Improvements in Quality Control for IRIS Weather Radar Wind Profiles

Joseph Holmes[1], Reino Keranen[2], Iida Sointu[3]

[1]Vaisala Inc, Westford, MA, USA • [2]Vaisala Oyj, Vantaa, Finland • [3]University of Helsinki, Finland

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Abstract

The IRIS software has produced radar based wind profiles using the VVP algorithm since 1990. With the increasing use of these data as input to weather models, improved quality control is needed. To support this, Vaisala has included standard deviations with all the recorded VVP data. We now allow output-time thresholding of horizontal velocities based on standard deviation, sample size, and max/min velocity as recommended by OPERA_2005_19. The effect on quality and availability are presented for new recommended thresholds.

Quality and Availability

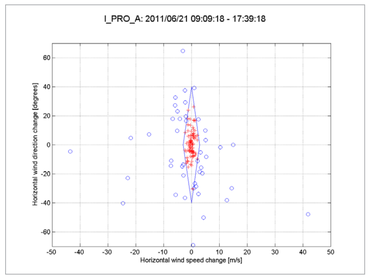
The goal of thresholding is to remove the bad data without removing much of the good data. To measure this, we define the two measures:

Quality = # good winds / # all winds

Availability = # good winds / # all winds possible

This assumes that we somehow know what are “good” and “bad” winds. Comparing radar profiles with atmospheric models was not accurate enough to do this. So we developed a self-consistency solution. We compare the calculated wind vector with the same vector calculated 30 minutes before. Therefore:

Good wind = velocity and direction changes inside diamond in 2D plot (+/- 3 m/s, +/- 40 degrees).

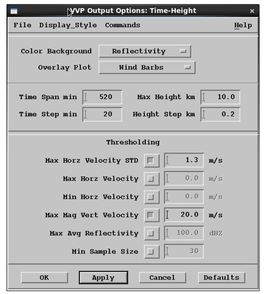


Example of “good wind” diamond

Threshold Choices

Our legacy systems thresholded using only the standard deviation of the horizontal velocity. We have now added the following additional choices: Minimum and Maximum horizontal velocity; Maximum magnitude of vertical velocity; Maximum average reflectivity; and Minimum sample size.

We have experimentally determined that a standard deviation threshold of 1.3 m/s works well in the chosen examples. This was used in all cases. This is the only threshold available in the legacy system. In the new version, we have added a threshold of 20 m/s Maximum magnitude of vertical velocity. This allows detection of cases where the least squares VVP fit is unstable, but still has a low standard deviation.



Example of VVP output options

Test Case Results

Data were recorded and processed over the summer of 2011 to evaluate the changes. We wanted to determine which thresholds were useful. Shown in the poster are 3 examples showing common weather scenarios: Stratiform rain, Convective rain, and Clear weather.

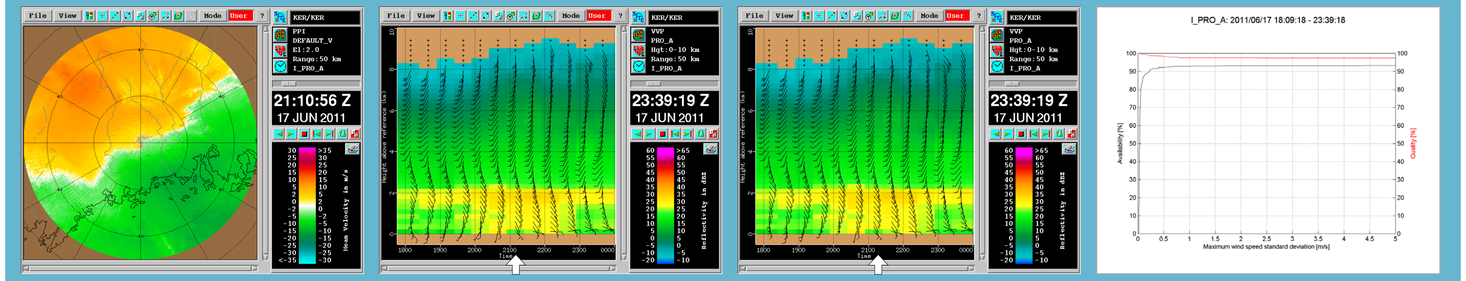
- Max Standard Deviation: This was by far the most useful. In both Stratiform rain and Clear weather, the standard deviation threshold had no problem separating the good from bad winds.
- Max Mag Vertical Velocity: In the Convective rain case, the addition of a maximum magnitude of vertical velocity was able to remove the remaining outliers. In all cases, the vertical velocity threshold did not significantly remove the good winds.
- Max Horiz Velocity: In all cases anomalously high values were removed by STD and Vert velocity.
- Min Horiz Velocity: In all cases we never had a anomalously low velocity.
- Max Reflectivity: This was intended to detect severe convective weather. Unfortunately Helsinki does not have a lot of these cases.
- Min Sample Size: In all cases, bad values removed by raising this threshold were also removed by STD and Vert Velocity.

System Specifications

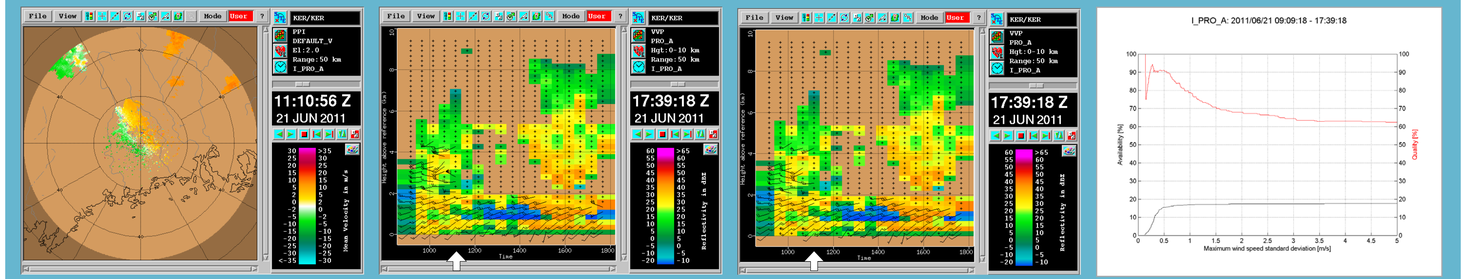
Data from Vaisala research radar, Kerava, Finland (near Helsinki)

Altitude: 95 meters
Wavelength: 5.33 cm
PRF: 1900/1267 Hz
Nyquist Velocity: 49.97 m/s
Pulse Width: 0.5 microseconds
Scan Rate: 12 deg/s
Bin Spacing: 100 meters to 50 km
Elevation List: 0.5, 2.0, 6.0, 12.0, 29.0 deg
Repeat time: Every 30 minutes

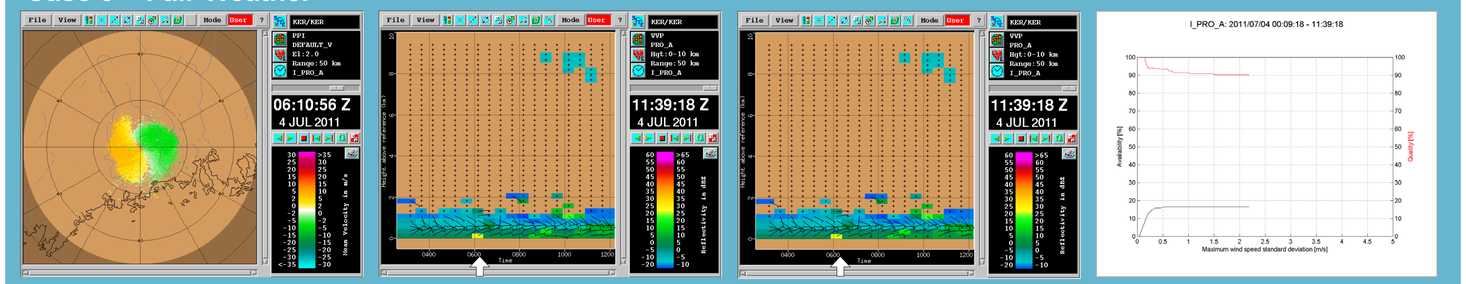
Case 1 – Stratiform Rain



Case 2 – Difficult Rain



Case 3 – Fair Weather



References

Holleman, I., 2005: Quality Control and Verification of Weather Radar Wind Profiles. *J. of Atmos. and Oceanic Technol.* **22**:1541-1550

Holleman, I., Michelson, D., Galli, G., Germann, U., and Peura, M., 2006: Quality information for radars and radar data. *OPERA_2005_19 Working Document*