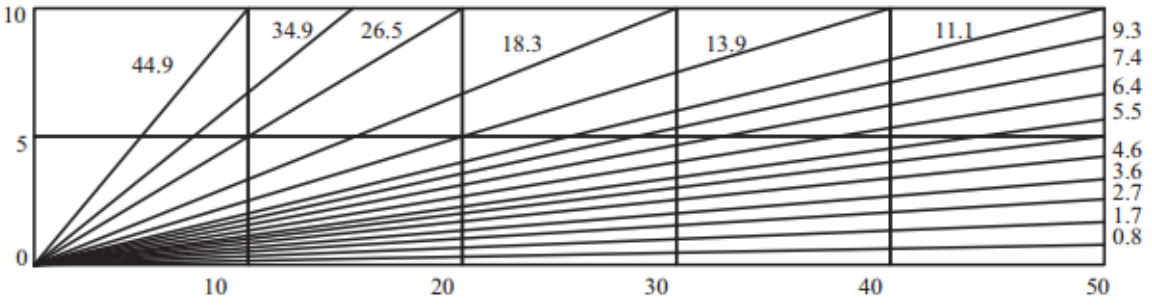


Figure 19 Example of 15-tilt Volume Scan

4.1.3 Data Types

Radar product data type defines what is calculated from the received radar pulse reflections.

The data types are used in both preconfigured and live products:

- In preconfigured products, the data type is indicated in the radar product name.
- In live products, you can select the intended data type from the drop-down menu on the **Weather Product** panel.

Data types in IRIS Focus never use letters from the Greek alphabet, and are always written in uppercase, even when signal processing and meteorological conventions use subscript. For example, instead of Φh, IRIS Focus uses PHIH.

Horizontally and vertically polarized pulses are generally abbreviated in the data types as H and V. Data types that use both sent and received signals as input include a combination of letters H and V to describe the process. For example, HV refers to horizontal transmit and vertical receive.

Data type	Definition	Description
HCLASS	Hydrometeor Classification	Estimated hydrometeor type in the precipitation area.
KDP	Specific Differential Phase	An indicator of the rate of change of the phase difference between horizontally and vertically polarized pulses of the radar. A greater horizontal shift results in a positive KDP value, and a greater vertical shift results in a negative KDP value. Typical cause for a high KDP area is heavy rain.
LDRH (LDRV)	Linear Depolarization Ratio H to V (or V to H).	The ratio of cross-polar to co-polar reflectivity measured in dB.
PHIH (PHIV)	Horizontal (or Vertical) Differential Phase	Phase difference for the total round trip between radar and the volume where the signal is reflected. PHIH is measured between HH and HV channels. PHIV is measured between VV & VH channels.
PHIDP	Differential Phase	The phase difference due to propogation between the HH and VV channels of the radar.
RHOHV (RHOH/RHOV)	Correlation coefficient between HH and VV (or HH & HV / VV & VH) channels)	Higher (>0.95) values indicate uniform precipitation areas and lower values more mixed hydrometeor types, such as melting snow, wet snowflakes, or airborne debris.
SNR	Signal to Noise Ratio	Generic measurement of signal-noise ratio in dB.
SQI	Signal Quality Index	A value between 0-1 that measures the signal's Doppler coherency, that is the correlation between the signal and its doppler lag. • 0 indicates white noise • 1 is the perfect doppler point target
T	Total Reflectivity	Total power returned to the radar in reflectivity units. It typically represents the horizontal reflectivity without ground clutter correction.

Data type	Definition	Description
TV (TE)	Total Vertical (HV Enhanced) Reflectivity	Total reflectivity from the vertical polarization channel (TV) and combination of the horizontal and vertical channel (TE).
V	Velocity	Average radial velocity (towards or away from the radar) of detected hydrometeor areas.
VC	Corrected Velocity	Same as Velocity, but corrected for effects of Range folding (page 111) and Velocity folding (page 112).
W	Spectral Width	Variability of Doppler velocity values within the measurement area.
Z	Reflectivity	Usually referred to as dBZ in professional literature. It is the common data type that measures radar signal reflectivity, and is used to estimate precipitation intensity from that. All Z measurements are corrected for ground clutter.
ZV (ZE)	Vertical (HV Enhanced) Reflectivity	Total reflectivity from the vertical polarization channel (ZV) and combination of the horizontal and vertical channel (ZE). Corrected for ground clutter.
ZC	Corrected Reflectivity	Same as Z, but corrected for attenuation and beam blockage effects.
ZDR	Differential Reflectivity	The ratio of SNR in the horizontal channel to the SNR in the vertical channel. Positive values indicate more prominent horizontal echoes and negative values more prominent vertical echoes. Larger hydrometeor sizes are usually identified by high positive ZDR values.
ZDRC	Corrected Differential Reflectivity	Same as ZDR, but corrected for attenuation and beam blockage effects.

More Information

- Radar Product Codes (page 41)

4.2 Radar Product Codes

All radar products are identified by their product code. The codes are specified in the IRIS Analysis system. All radar products have a code that conveys the relevant characteristics of that product. The common practice in IRIS is to give each product an abbreviated code in the format:

```
[Product type]-[Data type]-[Range]
```

For example, a product called **`PPI-Z-400`** is:

- **`PPI`**: PPI radar product. See 4.6.7 Plan Position Indicator (PPI) (page 72).
- **`Z`**: measuring reflectivity in dBZ. See 4.1.3 Data Types (page 40)
- **`400`**: up to horizontal range of 400km

Radar products are listed by their product codes in the **Weather Products** pane.

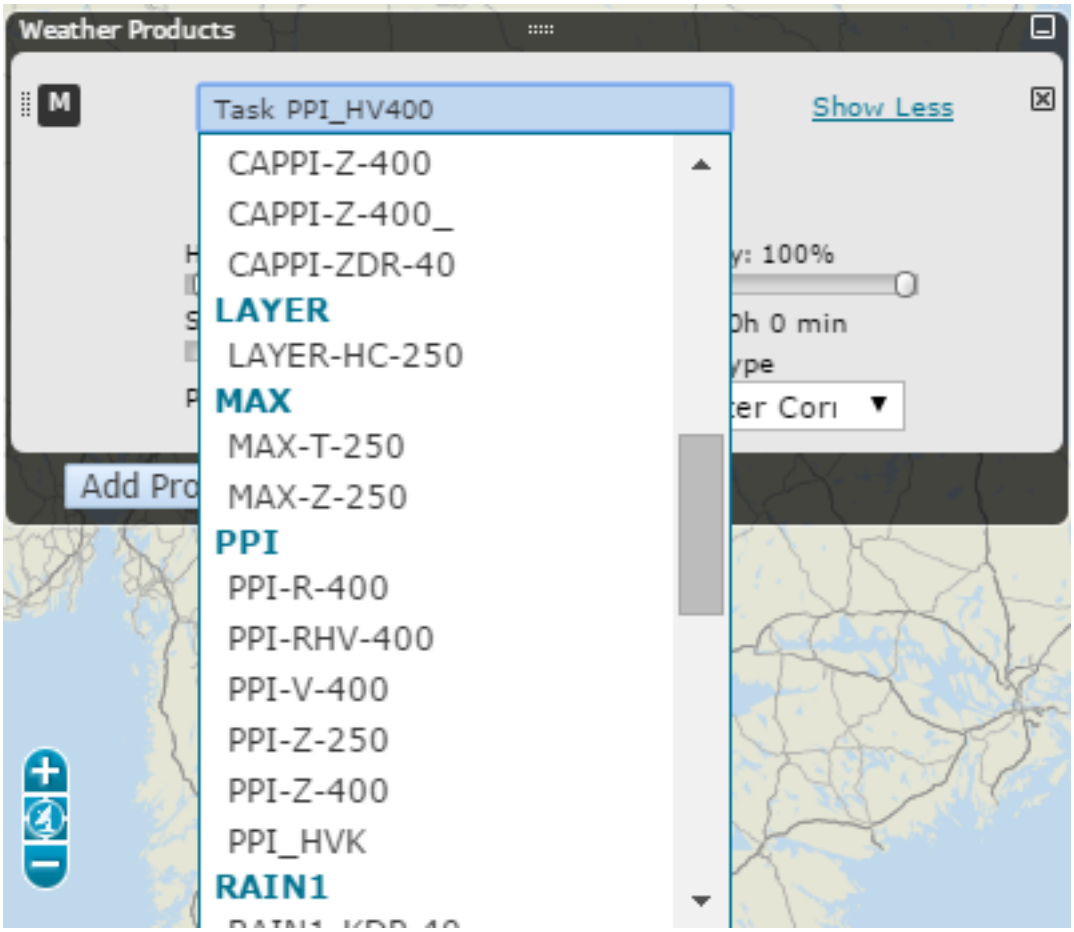


Figure 20 List of Available Radar Products

More Information

- Live Radar Products (page 45)
- Pre-configured Radar Products (page 65)
- Data Types (page 40)
- IRIS Product Family (page 10)

4.3 Radar Product Smoothing

As they are processed, all radar products are rasterized as 2D bitmap images to be displayed on top of the map view area. The bitmap image is calculated by interpolation from the whole three-dimensional volume data.

Live radar products allow you to set a smoothing effect on the weather data layer. The smoothing value sets how close the radar product pixels must be in meters before their quantitative values are blended together. Larger values result in a heavily smoothed area, while a value of 0 disables smoothing completely.

Smoothing is only performed on the rasterized bitmap data. It does not take the vertical dimension of measurements into account.

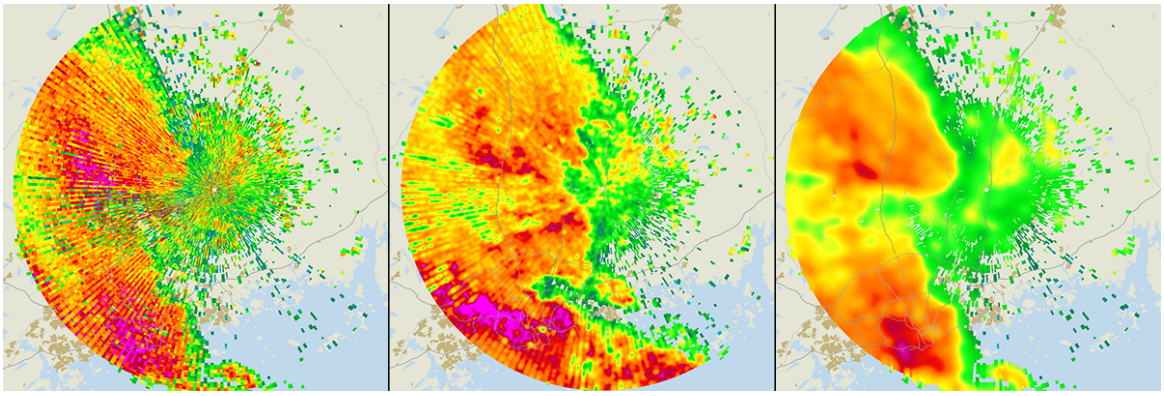


Figure 21 Different Smoothing Levels

Heavy smoothing may lose details that are detectable on lower smoothing levels.

More Information

- Live Radar Products (page 45)

4.4 Radar Product Reflectivity Threshold

Some live radar products allow you to set a reflectivity threshold (dBZ) for the amount of data displayed in the image.

Use the slider to select a value within the range -32...96 dBZ.

Low reflectivity threshold values display more data, while higher reflectivity threshold values filter out all data with reflectivity below the defined threshold to make it easier to focus on the most important data.

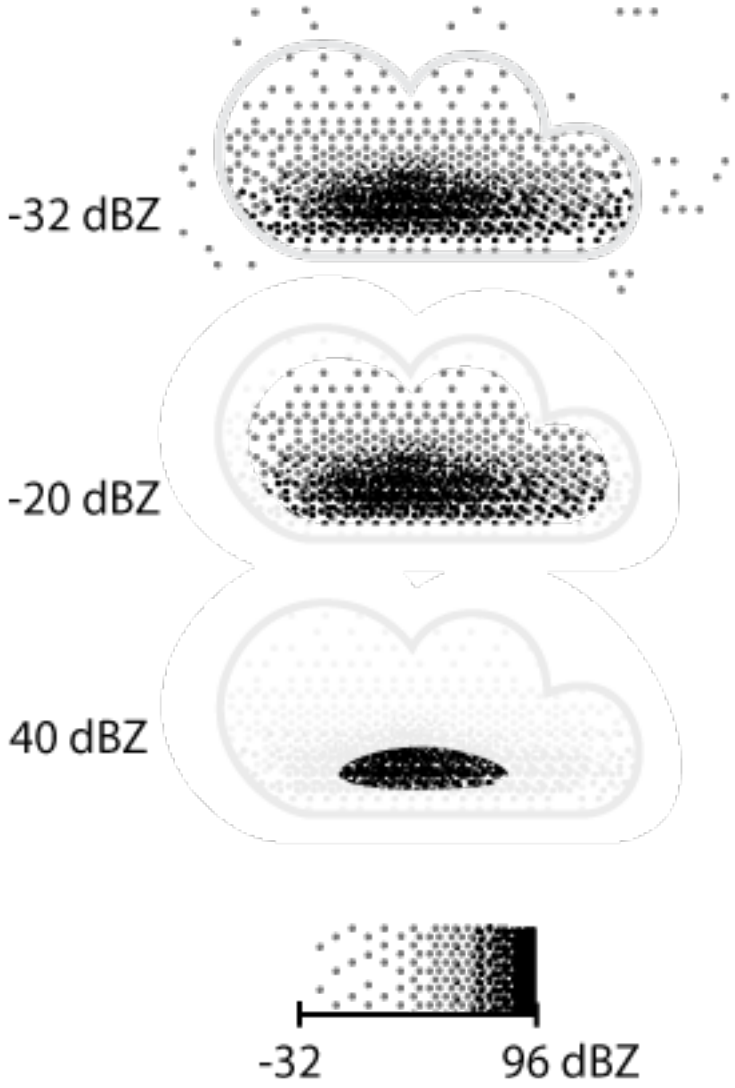


Figure 22 Reflectivity Threshold

More Information

- BASE Threshold Value (page 47)
- THICK Threshold Value (page 61)
- TOPS Threshold Value (page 63)

4.5 Live Radar Products

Live radar products displayed in IRIS Focus receive raw data from the IRIS back-end. The data is manipulated in the IRIS Focus UI with the Scan Service, which is an HTTP service that functions as an interface between IRIS Focus and the radar-side signal processing. Through the Scan Service, IRIS Focus can read the raw volume data and generate radar products in real-time.

As the user pans and zooms the map, the location and size of each pixel changes. The live products recalculate the value of each pixel based on the new geographical definition. This ensures that the data resolution is optimized for viewing.

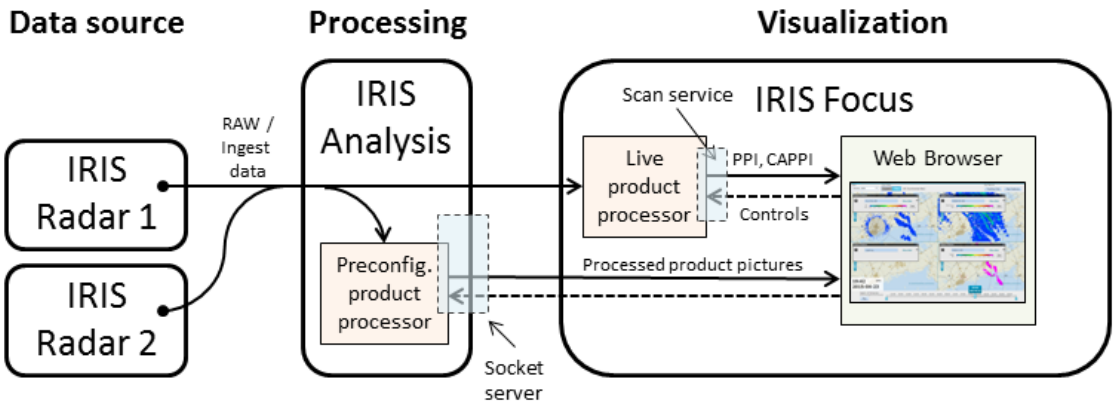


Figure 23 IRIS Focus Data Flow

The raw volume data from the radar signal processor is stored in the radar scan database, which Scan Service makes accessible for the IRIS Focus UI.

IRIS back-end collects data in several different configurations, that are defined as *Tasks* in IRIS Analysis. Tasks are sets of operating parameters for the radar hardware and signal processing components. Examples of Tasks include:

- Surveillance PPI scan at a single elevation angle
- Complete volume scan at multiple elevation angles
- Wind velocity scan

Each task type provides different source data, and the user can select the task type when selecting a live radar product to display on screen.

4.5.1 Live Echo Base (BASE)

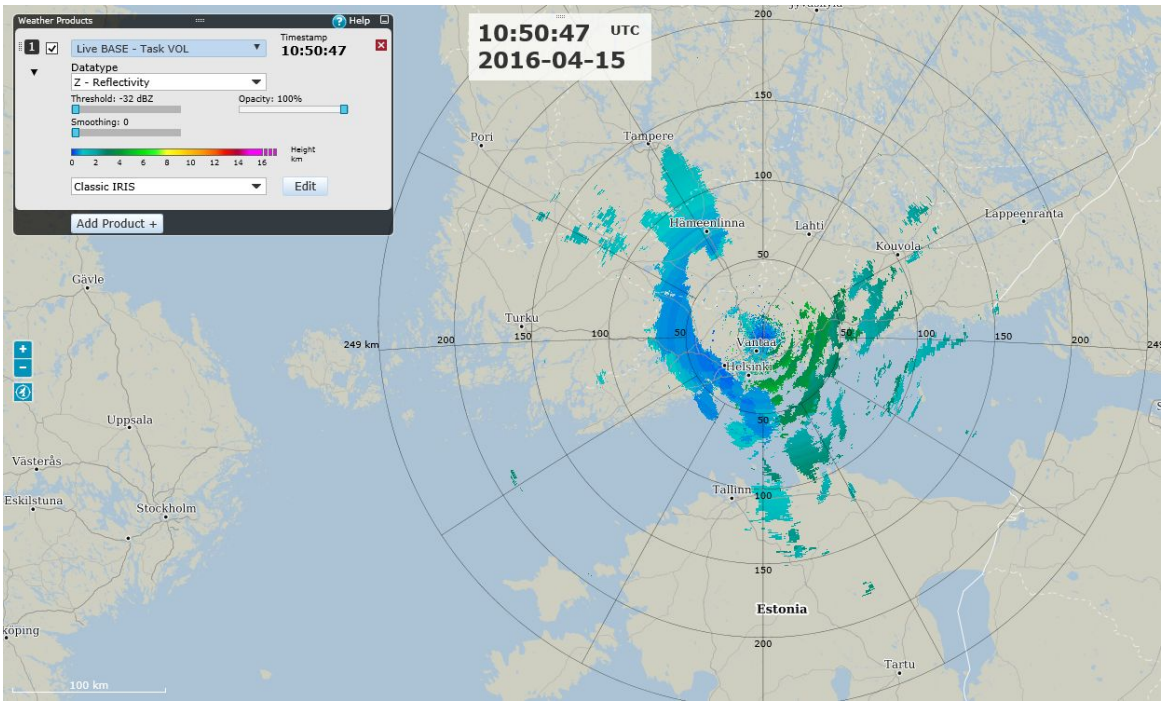


Figure 24 Live BASE Example

BASE (also known as echo Base) is the radar-indicated bottom of an area of precipitation. The system locates the lowest altitude of the defined reflectivity threshold at each pixel location.

BASE displays the base level of detected signal echoes, which usually reflects the bottom of the cloud base or precipitation area.

As the following image shows, the minimum height above ground where echo bases can be detected increases with measurement range due to the curvature of Earth.

The opposite of live **BASE** is the 4.5.6 Live Echo Tops (TOPS) (page 62) product.

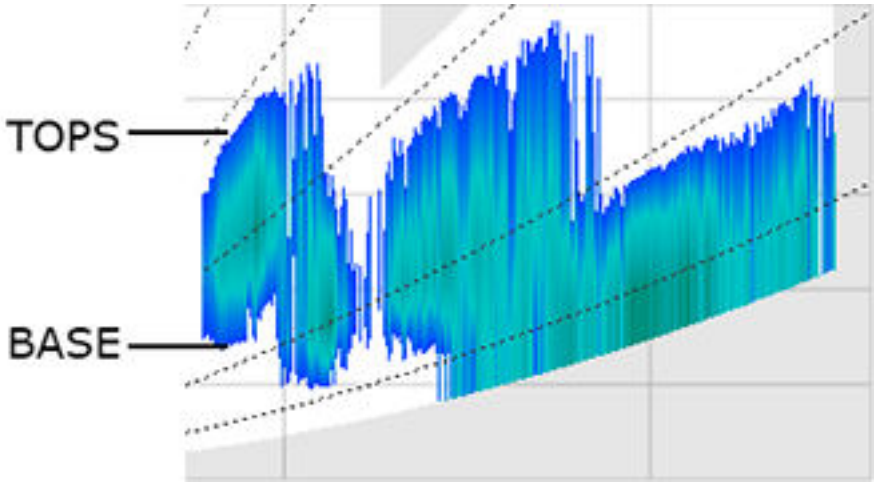


Figure 25 BASE and TOPS Products

More Information

- Live Echo Tops (TOPS) (page 62)
- Live Echo Thickness (THICK) (page 60)

4.5.1.1 BASE Threshold Value

The configurable threshold value defines the minimum reflectivity that must present to be displayed in the image.

The first of the following images shows **BASE** with a -20 dBZ threshold defined. In this image, the lower, less dense cloud is shown in the displayed image.

In the second image, with a 40 dBZ threshold, the lower cloud is not shown in the displayed image because its reflectivity value is lower than the defined threshold.

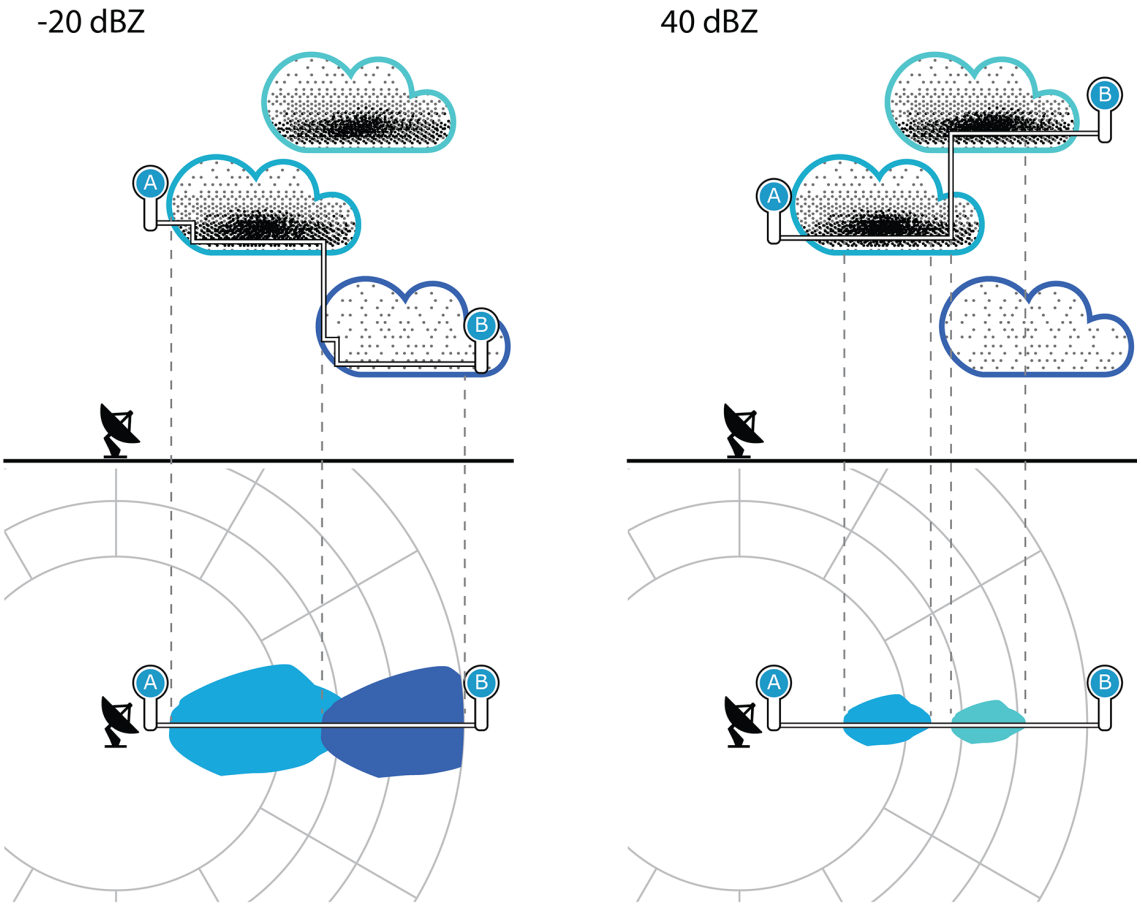


Figure 26 BASE, -20 and 40 dBZ Thresholds

More Information

- Radar Product Reflectivity Threshold (page 43)

4.5.1.2 Calculating Live BASE

For each pixel in the image, the algorithm calculates live **BASE** as follows:

1. Calculates the azimuthal equidistant (`AzEQ`) point around the radar.
2. Uses co-ordinates in `AzEQ` to calculate the distance from the `radar(vector length)`.
3. Checks if the `AzEQ` point is in the radar's range for the **BASE** product.
4. Calculates the azimuth angle to `radar(atan2)`.
5. Determines the lowest sweep with a reflectivity value over the threshold.
6. Optimizes the calculation of the minimum height by calculating the height of the lowest point with reflectivity over threshold from the height of the lowest sweep.
   The calculation uses the `minHeightOfSweep` by calculating downwards until reflectivity is no longer present.

The minimum height of a sweep represents the height with the minimum reflectivity as defined in the threshold.

The algorithm scans downwards until it finds a height for which there is no reflectivity value over the threshold. The last height with a valid reflectivity value is the result.

The final output of the product is a color-coded map of echo BASE heights for the selected dBZ threshold.

4.5.2 Live Constant Altitude Plan Position Indicator (CAPPI)

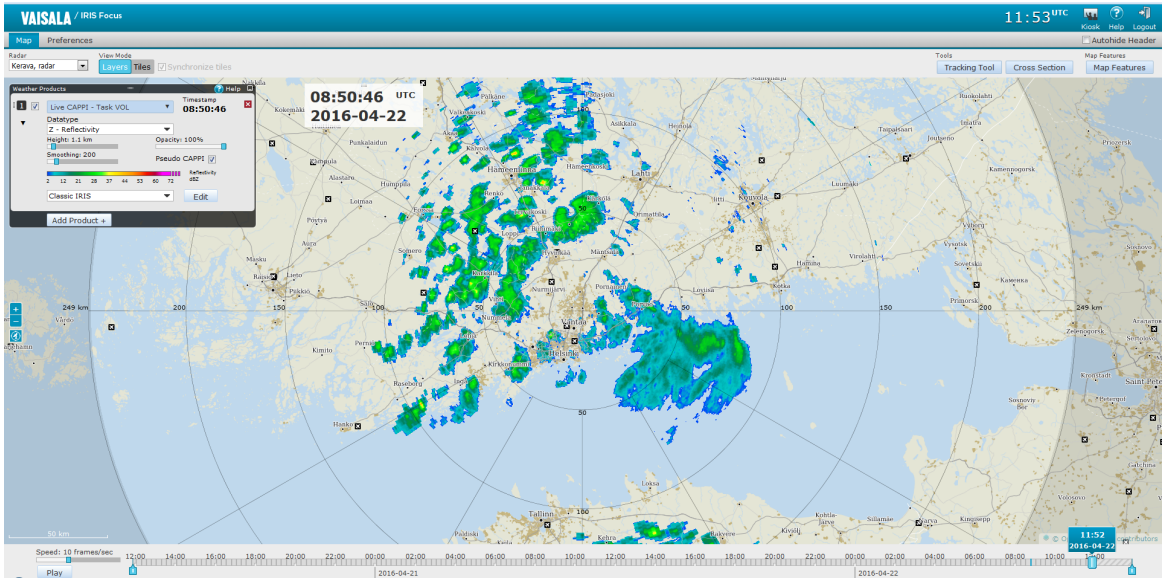


Figure 27 Live CAPPI Example

Live **CAPPI** (Constant Altitude PPI) displays a horizontal cross-section of the signal reflectivity at the selected altitude.

In the following cross-section image, the **CAPPI** product is calculated for a defined 5 km constant altitude. The red lines represent the interpolation from the ray data while the black line represents the constant altitude.

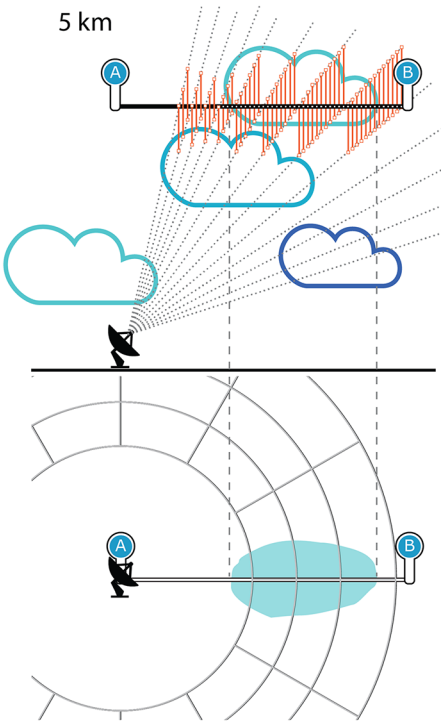


Figure 28 CAPPI Measuring the Defined Altitude

The image does not show the cloud reflectivity values that are included in an actual **CAPPI** product.

Optional radar product smoothing is performed on the bitmap image, not on the volume data.

More Information

- Cross Section Tool (page 22)
- Live Plan Position Indicator (PPI) (page 57)
- Radar Product Layer Settings (page 16)

4.5.2.1 CAPPI Height Value

The configurable height (km) defines the altitude of the cross-section displayed in the image.

Use the **Height** slider to define the displayed **CAPPI** height.

The first of the following images shows the weather displayed in a **CAPPI** with an altitude of 3 km.

The second image shows the weather displayed in a **CAPPI** with an altitude of 5 km.

A and B in the image indicate start and end of a vertical cross section through the radar's scan volume.

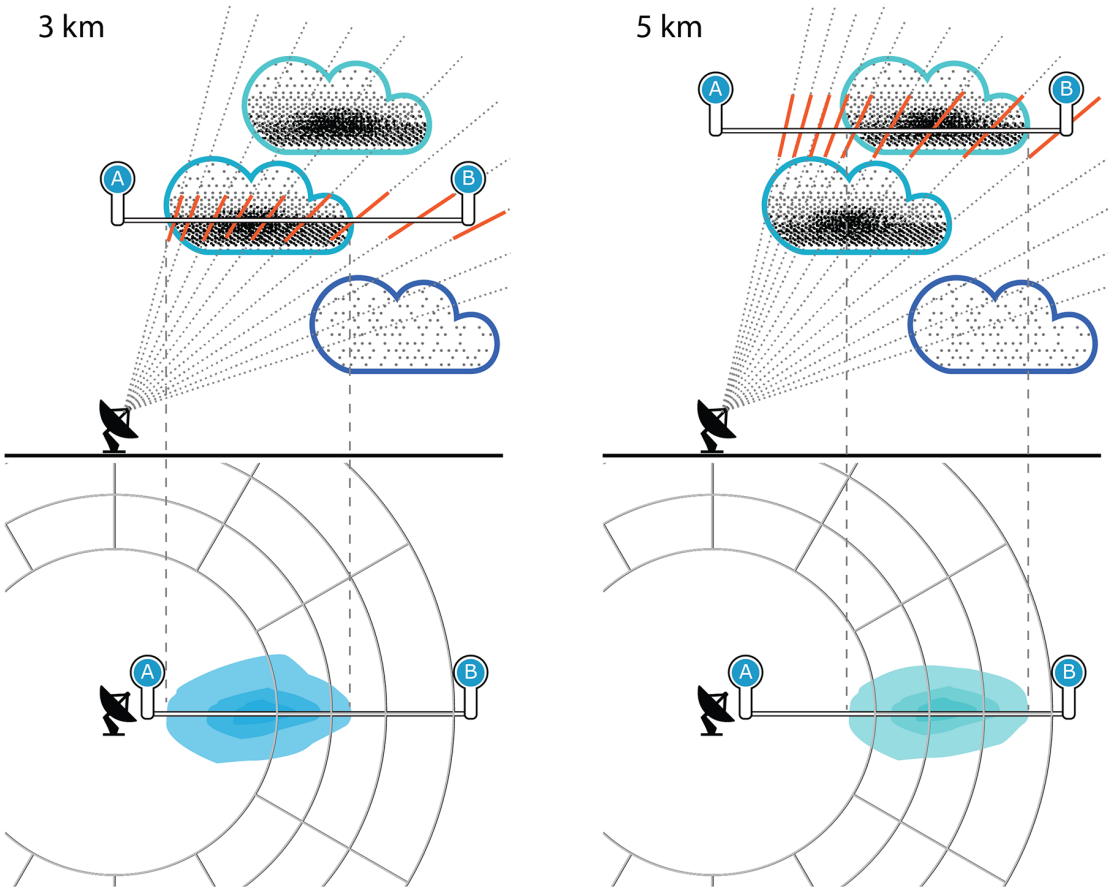


Figure 29 CAPPI with 3 km and 5 km Heights

4.5.2.2 Pseudo CAPPI

Select the **Pseudo CAPPI** option to add pseudo CAPPI calculations to your CAPPI product.

Pseudo CAPPI attempts to visualize those parts within the radar range that are not measured directly, including, for example, the area immediately around the radar, and the volume border with the highest altitude.

In the first cross-section image, the **CAPPI** product is calculated from ray data for a defined constant altitude. The red lines represent the interpolation from the ray data while the black line represents the constant altitude.

The heavy red lines in the second cross-section image indicate how the **Pseudo CAPPI** product uses the value of the closest ray to extend the **CAPPI** product above and below the constant altitude.

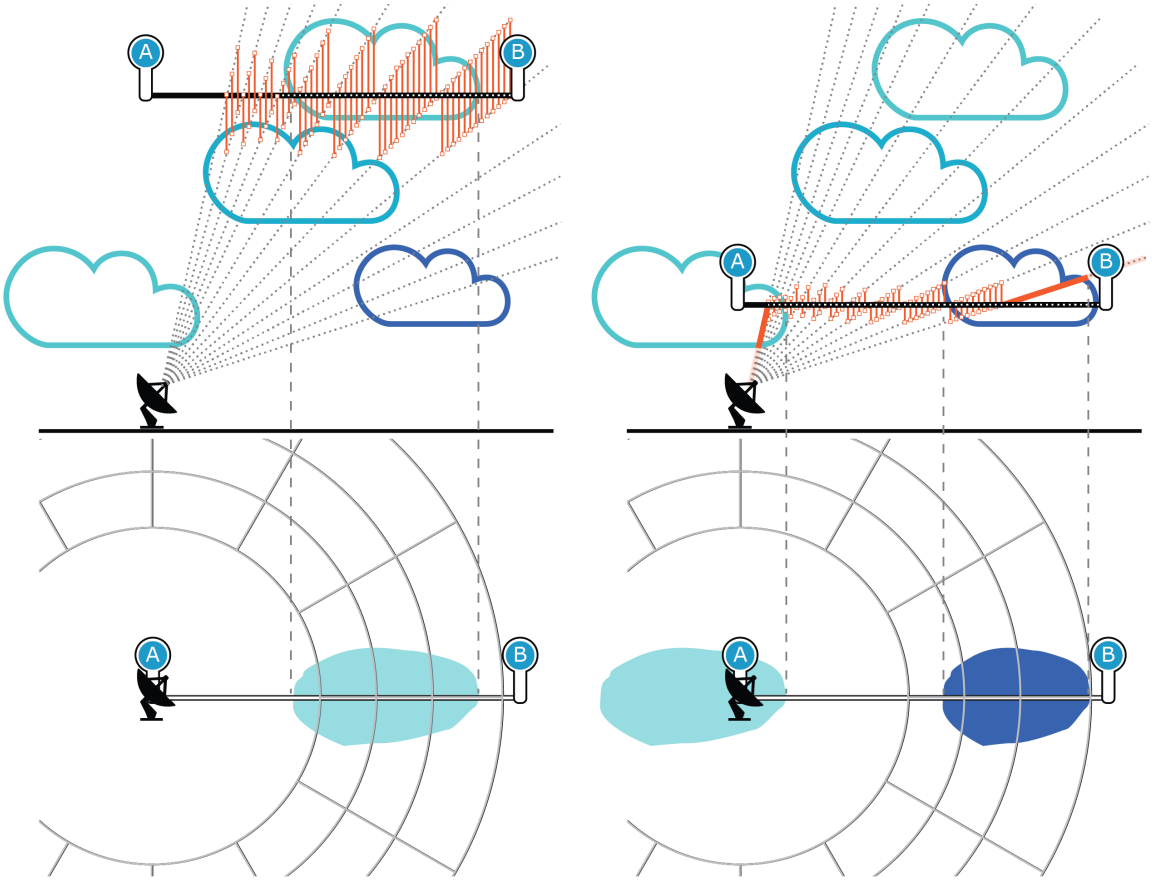


Figure 30 Pseudo CAPPI Extending from CAPPI

The image does not show the cloud reflectivity values that are included in an actual **CAPPI** product.

For **Pseudo CAPPI**, not all data comes from the CAPPI height and may be quite far from the actual height.

4.5.2.3 Calculating Live CAPPI

A **CAPPI** product is displayed on screen by reading the whole scan volume data and calculating a horizontal cross-section at the selected altitude. The cross-section is drawn as a rasterized bitmap. The directly measured data is only from the areas where radar pulses intersect the selected altitude layer. The rest of the bitmap is interpolated both horizontally and vertically from known values.

Calculating a **CAPPI** product requires that a full **PPI** volume scan is completed first. A **CAPPI** product is only updated when the whole volume has been scanned and processed.

For each pixel in the image, the algorithm calculates live **CAPPI** as follows:

1. Checks the Azimuthal Equidistant (AzEq) cylinder volume from the 2 nearest (in elevation) volume data points of the CAPPI constant altitude plane point.
2. Linearly interpolates the volume data points at the nearest elevations to define a single CAPPI plane data point value.

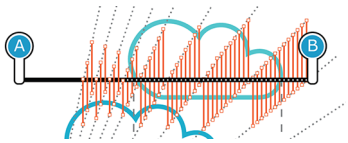


Figure 31 Calculating the AzEq Cylinder Volume From 2 Nearest Data Points

More Information

- Calculating Live PPI (page 59)

4.5.3 Live Maximum Data (MAX)

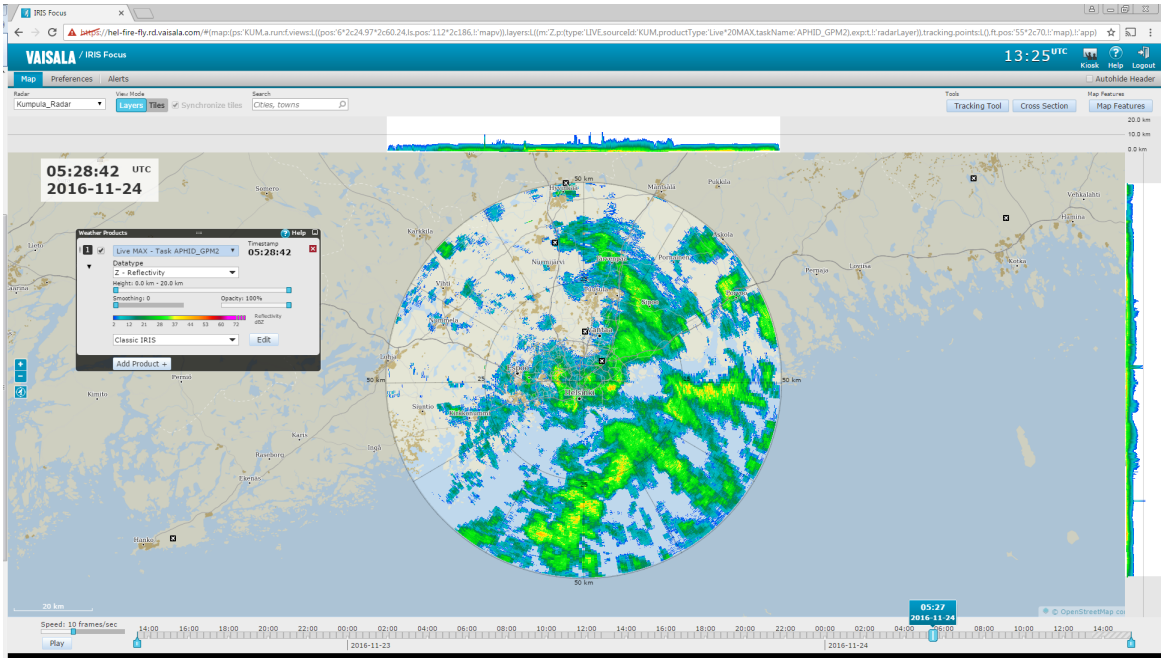
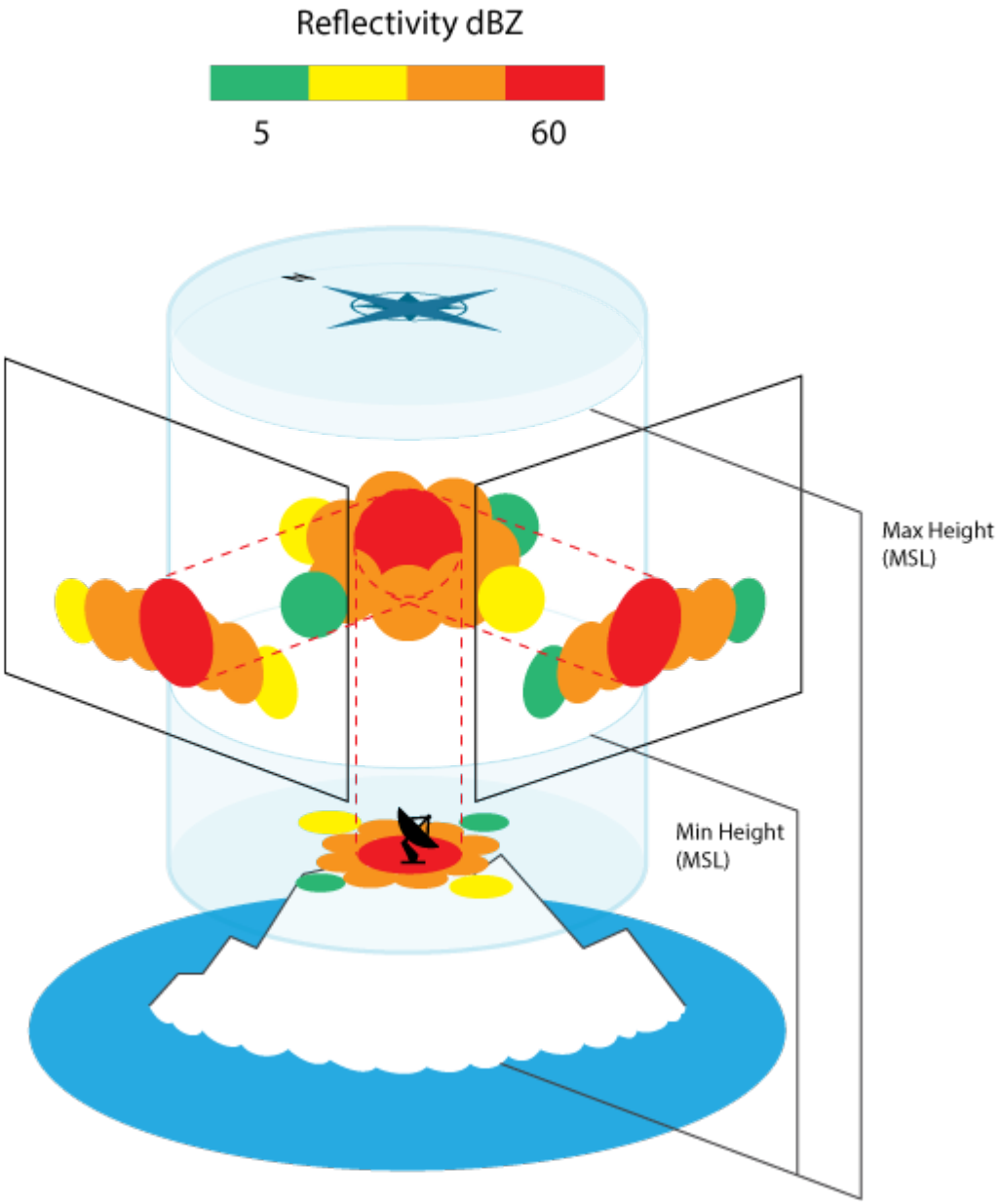


Figure 32 Live MAX Example

Live **MAX** shows the echo height and intensity in a report of maximum data, for example, reflectivity.

You can use **MAX** when observing areas of severe weather, for example, from the surface to the troposphere, in the layer below the melting level, or in the layer above the melting level



In the main view, **MAX** shows the maximum data (in dbZ) in all points of the measured area. Top and right side panels show two horizontal projections: north-south and east-west.

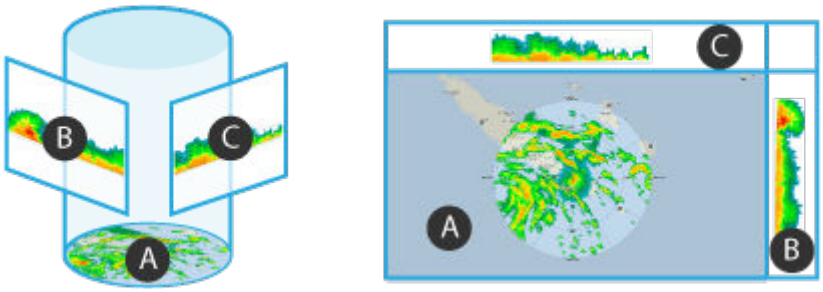
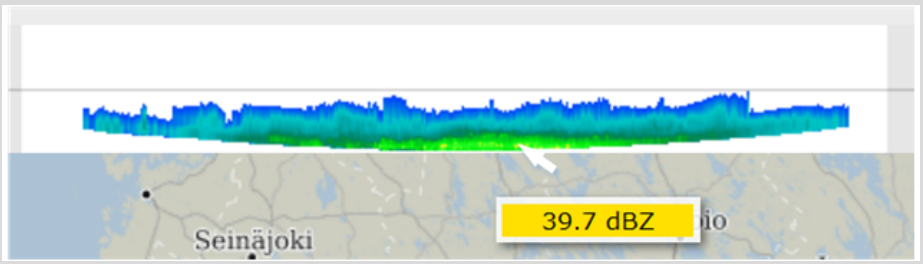


Figure 33 MAX Views

A Horizontal maximum projection
B North-South maximum projection
C East-West maximum projection

Hover over the measured area in either the map view or side panel for detailed information about the measured area.



4.5.3.1 MAX Height Values

The configurable heights defines the measured area above sea level (MSL) for calculating the **MAX** product

Use the **Height** slider to define the displayed **MAX** upper and lower heights.

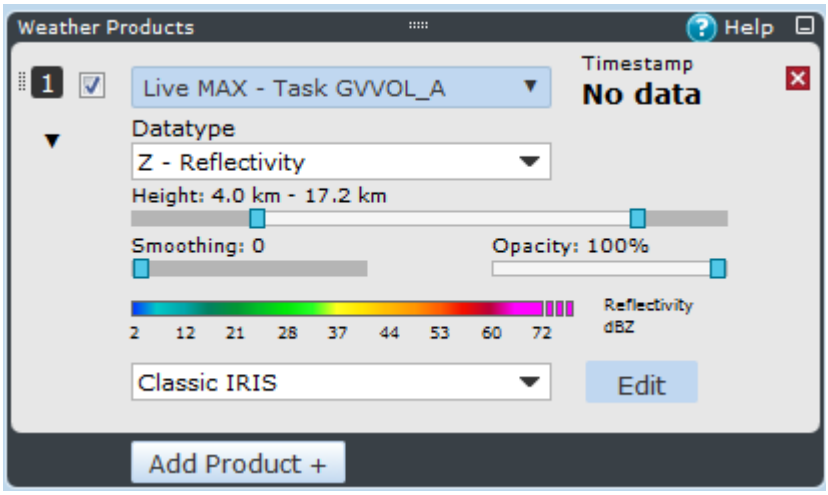


Figure 34 MAX Settings

In most cases, do not use smoothing as the maxima can be diminished by the smoothing filter.

You can check the height values in the top right of the display.

More Information

- Radar Product Smoothing (page 42)

4.5.3.2 Calculating Live MAX

For each pixel in the image, the algorithm calculates live **MAX** as follows:

1. Calculates the azimuthal equidistant (`AzEQ`) cylinder volume around the radar.
2. Uses co-ordinates in `AzEQ` to calculate the distance from the radar (vector length).
3. If the point is in the radar's range for that particular product, the algorithm calculates the azimuth angle to the radar.
4. Using the previous calculations, the algorithm calculates the maximum reflectivity value of the specific air column.

The horizontal maximum projection is calculated by taking the highest data value in the user-specified layer over each pixel.

The east-west maximum projection is obtained by taking the maximum reflectivity for each pixel along the corresponding north-south line.

The north-south maximum projection is obtained by taking the maximum reflectivity along east-west lines.

4.5.4 Live Plan Position Indicator (PPI)

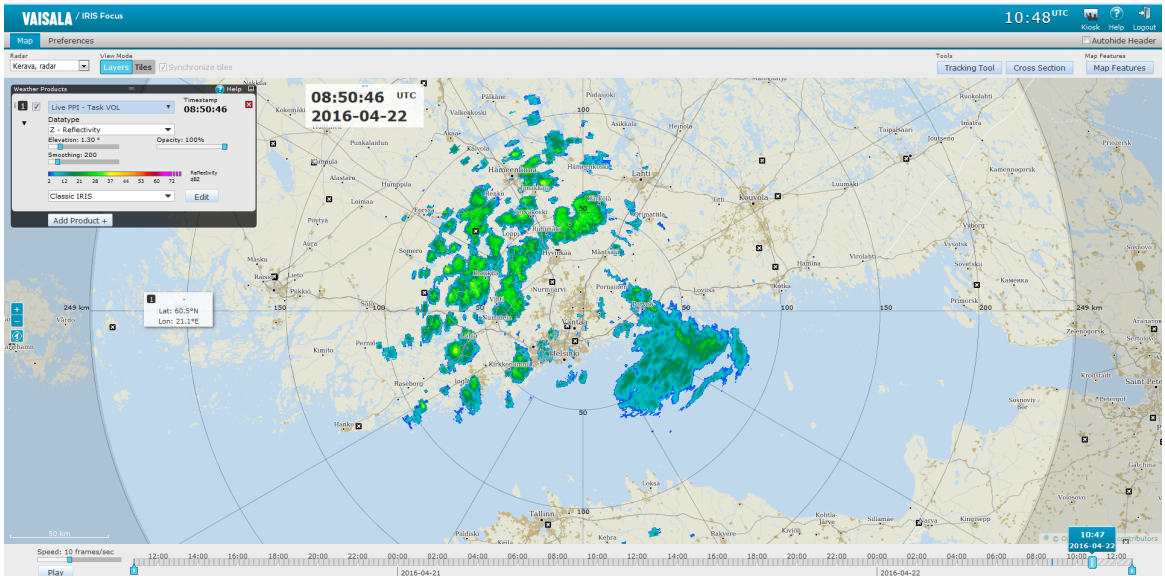
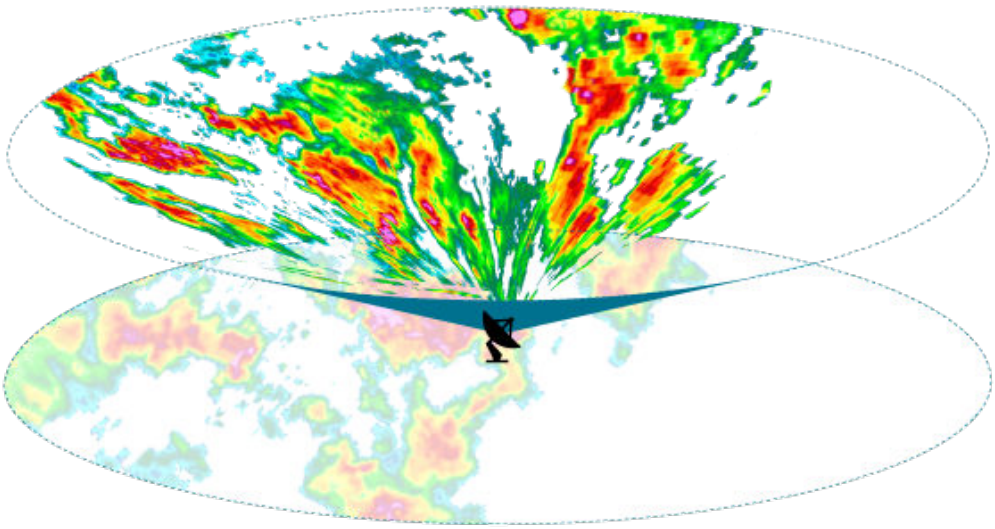


Figure 35 Live PPI Example

PPI (Plan Position Indicator) displays the signal reflectivity on a surface layer that is formed as the radar performs a full 360° horizontal sweep at a constant elevation.

PPI is the classical radar view that is used for visual weather surveillance and air traffic control, among other uses. The products are refreshed as soon as the sweep is completed instead of waiting for the end of a full volume scan.

In the following image, the **PPI** scan is performed on the highlighted elevation.



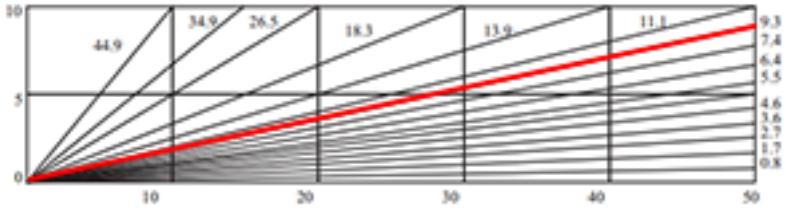


Figure 36 PPI Measuring the Defined Elevation

4.5.4.1 PPI Elevation Angle Value

The configurable elevation angle defines which elevation angle sweep is displayed in the image.

Use the elevation slider to define the displayed **PPI** elevation.

The first image shows **PPI** with a 45° elevation angle defined. In this image, the high-level clouds are displayed in the IRIS product.

The second images shows **PPI** with a 20° elevation angle defined. In this image, the lower-level clouds are displayed in the IRIS product.

A and B in the image indicate start and end of a vertical cross section through the radar's scan volume.

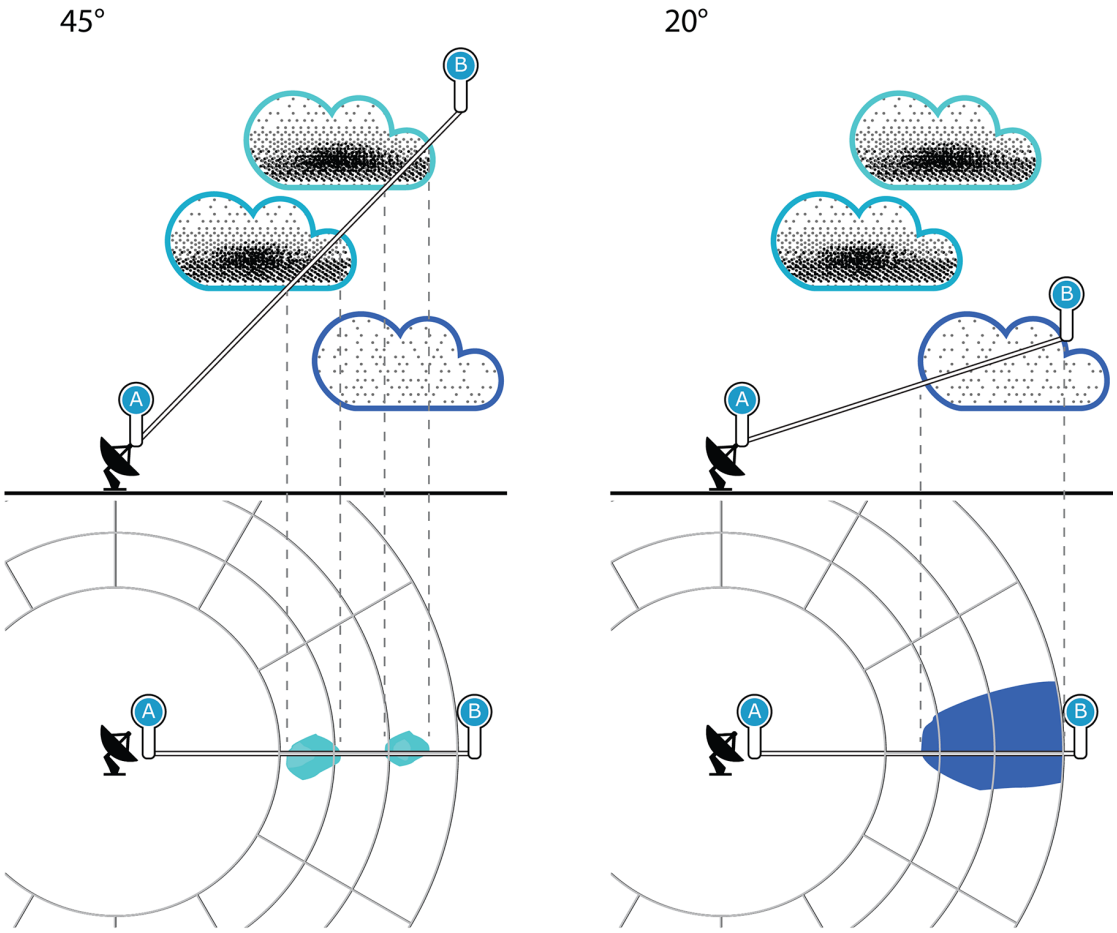


Figure 37 PPI With Elevation Angles of 45° and 20°

4.5.4.2 Calculating Live PPI

For each pixel in the image, the algorithm calculates live **PPI** as follows:

1. Convert pixel coordinates to map coordinates.
2. Convert the map co-ordinates to Azimuthal Equidistant (AzEq) around the radar.
3. Calculate distance to radar (vector length) and azimuth angle to radar `atan2`.
4. Calculate the actual value at that point using a sweep parameter.

4.5.5 Live Echo Thickness (THICK)

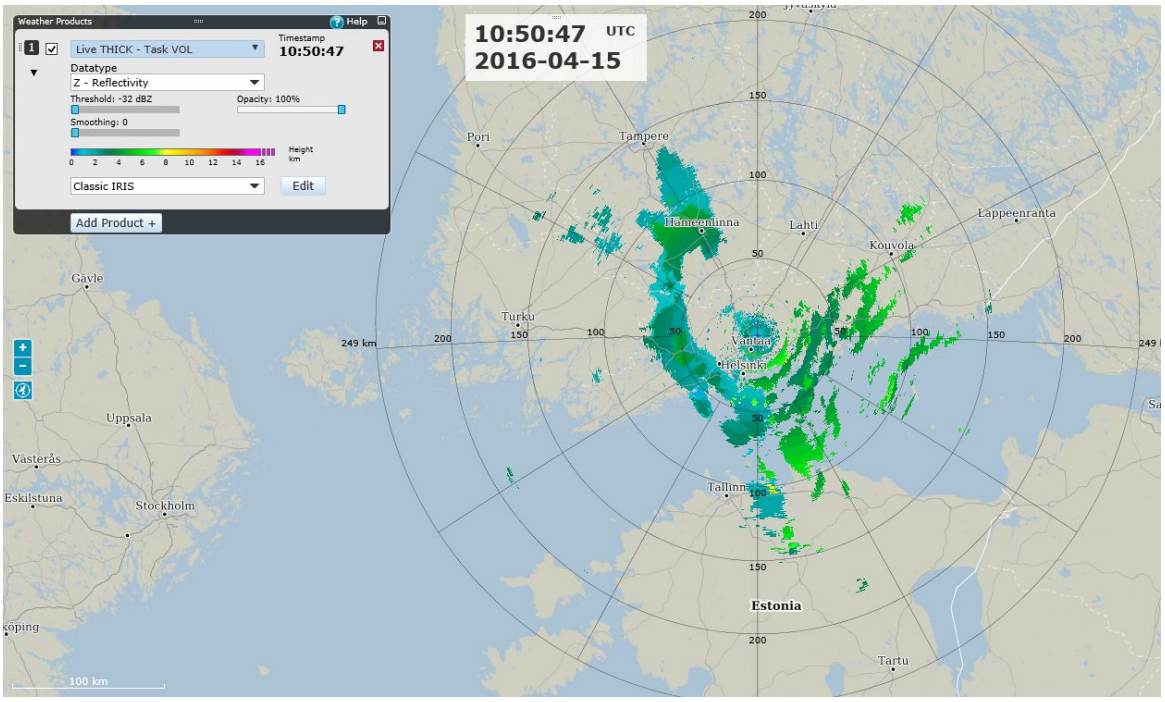


Figure 38 Live THICK Example

THICK is the radar-indicated cloud cover thickness of an area of precipitation.

THICK calculates the difference between the live BASE and TOPS products.

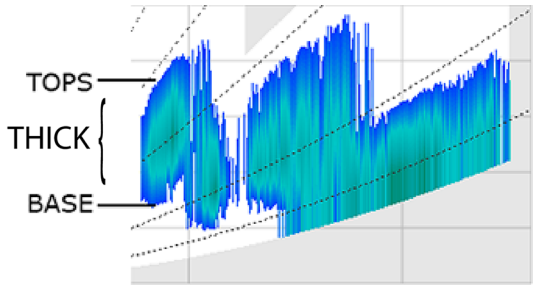


Figure 39 THICK with BASE and TOPS

More Information

- Live Echo Base (BASE) (page 46)
- Live Echo Tops (TOPS) (page 62)

4.5.5.1 THICK Threshold Value

The configurable threshold value defines the minimum reflectivity that must be present to be displayed in the image.

The first of the following images shows **THICK** with a -20 dBZ threshold defined. In this image, more data is displayed in the image, including the lower, less dense cloud content.

In the second image, with a 40 dBZ threshold, a much smaller set of data comprising only cloud cover with a reflectivity of 40 dBZ or higher, is displayed.

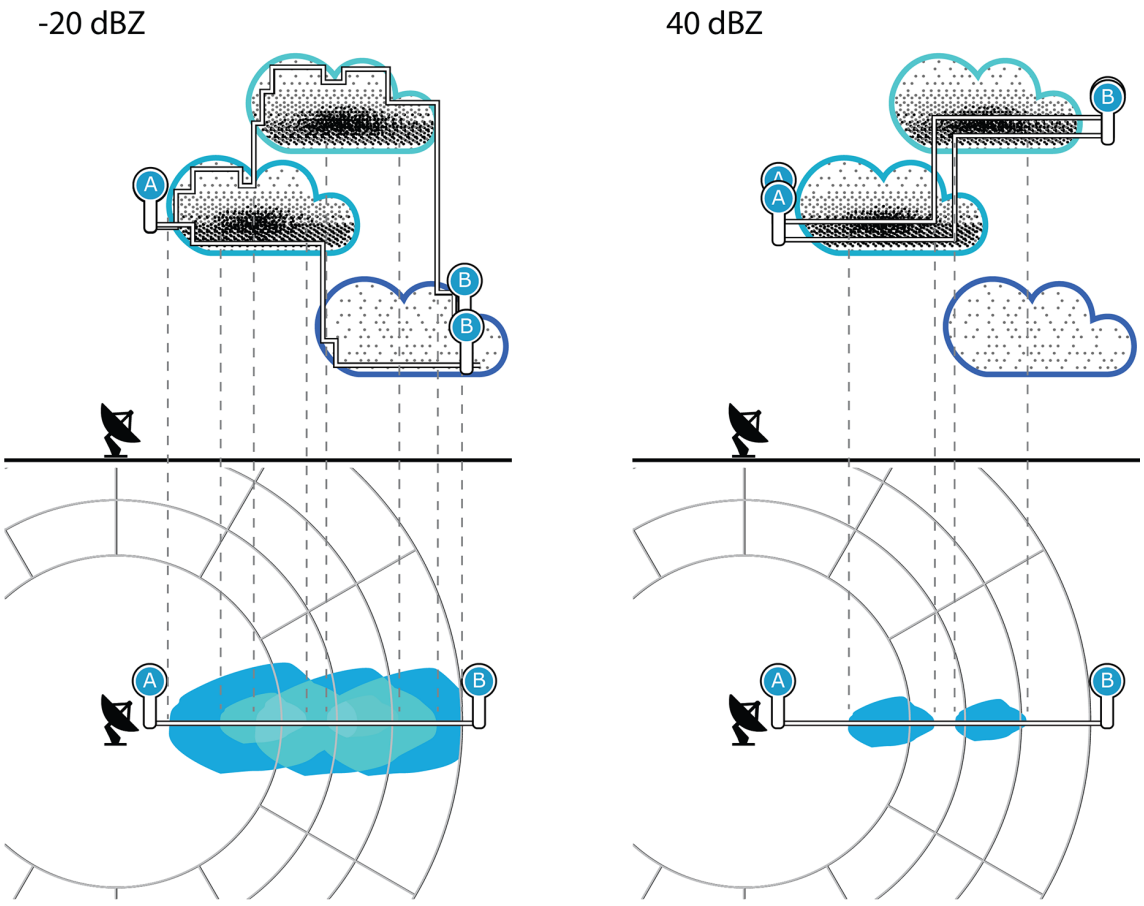


Figure 40 THICK with -20 dBZ and 40 dBZ Thresholds

More Information

- Radar Product Reflectivity Threshold (page 43)

4.5.5.2 Calculating Live THICK

THICK is calculated by calculating both TOPS and BASE at a point and subtracting **BASE** from **TOPS**.

More Information

- Calculating Live BASE (page 48)
- Calculating Live TOPS (page 64)

4.5.6 Live Echo Tops (TOPS)

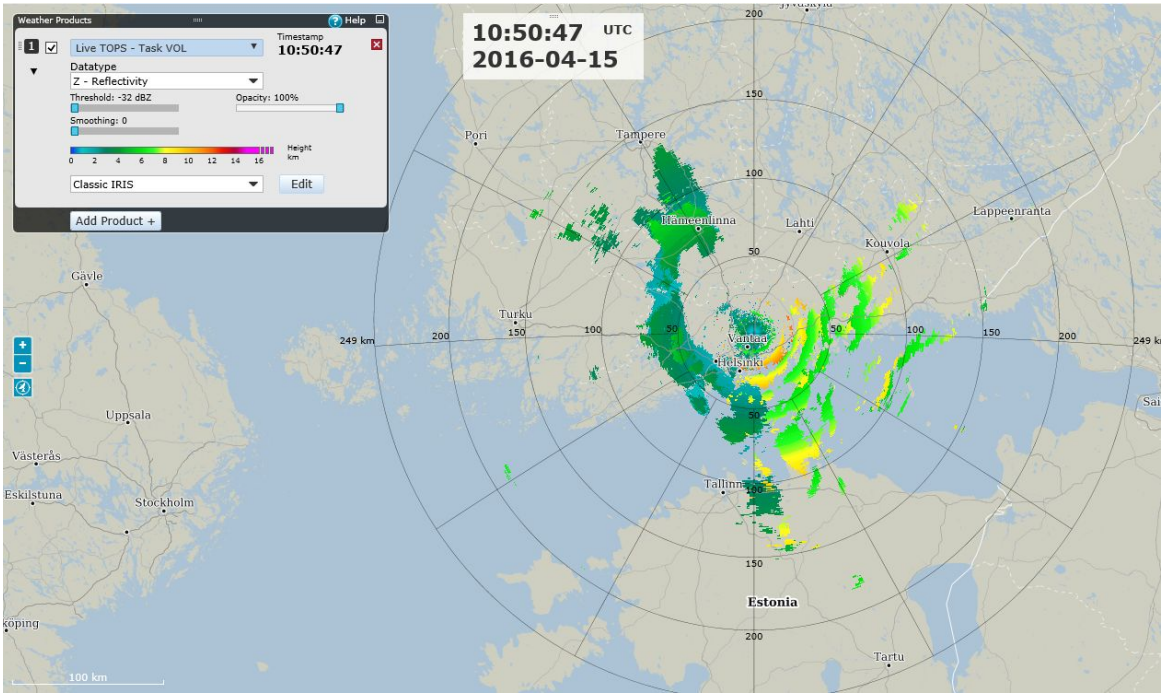


Figure 41 Live TOPS Example

TOPS (also known as echo Tops) is the radar-indicated top of an area of precipitation. The system locates the highest altitude of the defined reflectivity threshold at each pixel location.

Live **TOPS** displays the detected signal echoes above the value defined in the **Threshold** (dBZ), which usually measures the top of the precipitation area or cloud cover.

TOPS can be useful when identifying strong updrafts, severe weather, and hail.

The opposite of TOPS is the BASE product.

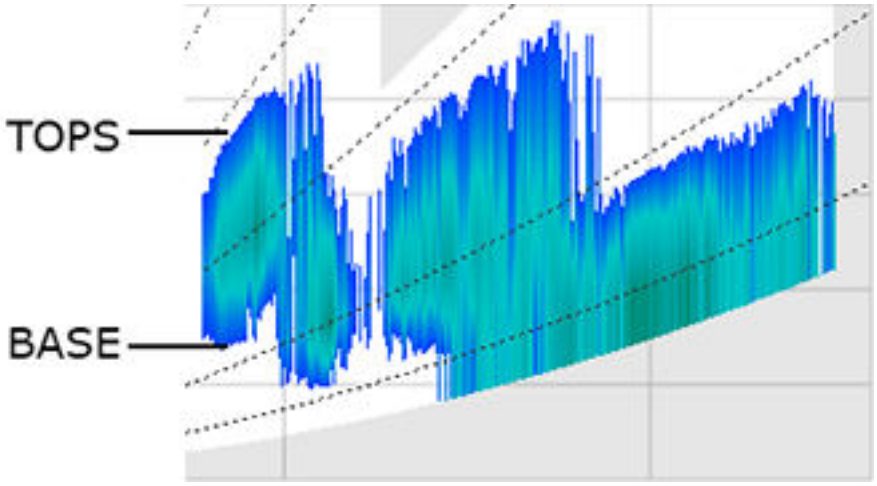


Figure 42 BASE and TOPS Products

More Information

- Live Echo Base (BASE) (page 46)
- Live Echo Thickness (THICK) (page 60)

4.5.6.1 TOPS Threshold Value

The configurable threshold value defines the minimum reflectivity that must present to be displayed in the image.

The first of the following images shows **TOPS** with a -20 dBZ threshold defined. In this image, the higher, less dense parts of the cloud are shown in the displayed image. In TOPS, using lower threshold values can help determine the height of surrounding precipitation. For example, a 50 dBZ TOP 1 km above the freezing level can be produced only by a vigorous convective storm, and is probably caused by the presence of hail.

In the second image, with a 40 dBZ threshold, higher part of the cloud is not shown in the displayed image because its reflectivity value is lower than the defined threhold.

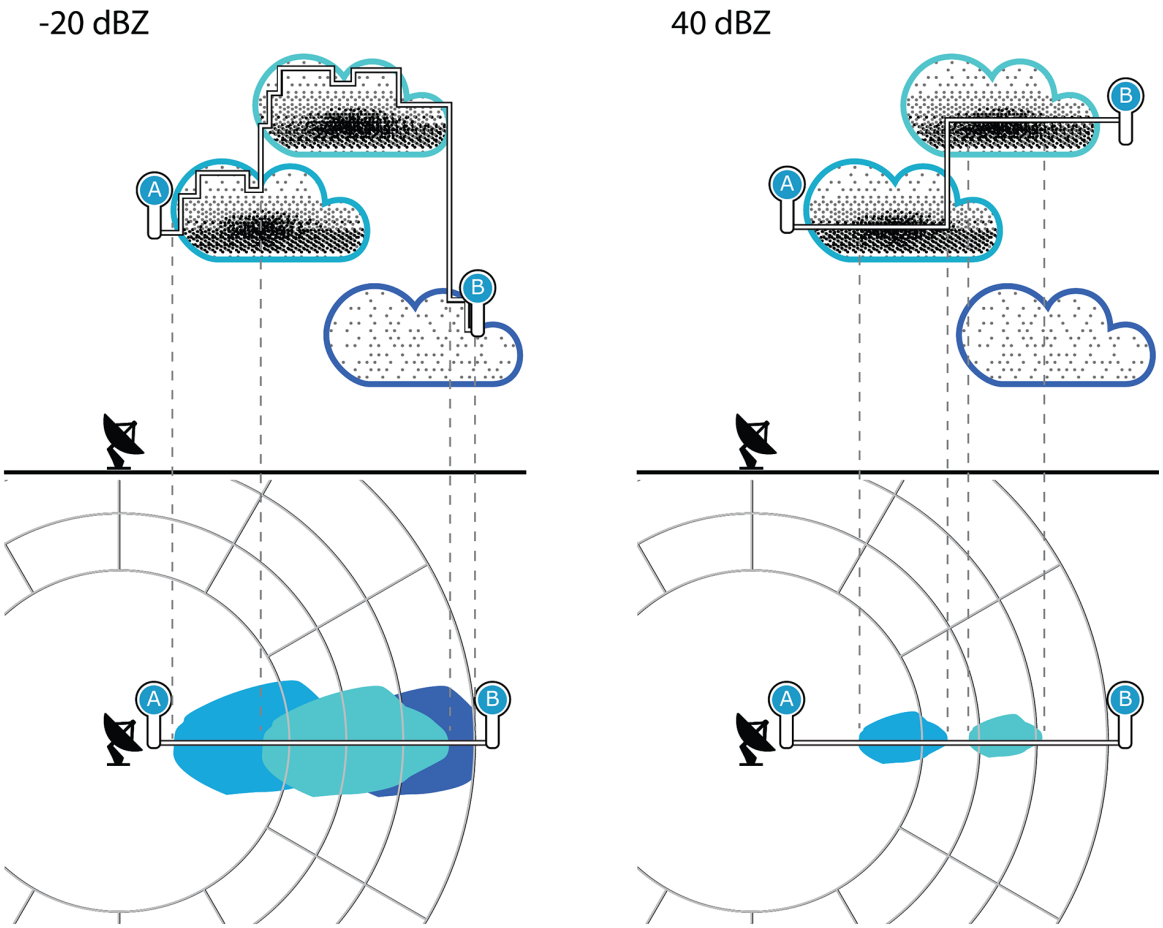


Figure 43 TOPS with -20 dBZ and 40 dBZ Thresholds

More Information

- Radar Product Reflectivity Threshold (page 43)

4.5.6.2 Calculating Live TOPS

For each pixel in the image, the algorithm calculates live **TOPS** as follows:

1. Calculates the azimuthal equidistant (`AzEQ`) point around the radar.
2. Uses co-ordinates in `AzEQ` to calculate the distance from the `radar(vector length)`.
3. Checks if the `AzEQ` point is in the radar's range for the **TOPS** product.
4. Calculates the azimuth angle to `radar(atan2)`.
5. Determines the highest sweep with a reflectivity value over the threshold.
6. Optimizes the calculation of the maximum height by calculating the height of the highest point with reflectivity over threshold from the height of the highest sweep. The calculation uses the `maxHeightOfSweep` by calculating upwards until reflectivity is no longer present.

The maximum height of a sweep represents the height with the minimum reflectivity as defined in the threshold.

The algorithm scans upwards until it finds a height for which there is no reflectivity value over the threshold. The last height with a valid reflectivity value is the result.

The final output of the product is a color-coded map of echo TOP heights for the selected dBZ threshold.

4.6 Pre-configured Radar Products

Pre-configured radar products are generated by the back-end signal processing components of IRIS Analysis. IRIS Focus reads the list of products, and allows you to select which one to display on the IRIS Focus map view.

The radar products and their settings are defined in the back-end, and only displayed in IRIS Focus. They cannot be edited in the IRIS Focus map view.

There is no upper limit to the number of pre-configured radar products that IRIS Focus can have.

The raw volume data is not stored for later processing. All the information that is not used in radar product generation is lost.

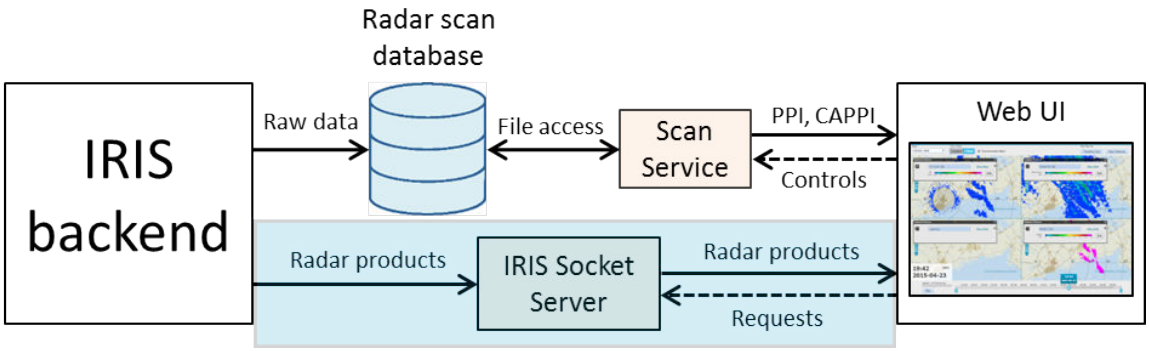


Figure 44 Pre-configured Radar Product Components

The radar products are rasterized into 2D bitmap images, based on the back-end signal processing settings. The images are sent to IRIS Focus web UI through the IRIS Socket Server interface.

When you select a specific pre-configured product in IRIS Focus, IRIS Focus polls the Socket Server and loads the image.

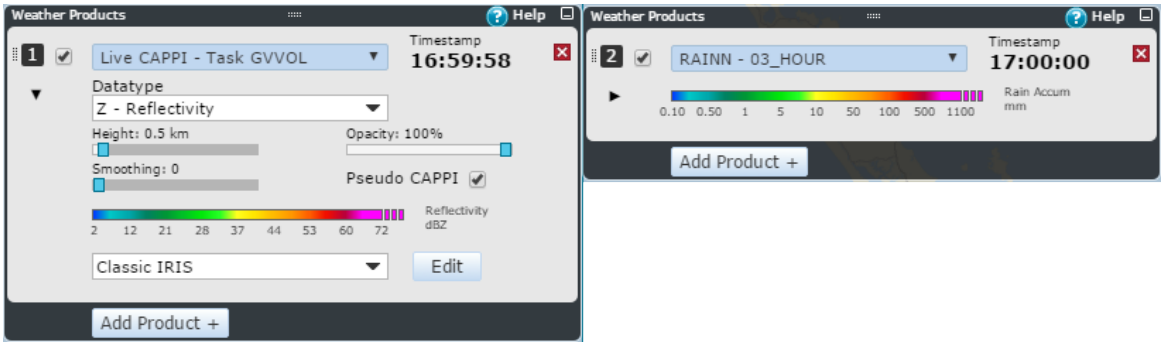


Figure 45 Live and Pre-configured Product Settings

More Information

- IRIS Focus Overview (page 9)
- Radar Product Codes (page 41)
- Radar Products (page 37)

4.6.1 Constant Altitude Plan Position Indicator (CAPPI)

CAPPI displays a horizontal cross-section of the signal reflectivity at the selected altitude.

In the following image, the CAPPI scan is calculated from the PPI data on the highlighted altitude.

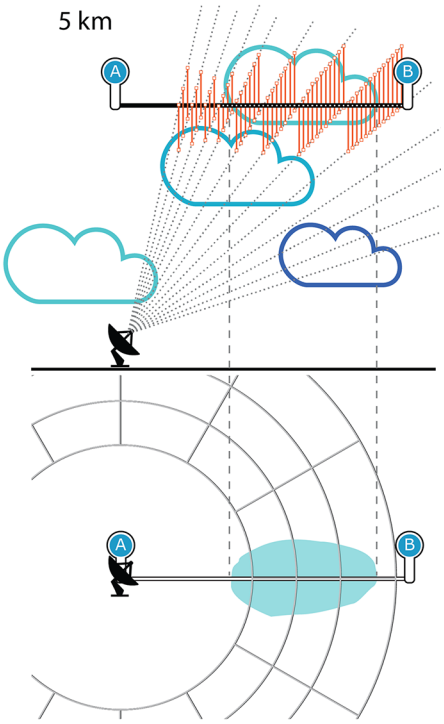


Figure 46 CAPPI Measuring the Defined Altitude

Calculating a **CAPPI** product requires that a full **PPI** volume scan is completed first. A **CAPPI** product is only updated when the whole volume has been scanned and processed.

A **CAPPI** product is displayed on screen by reading the whole scan volume data and calculating a horizontal cross-section at the selected altitude. The cross-section is drawn as a rasterized bitmap. The directly measured data is only from the areas where radar pulses intersect the selected altitude layer. The rest of the bitmap is interpolated both horizontally and vertically from known values.

4.6.2 Echo Base (BASE)

Displays the base level of detected signal echoes, which in most situations reflects the bottom of the cloud base or precipitation area. Note that the minimum height above ground where echo bases can be detected increases with measurement range due to the curvature of Earth.

The opposite of BASE is the TOPS product.

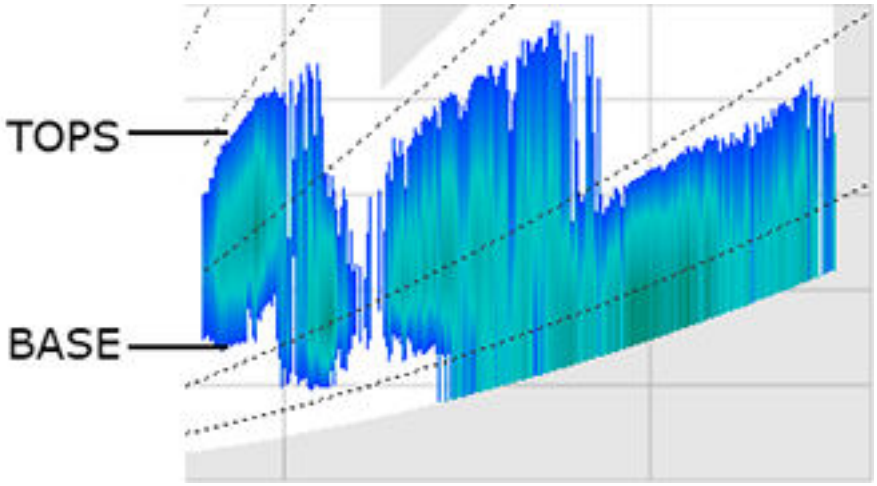


Figure 47 BASE and TOPS Products

More Information

- Echo Tops (TOPS) (page 74)

4.6.3 Antenna Beam Pattern (BEAM)

A system testing product. Used for calibration and alignment purposes and for verifying antenna pattern.

4.6.4 Layer Average (LAYER)

Used to compute layer averages of any polar data types in the ingest files.

In addition, it generates the base data for computing **VIL** (vertically integrated liquid) density.

More Information

- Vertically Integrated Liquid (VIL) (page 74)

4.6.5 Maximum Data (MAX)

MAX provides an easy-to-interpret presentation of the echo height and intensity in a single display used for depicting areas of severe weather.

MAX determines the maximum data in all points of the measured area. In addition MAX draws two horizontal projections next to the main map view: east-west and north-south.

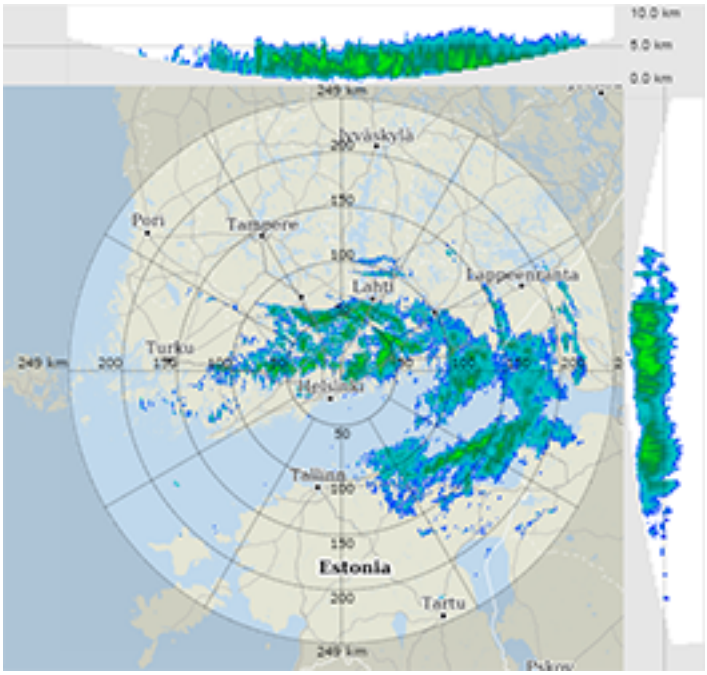


Figure 48 MAX Product and Projections

4.6.6 Motion Vector Field (MVF)

The motion vector field (MVF) describes the general *motion* of weather in a set of products. In IRIS Focus, MVFs are illustrated with wind barb symbols.

IRIS Focus calculates current motion vectors (MVFs) as the first step in nowcasting calculations.

You can check the MVF product to check the direction and velocity of precipitation in the atmosphere and to verify the nowcasting configurations.

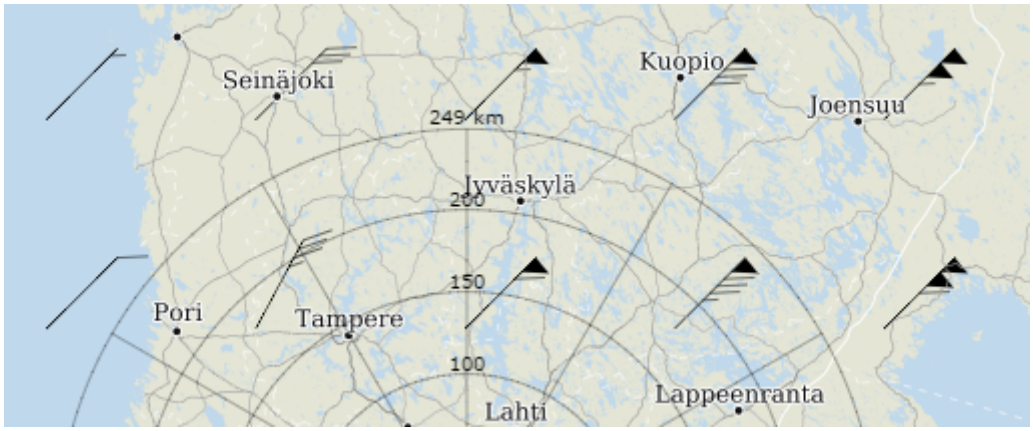


Figure 49 MVF Example

Motion Vector Indicators

Motion vectors on the display show the direction from which the weather is moving. Short barbs and pennants on the vectors indicate the speed, similar to wind barbs on wind displays. A circle indicates calm conditions.

Table 5 MVF Wind Barb Symbols

Symbol	Speed (m/s)	Wind speed (knots)
○	Calm	Calm
—	<1.5	<3
—╱	2.6	5
—╱	5.1	10
—╱╱	7.7	15
—╱╱	10.2	20
—◢	25.7	50
—◢▨	38.5	75

IRIS Focus calculates the MVF by passing a configurable number of a radar products through a nowcasting algorithm.

Because MVF generation can take some time, IRIS Focus generates only one MVF product per site. Once this is configured, IRIS Focus generates MVFs automatically when a new product of the configured type arrives from IRIS.

You must configure the MVF before you can start using nowcasting. Many users perform the configuration during installation, but it can also be done later.

After configuration, IRIS Focus generates the MVF automatically when a new product of the configured type arrives from IRIS. MVFs are not calculated for historical input products.

More Information

- Configuring Nowcasting (page 88)
- Configuring MVF (page 89)
- Nowcasting (page 23)

4.6.6.1 Calculating Motion Velocity

IRIS Focus nowcasting uses the TREC algorithm to determine the predicted veloicty of fields in the motion vector field.

TREC Algorithm

The TREC (tracking radar echoes by correlation) algorithm is an iterative search method based on a maximum cross-correlation criteria used to estimate motion in a vector grid between consecutive images.

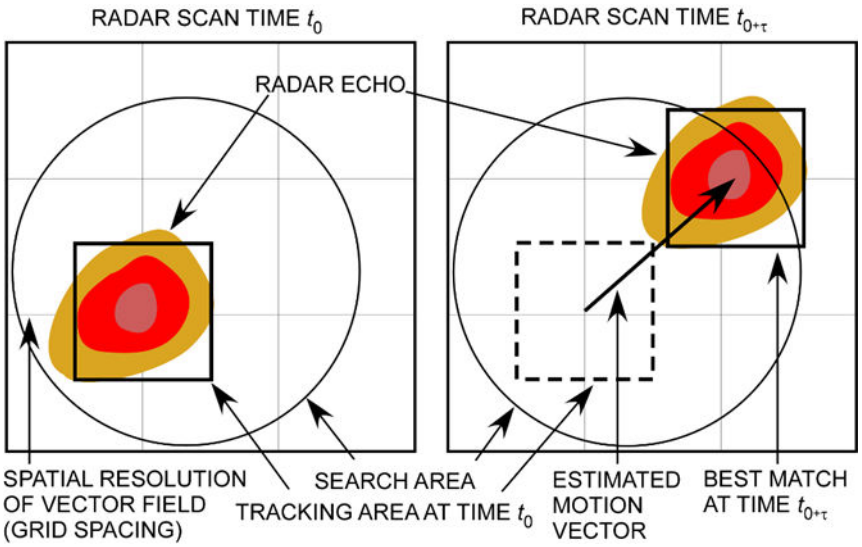


Figure 50 Calculating TREC

t_0 Current time

$t_{t_0+\tau}$ Nowcasting predicted time

1. Calculate the cross-correlation coefficient corresponding to the data within this subgrid and to a time in the future (τ), $t_{t_0+\tau}$.
2. Compute a motion vector between these locations.
3. Repeat for each grid point or a subset of grid points in the data field.

References

For more information on TREC calculations, see the publically available references. For example:

- Chornoboy, E. S., A. M. Matlin, and J. P. Morgan, 1994: Automatic storm tracking for air traffic control *Lincoln Labs. J.*, **7**, 427–448.
- Li, L. W., W. Schmid, and J. Joss, 1995: Nowcasting of motion and growth of precipitation with radar over a complex orography. *J. Appl. Meteor.*, **34**, 1286–1299.
- Mecklenburg, S., J. Joss, and W. Schmid, 2000: Improving the nowcasting of precipitation in an Alpine region with an enhanced radar echo tracking algorithm. *J. Hydrol.*, **239**, 46–68.
- Rinehart, R. E., and E. T. Garvey, 1978: Three-dimensional storm motion detection by conventional weather radar. *Nature*, **273**, 287–289.
- Rinehart, R. E., 1981: A pattern-recognition technique for use with conventional weather radar to determine internal storm motions. *Atmos. Technol.*, **13**, 119–134.
- Tuttle, J. D., and G. B. Foote, 1990: Determination of the boundary layer airflow from a single Doppler radar. *J. Atmos. Oceanic Technol.*, **7**, 218–232.
- Wolfson, M. M., B. E. Forman, R. G. Hallowell and M. P. Moore, 1999: The growth and decay storm tracker. Preprints, *Eighth Conf. on Aviation, Range, and Aerospace Meteorology*, Dallas, TX, Amer. Meteor. Soc., 58–62.

4.6.7 Plan Position Indicator (PPI)

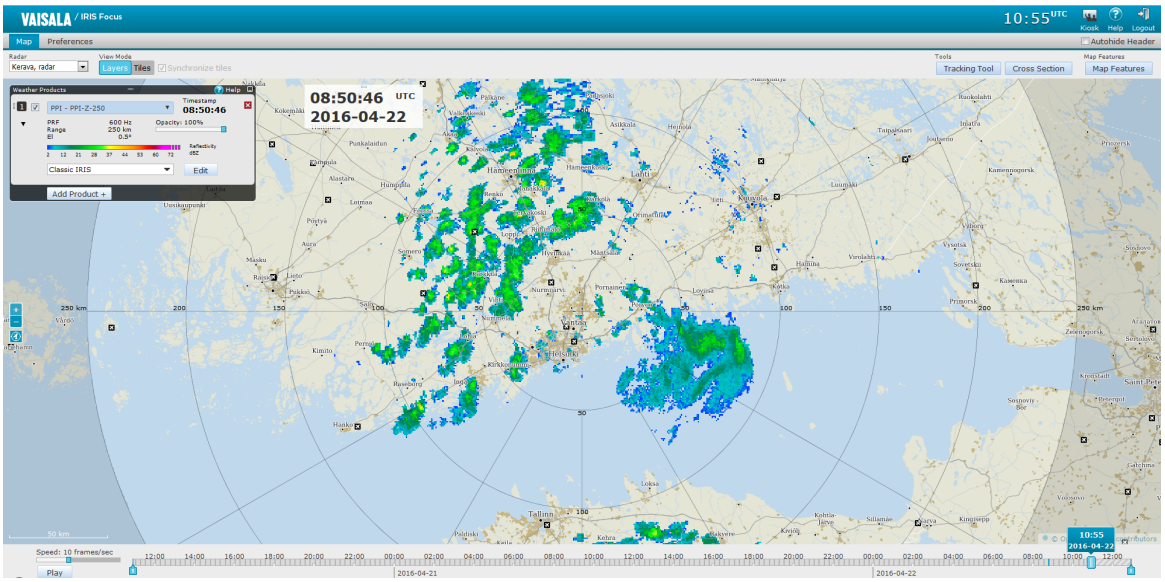


Figure 51 PPI Example

PPI displays the signal reflectivity on a surface layer that is formed as the radar performs a full 360° horizontal sweep at a constant elevation.

PPI is the classical radar view used for visual weather surveillance and air traffic control, among other uses. The products are refreshed as soon as the sweep is completed instead of waiting for the end of a full volume scan.

In the following image, the **PPI** scan is performed on the highlighted elevation.

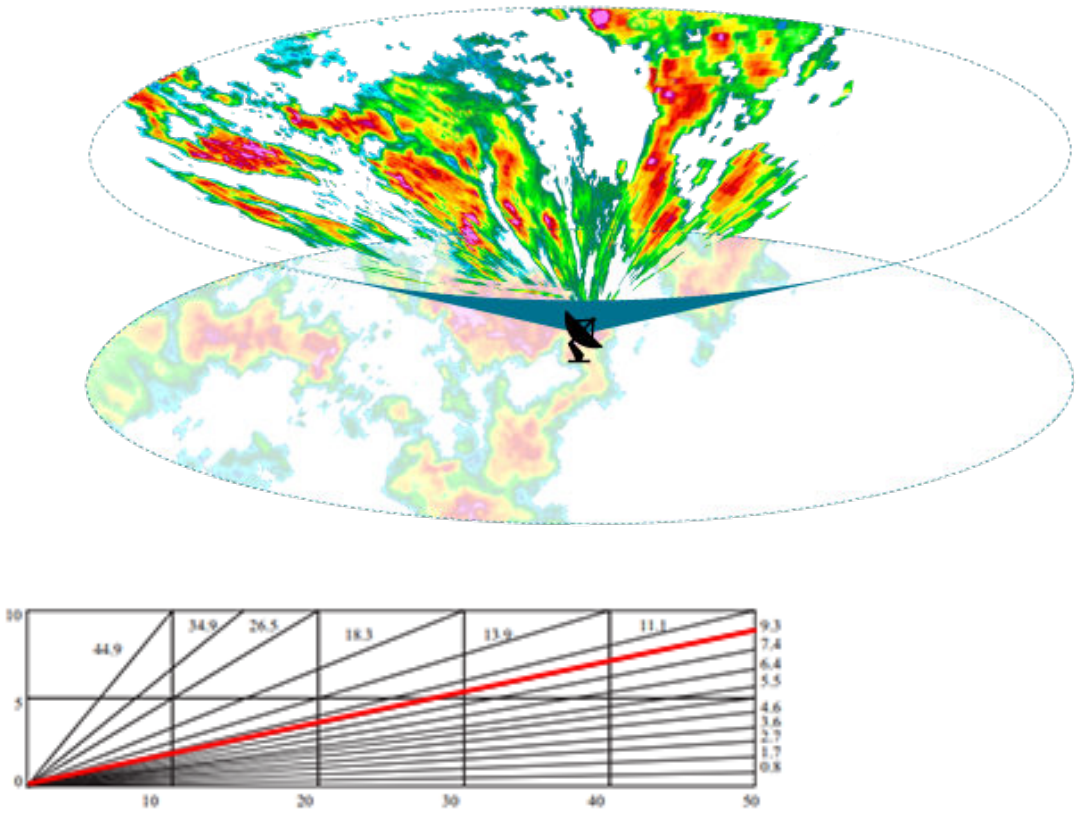


Figure 52 PPI Measuring the Defined Elevation

4.6.8 X Hour Running Precipitation (RAINN)

Displays an estimated running precipitation amount over the last *N* hours. For example, RAIN1 displays the precipitation from the last hour. Used for estimating rainfall intensity.

4.6.9 Echo Thickness (THICK)

THICK measures the full thickness of cloud cover.

THICK is the difference between **TOPS** and **BASE** products.

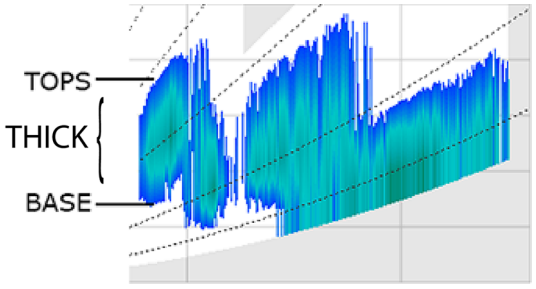


Figure 53 THICK with BASE and TOPS

More Information

- Echo Base (BASE) (page 67)
- Echo Tops (TOPS) (page 74)

4.6.10 Echo Tops (TOPS)

Displays the maximum height of the detected signal echoes, which usually measures the top of the precipitation area or cloud cover. TOPS can be useful when identifying strong updrafts.

The opposite of TOPS is the BASE product.

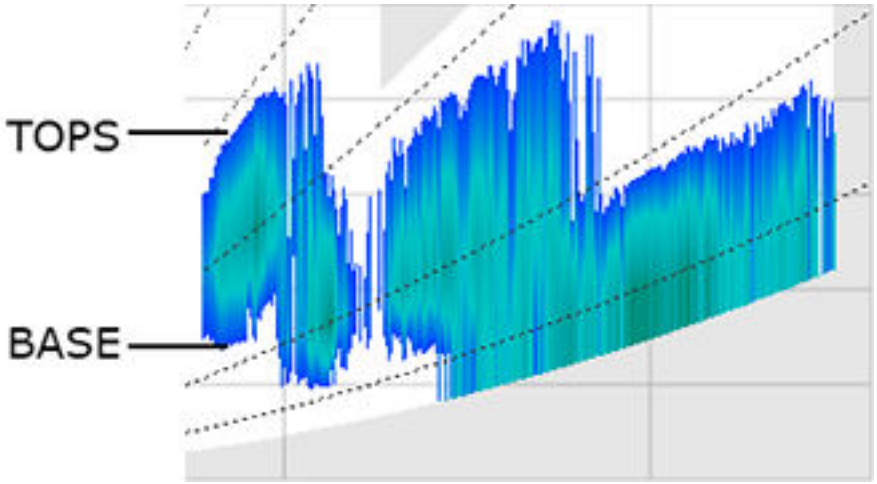


Figure 54 BASE and TOPS Products

More Information

- Echo Base (BASE) (page 67)

4.6.11 Vertically Integrated Liquid (VIL)

Displays the estimated total amount of liquid water in a vertical column of air. The data is calculated from the complete volume scan, and indicates the total amount of rainfall (in millimeters) that is present in the vertical area. As VIL measures the entire depth of the atmosphere, it performs well in detecting precipitation that has not yet reached the ground. High values may be indicative of heavy rainfall, thunderstorms, or hail.

The VIL product also includes the VIR (Vertically Integrated Reflectivity) product that displays the calculated reflectivity value of the vertical air column area measured in dBZ. The results tend to be close to VIL values.

More Information

- Layer Average (LAYER) (page 67)

5. Administration

All administration tasks such as managing licensing and users, are done from the **Administrator** panel, which is enabled when you are logged in with an administrator account.

To access the Administrator panel, select **Admin**.

If the **Admin** button is not visible, you are not logged in as an administrator.

5.1 Administrator Panel

The Administrator panel has the following subsections:

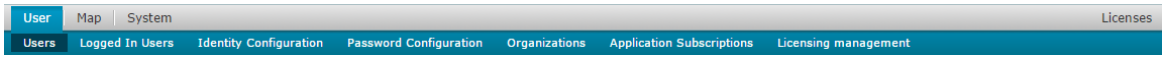


Figure 55 Administrator Panel

- User - User and organization
- Map - Map layer management
- System - License management and notification texts for the front page
- Licenses - Lists the software license

5.2 User Management

Access to different features in IRIS Focus depends on what roles have been enabled for a user account. For example, the administration features are available to user accounts with administrator role.

IRIS Focus uses the following roles:

- *administrator* - Can access administration features
- *focus* - Can access the full IRIS Focus feature set
- *kiosk* - Can only access the non-interactive full screen Kiosk mode
- *poweruser* - Not used
- *user* - Can access limited application features

To enable all IRIS Focus features for an account, set both *user* and *focus* roles for that account.

IRIS Focus builds on earlier Vaisala IRIS software. The release preceding IRIS Focus was IRIS Vision, which is included in IRIS Focus as a limited environment that users without a *focus* role or a valid IRIS Focus license can use. A user account that has *user administrator* or role without *focus* role set enters the IRIS Vision mode. IRIS Vision does not include features such as cross-section or live radar products.

Each logged-in user account with *focus* role reserves one IRIS Focus seat from the license pool. When the user logs out, the seat is released. If a user with *focus* role logs in and there are no IRIS Focus seats left, the user enters the restricted IRIS Vision mode. When a seat is again available, the user receives a pop-up message that offers the option to switch to IRIS Focus.

Each user account belongs to one or more organizations. Each organization can have a subscription to a selected software for a selected number of users. However, you can use organizations to create subgroups that have separate license pools and manage the license availability that way.

By default, an *administrator* account does not have the *focus* role set to avoid reserving an IRIS Focus license when performing administration tasks.

More Information

- Licensing (page 11)

5.2.1 Users View

The currently defined user accounts are listed in the **Administrator > Users** view.

User accounts have the following parameters:

- Username - Permanent ID for the user. Used when logging in.
- Password - User password. Must conform to password requirements.
- State - Set as `Active` to enable login for that account. Set as `Locked` to disable the account without deleting it.
- Personal details - Email, first name, last name, city, country, time zone, language
- Organization membership - Which organization(s) the user belongs to
- Roles - What features of the application the user can access

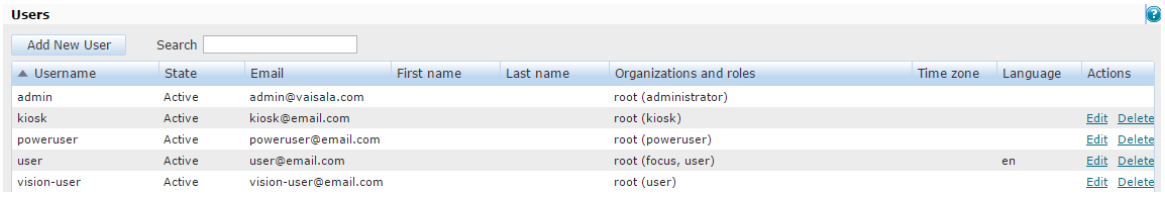


Figure 56 Users View

When adding or editing a user, you can assign multiple roles for the user account by holding down **SHIFT** or **CTRL** and selecting roles from the list.

If a user account belongs to multiple organizations, the user roles are applied according to the organization that has the highest **Rank**.

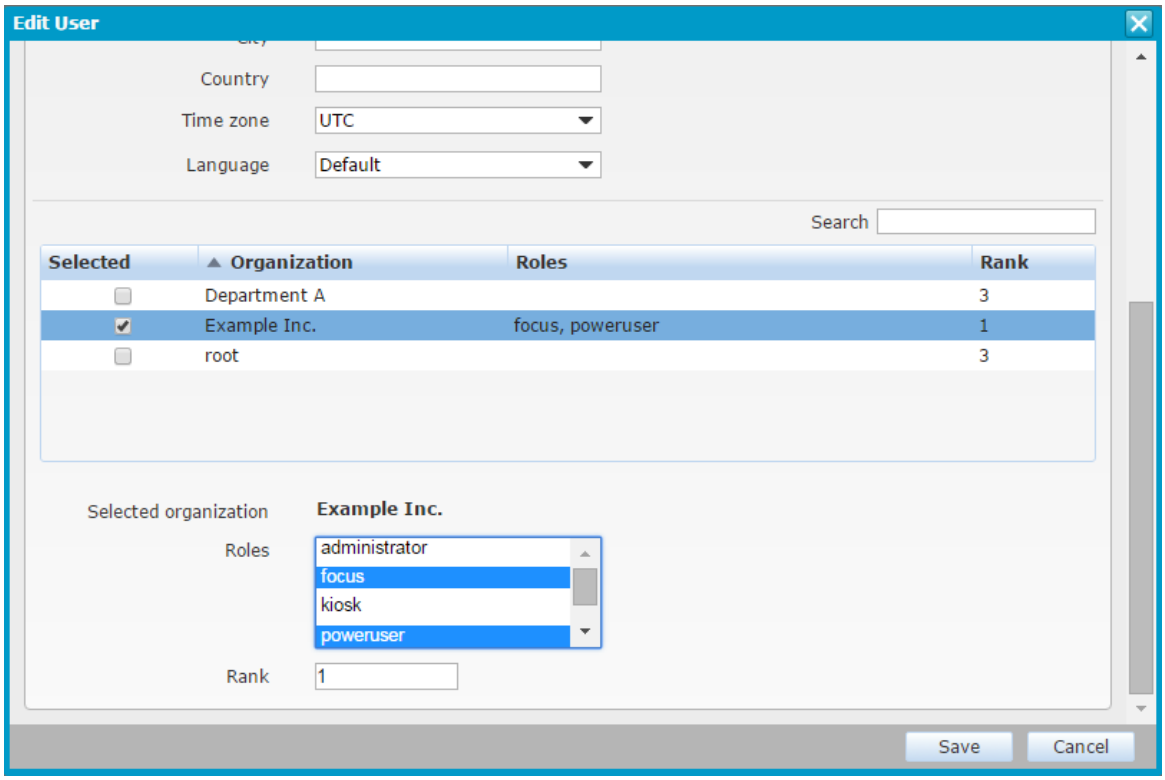


Figure 57 Creating New Users

To enable IRIS Focus features for a user account, you must select both the `user` and `focus` roles.

5.2.2 Managing User Accounts

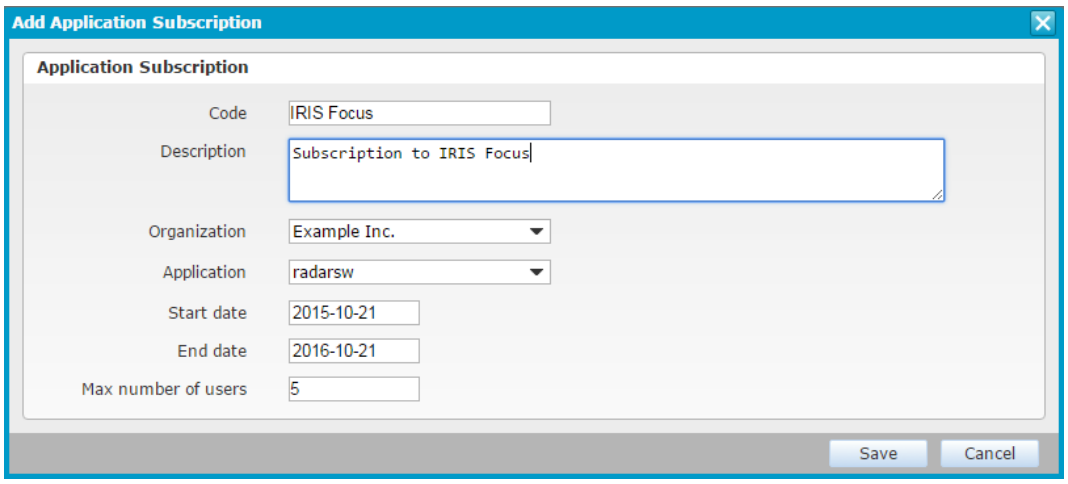
1. Log in with an *administrator* account
2. Select **Admin** in the upper right corner.
   The **Users** window opens with tools for adding, editing, and deleting users.

5.2.3 Creating User Accounts After First Install

After a fresh installation, start creating user accounts.

1. Choose which organization you want to create your users in:
   - Use the default `root` organization.
   - For more control over license seat allocation, create a new organization in the **Organizations** tab.

2. Subscribe the organization to a license pool in the **Application Subscriptions** tab:
   a. Select the *radarsw* organization.
   b. Enter the validity period.
   c. Enter the maximum allocated users (licenses).



3. Add users to the organization in the **Users** tab:
   a. Add user details.
   b. Select an organization for user.
   c. Add roles to user
   d. Add both focus and user roles to make IRIS Focus features available.
   e. To select multiple roles, press **CTRL**.

   The default administrator account does not have the focus role set. This is to avoid reserving an IRIS Focus license when performing administration tasks.

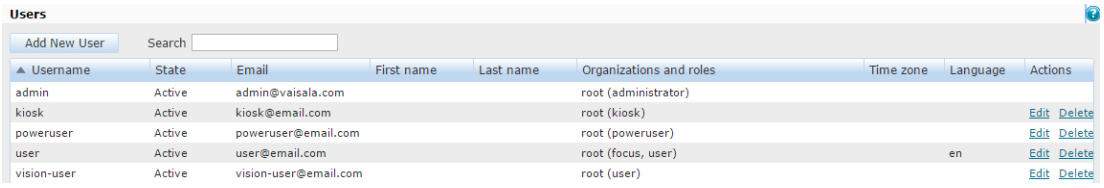
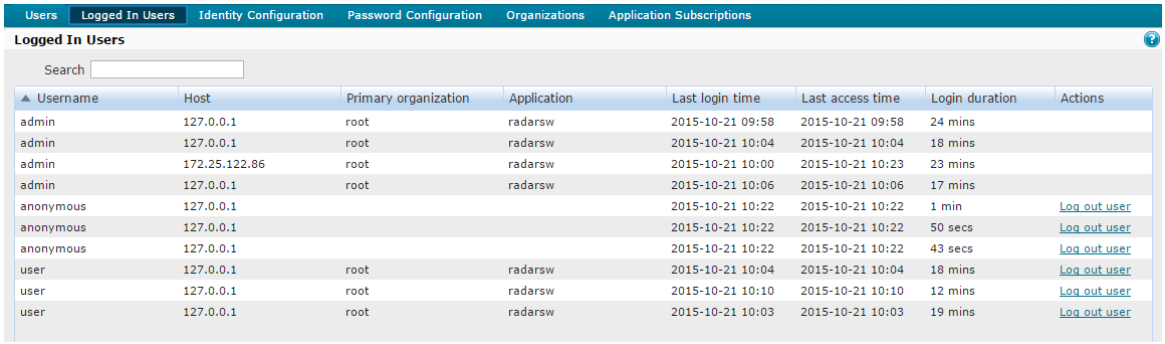


Figure 58 Users List

5.2.4 Logged In Users View

Logged In Users view displays all the currently logged in user accounts.

To force individual users to log out, select **Log Off User** at the end of each non-administrator user account.



Username	Host	Primary organization	Application	Last login time	Last access time	Login duration	Actions
admin	127.0.0.1	root	radarsw	2015-10-21 09:58	2015-10-21 09:58	24 mins	
admin	127.0.0.1	root	radarsw	2015-10-21 10:04	2015-10-21 10:04	18 mins	
admin	172.25.122.86	root	radarsw	2015-10-21 10:00	2015-10-21 10:23	23 mins	
admin	127.0.0.1	root	radarsw	2015-10-21 10:06	2015-10-21 10:06	17 mins	
anonymous	127.0.0.1			2015-10-21 10:22	2015-10-21 10:22	1 min	Log out user
anonymous	127.0.0.1			2015-10-21 10:22	2015-10-21 10:22	50 secs	Log out user
anonymous	127.0.0.1			2015-10-21 10:22	2015-10-21 10:22	43 secs	Log out user
user	127.0.0.1	root	radarsw	2015-10-21 10:04	2015-10-21 10:04	18 mins	Log out user
user	127.0.0.1	root	radarsw	2015-10-21 10:10	2015-10-21 10:10	12 mins	Log out user
user	127.0.0.1	root	radarsw	2015-10-21 10:03	2015-10-21 10:03	19 mins	Log out user

Figure 59 Logged In Users view

5.2.5 Identity Configuration

Identity Configuration view defines the following user account security settings:

- Lock on failure - Enable to lock user accounts after too many login failures
- Max attempts before lock - How many times a user can attempt logging in before being locked out
- Lock duration - How long (in seconds) the lockout time lasts
- Expire password - Enable to set an expiration counter for the password
- Password validity - How many days the password is valid before the user is prompted to change it

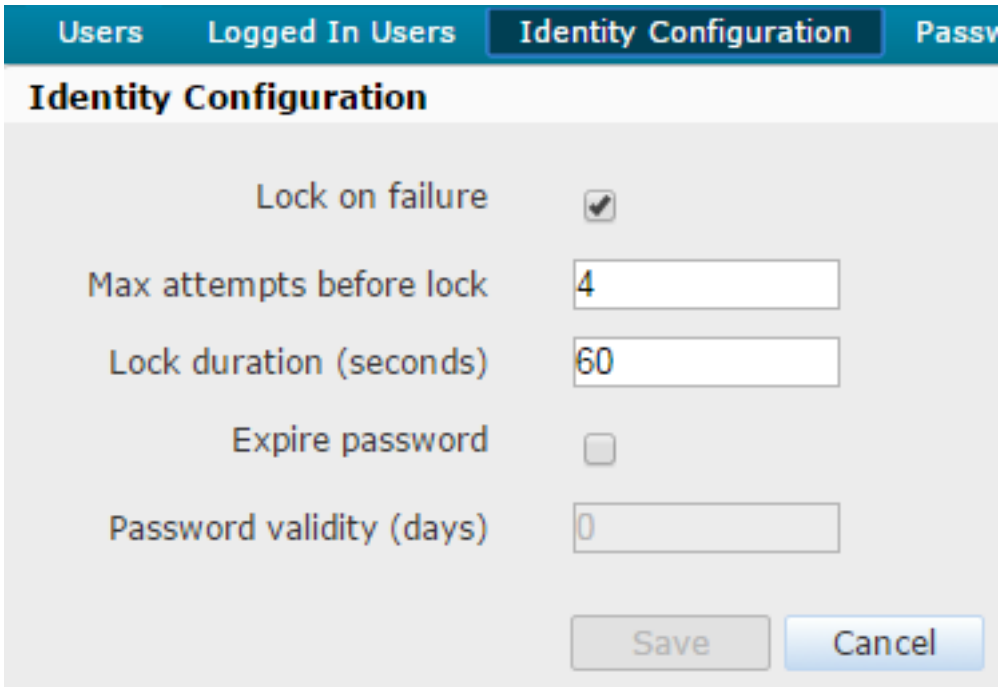


Figure 60 Identity Configuration view

5.2.6 Password Configuration View

Password Configuration view defines requirements for password complexity. The settings for the password are:

- Minimum and maximum length
- What combination of (upper and lower case) letters or digits the password must contain
- Whether the password must contain special characters **(!"#$%&'()*+,-./:;<=>?@[]^_`{|}~)**
- Whether the password must conform to a defined regular expression
- How many previous passwords are forbidden to reuse

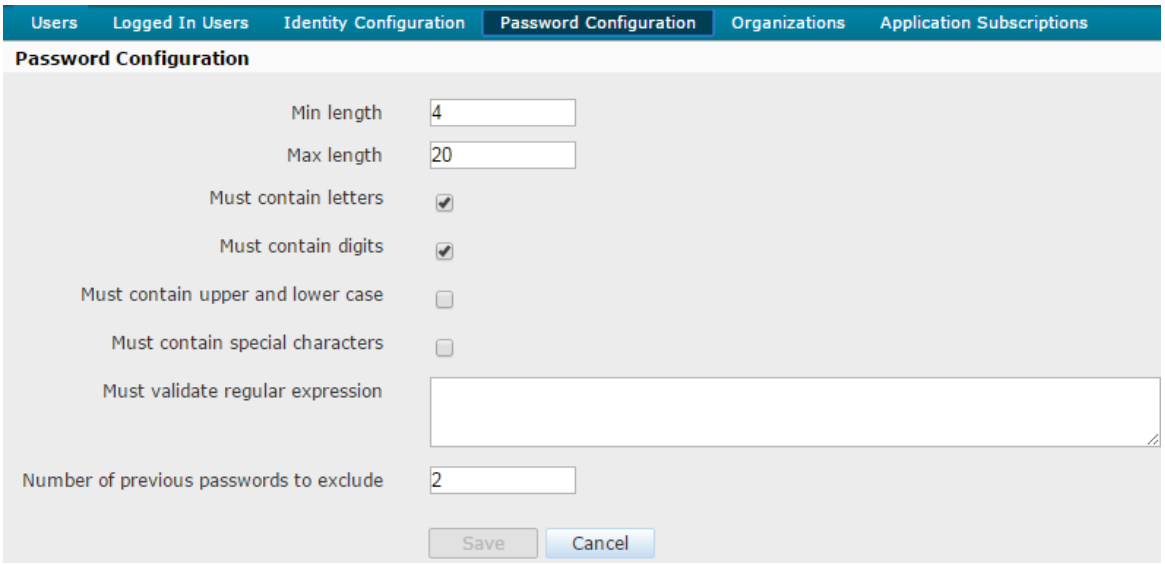


Figure 61 Password Configuration view

5.2.7 Organizations View

Organizations view lists all the organizations that have been set up in the application. Organizations have the following parameters:

- Code - Title of the organization. This is visible when assigning users to organizations
- Description - Full text description of the organization

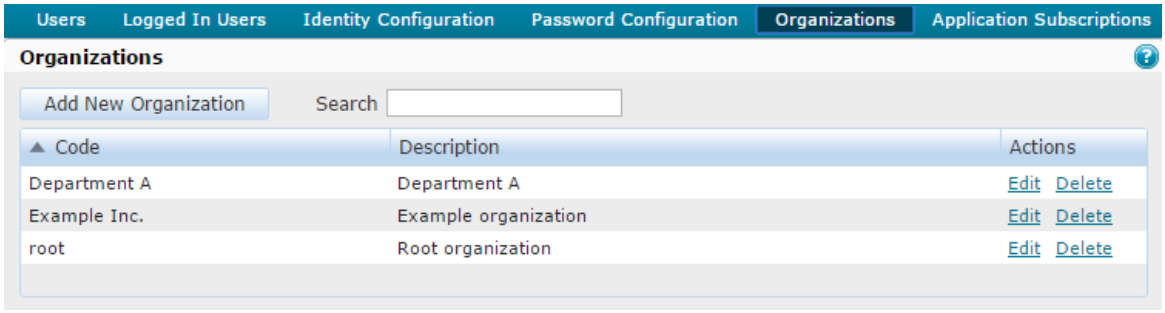


Figure 62 Organizations View

More Information

- Licensing Management (page 87)

5.2.8 Application Subscriptions View

Application Subscriptions view lists all active and expired subscriptions. Each subscription creates a relationship where the organization subscribes to the application for a defined length of time. By subscribing, the organization reserves a pool of licenses to allocate for users in that organization.

Currently the IRIS Focus application *radarsw* is the only available application to subscribe organizations for. Subscriptions are a way to manage available licenses between different organizations.

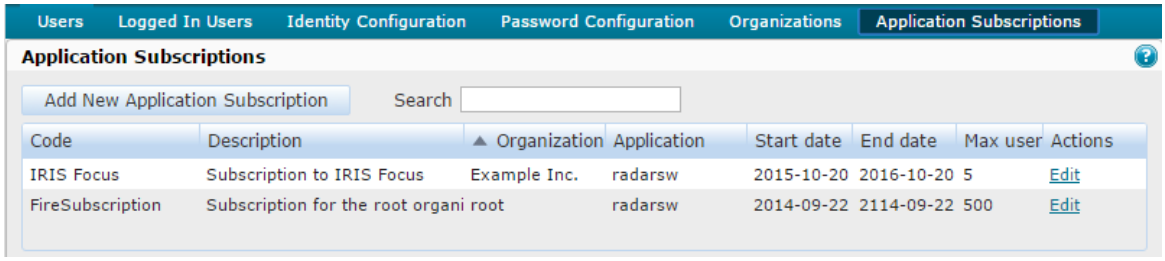


Figure 63 Application Subscriptions view

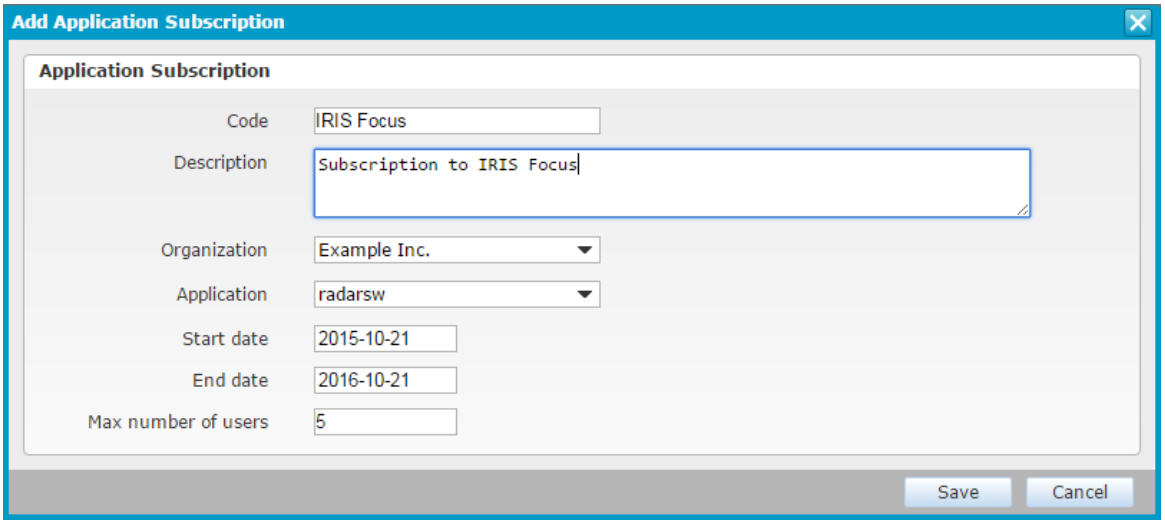


Figure 64 Creating a new Subscription

More Information

- Licensing Management (page 87)

5.2.9 Removing User Accounts

When user accounts are removed from the system database using the **Delete** button in 5.2.1 Users View (page 76), the user name of the deleted account remains in the system database. This keeps log files intact, as references to deleted users remain in the audit logs.

IRIS Focus does not allow you to create a new user with a similar user name as an existing one. This applies even when the account has been removed beforehand, because the account name remains in the database.

5.3 Map Management

The standard installation of IRIS Focus includes a complete world map that is suitable for most scenarios.

The map consists of many separate layers that are further separated into base layers and non-base layers. One base layer and one non-base layer are always rendered on the screen. Typically, base maps contain the underlying terrain and the non-base layers contain additional details that can be displayed on top of the base map.

Map data is served to the IRIS Focus web interface by GeoServer map server using Web Map Service (WMS) protocol. To improve performance, instead of calling for new map data each time the map view changes, the maps are cached in pre-rendered PNG tiles using GeoWebCache .

You can select the layers from the **Map Features** menu in the map view.

You can add custom map layers or edit the existing layers in the **Map** panel.

5.3.1 Map Layers

The **Map Layers** view lists the available map data layers. Each layer has the following properties:

- Title - Layer name
- URL - Address for the WMS server
- Layer - Title of the layer on the server
- Base layer - Enable to set this layer as a base layer
- Transparent - Enable to use PNG or GIF alpha channel for transparency
- MIME type - Select image type
- Layer style - Add SLD (Styled Layer Descriptor) parameters for styling the layer in more detail

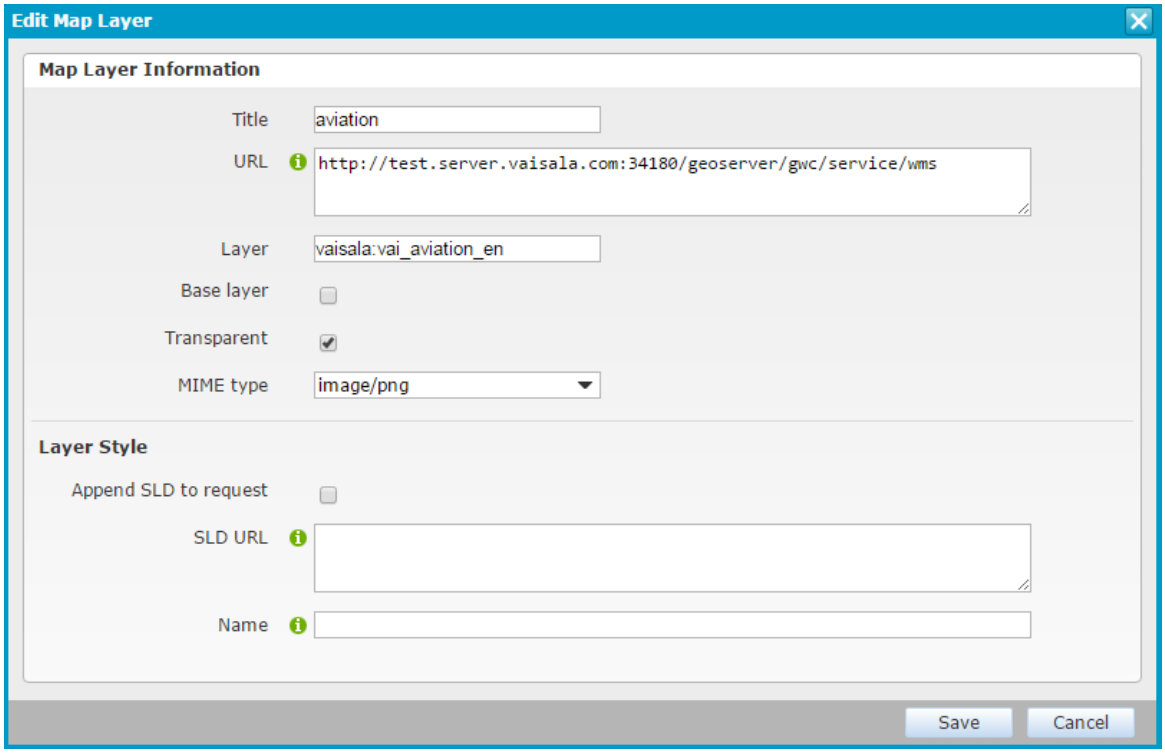


Figure 65 Editing a Map Layer

5.3.2 Map View Context

The **Map View Context** view lists all defined maps.

Only the default **TheMap** context is available.

You perform all map layer customization in the default **TheMap** context, you do not create new map contexts for custom map layers.

- To set which layers are enabled and which are disabled for users in the map view, edit TheMap.
- To set the order in which multiple map layers are rendered on screen, change the **Z level** of map layers.
  The lowest number is rendered first, and higher numbers rendered on top of that.

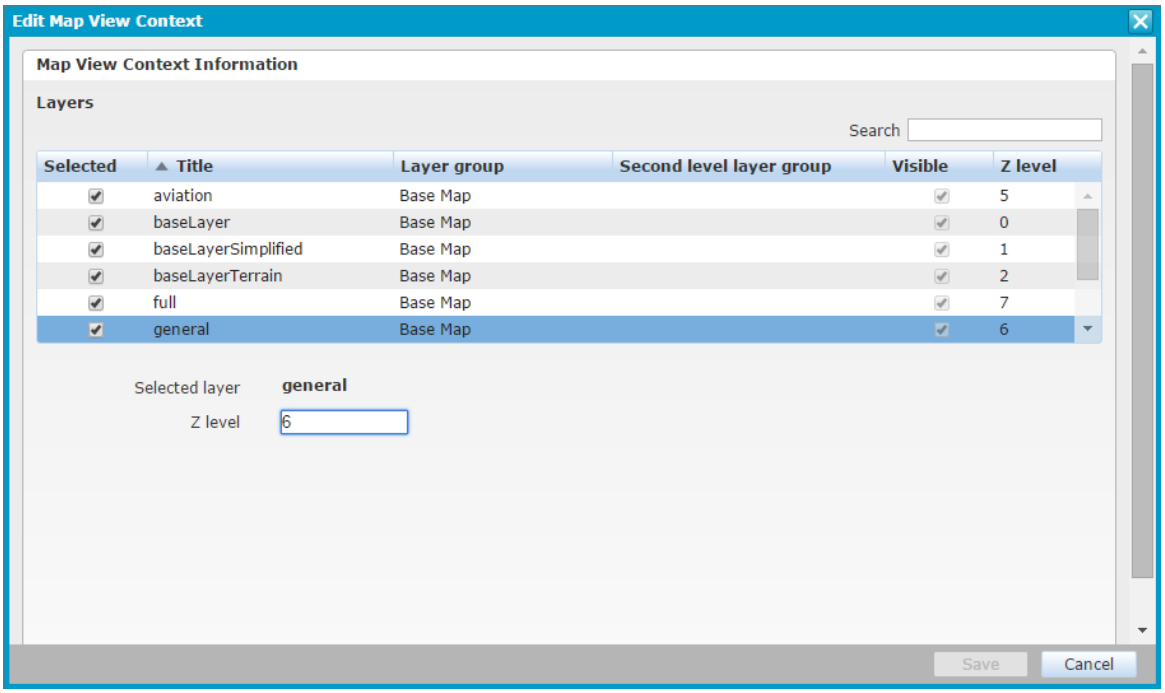


Figure 66 Editing the Map Context

5.3.3 Adding External Map Layers

To perform these steps you must be familiar with Web Map Server (WMS) and Geoserver

IRIS Focus displays single radar products in azimuthal equidistant projection. Because most external Geoservers and WMS providers do not support azimuthal equidistant projection, you must use a proxy to dynamically reproject the external layer's projection to Azimuthal Equidistant projection.

Using IRIS Focus administrator tools, you can import an external map layer from Geoserver to IRIS Focus for display in a composite radar view.

To add a layer to a radar AZEQ view, you must configure a Web Map Server (WMS) proxy to the IRIS Focus Geoserver.

1. Open the file: */etc/vaisala/radarsw/configuration/gis-override.ini*
2. Copy the **geoserver admin** password.
   This password is autogenerated during installation.
3. Login to IRIS Focus Geoserver at: http://<server>:34180/geoserver/web/
   Login using the username **admin** and the password you copied earlier.
4. Add the new external WMS store. See the Geoserver documentation: http://docs.geoserver.org/latest/en/user/data/cascaded/wms.html.
   The following features are NOT supported:
   - Styling layers with **Styled Layer Descriptor** (SLD).
   - Alternate (local) styles.
   - Extra request parameters such as **time**, **elevation**, or **cql_filter**.
   - **GetLegendGraphic** requests.
   - Specifying the image format. GeoServer attempts to request PNG images. If that fails, it uses the remote server's default image format.
   - Authentication for the remote WMS. The remote WMS must be unsecured.
5. Publish the layers you want to display in IRIS Focus.
6. Login to IRIS Focus as admin user:
   a. Add the layer with the information you entered in the previous step.
   b. Add the new layer to the map view context **TheMap**.
      Choose an appropriate **Z level**, most likely an integer one higher than the others is good. This means that the layer will be displayed on top all the other layers.
7. In Geoserver, enable tile caching for the new layer (this requires quite a lot of clicking).
   a. Edit the new layer.
   b. Navigate to **Tile Caching**.
   c. Add a grid subset to all codes starting with **EPSG:741xxx**. This requires quite a bit of manual clicking.

   Instead of adding all the EPSG codes, you can go straight to the next step and observe from browser network status which WMS requests fail. From these requests, you can see the EPSG codes that your radar(s) use and. You only the EPSG codes currently used by the system.

8. Login to IRIS Focus as a user:
   a. In the upper right corner, select **Map Features**.
   b. Enable the new layer.

5.4 System Management

System Management lets you set status messages for the login page and verify the licensing status.

5.4.1 System Properties

The application login page contains 2 text fields where you can publish status messages or other notifications.

You can write the messages in the **System Properties** view. Empty fields are not displayed on the login page.

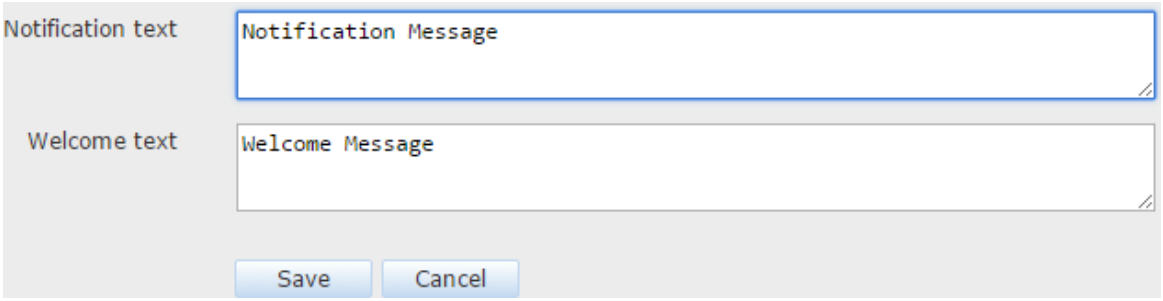


Figure 67 Entering Status Texts

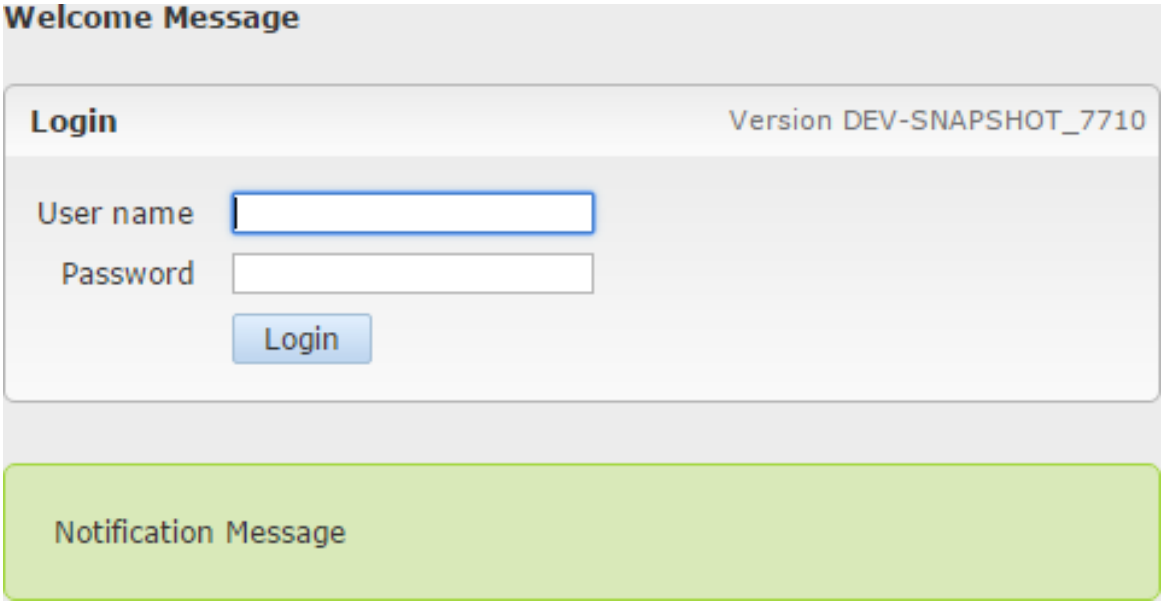


Figure 68 New Login Page

5.4.2 Licensing Management

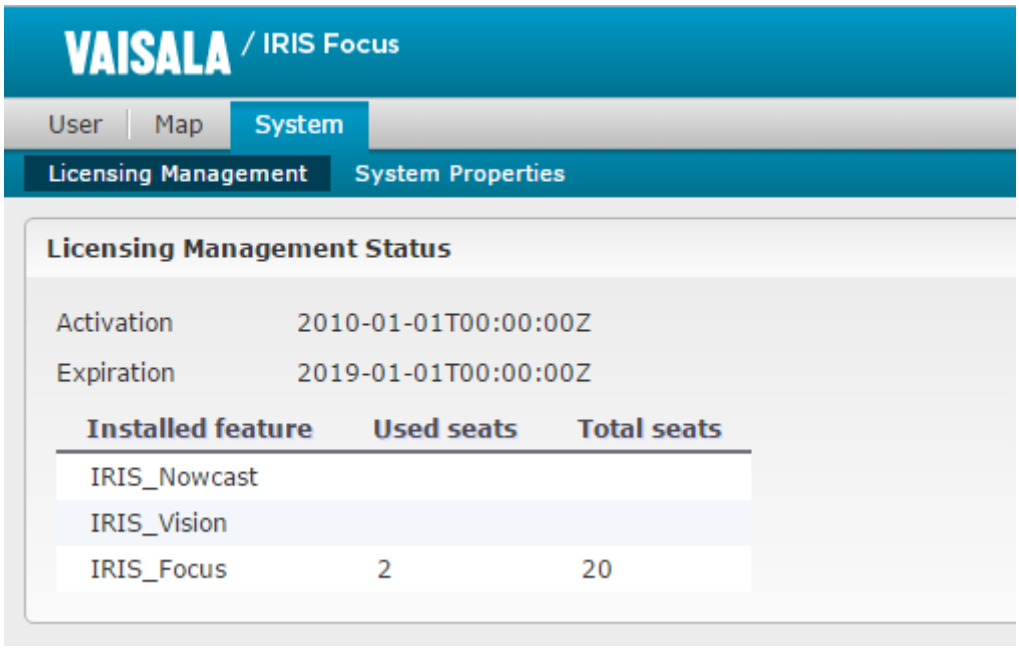


Figure 69 Licensing Management Status

When logged in IRIS Focus as an **admin**, select **System > Licensing Management** to display the licensed features allocation status of the current IRIS Focus license pool.

- `IRIS_Nowcast`
  The seat columns are empty because the IRIS Nowcast license is server-based, and does not rely on a seat allocation.
- `IRIS_Vision`
  The seat columns are empty because the IRIS Vision license is server-based, and does not rely on a seat allocation.
- `IRIS_Focus`
  Total seats - Size of the active license pool. This depends on your licensing plan.
  Used seats - Number of seats currently in use.

> Due to restrictions you might have set for organizations or application subscriptions, an organization can run out of licenses even when there are available IRIS Focus seats in the total license pool.

More Information

- Application Subscriptions View (page 81)
- Organizations View (page 80)
- Licensing (page 11)

5.4.2.1 Licensing on Server Restart

Active sessions and their licenses are not stored when the IRIS Focus server is shut down.

When the server restarts, the licensing seats are allocated from scratch to users who log in. The total number of seats in the license pool is unaffected.

More Information

- Licensing (page 11)

5.4.3 File Locations

Table 6 IRIS Focus Application and Configuration Files

File or Directory	Description
/etc/vaisala/radarsw/configuration • *gis-override.ini* GeoServer database settings. • *logback.xml* Logging level settings. • *radar_centers.properties* List of stored radar site center points.	Configuration files for IRIS Focus module settings. The files listed here are the most important. **CAUTION!** Some settings have a default config file and an override file. For example: • *gis-config.ini* • *gis-override.ini* When needed, edit the override file.
/etc/vaisala/radarsw/configuration/vsoweb-override.ini	Connection settings for socket server, lightning layers, nowcasting and so on.
/etc/vaisala/radarsw/nowcast/nowcast.ini	Configuration files for the nowcast server.
/usr/vaisala/radarsw/configuration	Configuration files for helper applications used in IRIS Focus maintenance.
/var/lib/radarweb	Home directory of the radarweb user. The IRIS Focus Web Application is deployed here.
/var/lib/radarscan	Home directory of the radarscan user. The RAW files for the Scan Service database are stored here.
/var/log/vaisala/radarsw	Log files from IRIS Focus web application
/var/lib/radarscan/scans.sqlite	SQLite database that contains information on radar volume scans used in the Scan Service
/var/lib/warnreader	Configuration files for events and alerts.

5.4.4 Configuring Nowcasting

Nowcasting is enabled by default. However, during installation or later, you can adjust the nowcasting configuration.

Configuring IRIS Focus for nowcasting includes

- Enabling nowcasting in the IRIS Focus web application and the nowcasting server. See *IRIS Focus Administrator Guide*
- Configuring MVF and nowcasting criteria.
- Fine-tune the algorithms.
  Most users do not need to adjust the nowcasting algorithms.

More Information

- Configuring MVF (page 89)
- nowcast.ini (page 105)
- Motion Vector Field (MVF) (page 68)
- Nowcasting (page 23)

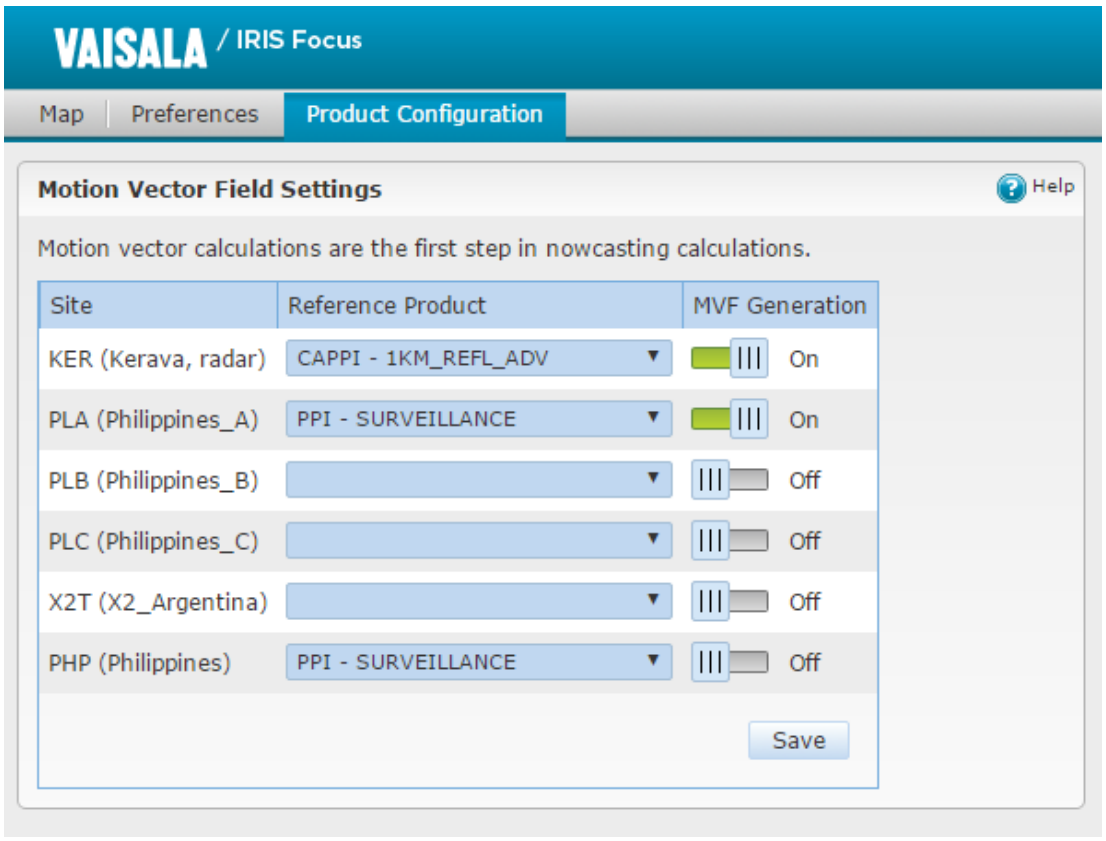
5.4.5 Configuring MVF

To use nowcasting, for each radar site you must enable MVF generation and pre-configure the MVF product to define a product type and product name.

IRIS Focus generates one MVF product per site. If meteorological conditions vary across your radar sites, you may wish to use different products for each radar site.

1. Log in to IRIS Focus as **`admin`**

2. Select **Product Configuration**.



3. For each radar site, select whether MVF generation is enabled for that site.
   To minimize performance problems, do not enable MVF generation for sites that do not need the nowcasting feature.
4. For the sites with MVF generation enabled, select the product used to create MVFs.
   The product can be of any data type except **V** and **PHIDP**.

Minimize performance problems by avoiding:

- Products that generate too much data, for example, those with large resolutions.
  Vaisala recommends using a **CAPPI** at 2km height at with a 480x480 resolution.
- Generating the MVF product too frequently.
  Vaisala recommends using products that are configured to be created no less than 10 minutes apart.

For more information on pre-configuring products, see *IRIS Radar User Guide* and *IRIS Product and Display Guide*.

5. Select **Save**.

More Information

- Configuring Nowcasting (page 88)
- File Locations (page 88)
- Motion Vector Field (MVF) (page 68)
- Radar Products (page 37)
- Radar Product Codes (page 41)
- vsoweb-override.ini (page 107)

5.5 Managing Alerts for Significant Weather

In IRIS Focus, a weather *event* is an occurance of a pre-configured **WARN** product appearing in the display.

A weather *event* becomes an *alert* when the pre-configured **WARN** product moves into a protected area in the display.

To use IRIS Focus alerts, you must define **WARN** products in IRIS Radar and then draw protected areas in IRIS Focus.

Perform the steps in the following sections.

1. Learn about IRIS **WARN** products.
   See 5.5.1 WARN: Warning/Centroid Product (page 91).
2. 5.5.2 Setting-up Public Key Authentication (page 95).
3. 5.5.3 Configuring WARN Products (page 96).
4. 5.5.4 Scheduling WARN Products (page 99).
5. 5.5.5 Configuring an IRIS Output Device for WARN Products (page 101).
6. 5.5.6 Sending WARN Products from IRIS to IRIS Focus (page 102).

When you have configured the **WARN** products that are displayed as events in IRIS Focus, draw protected areas in IRIS Focus so you are alerted when an event enters that area.

More Information

- Alerts for Significant Weather (page 28)
- Alerts for Significant Weather (page 28)
- Drawing Protected Areas (page 29)

5.5.1 WARN: Warning/Centroid Product

The **WARN** product uses other IRIS products to detect significant weather.

Example: Detecting Hail

The occurrence of 45 dBZ at 1.5 km above the freezing level is a good indicator of hail in many mid-latitude locations. Assuming that the freezing level is at 4 km, and you run an echo **TOPS** product for the 45 dBZ contour, your pre-configured warning could check if:

- The **TOPS** product shows 45 dBZ tops at heights greater than 5.5 km. If yes, there is a high probability of hail.
- So you do not issue an alarm based on a single pixel, a "threshold region" parameter checks if the region of hail signature at least 10 km^2 .
- The **VIL** for the same region (1 ... 10 km) is greater than 5 mm (or a value determined from the local climatology of hail).

The **WARN** product automates this procedure in real time by searching the products for significant weather, and alerts the operator when an event is detected. The following figure shows how the **WARN** product works.

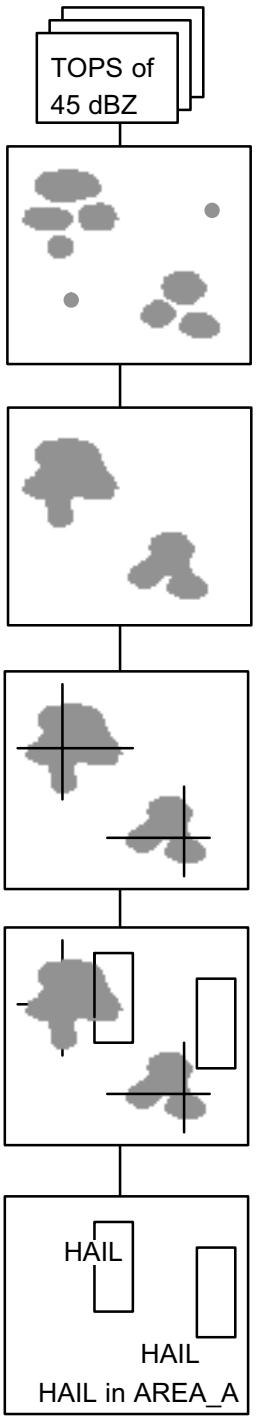


Figure 70 HAIL Warning/Centroid

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 (3.4 mi)).
The result is a 2-D binary array.
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.
5 Display the **WARN** product as an event outside protected areas or as an alert within protected areas.

Warning Message

You can define the content of the message. 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.

The messages are added to the IRIS **Message Summary** menu.

Warning Criteria

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.

Up to 3 criteria can be used. The thresholding and smoothing is performed separately for each, then the results are **AND**ed together so that centroid definition is performed on the combined field. For example, the additional criterion of the 1 ... 10 km (0.6 ... 6.2 mi) `VIL` >>5 mm (0.2 in) could be added to reduce a `HAIL` warning false alarm rate.

The following table shows some examples of warning criteria. Each criterion, surrounded by square brackets above, is one task. The results of multiple tasks are **AND**ed together.

Table 7 Warning Criteria Examples

Criteria	Example

Wind shear detection	`[Shear >10 m/s/km at 0.5° EL]`
	`AND`
	`[ ... at 0.7° EL]`
	over an area of 3 km^2 (1.2 mi^2)

Storm turbulence detection	`[Spectrum Width >6 m/s (>19 ft 8 in / s)]`
	`AND`
	`[Reflectivity >20 dBZ]`
	over an area of 10 km^2 (3.9 mi^2)

Hail detection	`[45 dBZ TOPS >1.5 km (>0.9 mi) above freezing level]` over an area of 10 km^2 (3.9 mi^2)
Precipitation surveillance detection	`[1.5 to 14 km (0.9 to 8.7 mi) VIL >1 mm (>0 3/64 in)]` over an area of 10 km^2 (3.9 mi^2)

Criteria	Example

Severe storm detection or lightning hazard	`[1.5 to 15 km (0.9 to 9.3 mi) VIL >10 mm (>0 25/64 in)]`
	`AND`
	`[10 dBZ TOPS >8 km (>5.0 mi)]`
	over an area of 10 km^2 (3.9 mi^2)

Flash flood warning	`[Hourly Rainfall or N-Hour Rainfall >5 mm (>0 13/64 in)]` over an area of 25 km^2 (9.7 mi^2)

To function effectively, a **WARN** product must be based on the local climatology and experience. Vaisala can work with you to develop such a climatology or to better understand the capabilities and limitations of the **WARN** product.
Vaisala makes no warranty, either express or implied, that the **WARN** product can detect all hazardous weather situations. In no event can Vaisala 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.

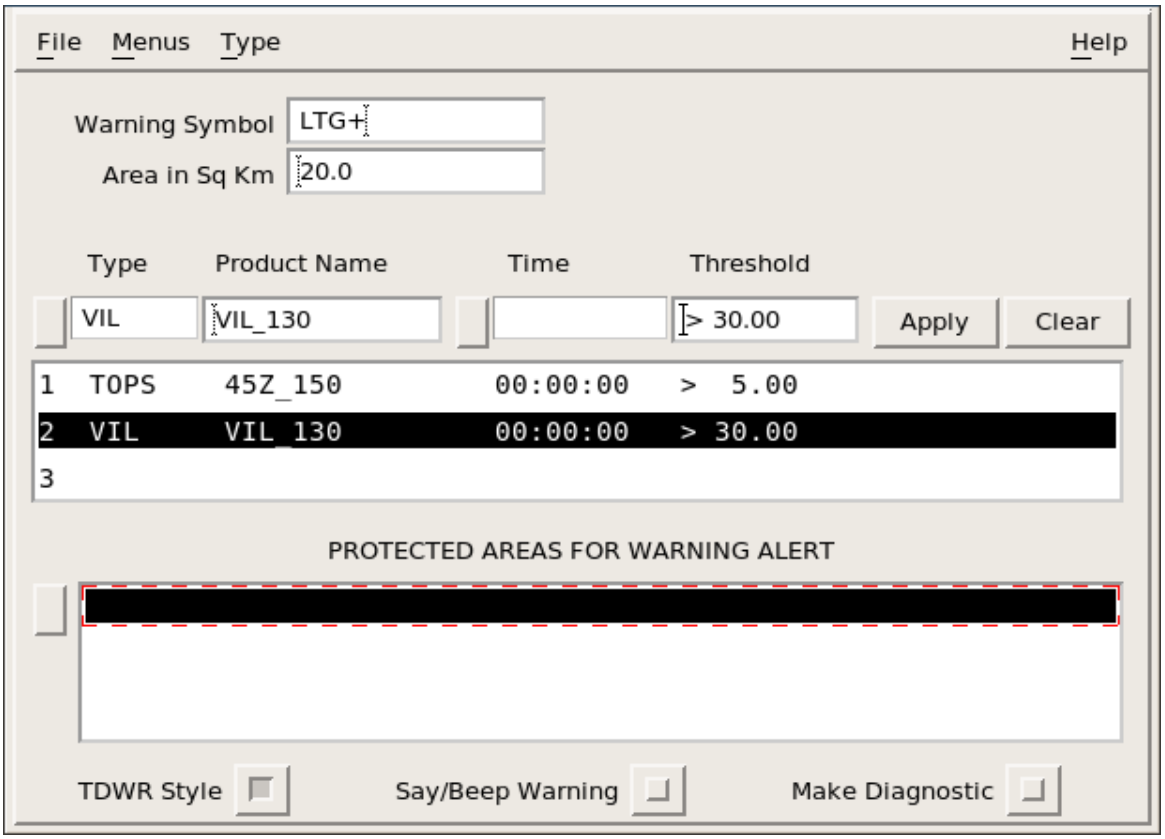
5.5.2 Setting-up Public Key Authentication

To support sending **WARN** products from IRIS to IRIS Focus, you must add the public key of the root user of the IRIS machine to the authorized keys list on the IRIS Focus machine.

This allows the files to transfer over the network securely, automatically, and without passwords.

1. On the IRIS machine, copy the contents of: */root/.ssh/*`<public_key_file>` (for example `id_rsa.pub`)
2. On the IRIS Focus machine, copy the key file to: */var/lib/warnreader/authorized_keys*

5.5.3 Configuring WARN Products



If you wish to be alerted to events entering protected areas you draw in IRIS Focus, you must configure a **WARN** product for each tracked event in IRIS Radar.

Use the **WARN** product configuration menu to specify the message, the area of the threshold region, and up to 3 products to use as criterion for the warning.

IRIS Focus does not include a **WARN** product of its own. You must configure **WARN** products in IRIS.

1. In the main menu bar, select **Menus > Product Configuration**.
2. In the main menu bar, select **Type > WARN**.
   The **WARN Product Configuration** menu opens.

3. In **Warning Symbol**, specify the text used in the warning messages.
   For example, the text may be, `HAIL` or `MBW`, `S++`, or `TRW+`.
   If you define the **Warning Symbol** with a predefined IRIS Focus **Warning Symbol**, IRIS Focus displays the weather with as an icon. If you use a different **Warning Symbol**, IRIS Focus displays the weather with the `UNKNOWN` icon.

   Table 8 IRIS Focus Warning Symbols

IRIS Warning Symbol Label	IRIS Focus Event Icon	IRIS Focus Alert Icon
`DOWNBURST`		
`HAIL`		
`THUNDERSTORM`		
`WINDSHEAR`		
Other **Warning Symbol** value		

4. 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 square km.
   For example, for a 3 km by 3 km (1.9 × 1.9 mi) size area, enter **9**.

5. Select the button next to **Product Type** and **Product Name**, select up to 3 products to be examined by the `WARN` product.

- Products must have the same maximum product range per the respective Product Configuration menus.
- Products must have the same resolution per the respective Product Configuration menus.
- Products must be of a supported data type: `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.

a. Select the product type.
The **Product Name** information is filled in automatically. You an edit the name if you wish

b. Select the product name.

The list of product names shows products currently in your system. If the product you want does not show, run your system until it does show.
Alternatively, chose a different product of the desired type and override the product name.

c. For each product, use **Time** values to use products from different tasks or different runs of the same task.
Use the plus and minus buttons to increase or decrease the hours, minutes, or seconds or type a time value in the window.
This field applies only when there is more than one criterion. For example, if 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.
You must know your task schedule. If you use products based on different tasks, you must set the **Time** field to some nonzero number or the product does not run. In general, if all of your product criteria are based on the same task, set all the times to `00:00:00` so that only data from the same run are used.

d. For each product, enter the warning threshold in **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

- `TOPS` thresholds are specified in km
- `VIL` thresholds are specified in mm.

Check the appropriate **Product Configuration** menu if you are uncertain about the units of measure.

For the VVP product, the threshold refers to the divergence in units of m/s per km (10^{-3} s^{-1}). When the WARN 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. To properly set for microburst alerts, you must know the local characteristics of the phenomena.

6. Do not configure **Protected Areas for Warning Alert**. You do this later in the IRIS Focus display.
7. In IRIS Radar, schedule the WARN product.
   a. Select **Menus > Product Scheduler**.
   b. In **Add for**, select the radar site for which you want to schedule the WARN product.
   c. In the list, right-click the WARN product header.
   A list of all available WARN product configurations appears.
   d. In the list of WARN product configurations, select the WARN product you just configured.
   The new product appears in the list in a stopped state.
   e. To schedule the WARN product indefinitely, right-click the **Status** column for that row and select **All**.

   For more information, see *IRIS Radar User Guide*.

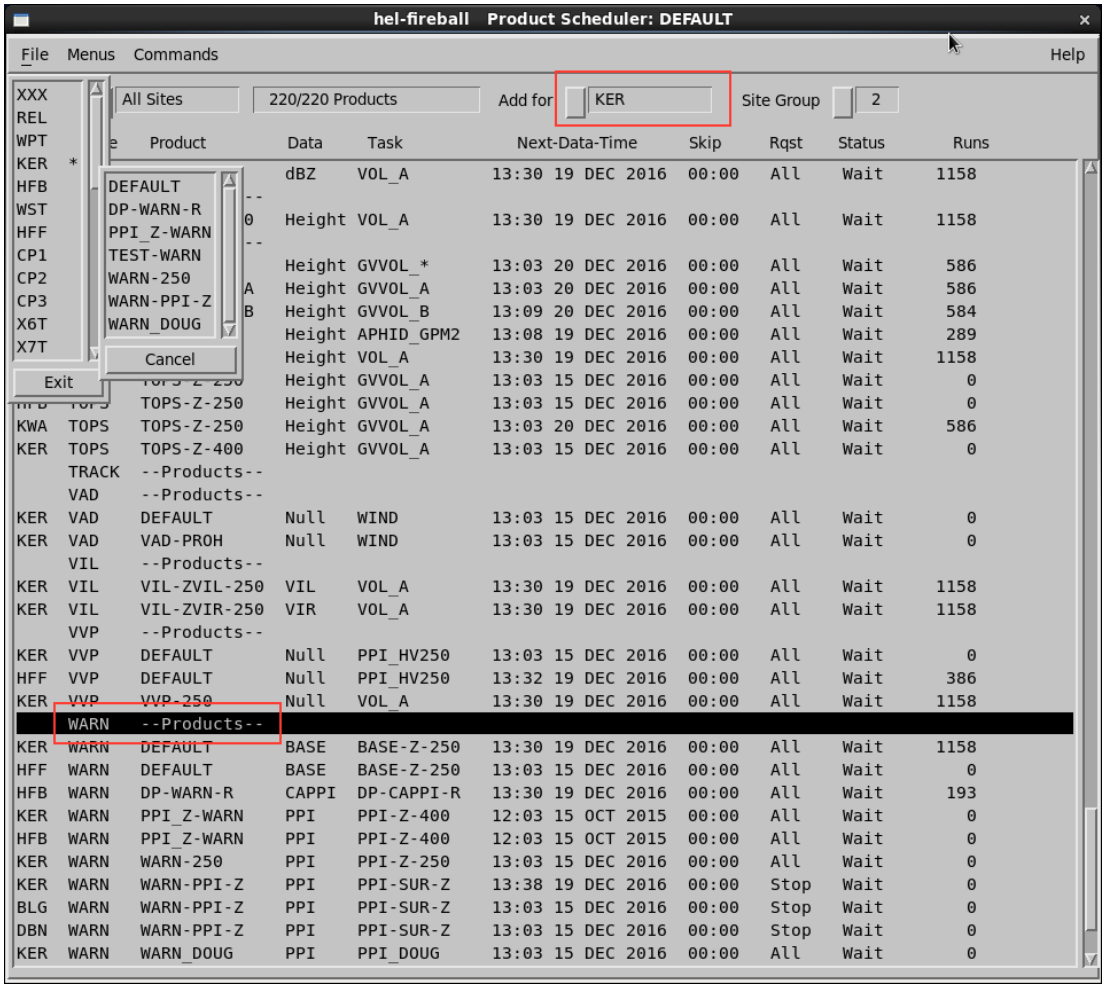
5.5.4 Scheduling WARN Products

You must configure WARN products before you can schedule them.

If you wish to use alerts and protected areas in IRIS Focus, you must schedule a WARN product in IRIS Radar.

1. Select **Menu > Product Scheduler**.
   A list of available product types appears.
2. On first line of the menu, select the button next to **Add For** and select the code for your local radar.

3. In the list, right-click the **WARN** product header.
   A window appears listing the available **WARN** product configurations.



4. Right click the **WARN** product header.
   A window appears listing the available **WARN** product configurations.

   a. Select the **WARN** configuration you created earlier.
      The product appears on the list of scheduled products in a stopped state.

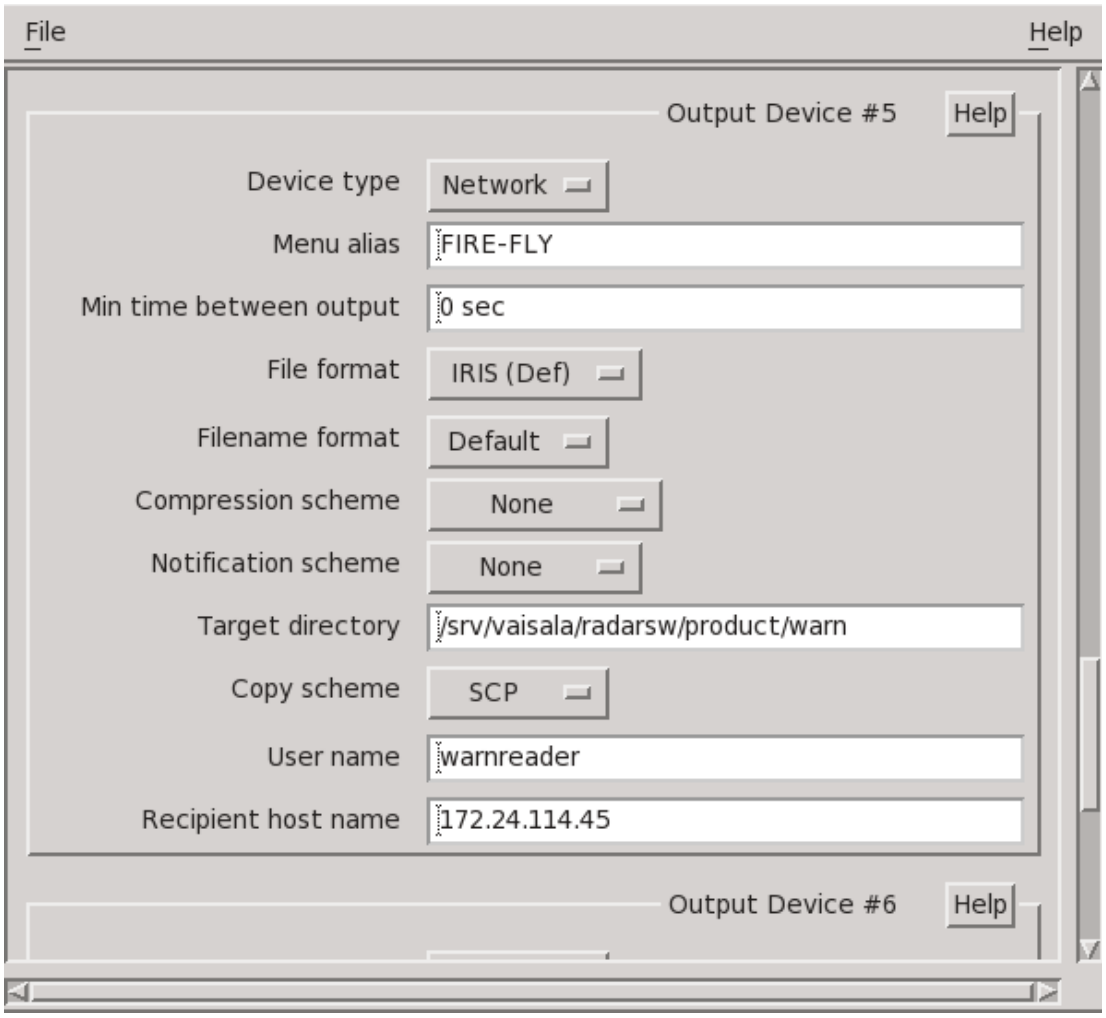
   b. Schedule the **WARN** indefinitely by right-clicking the **Status** column for that row and selecting **All**.

5.5.5 Configuring an IRIS Output Device for WARN Products

In IRIS, you must configure the IRIS Focus server as an output device to which IRIS copies **WARN** product files. The output device configuration would look something like the following, except the *Menu alias* and *Recipient host name* fields would be filled in with a name for the output device and with the network address of the FIRE server (don't forget to save and restart IRIS after making changes to output device configurations):

1. In the IRIS terminal window, type: **setup&**
   The IRIS **Setup** utility starts.
2. In the IRIS **Setup** utility, select **Output**.
3. In **Number of Output Devices**, raise the number of devices by 1.

4. Scroll down to the first unconfigured output device and begin configuring the device for IRIS Focus **WARN** products.



   a. For **Device type**, select **Network**.

   b. For **Menu alias** type the name of the output device.
   The image shows an example.

   c. **Recipient host name** type the network address of the IRIS Focus Server.
   The image shows an example.

5. Save your changes and restart IRIS to take the changes into effect.

5.5.6 Sending WARN Products from IRIS to IRIS Focus

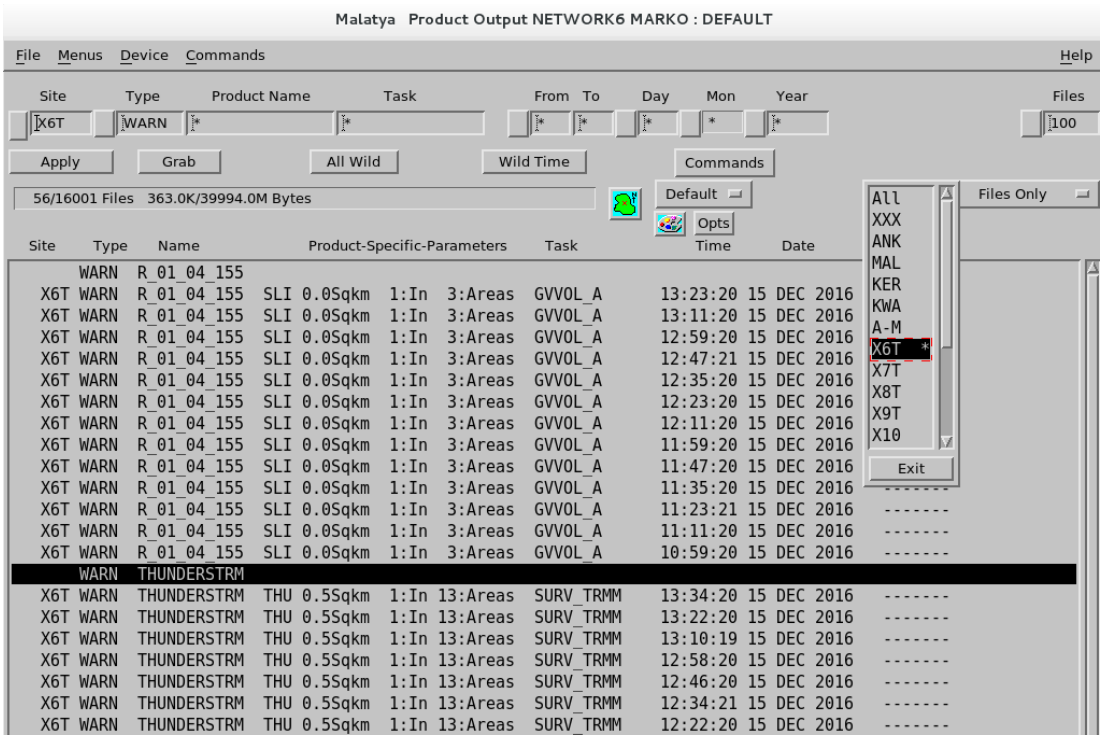
When you have configured and scheduled the **WARN** product, you can start sending **WARN** products over the network to IRIS Focus.

1. In the IRIS terminal window, type: **iris&**
   The IRIS Radar application starts.

2. Select **Menus > Product Output**.
3. In the **Device** menu, select the IRIS Focus device you want to send products to.

This is the device you configured in 5.5.5 Configuring an IRIS Output Device for WARN Products (page 101).

4. Filter the list of output products:



   a. For the **Site** field, select the correct radar site.
   b. For the **Type** field, select `WARN`.
   c. Select **Apply**.

   The `WARN` products that are generated for this radar site.are shown.

5. Right-clicking the **Request** column and select the site you want to start sending the product to.
   In the example above, the `THUNDERSTRM WARN` product will be sent to the `X6T` site.

Appendix A. Nowcasting Configuration Files

A.1. nowcast.ini

The following example shows the *`nowcast.ini`* configuration file for configuring the nowcasting HTTP server.

```
; Algorithm to use.
correlator=trec
```

TREC

```
[trec]
; Number of decimals to keep in data when converting to integers.
; Range:  [0 ; 3]. Default: 2.
input_precision=2
```

```
; The value in image that declares a missing/invalid value.
; Default: -999.0.
missing_value=-999.0
```

```
; The value in image that declares a not-scanned pixel, outside the aperture
area.
; Default: -900.0.
not_scanned_value=-900.0
```

```
; Minimum measurement aperture coverage (%) in correlation region.
; Range:  [0.0 ; 1.0]. Default: 0.60.
aperture_coverage_threshold=0.60
```

```
; Minimum signal value for the pixel to be 'active' and used.
; Default: 10.0.
signal_threshold=10.0
```

```
; Feature box size.
; Range:  > 0 Default: 14
field_feature_box_width=14
```

```
; Amount of skip when calculating field values.
; Range:  > 0.  Default: 1 (no skip).
field_feature_box_spacing=1
```

```
; Minimum fraction (%) of active pixels in feature box needed to trigger
correlation analysis.
; Range:  [0.0 ; 1.0] Default: 0.10
field_signal_coverage_threshold=0.10
```

```
; Minimum allowable cross-correlation coefficient.
; Range:  [0.0 ; 1.0] Default: 0.55
correlation_threshold=0.55
```

```
; Maximum storm movement between images, search region radius.
; Range:  > 0  Default: 15
speed_limit=15
```

```
; Spatial smoothing factor, exp(-d/decay). Used for spreading effect
; of local motion vector to its surroundings.
; Range:  >= 0 (0 == no spatial smoothing) Default: 6
field_spatial_decay=6
```

```
; Spatial filtering flag. Whether to discard points that differ from global
average.
; Range:  0 == NO; 1 == GLOBAL; 2 == LOCAL . Default: 1(GLOBAL)
field_use_spatial_filtering=1
```

```
; Feature box size for local spatial thresholding (applied only when using
local spatial thresholding).
; Range:  > 0   Default: 9
field_spatial_filtering_box_width=9
```

```
; Maximum allowed direction difference from mean motion (applied only when
using spatial filtering).
; Range: [0 ; 180]  Default: 90
field_spatial_direction_threshold=90
```

```
; Maximum allowed speed (mgt*mean_motion) above mean motion (applied only when
using global spatial filtering).
; Range:  >= 1.0  Default: 3.0
field_spatial_magnitude_threshold=3.0
```

```
; Global vector weight applied to local values.
; Range:  [0.0 ; 1.0] (0.0 = no global weighting). Default: 0.25
field_global_weight=0.25
```

```
; Method for temporal smoothing.
; Range: 0 == NO_TEMPORAL_SMOOTHING; 1 == HISTORY_WEIGHTING; 2 ==
CHANGE_WEIGHTING.
; Default: 1(HISTORY_WEIGHTING)
temporal_smoothing_method=1
```

```
; History weight factor (applied when temporal smoothing is made by using
HISTORY_WEIGHTING).
; Range:  ]0.0 ; 1.0]  Default: 0.25
temporal_smoothing_history_weight=0.25
```

```
; Change weight factor (applied when temporal smoothing is made by using
CHANGE_WEIGHTING).
; Range:  ]0.0 ; 1.0] Default: 0.33
temporal_smoothing_change_weight=0.33
```

More Information

- Configuring Nowcasting (page 88)

A.2. vsoweb-override.ini

The *vsoweb-override.ini* configuration file contains setting for managing the MVF and advection used in nowcasting.

Vaisala has carefully chosen good defaults for the nowcasting configuration.
The raster product, such as **PPI**, **CAPPI**, of any intensity moments like `Z`, `R`, `KDP`, or `rhoHV` that is used as an input for MVF generation should have:

- As little as possible of ground clutter and the near-radar clear air or particulates (such as dust) returns.
- The bounding box not smaller than any other raster product produced from this site's data.

Because the two conditions are contradictory, the easiest way to satisfy first condition is to use a true (not pseudo) **CAPPI** product with a height of 1.5 ... 2km , but the longest range (biggest bounding box) product is a raster product generated from the survey scans, which usually consist of just one **PPI** scan and cannot be used to generate true **CAPPI** products. You must balance these two conditions.

If there are not enough valid products to generate an MVF request, the iteration is skipped and the system waits for the next product to arrive from IRIS.

Basic Settings

`nowcast.mvf.run` defines if MVF generation is enabled in IRIS Focus. By default, MVF generation is enabled (`true`).

```
[NOWCAST]
nowcast.mvf.run = true
```

The nowcast server URL defines identifies where the nowcast HTTP server runs. The default value is for a fully local installation, which is the default installation configuration.

```
nowcast.http.server.url = http://localhost:34480/api/v1/mvf/
```

The netCDF directory stores MVF generation requests and responses to the Nowcast HTTP Server in netCDF format as well as internal representations of MVF serialized to disk. This directory is cleaned periodically by default.

```
nowcast.netcdf.dir = /srv/vaisala/radarsw/product/nowcast/
```

Advanced Settings

`nowcast.mvf.request.num.rasters` defines the number of products sent to the nowcast server for generating the motion vector field (MVF). Default is 2.

```
nowcast.mvf.request.num.rasters = 2
```

`nowcast.mvf.product.age.limit.minutes` defines the maximum number of minutes (5 ... 1000) the system goes back in time to find valid products (of the type used to define MVF generation for a site) to use in generating the MVF. Default is 100.

```
nowcast.mvf.product.age.limit.minutes = 100
```

`nowcast.mvf.max.gap.minutes` defines the maximum acceptable gap in minutes (1 ... 1000) between products for MVF generation. Default is 30.

MVF is a shift in pixels per time interval between frames of the product which was used to generate MVF. The interval between advected products could easily be different from the interval between advected frames. For example, if MVF was generated from the product which was available every 5 minutes but the interval between advected frames has to me 10 minutes, the MVF shift should be doubled. That MVF scaling is taken into account by scaling shift in every iteration.

```
nowcast.mvf.max.gap.minutes = 30
```

`nowcast.product.times.age.limit.minutes` defines the time range for calculating advected product times (2 ... 2880 mininutes. 2880 is the entire two day range). Default is 100

Advected product times must be evenly spaced (due to the calculation). The time is derived by dividing the last number of minutes defined in this property by **n** products found in that period.

The spacing is used as the time gap between advected products. In most cases, you should set this value to match the value in `nowcast.mvf.product.age.limit.minutes`.

```
nowcast.product.times.age.limit.minutes = 100
```

`nowcast.advection.mvf.age.limit.minutes` is the maximum number of minutes to go back in time to find an MVF when generating advected products. If an MVF is not found in the time span given, the iteration is skipped and Focus waits for the next product to arrive from IRIS. Range: 5 ... 1000 minutes. Default is 30.

```
nowcast.advection.mvf.age.limit.minutes=30
```

`nowcast.advection.time.span.minutes` defines the time limit when extending nowcasted products into the future, in minutes. The normal range is 1 ... 3 hours. Default is 120.

You can raise the time span to as much as 6 hours but this is not recommended as accuracy becomes more vague as time is extended into the future.

```
nowcast.advection.time.span.minutes=120
```

Glossary

advection
The transfer of a property of the atmosphere, such as heat, cold, or humidity, by the horizontal movement of an air mass. Advection calculations are used to perform some of the nowcasting calculations.

Bin
A single sample of weather data detected at a known direction, altitude, and distance from the radar site. The radial size of a bin depends on decreases with distance, so bins further from the radar site cover a larger area than nearby bins.

Hydrometeor
A particle of condensed water vapor in the atmosphere. Rain, snow, and hail are examples of hydrometeors.

MSL
Mean sea level. An average level for the surface of the sea or ocean.

NDOP product
Dual-Doppler velocity product. Combines the velocity measurements from 2 or more radars to get the wind direction and speed.

Nowcasting
Weather forecasting within the next 6 hours.

NWP
Numerical weather prediction

PRF
Pulse Repetition Frequency measured in Hz (pulses per second). When measuring PRF, a *pulse* contains transmit, receive, and dead time phases. PRF affects *range folding* and *velocity folding* detection. Normal PRF values for Doppler radars are up to 1000 Hz. Vaisala radars generally operate around 400-700 Hz. In Vaisala IRIS products, PRF limits the area displayed in radar images and the maximum measurable wind speed.

Pulse
A short burst transmission signal sent by the radar, used to measure the weather activity in atmosphere. The reflection measurements from a pulse are sorted into bins. See also Bin (page 111).

Range folding
Radar signal echoes from outside the radar maximum range that are incorrectly displayed within the radar measurement area. Also called range aliasing.

Sweep
A collection of pulses at a constant elevation as the radar rotates around its axis 360°. After a sweep, the radar usually changes its elevation and starts a new sweep. Each sweep typically contains the same number of bins independent of the elevation. See also Bin (page 111).

Velocity folding

Erroneous readings due to particles in the measurement area exceeding the maximum velocity detection threshold of the radar system. The measured velocity "wraps around" to the other end of the scale, resulting in discontinuous readings. Also called velocity aliasing.

Volume

Complete set of raw measurement data collected from sweeps, that is used to calculate a model of the atmosphere. The maximum volume is half of a sphere (from 0° elevation upwards), but other shapes are more typical.

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Technical Support

Contact Vaisala technical support at helpdesk@vaisala.com. Provide at least the following supporting information:

- Product name, model, and serial number
- Name and location of the installation site
- Name and contact information of a technical person who can provide further information on the problem

For Vaisala Service Center contact information, see www.vaisala.com/servicecenters.

Warranty

For standard warranty terms and conditions, see www.vaisala.com/warranty.

Please observe that any such warranty may not be valid in case of damage due to normal wear and tear, exceptional operating conditions, negligent handling or installation, or unauthorized modifications. Please see the applicable supply contract or Conditions of Sale for details of the warranty for each product.

Recycling

Recycle all applicable material.

Follow the statutory regulations for disposing of the product and packaging.

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