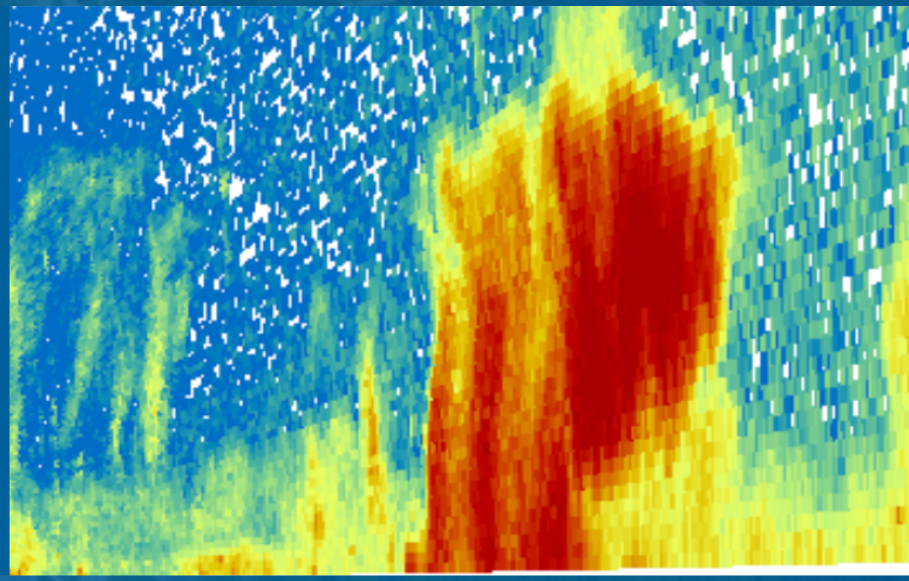
USING HOUSTON NEXRAD DATA TO INFORM EXPERIMENTAL DESIGN

KNOWN UNKNOWNS AND UNKNOWN UNKNOWNS



SCOTT COLLIS, ROBERT JACKSON AND MARK PICEL
Argonne National Laboratory

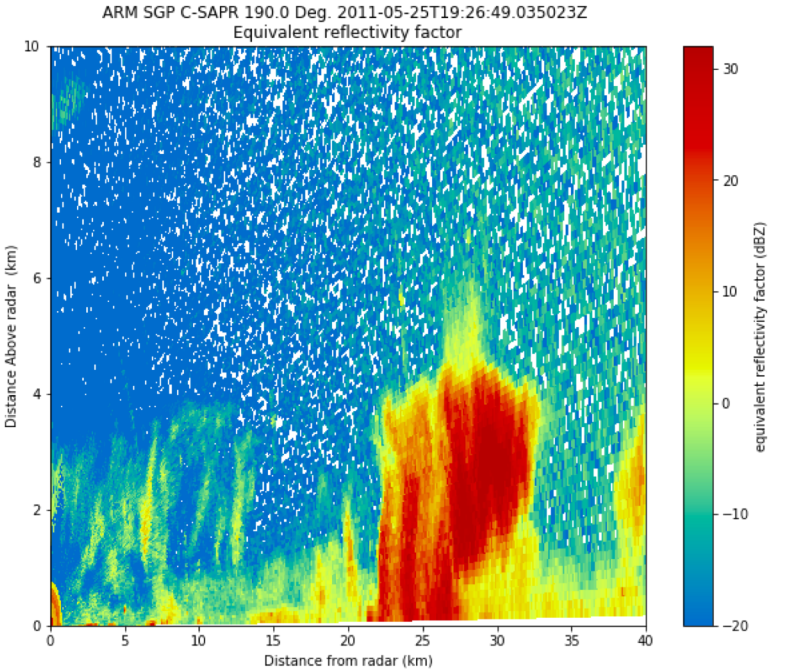
MARCUS VAN LIER-WALQUI AND ANN FRIDLIND
NASA Goddard Institute of Space Sciences

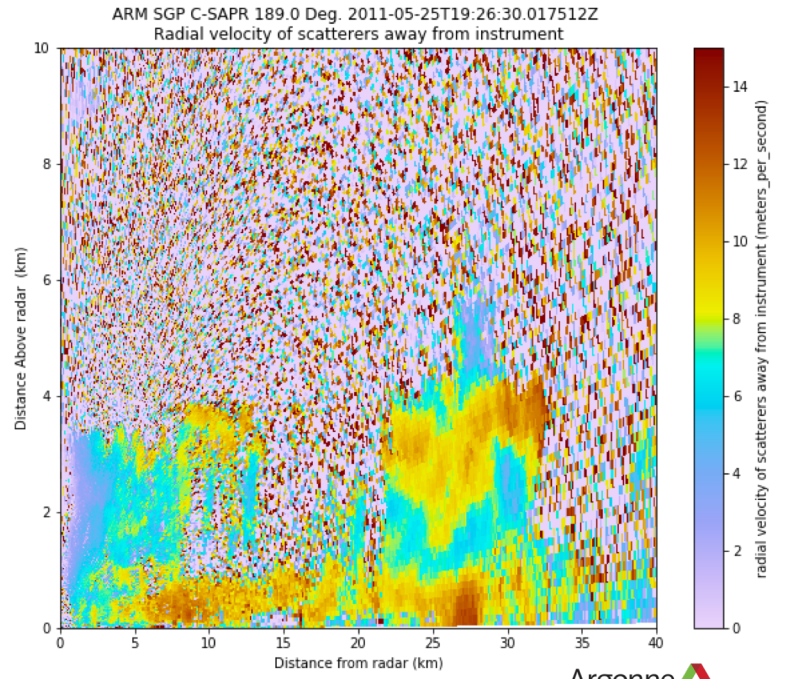
Argonne NATIONAL LABORATORY

HI… I'M SCOTT…

… And I like isolated convection

- Don't get me wrong… MCS, MCCs and synoptic scale systems are **really important.**
- But there are many processes we are struggling to understand including nucleation, growth, entrainment and precipitation onset.
- Isolated convection is easier to study (generally less issues in radar retrievals at higher frequency) geometrically less complex and easier to model (idealized modelling being possible).
- Simple science question: What is the joint PDF between updraft/plume size and strength?



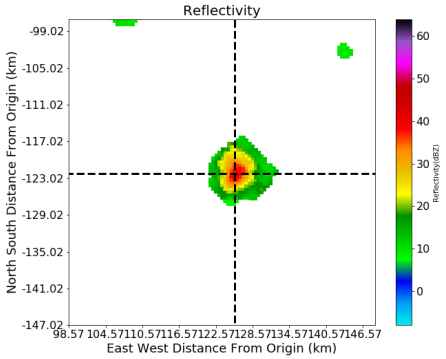


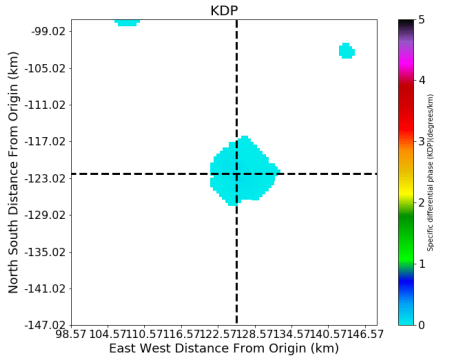
Argonne NATIONAL LABORATORY

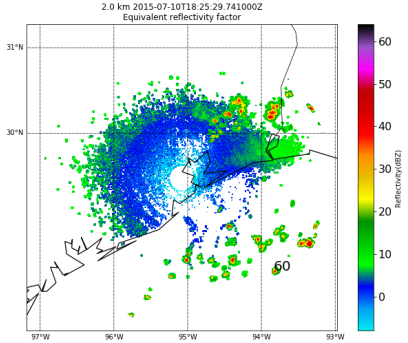
HOUSTON IS INTERESTING

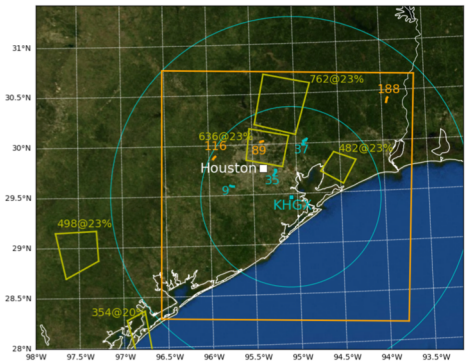
Trade-like flow regime with an interesting aerosol background

- Storms come off the gulf of Mexico.
- Some head into the Houston Metroplex where anthropogenic aerosols abound.
- Some head to the west of the city in a more (but not completely) pristine airmass.
- Some time as “trade like” regime can dominate with storms topped by a PV advection inversion. Kind of reminds me of Queensland, Australia.







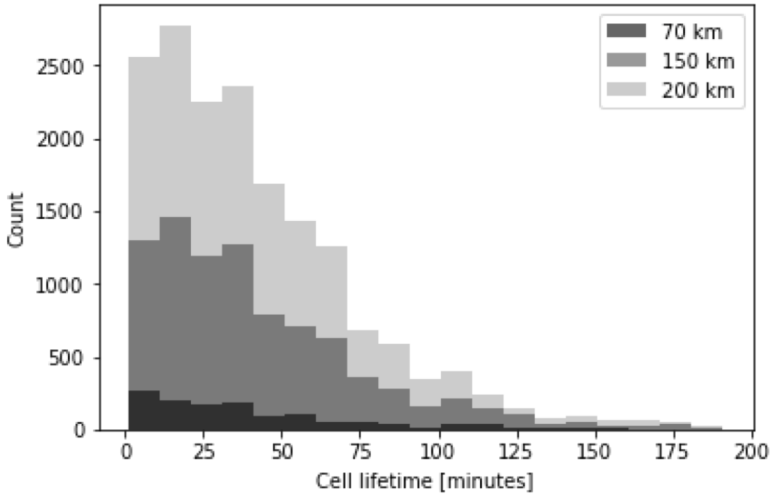


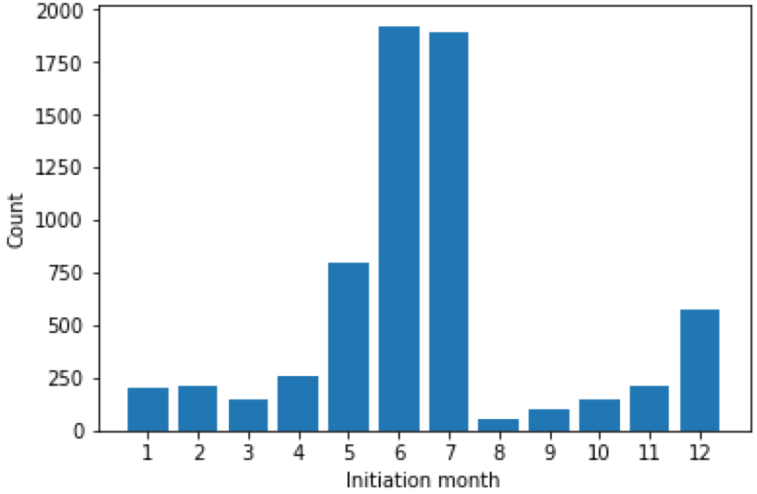
Argonne NATIONAL LABORATORY

JUST HOW INTERESTING? LETS LOOK

Open data + open source software = awesome

- NEXRAD is an amazing open source data set.
- CMAC2.0-like processing applied to correct and retrieve KDP using the Giangrade method in Py-ART.
- We used the CMDV supported TINT Is Not TITAN tracking software to do cell tracking on four years of data (whole dual pol period).
- 7TB NEXRAD data -> 100MB of track data.
- Question being addressed: If we sent a radar to Houston how many storms would we see with the full lifecycle in the MUR?

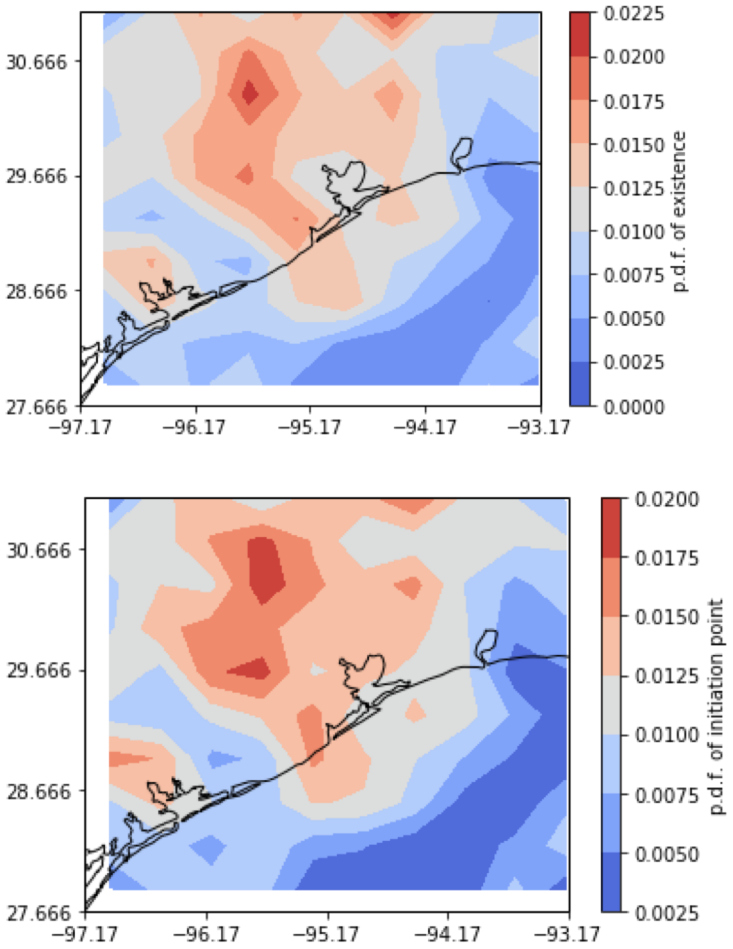




JUST HOW INTERESTING? LETS LOOK

Open data + open source software = awesome

- NEXRAD is an amazing open source data set.
- CMAC2.0-like processing applied to correct and retrieve KDP using the Giangrade method in Py-ART.
- We used the CMDV supported TINT Is Not TITAN tracking software to do cell tracking on four years of data (whole dual pol period).
- 7TB NEXRAD data -> 100MB of track data.
- Question being addressed: If we sent a radar to Houston how many storms would we see with the full lifecycle in the MUR?



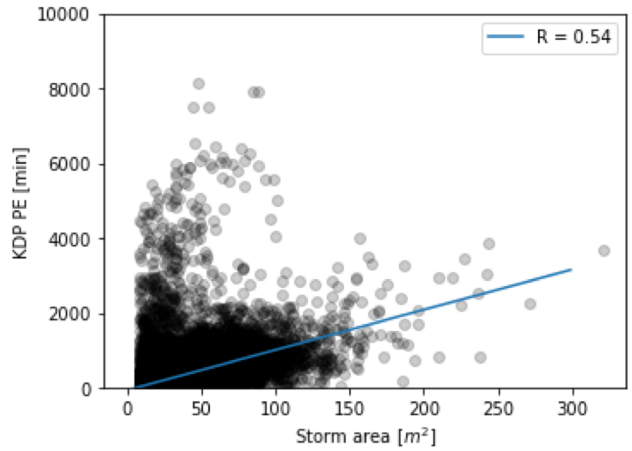
Argonne NATIONAL LABORATORY

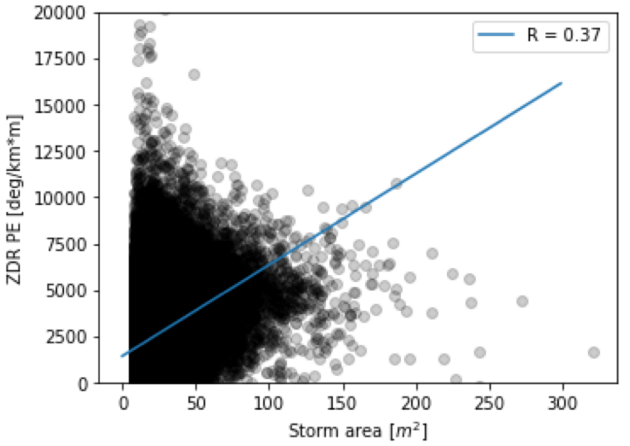
CAN WE SEE A MICROPHYSICAL IMPACT OF HOUSTON?

Using KDP column structure

- After van Lier Walqui et al and Kumjian et al we define a bulk parameter that is indicative of the super cooled liquid above the freezing level.
- This is averaged over a storm cells giving a bulk indication as to updraft intensity, or, more aptly the mean residence time above the FZL until drops stop being drops.
- Tantalizing statistics. Specific differential phase (RWC) more robust than differential reflectivity (Dm).
- Tempted us to investigate if we could see an impact of Houston.

$$\xi = \int_{z_m}^{z_f} \phi(z)(z - z_m)\,\mathrm{d}z$$



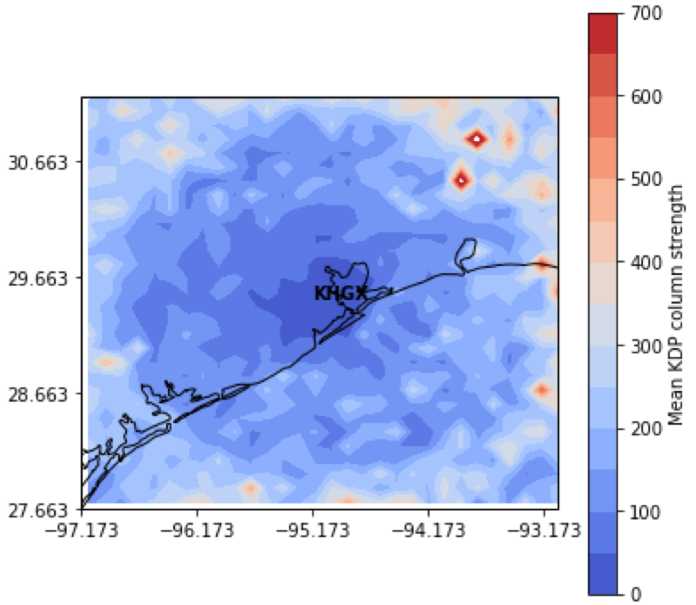


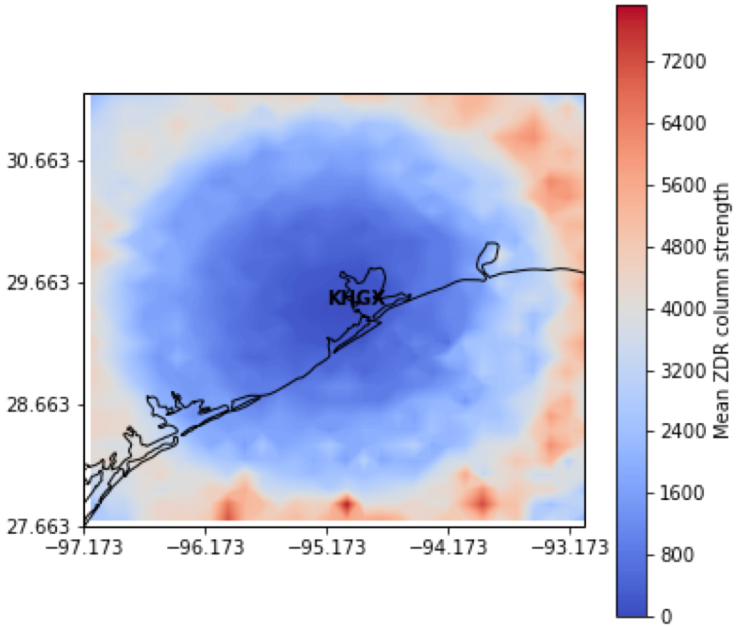
Argonne NATIONAL LABORATORY

NOPE

Sampling kills us…

- Averaging over the three years of data gives us a radial pattern. The differential reflectivity is more smooth and the specific differential phase is more noisy.
- Both exhibit an increasing value with radius with a “kick” at 150km.
- Can we reduce the spatial complexity by looking at azimuthal averages in four sectors?

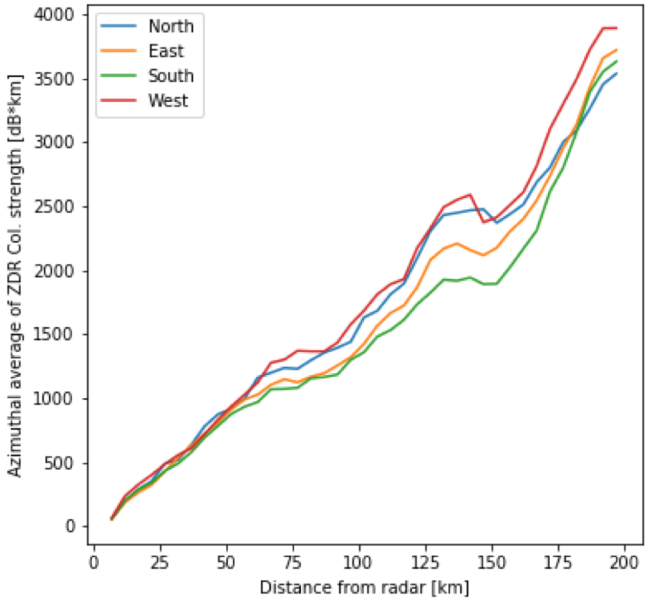


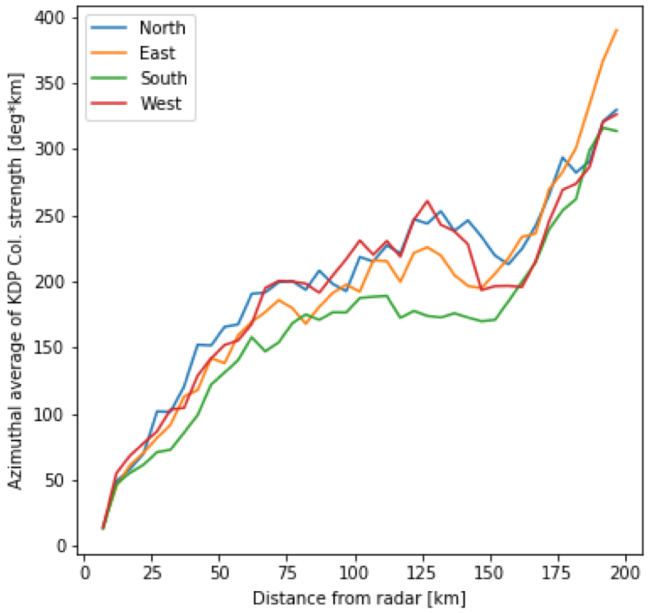


NOPE

Sampling kills us…

- Averaging over the three years of data gives us a radial pattern. The differential reflectivity is more smooth and the specific differential phase is more noisy.
- Both exhibit an increasing value with radius with a “kick” at 150km.
- Can we reduce the spatial complexity by looking at azimuthal averages in four sectors?
- There are some tantalizing differences in **both ZDR and KDP.**
- Humps are when VCP crosses FZL.
- **We can not get the microphysical detail the program desires in “sit and spin”**

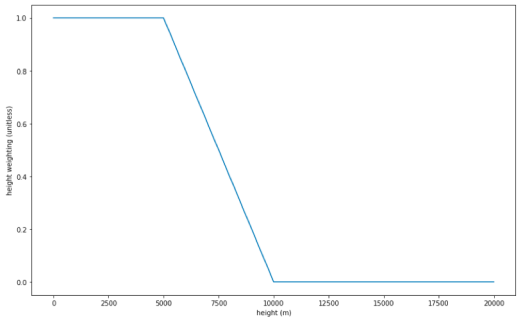


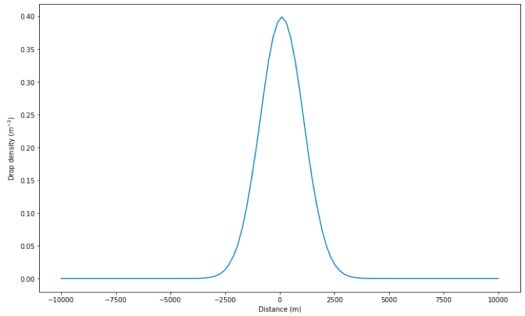


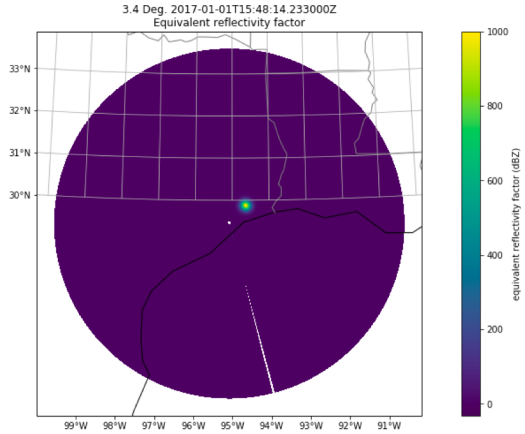
NEXT STEPS..

Really really really simple storms distributed using observations

- We developed a super simple analytical formulation for “matchstick” storms. Gaussian in radius, constant to FLZ and linearly decreasing to a depth.
- Look up table from Py-Tmatrix to convert LWC and Dm to Z/ZDR/KDP
- I wanted to show you so much more.
- Project is “grey matter” not quite dark, not quite funded. Dental issues on my part and other complications and it was the first domino to fall.
- Visit your dentist today..
- Radars and teeth need care and love.







Argonne NATIONAL LABORATORY