Radar Dealiasing and Analysis with Py-ART

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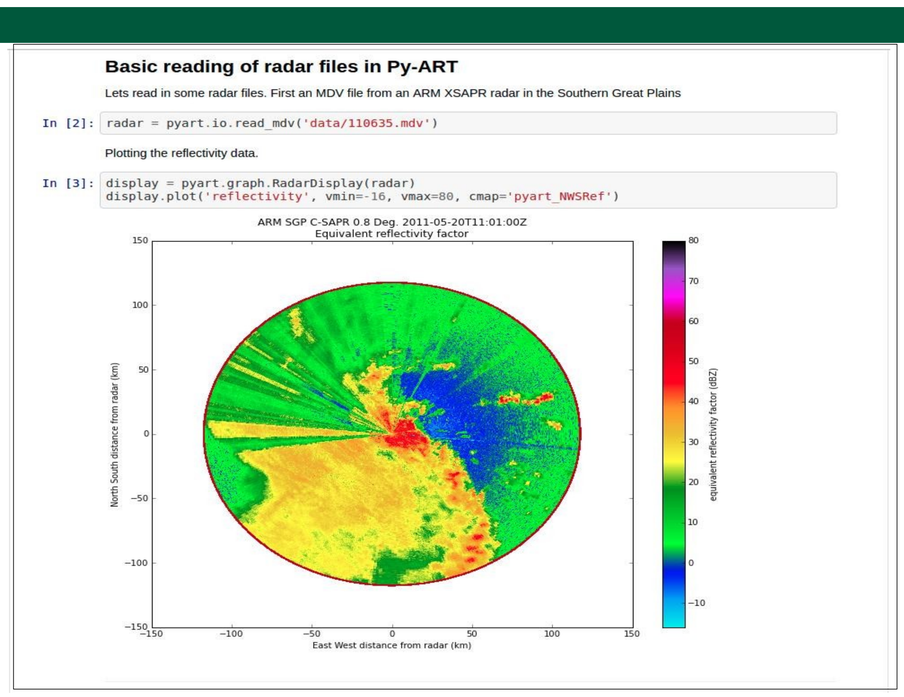
Goals

- Learn and become proficient with python and Linux.
- Utilize Py-ART to analyze radar data.
- Unfold (dealias) radar data and plot the number radar gates that were folded and when they occurred.
- Compare Py-ART's dealiasing to hand dealiasing and determine if errors occurred.
- Pinpoint errors and determine if they can be corrected.



Background Information

What can Py-ART do?

- Reading radar data in a variety of file formats.
- Creating plots and visualization of radar data.
- Correcting radar moments while in antenna coordinates.
  - Doppler unfolding/de-aliasing.
  - Attenuation correction.
  - Phase processing using a Linear Programming method.
- Mapping data from one or multiple radars onto a Cartesian grid.
- Performing retrievals on this mapped data or on the original radial data.

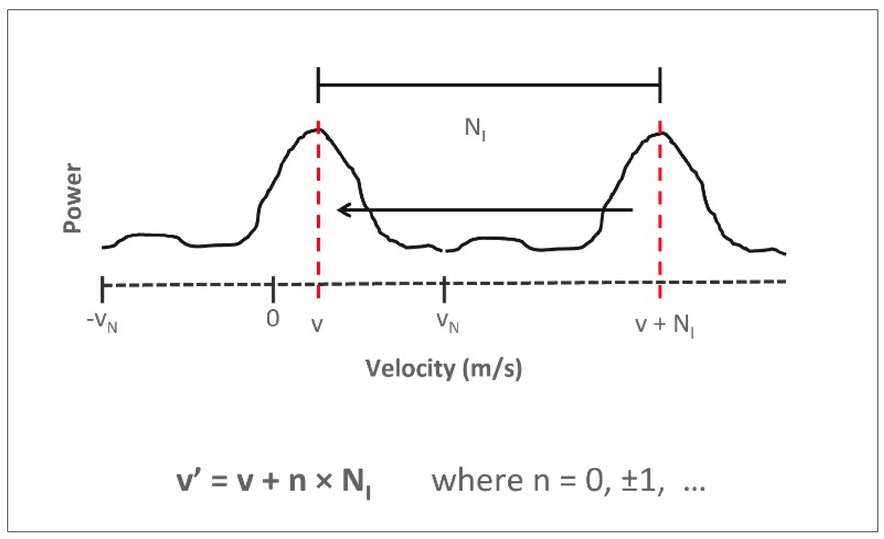
The Python ARM Radar Toolkit

- Py-ART, is a Python module containing a collection of weather radar algorithms and utilities.
- Py-ART is used by the Atmospheric Radiation Measurement (ARM) Climate Research Facility for working with data from a number of its precipitation and cloud radars, but has been designed so that it can be used by others in the radar and atmospheric communities to examine, processes, and analyze data from many types of weather radars.
- Has a rich IO layer allowing a very large number file formats to be read into the data model. Primary output format is CF-Radial.
- Community codebase on GitHub, main fork is DoE maintained and moderated.

Open Source: Helmus, Joanathan, Collis, Scott. http://arm-doe.github.io/pyart/

Aliasing

The DOPPLER Dilemma: A good choice of Pulse Repetition Frequency (PRF) to achieve a large unambiguous range will be a poor choice to achieve a large unambiguous velocity and vice versa.

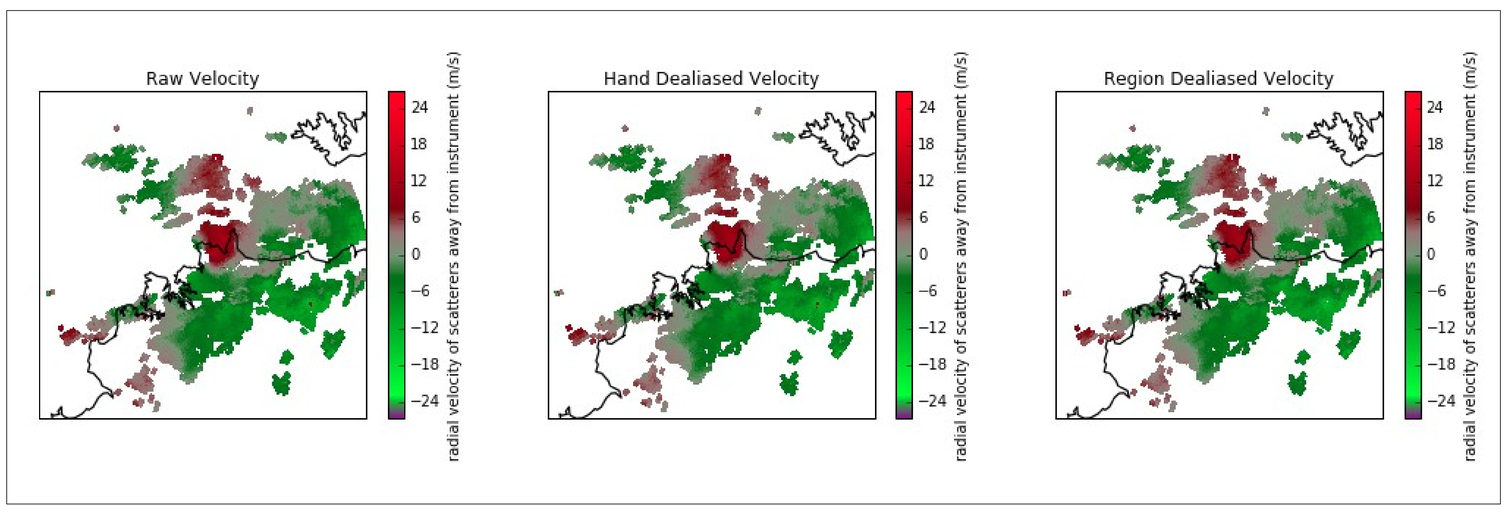


- When the PRF is high the radar has less time to sample the atmosphere between pulses. If the radar has less time to sense, it can not detect objects further away from the radar as compared to a low PRF. Thus, a high PRF has a smaller unambiguous range as compared to a low PRF.
- The Doppler dilemma states there is an inverse relationship between the unambiguous range and the unambiguous velocity.
- When PRF is low, unambiguous range is high, but that results in a low velocity range and vice versa.

Source: Wolff, Christian. Doppler Dilemma. http://www.radartutorial.eu/01.basics/Doppler%20Dilemma.en.html

Dealiasing with Py-ART

- Take CPOL (C-band Polarimetric) radar data and use Py-ART to fix radar aliasing.
- Determine the difference between hand dealiasing and Py-ART dealiasing
- Determine if Nyquist velocities were used correctly in both methods.



- Plot comparison plots to observe similarities and differences.

Results

- The python dictionaries in Py-ART are useful in interpreting radar data and create ease to the user for analyzing data.
- Py-ART was more efficient in correcting folding than hand dealiasing, but at some instances there was extra dealiasing that occurred.

Conclusion

- Py-ART does a fantastic job with importing different file types and also creating ease of plotting and interpreting data.
- Aliasing in radar data is an issue and creating using algorithms created in Py-ART are very useful in fixing aliasing.
- Future work includes adding a dealiasing function that corrects VAD (Velocity Azimuth Display) and also improving the current dealiasing of velocity.

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https://github.com/ARM-DOE/pyart