Using a model of crystal aspect ratio to reveal the polarimetric radar fingerprint of ice depositional growth

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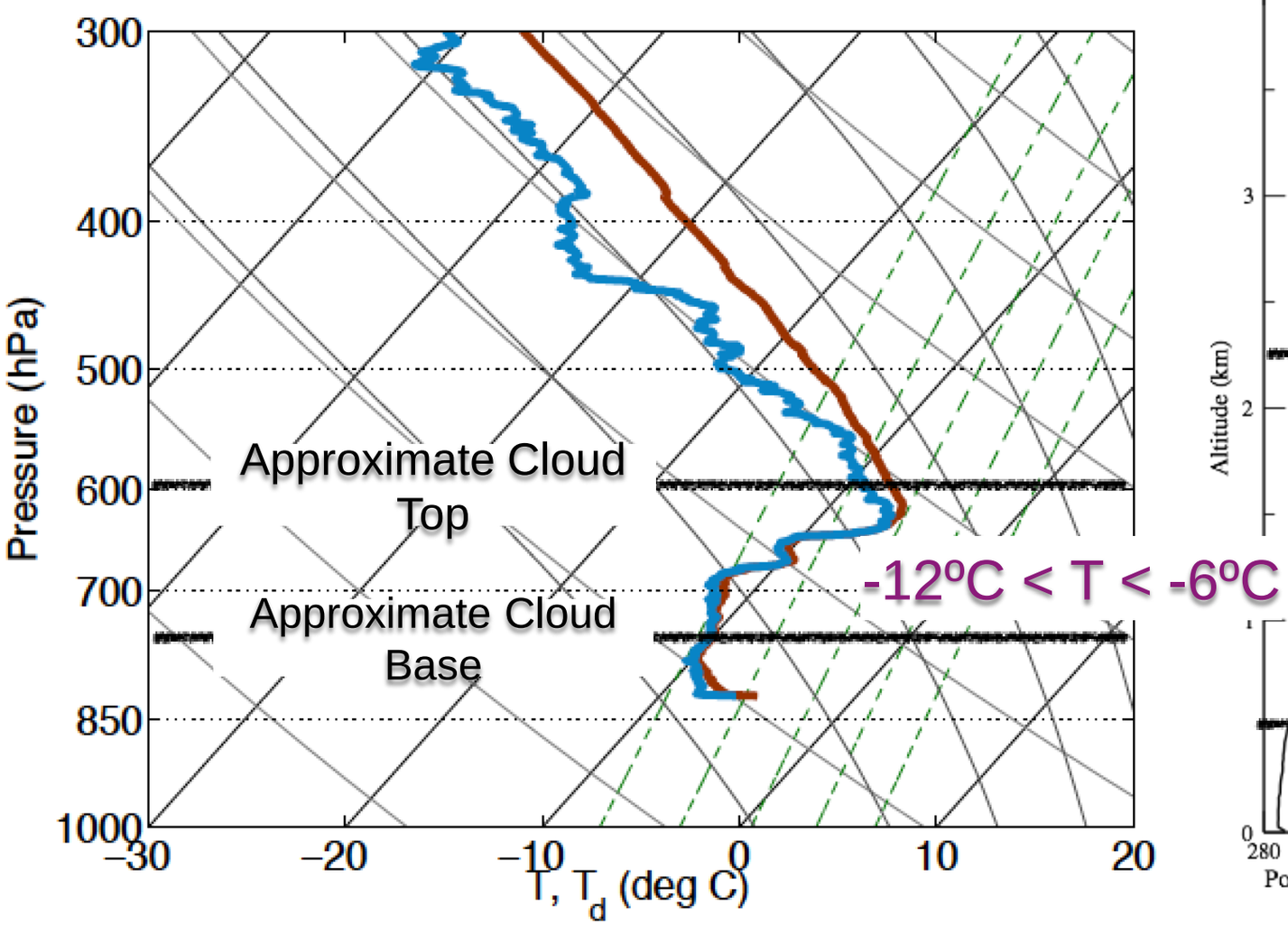
Initial Profile Characteristics

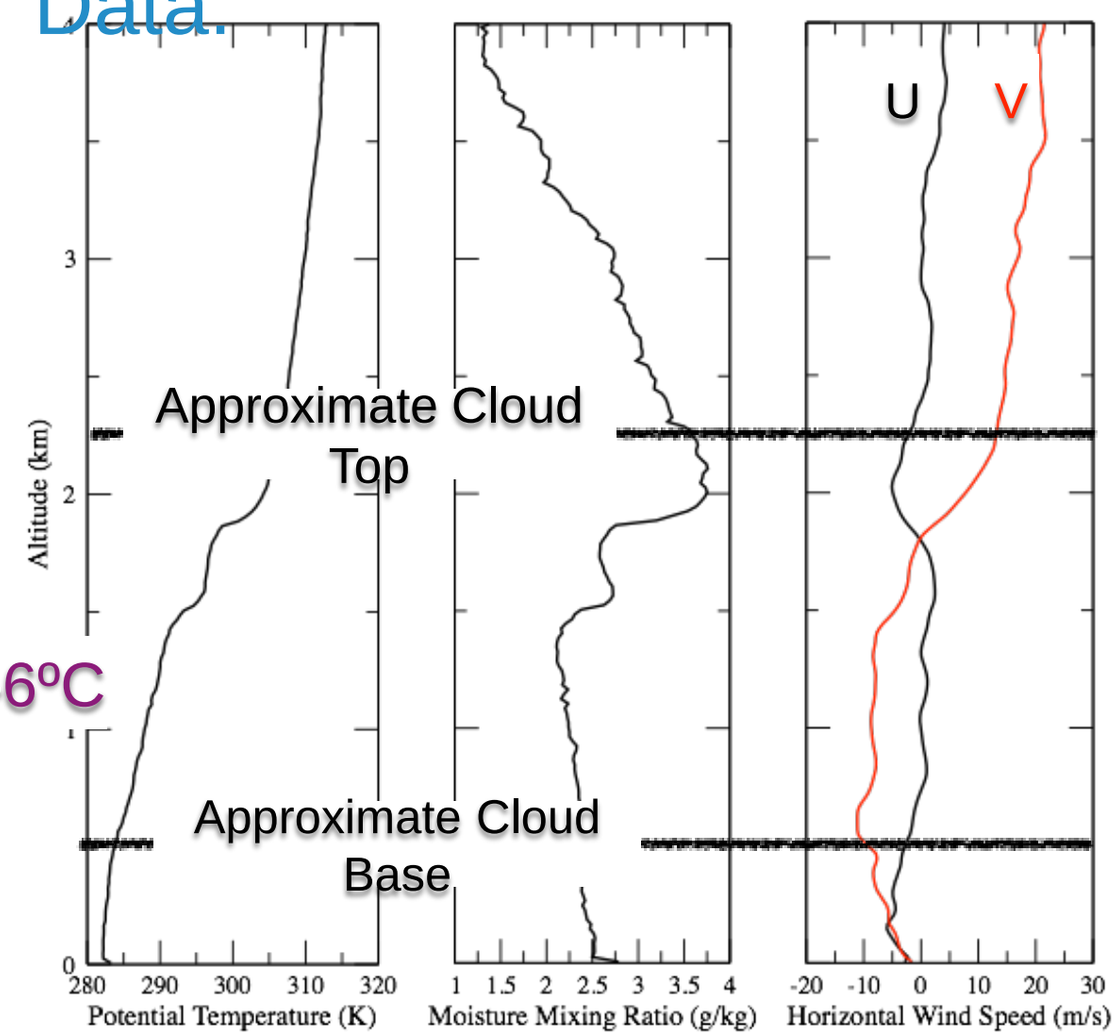
- *What: FROST Experiment*
- *Where: Marshall Field Site, CO*
- *When: 09 Apr 2013; 0820 UTC*

Case is representative of a shallow upslope cloud.

In-Situ Sounding Data:

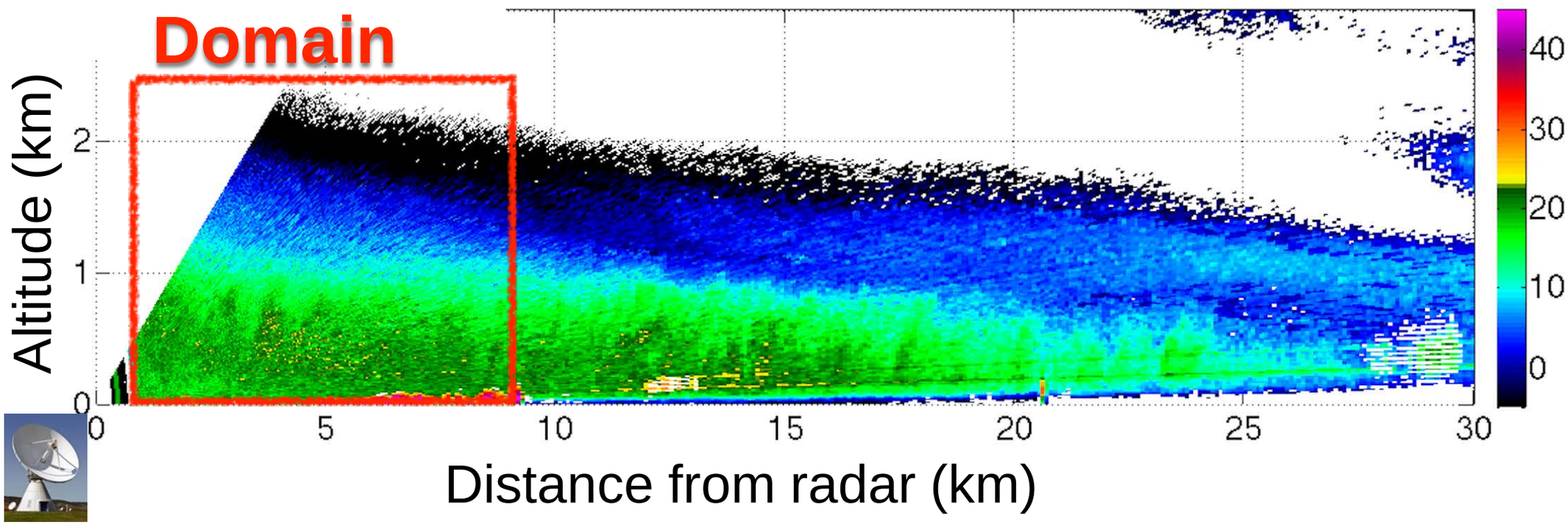


Model Input Sounding Data:



Observed Reflectivity, Z_H (dBz)

CSU-CHILL
X Band
0.3º beam width



WRF-LES V3.1.1, Adaptive Habit Ice Depositional Growth Method (Harrington et al., 2013)

Model Dimensions:

- 64 x 64 x 250 (xyz) grid points
- 50m x 50 m x ~10 m grid spacing

}

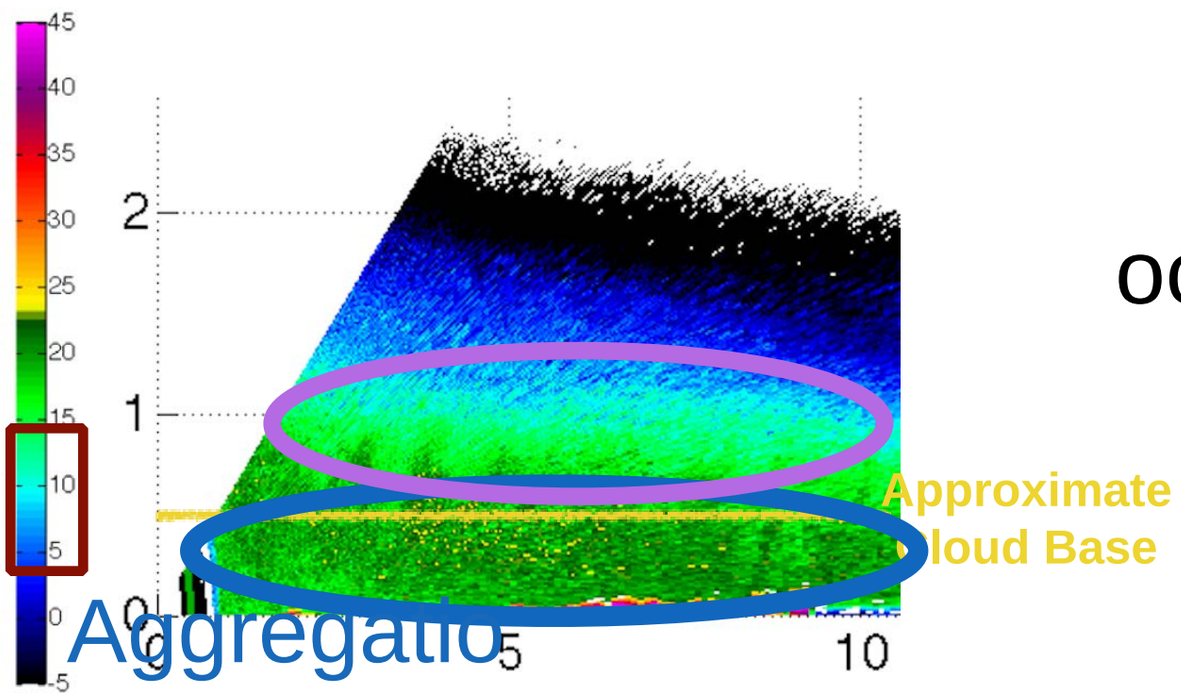
Model Output:
Averaged along y-direction
3.2 km x 2.5 km

Model Comparison

WRF-LES V3.1.1, Adaptive Habit Ice Depositional Growth Method

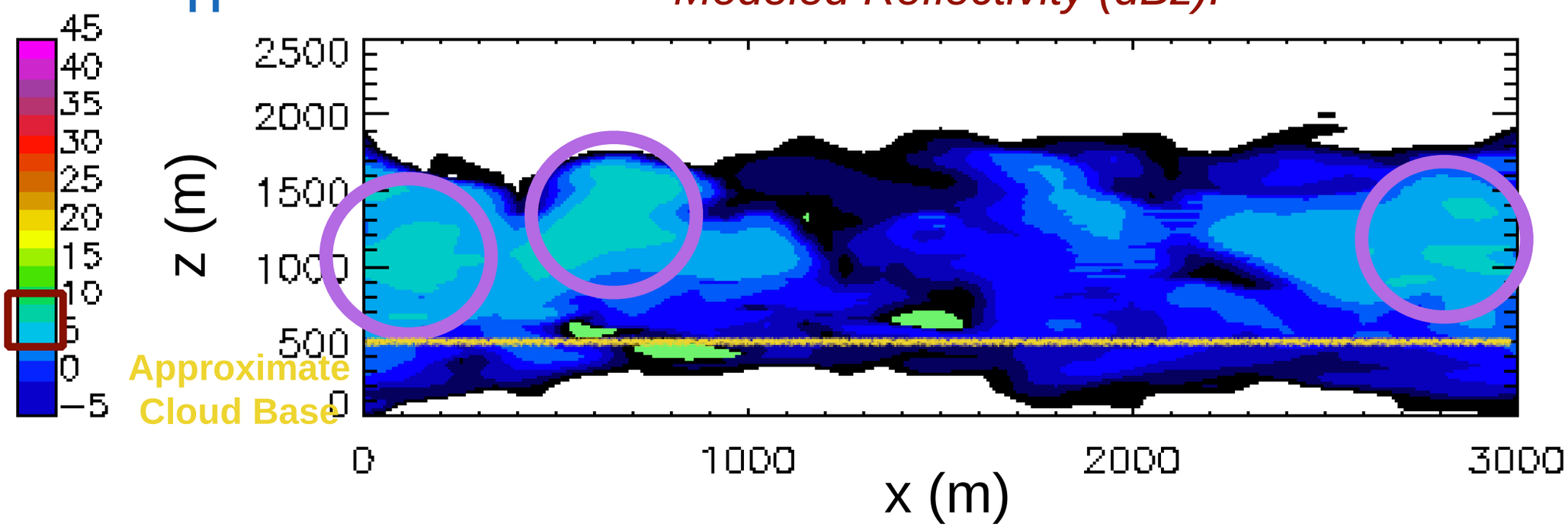
Results after 2 hr spin-up & 30 min ice growth @ 1050 UTC

Observed Reflectivity (dBz):



Reflectivity maxima occurring around same *location (1 km)* and *value (~5-10 dBz)*.

Modeled Reflectivity (dBz):



Model Comparison: Particle Shape

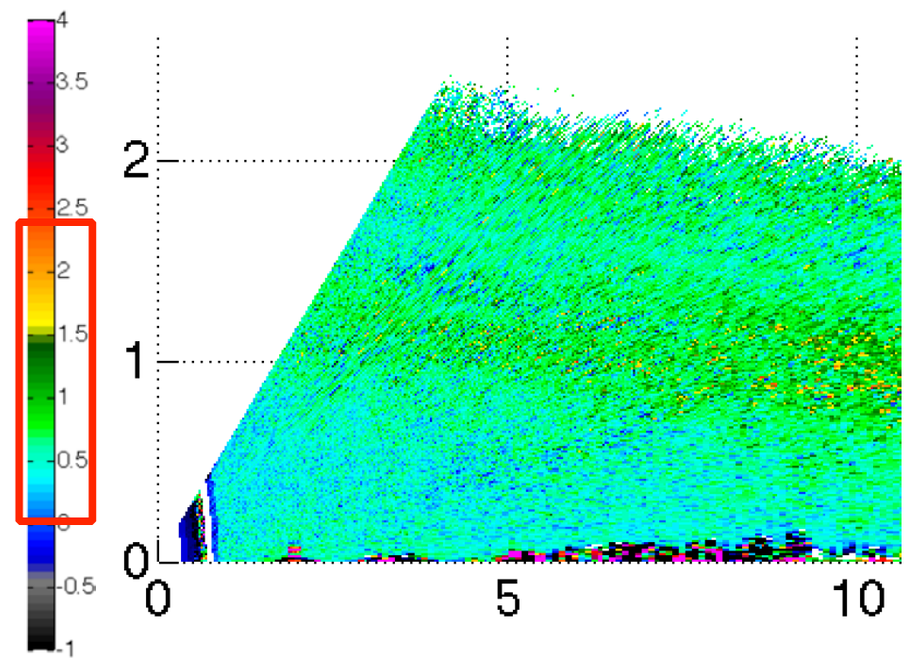
WRF-LES V3.1.1, Adaptive Habit Ice Depositional Growth Method

Results after 2 hr spin-up & 30 min ice growth

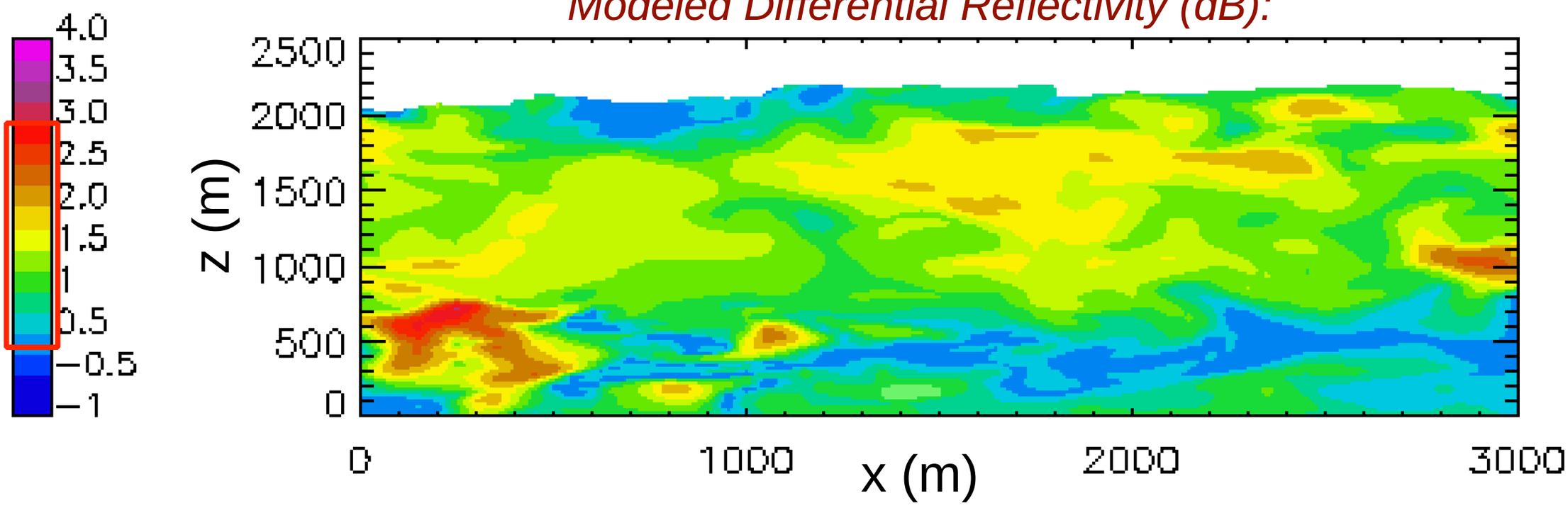
General agreement of overall Z_{DR} *values* and locations.

Both differential reflectivity and adaptive habit model can capture ice particle shape.

Observed Differential Reflectivity (dB):



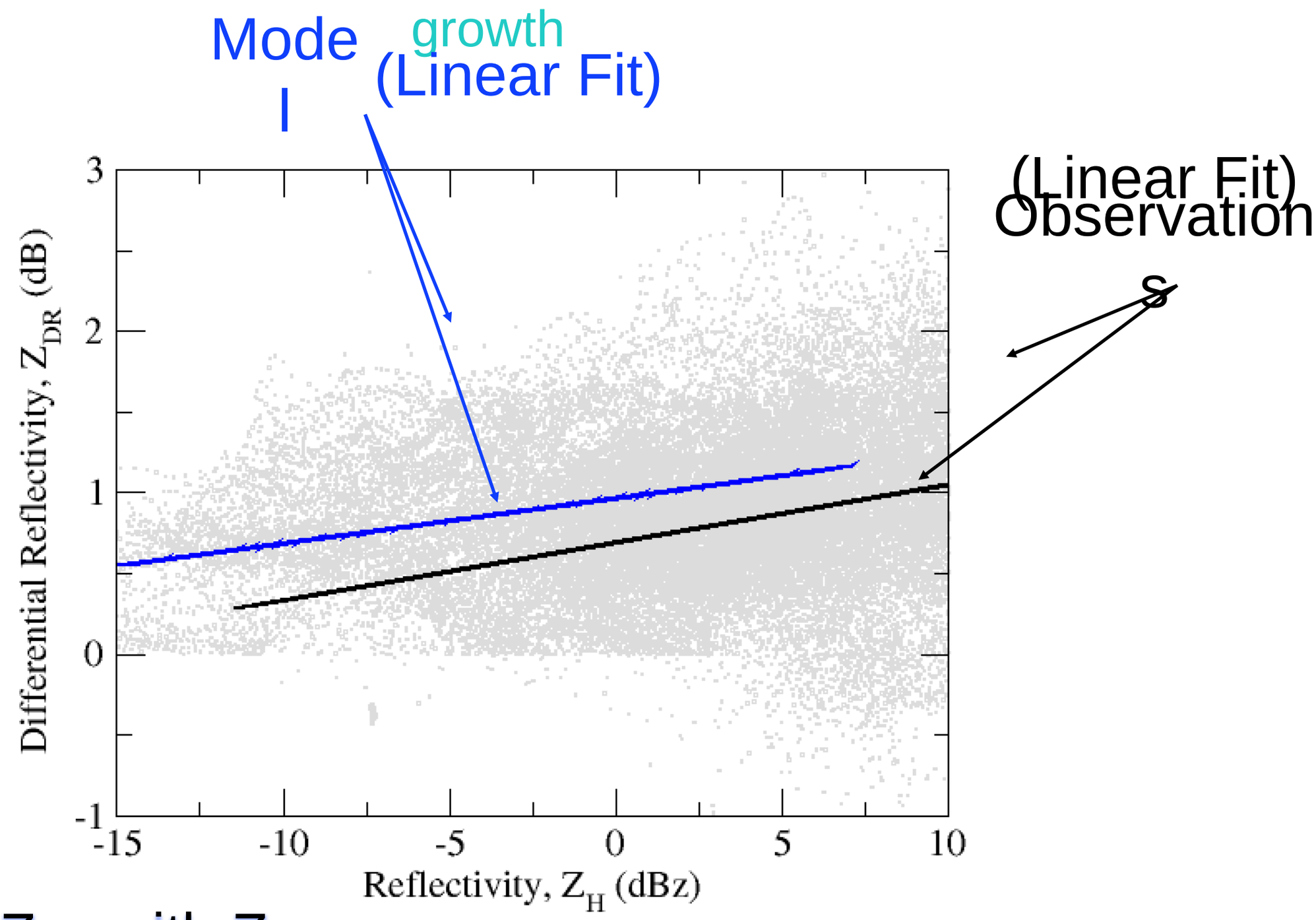
Modeled Differential Reflectivity (dB):



Model Comparison: Z_H vs Z_{DR}

WRF-LES V3.1.1, Adaptive Habit Ice Depositional Growth Method

Results after 2 hr spin-up & 30 min ice growth



Increase in Z_{DR} with Z_H:

particles becoming more anisotropic with growth.

Discussion & Questions

- *Still need to modify simulations to include riming, aggregation, and other important microphysical processes.*

- What other microphysical processes would be helpful to "fingerprint" from radar data for both observational and theoretical scientists?

- *Based on these preliminary results, should there be a stronger focus on particle properties and physical processes? What are some other ways this could be achieved?*

- As with microphysics, is there a need for defining the fingerprint for certain dynamical processes? Can this be done with current radar variables?

- *Other comments, questions, & concerns about this approach?*