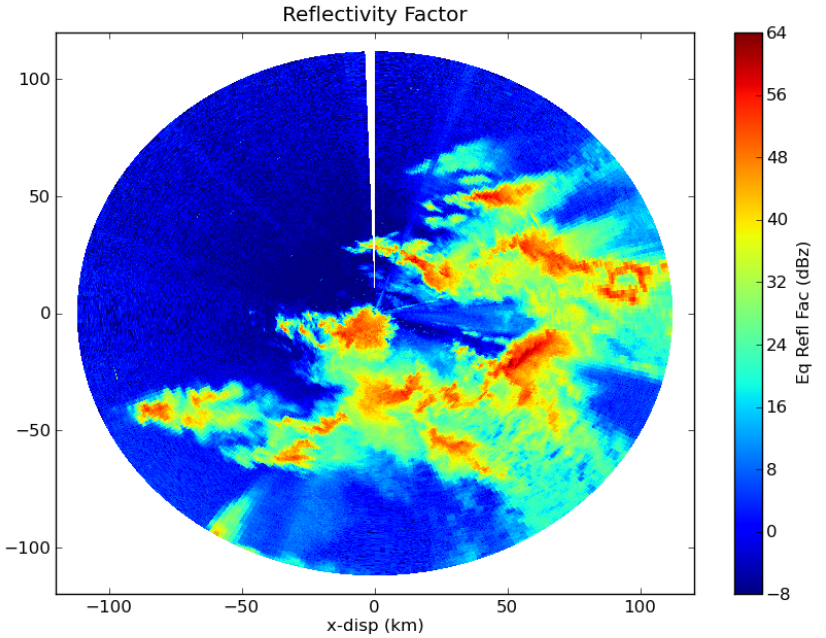
Moments to Models: Analyzing the data from the ARM Precipitation sensitive radars.

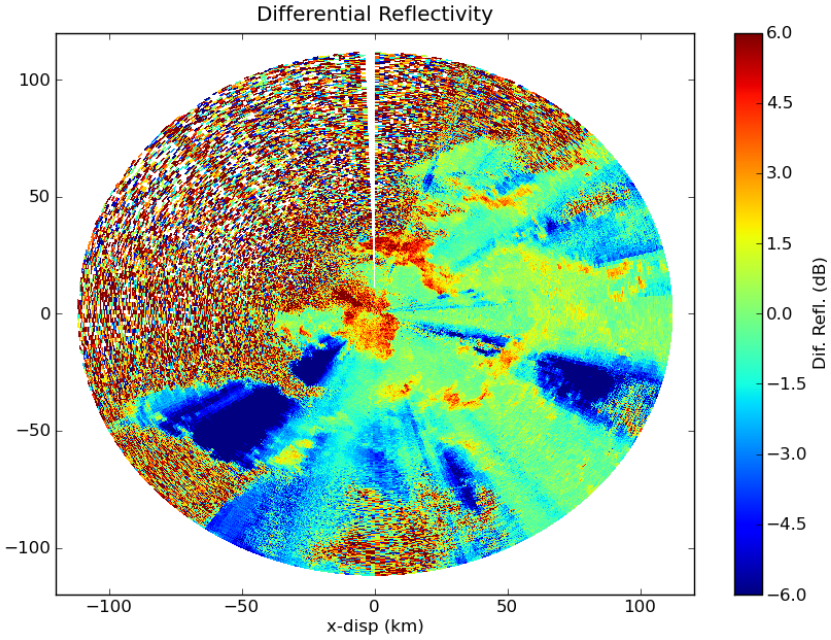
Scott Collis, Scott Giangrande, Kirk North, and Pavlos Kollias

This time last year…

What are we seeing from the radars?

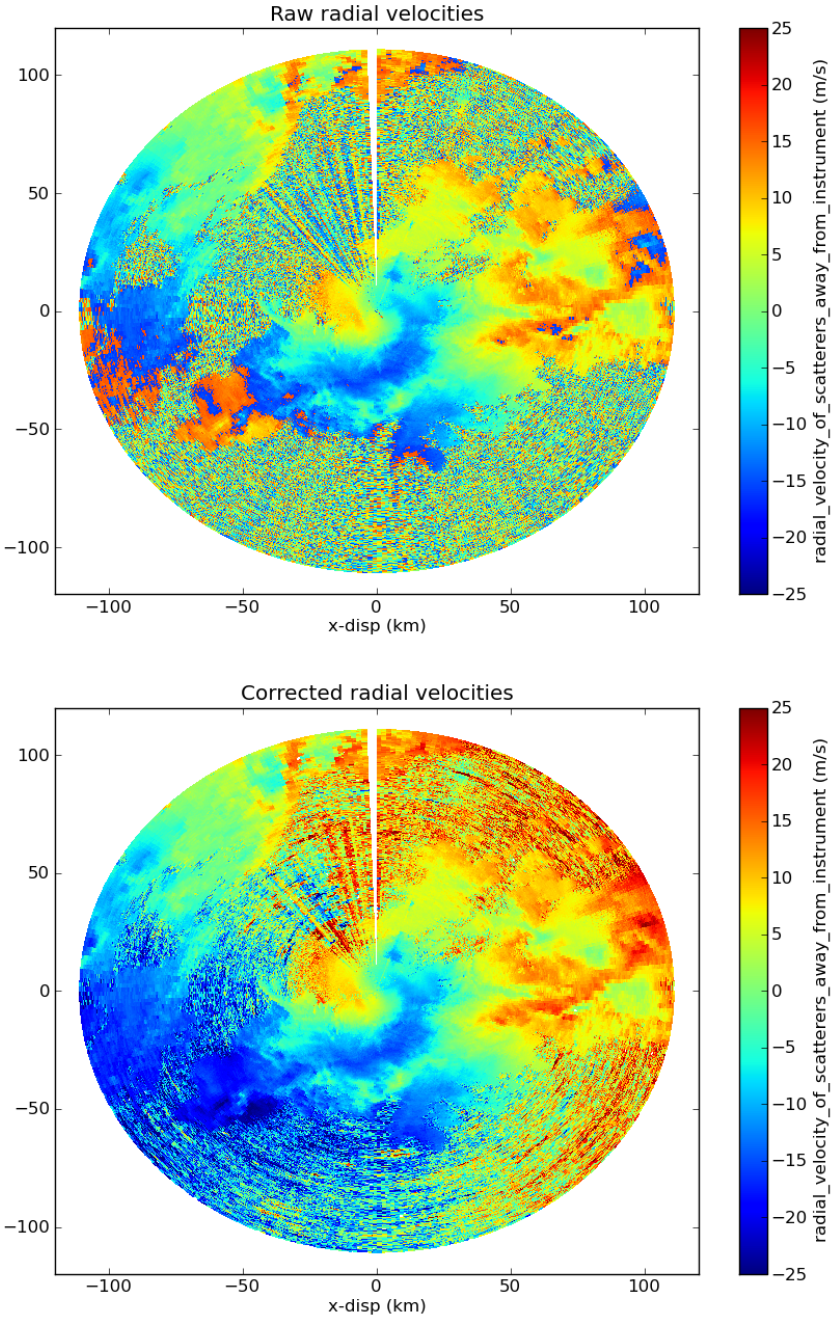
- Good high resolution data.
- Good vertical coverage from the agile X-SAPR systems.
- Working at high frequencies has meant nice KDP but issues with attenuation and differential attenuation.
- I have concerns using ZDR in OK, less in the tropics.





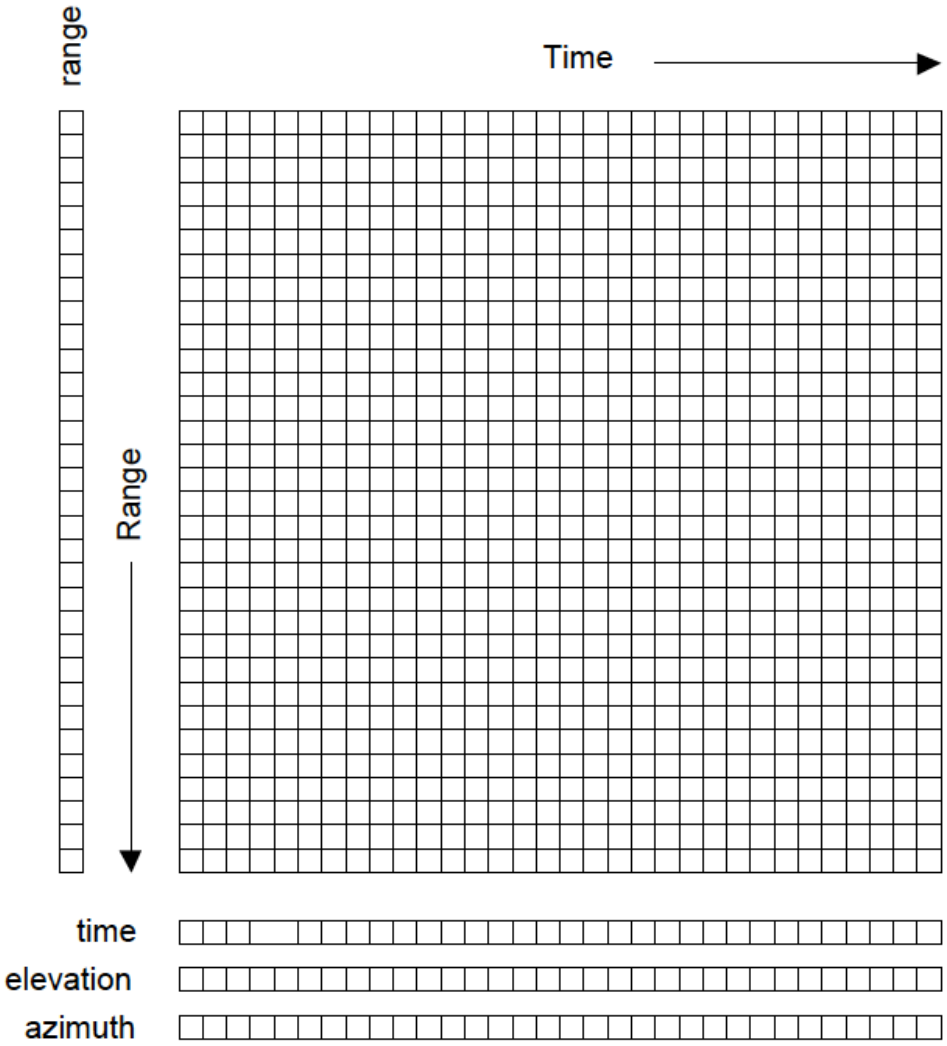
Corrections in antenna co-ordinates

- The university of Washington 4DD code has been adapted to work in a Python environment.
- ARM soundings used to generate a first guess. Dealiasing works well most of the times. Issues with clutter.
- Using a Z-PHI like method to correct for attenuation at C-Band. This is very sensitive and we need to improve processing.
- Work by Brenda and Angela from CSU on X-Band attenuation correction.



A VAP for radar folk

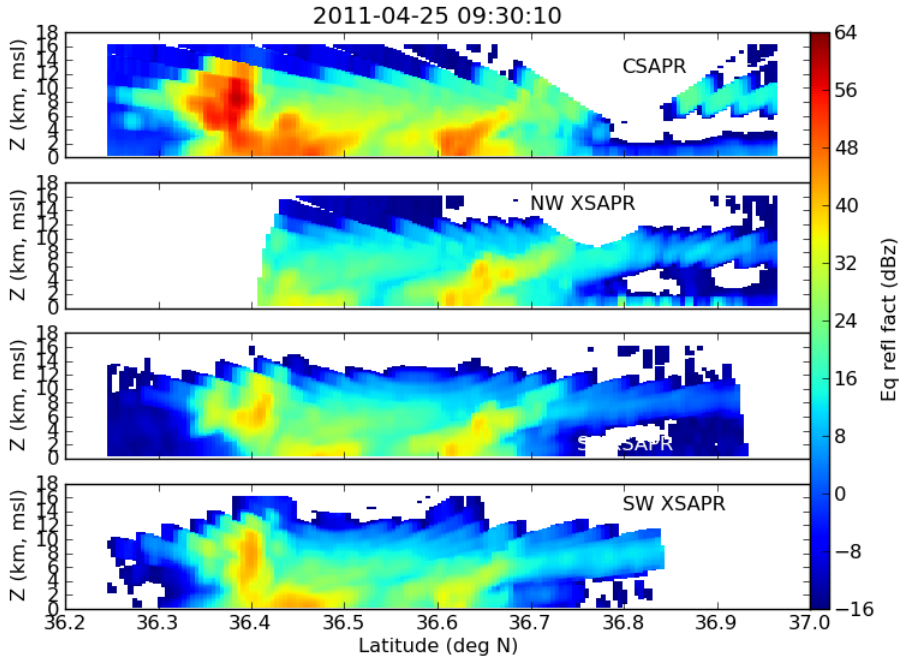
- Corrected Moments in Antenna Coordinates (CMAC) will be providing moment data in radial co-ordinates including any processing which has been done.
- The data format will be NetCDF adhering to the CF-Radial convections.
- This allows for very easy manipulation and plotting and ensured compatibility with a wide range of platforms.
- Will look very similar to ingested SACR data.

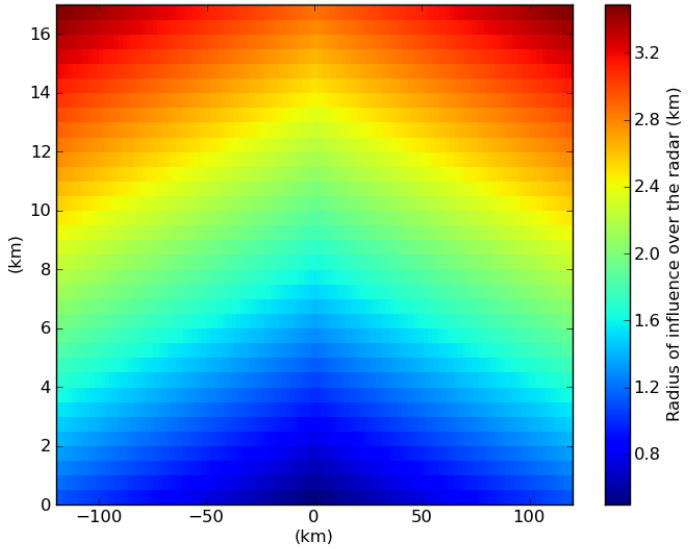


From the format document by Dixon et al.

Objective analysis, to reinvent the wheel?

- To increase the impact of the data we need it mapped to a model like grid.
- We tried to work with NCAR's Reorder as it is fast. We ran into issues with the inflexibility of the radius of influence.
- Need to have a formulation for ROI(**r**) that preserves low elevation detail and suppresses high elevation artifacts.
- We ended up writing our own code in a mix of C and Python. It is not as fast (we are optimizing!) but has a fully flexible formulation for ROI

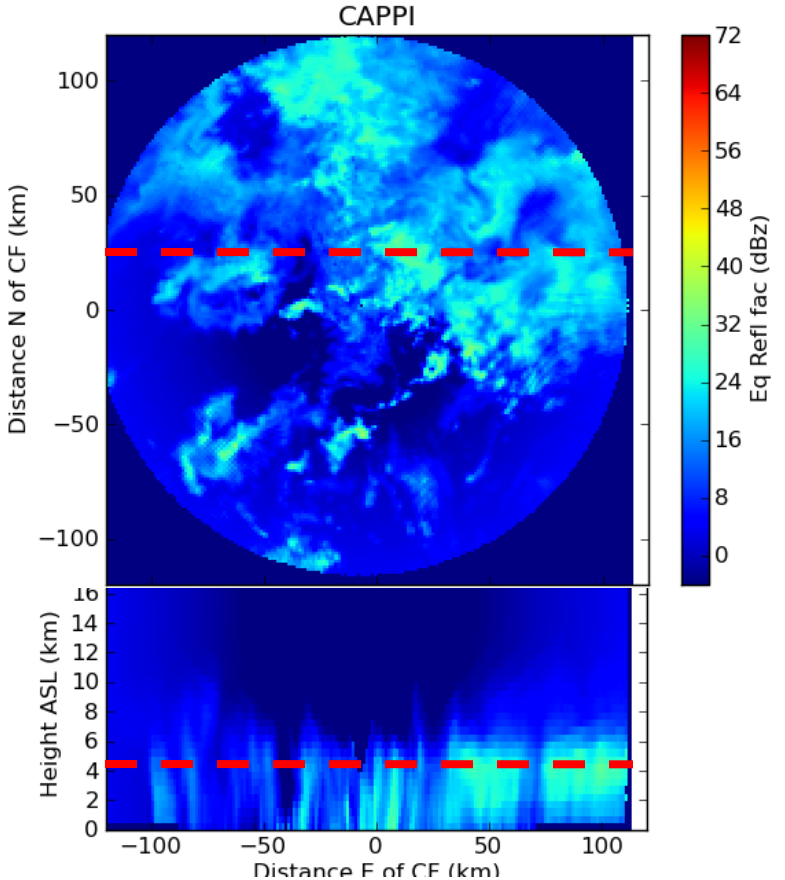


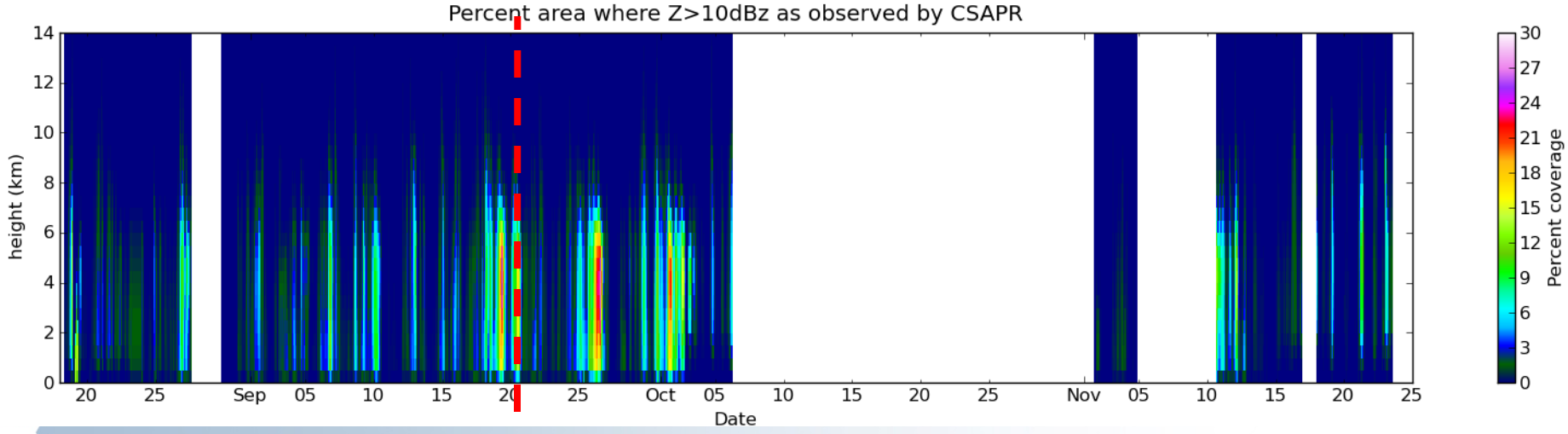


Mapped Moments to a Cartesian Grid (MMCG)

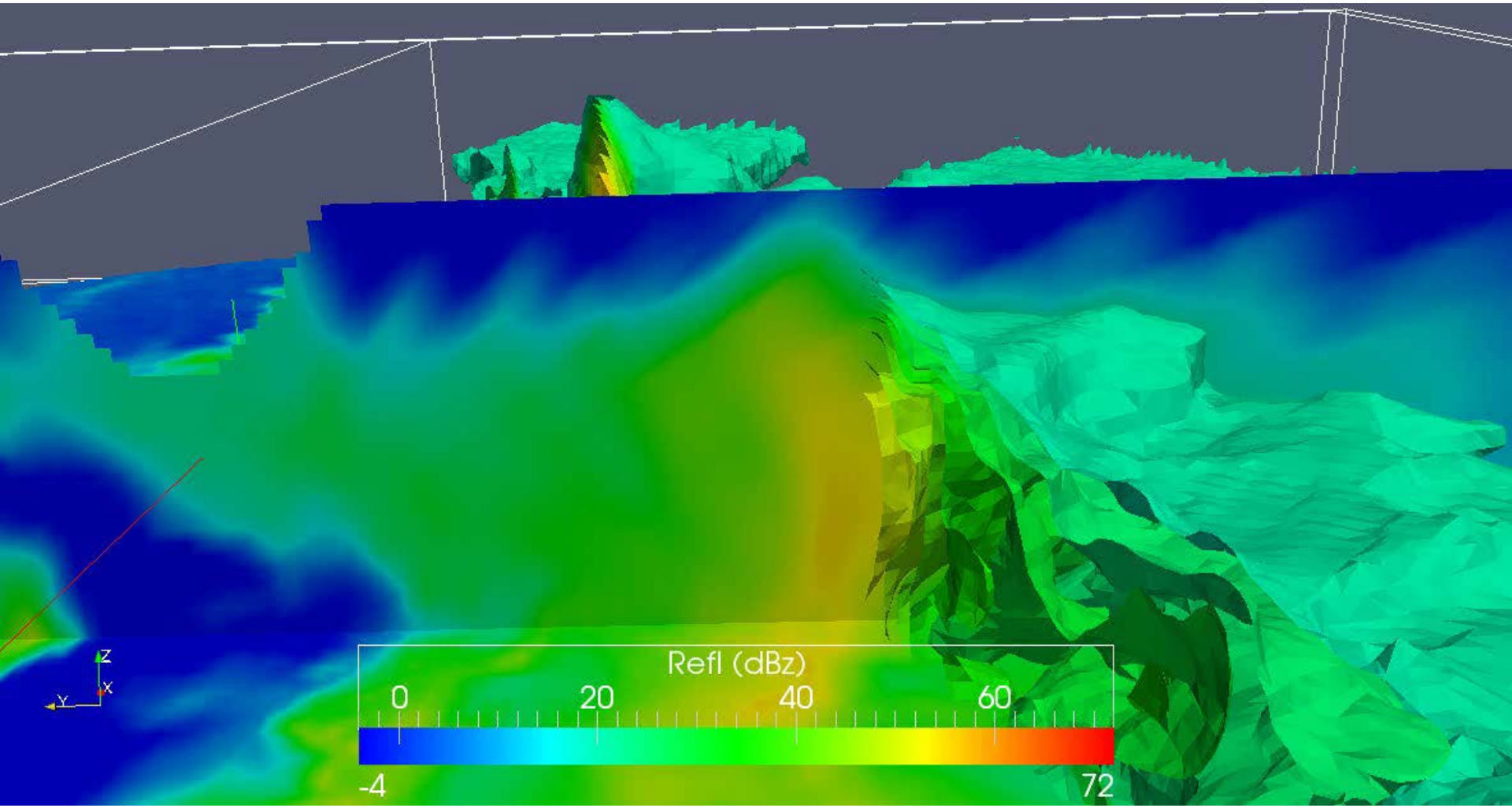
- First VAP from the ARM radars.
- CSAPR data from MC3E is in the development section (V0.1E) of the Archive AMIE Manus data soon to follow as well as X-SAPR data.

Site	Radar	Domain, resolution
SGP	CSAPR	240x240x17km, 1x1x0.5km
	CSAPR	100x100x17km, 0.5x0.5x0.5km
	XSAPR (x3)	100x100x17km, 0.5x0.5x0.5km
TWP Manus	CSAPR	240x240x18km, 1x1x0.5km
NSA Barrow		120x120x10km, 0.5x0.5x0.5km



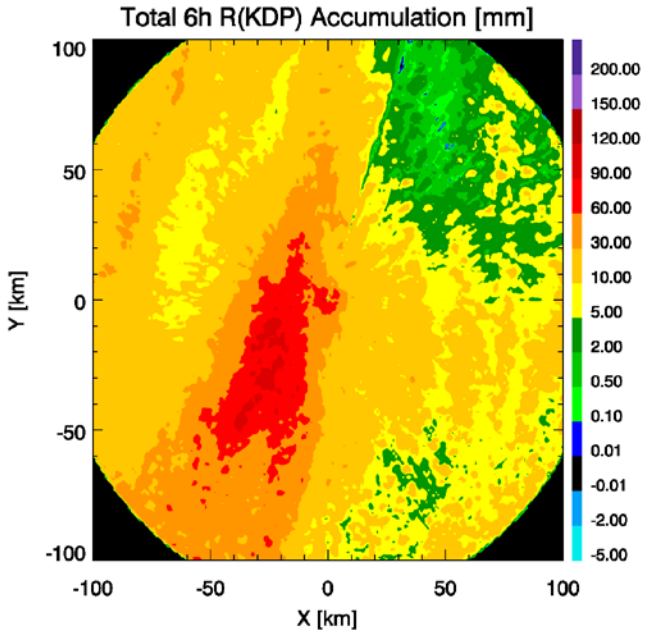


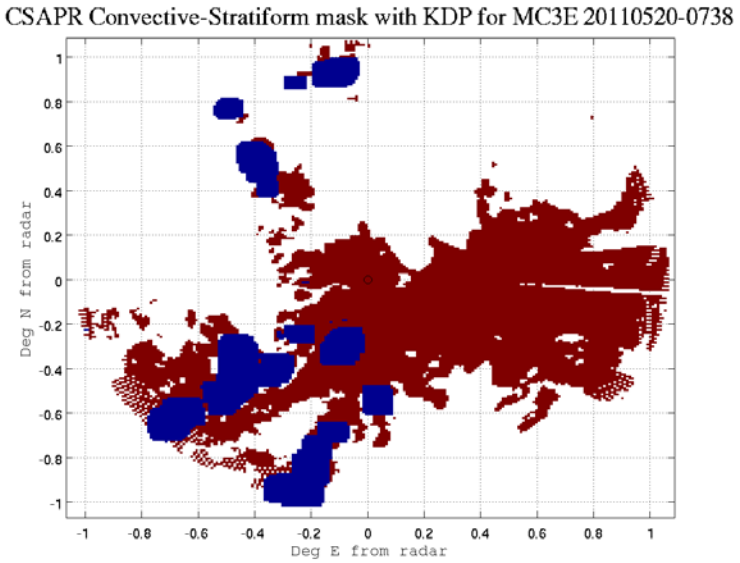
Three dimension storm structure

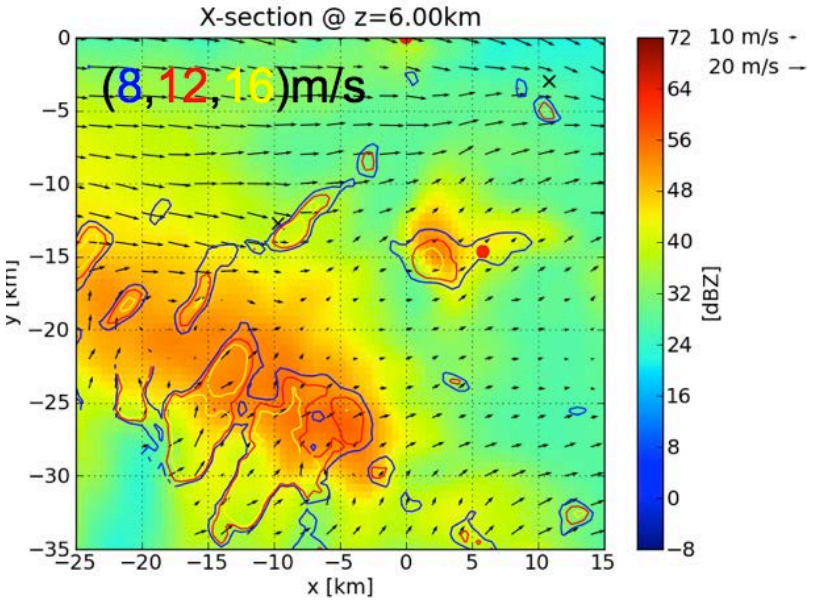


Retrievals

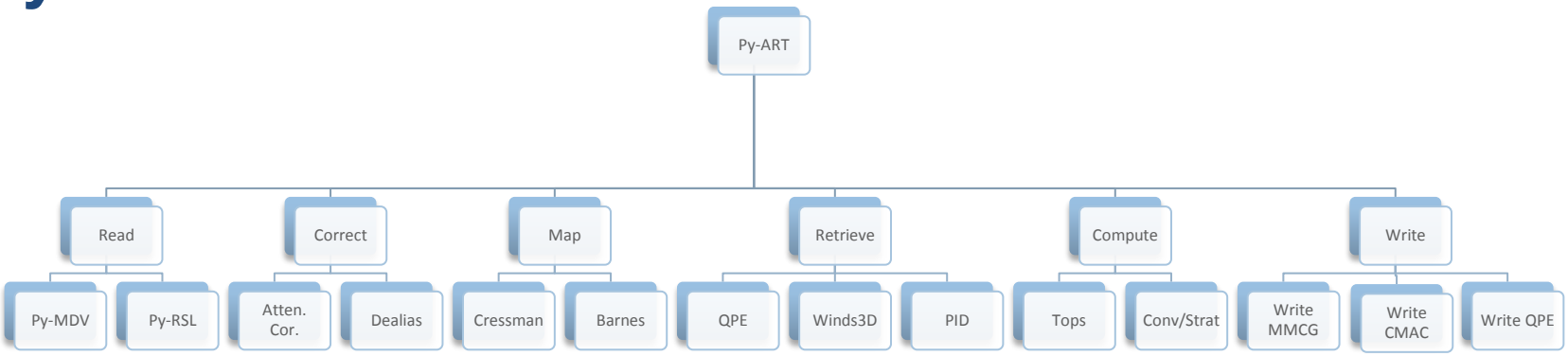
- Much of the work to date has been on QC and objective analysis.
- Much of the work on retrievals has been led by collaborators.
- Highlights include successful QPE retrievals for Oklahoma, first tri-doppler retrievals, great work by the CSU crew on X-Band particle ID.







Python-ARM Radar Toolkit



What is Py-ART

- Code used to produce VAPs from the precipitation radars released as an open source toolkit.
- Freely available and suited to working with the formats that ARM radars produce.
- Released under nonrestrictive licenses

We not only provide data streams and VAPS but the tools to work with the data.

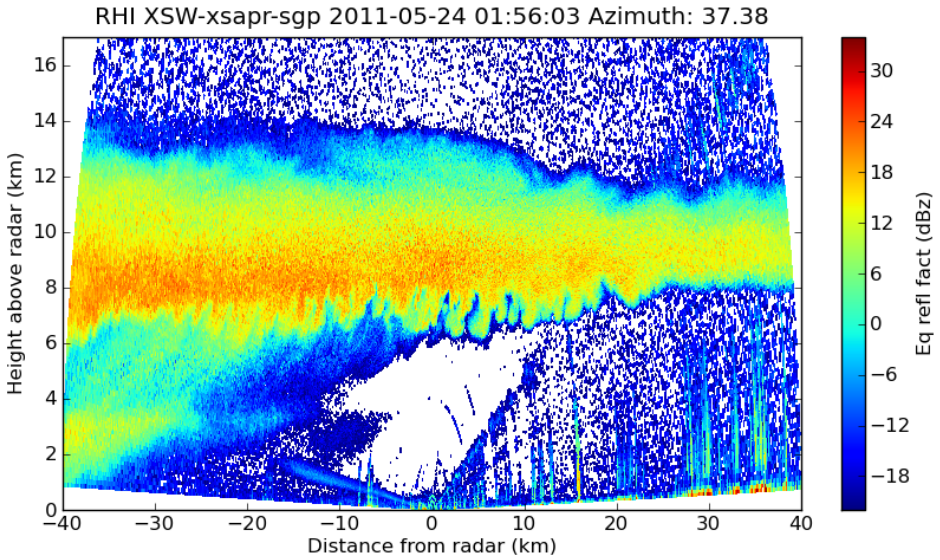
Why Python?

- Easy to prototype (easier to debug!).
- Open source by nature.
- Extensible, good success wrapping in existing radar codes into Python using Ctypes, Cython, SWIG et al.
- Great set of existing libraries.

Most importantly: A vibrant and engaged community!

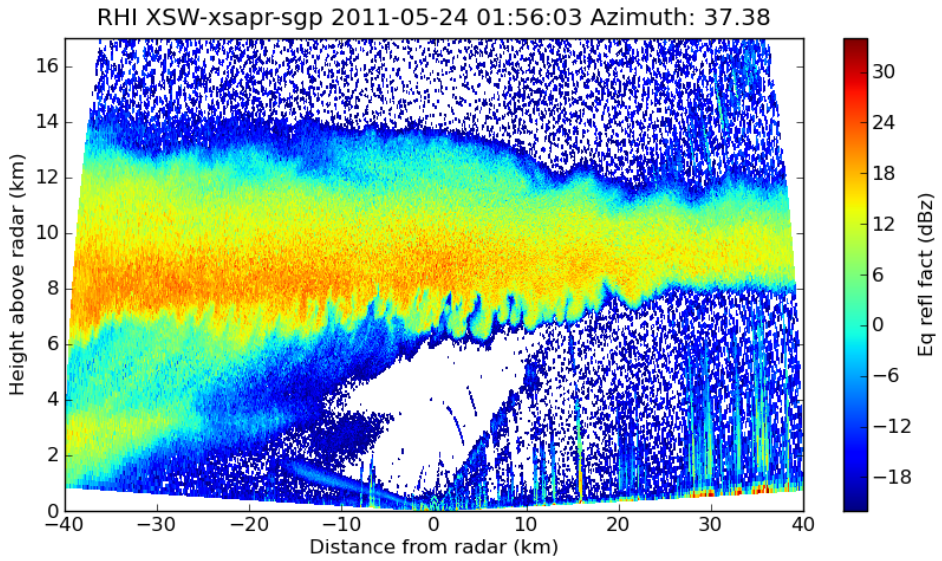
Operational modes of the radars conducive to retrievals.

- Initial work with the radars has helped shown how the facilities can be run to make our job “easier”.
- Timing: Having the radars synchronized greatly helps in multi-Doppler and multi-frequency retrievals.
- Timing: Having the radars start at predictable times (ie so you always get a scan that starts on the hour) helps with precipitation accumulations.
- Predictable mode changes.
- Also: The NW X-Band sees essentially the same as the CSAPR… Should we keep this is HSRHI mode?



HSRHIs?

- Amazing detail.
- X-Band sensitivity shows how we may use these instruments to “brid the gap”.
- Over the top scans give a great recording of tops.



Question is: What to Do with them?