

2.19 VVP: Velocity Volume Processing

wind VVP Product Configuration: VVP			
File	Menus	Type	Commands
Help			
TASK SUMMARY			
TASK Name	<input type="checkbox"/>	VVP	DSP Data <input type="checkbox"/> V
Scan Mode		PPI Full	Max Range <input type="text"/> 60.0
Angle List		AZ: -NA- EL: 5 Tilts from 3.0 to 25.0	
PRODUCT PARAMETERS		DATA CHOICES	
Data:Display	<input type="checkbox"/>	V : Wind	
Min/Max Range		<input type="text"/> 2.0 <input type="text"/> 60.0	
Min/Max Height		<input type="text"/> 0.0 <input type="text"/> 15.0	
Height Lvl		<input type="text"/> 20	
Bin Quota		<input type="text"/> 8000	
Unfolding	<input type="checkbox"/>		
		Reflectivity	<input type="checkbox"/>
		Vertical Wind	<input type="checkbox"/>
		Divergence	<input type="checkbox"/>
		Deformation	<input type="checkbox"/>

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

- Task Summary area, Section 2.1.1.
- Product Parameters, see Section 2.1.3.
- Display Parameters area, Section 2.1.4.

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

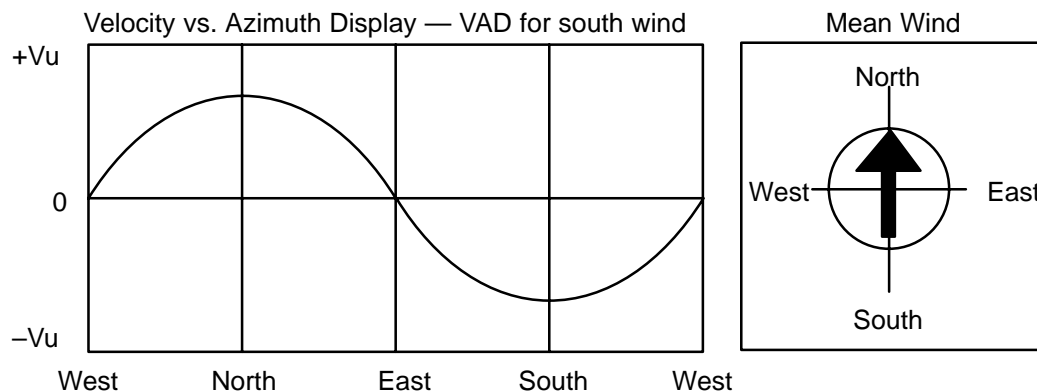
- Horizontal wind speed and direction
- Horizontal divergence (related to vertical air motions)
- Particle vertical velocity (airspeed and particle fallspeed combined)
- Horizontal deformation and axis of dilatation (related to frontal forcing)
- Average reflectivity.

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

A Doppler radar can only measure the component of wind either towards or away from the radar. This is called the “radial wind.” However, by looking at the wind over all azimuths around a full circle, the average wind speed and direction can be

determined. This is shown schematically in Figure 2–9 for the case of a south wind. The figure shows the radial velocity at a range bin as a function of azimuth. When the radar is looking directly south, the radial velocity measures the full speed of the wind (toward the radar). The SIGMET convention is that positive radial velocities are away from the radar. When the beam is pointed east or west, there is no component of the wind toward the radar, so the radial velocity is zero. The divergence over the radar is estimated by taking the average of the radial velocity. Other kinematic parameters can be estimated, such as the deformation and the axis of dilatation of the wind.

Figure 2–9: Example of Radial Velocity vs. Azimuth Display



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

To open the VVP Product Configuration menu:

Choose **Type→VVP** from the menu bar.

Data : Display

V Wind

Min/Max Range

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

Min/Max Height

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

Height Levels

Specify the number of height intervals. The example in the figure covers the height span from 1.0 to 12.0 km in 20 intervals.

Bin Quota

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

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

Unfolding

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

Reflectivity, Vertical Wind, Divergence, Deformation

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

2.19.1 Configuring the Associated TASK

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

2.19.2 Producing VVP Product Output

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

- **Line graphs vs. height** — Up to 3 parameters can be selected for plotting vs. height. Standard deviation bars are included on the plots.
- **Time-height cross-sections** — Wind barbs, wind strings or axis of dilation/deformation lines are superimposed on a colored background of reflectivity, deformation, divergence or vertical velocity. Time scale and height are selectable.

The selection of the display style, parameters, plot limits, and so on, are all made interactively in the Output Options menu of either the Quick Look or Product Output Menu.

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