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Use of Mid-Level Model Wind Data and VAD Winds to Improve WSR-88D Velocity Dealiasing

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Two-Dimensional Velocity Dealiasing Algorithm (2DVDA)

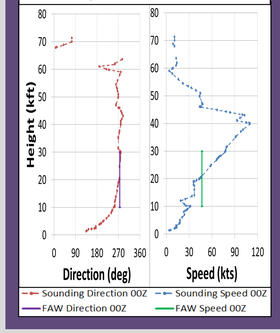
- **WSR-88D's primary dealiasing tool since 2013**
- **Features relevant to topic as of Build 16.1/17:**
  - **Develops internal Velocity Azimuth Display (VAD)**
    - Based on data, history, and RAP model data (latter ONLY upon startup or VAD not updated for 2 volumes)
    - Acts as a vertical wind profile
    - Updated as dealiasing occurs during elevation cut
  - **Uses internal VAD and identified features to initialize background Environmental Wind (EW) field**
  - **Dealiases full velocity field in 2 phases:**
    - Phase 1 – Generates subsamples of data field, applies 2D algorithm to dealias subsamples – dealiased subsamples update the EW field
    - Phase 2 – Partitions entire cut into smaller images, applies 2D algorithm to dealias individual gates, uses EW field from Phase 1 for global dealiasing

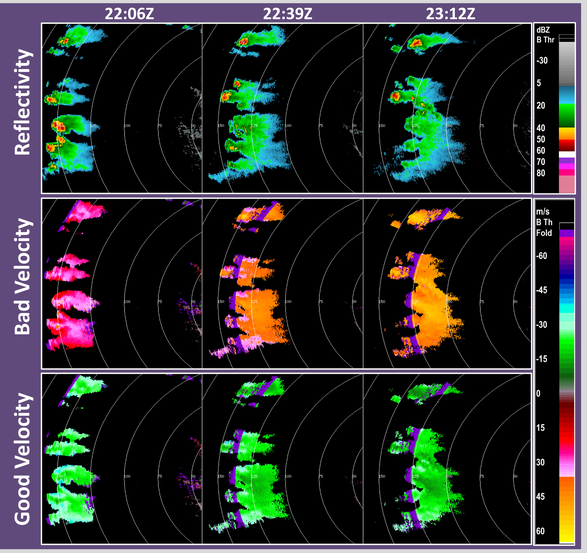
Problem – Dealiasing Failure

- **2DVDA assigned outbound velocities to truly inbound velocities**
- **Occurs when:**
  - New weather moves into radar coverage area
  - Minimal environmental wind data available in surface boundary layer
  - Low level winds very light or opposite in direction from new weather
- **Caused by:**
  - 2DVDA's internal VAD lacks sufficient data to interpolate correct wind direction
  - No independent check on internal VAD
  - Software conditions to use model data not met – can't verify with external source

- Case 1: Sioux Falls, SD (KFSD) Aug 07, 2015
- Errors: 21:37Z – 23:33Z
- Displayed: 22:06Z, 22:48Z, 23:12Z

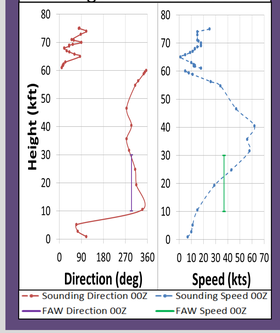
Aberdeen, SD 00Z Sounding
Average FAW nearest 00Z

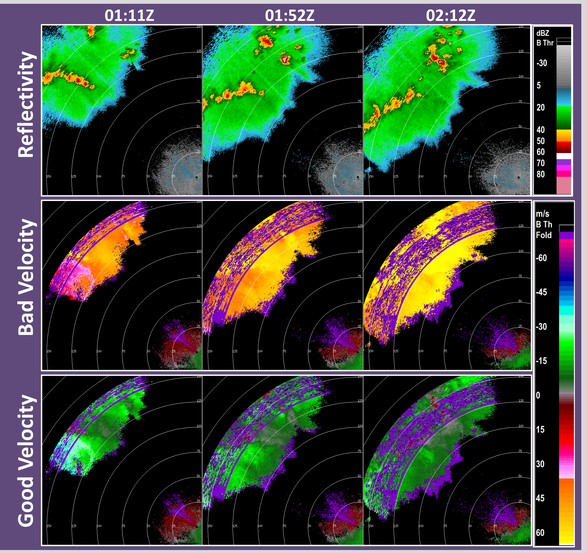




- Case 2: Hastings, NE (KUEX) June 29, 2016
- Errors: 00:20Z – 02:27Z
- Displayed: 01:11Z, 01:52Z, 02:12Z

Topeka, KS 00Z Sounding
Average FAW nearest 00Z





Solution – Model Data, VAD, and Free Atmospheric Wind

- **Update 2DVDA's code to:**
  - **Allow use of model wind profile (from RAP) each volume when:**
    - Weather is far from the radar
    - Internal VAD is not verified
  - **Compute Free Atmospheric Wind (FAW) estimate**
    - Verify model data and VAD with FAW
    - Replace bad internal VAD with FAW
    - Attempts to compute 1 FAW (speed and direction) per elevation cut
- **FAW Facts:**
  - Requires sufficient radar return between 3-9km (10-30kft) altitudes for calculation (150° az for <2° elv, 75° az for ≥2° elv)
  - Computed by applying 2D algorithm to all data in 3-9km altitudes, then performing independent VAD, separate from internal VAD, on same
  - Two values computed, better of two (value with smaller Fourier coefficient or smaller root mean square) selected
  - Values with high confidence are used outright; values with less confidence are stored and used to test vertical wind consistency

Testing the Solution

- **Model data unavailable for non-operational testing**
  - Used nearby vertical soundings as proxy for model data
- **Ran cases multiple times using updated code:**
  - No Model Data vs Good Model Data vs Bad Model Data
- **Tested sensitivity of new code to bad model data – modified wind direction and/or speed of proxy model data**

Results / Conclusions

- **FAW improves solutions even without model data**
- **Enhancements do not degrade dealiasing performance in other cases**
- **Verified that model data is not used when weather is close to the radar – bad model data will not contaminate dealiasing**
- **Use of model data makes dealiasing more robust**