Architectures for Rainfall Property Estimation From Polarimetric Radar

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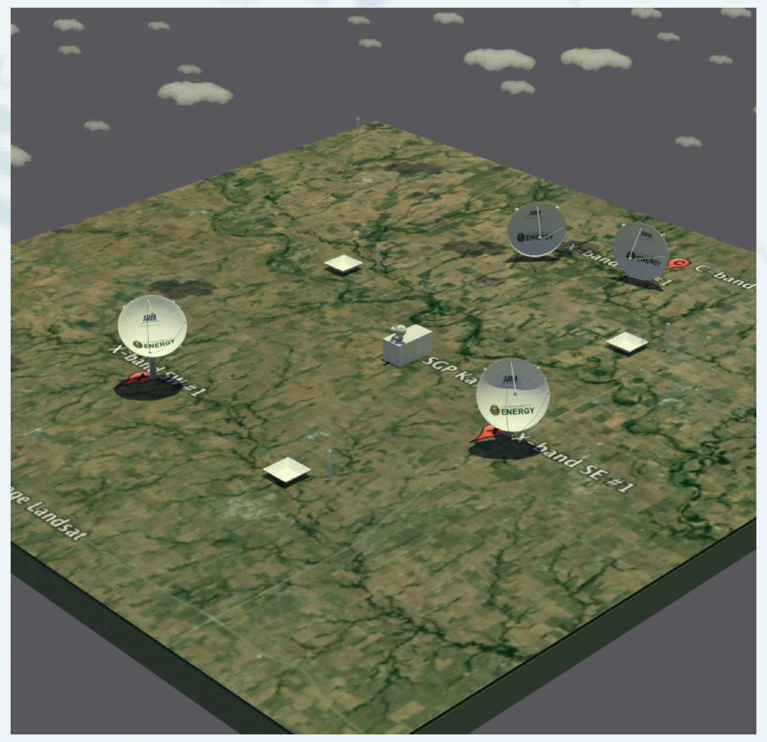
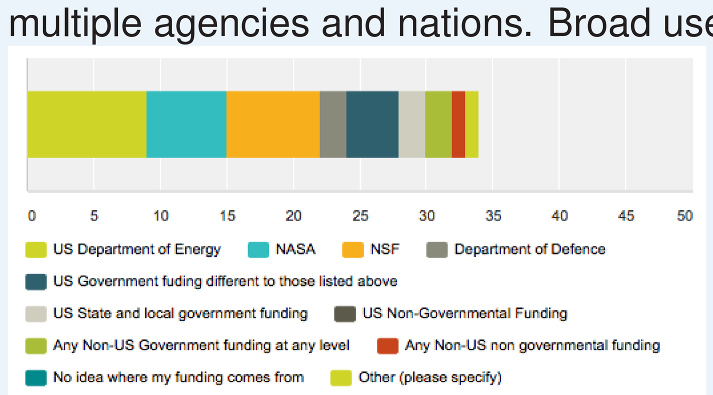
Introducton

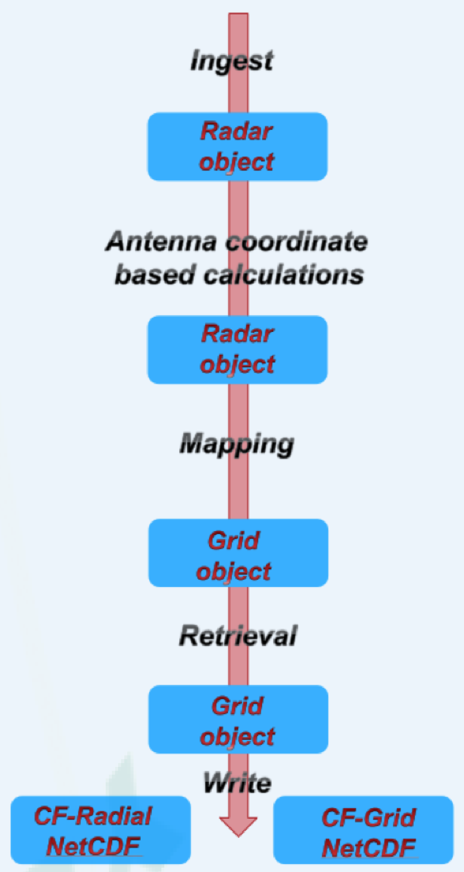
- Numerical simulations of decadal climate are done at resolutions far courser than the natural scale of precipitation. To even have a chance of understanding future precipitation extremes we must reconcile the relation between the statistics of broad-scale precipitation and high resolution observations.
- To this end The Department of Energy's ARM Climate Research Facility operates a network of 5 and 3 cm scanning radar systems.
- Fixed sites are at the Azores, Barrow on the North Slope of Alaska and a multi-scale heterogeneous network on the Southern Great Plains of Oklahoma.



Achieving insight with the community: The Python ARM Radar Toolkit

- Weather radars are not a new invention, first academic mention in Bent et al. (1943).
- Massive advances in computing and radar software has not kept up.
- They Python ARM Radar Toolkit, Py-ART is a data model driven architecture for interactively and offline processing of active remote sensing data. Open source and, using GitHub, community based.
- Part of a larger growing international community of codes, see Heistermann et al. (2014)
- Twenty four forks, eight active contributors from multiple agencies and nations. Broad user base.

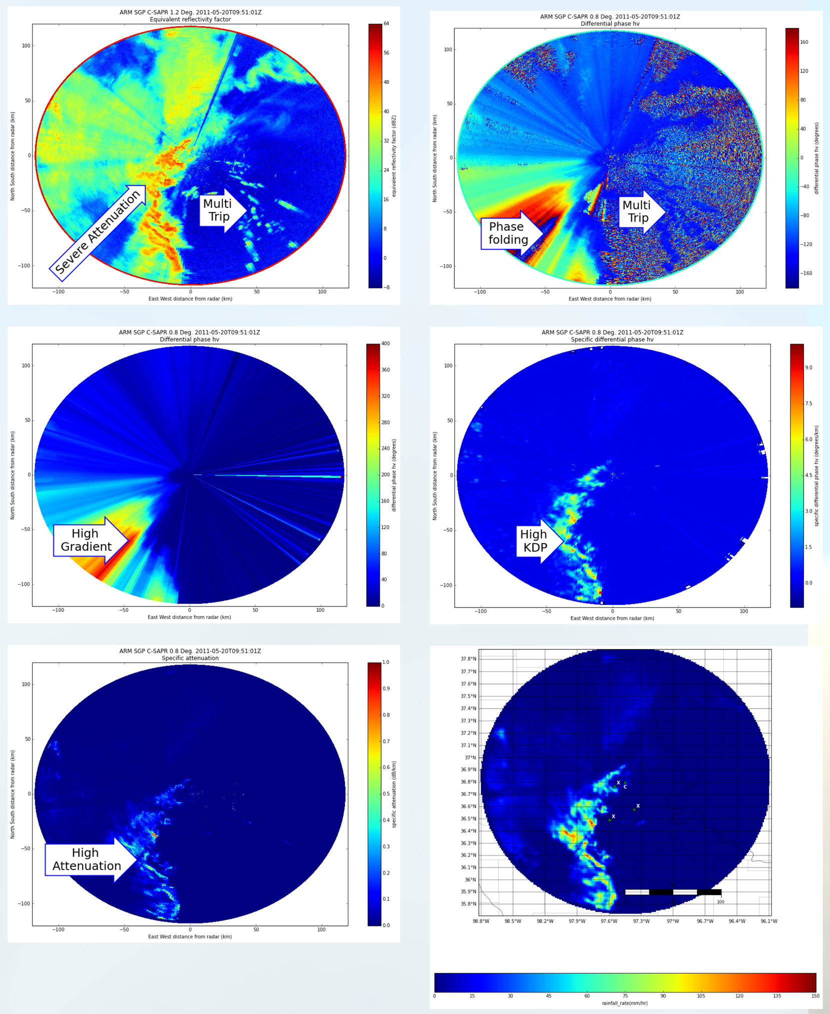




Links

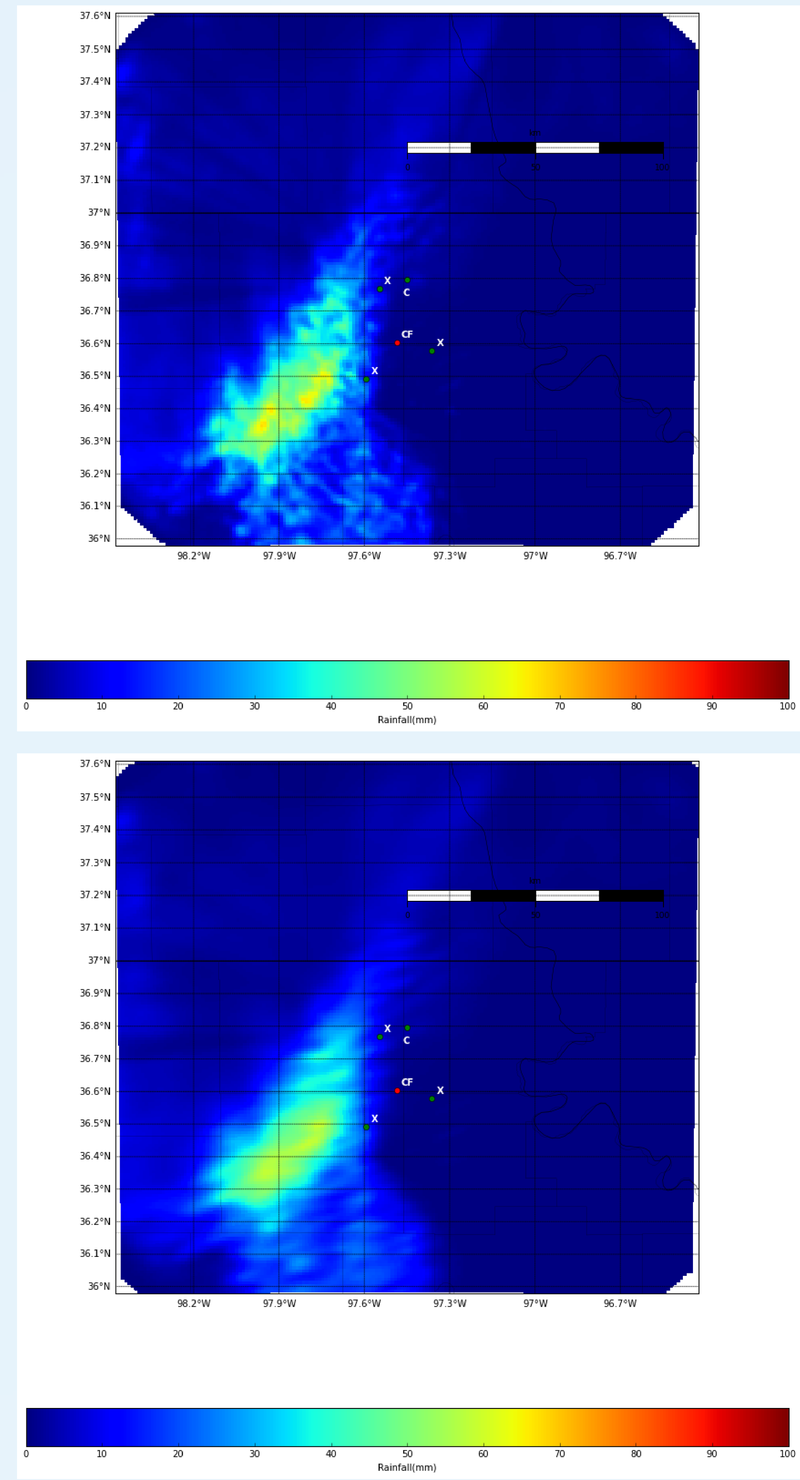
Raw data to Quantitative Precipitation Estimates

- Raw collected radar data in engineering units is unsuitable for comparison with model data.
- Shorter wavelength radar have a higher attenuation cross section. However Signal to noise in phase information much higher and calibration insensitive.
- Measured phase is a mix of propagation phase, phase shift on backscatter and artifacts: $\phi_{dp}^{signal}(r) = \phi_{dp}^{prop}(r) + \delta(r) + E(r)$.
- When calculating Specific Differential Phase, K_{dp} only the propagation component should be considered, $K_{dp} = \frac{d\phi_{dp}^{prop}(r)}{dr}$.
- Method of Giangrande et al. (2013) used to extract ϕ_{dp}^{prop} and a 20 point sobel filter $K_{dp} = \phi_{dp}^{prop} * f_{20} = \sum_{M=0}^{19} \phi_{dp}(r-M)f(M)$ where $f(M)$ is a linear ramp through zero.
- Specific attenuation is calculated using K_{dp} and Z_e using a method after Gu et al. (2011) and is used as a an estimator for rainfall using a method after Ryzhkov et al. (2014).



Mapping: Objective analysis

Advective interpolation



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