Hydrometeor Types From Dual-Pol Radar, Compared to GMI Brightness Temperatures

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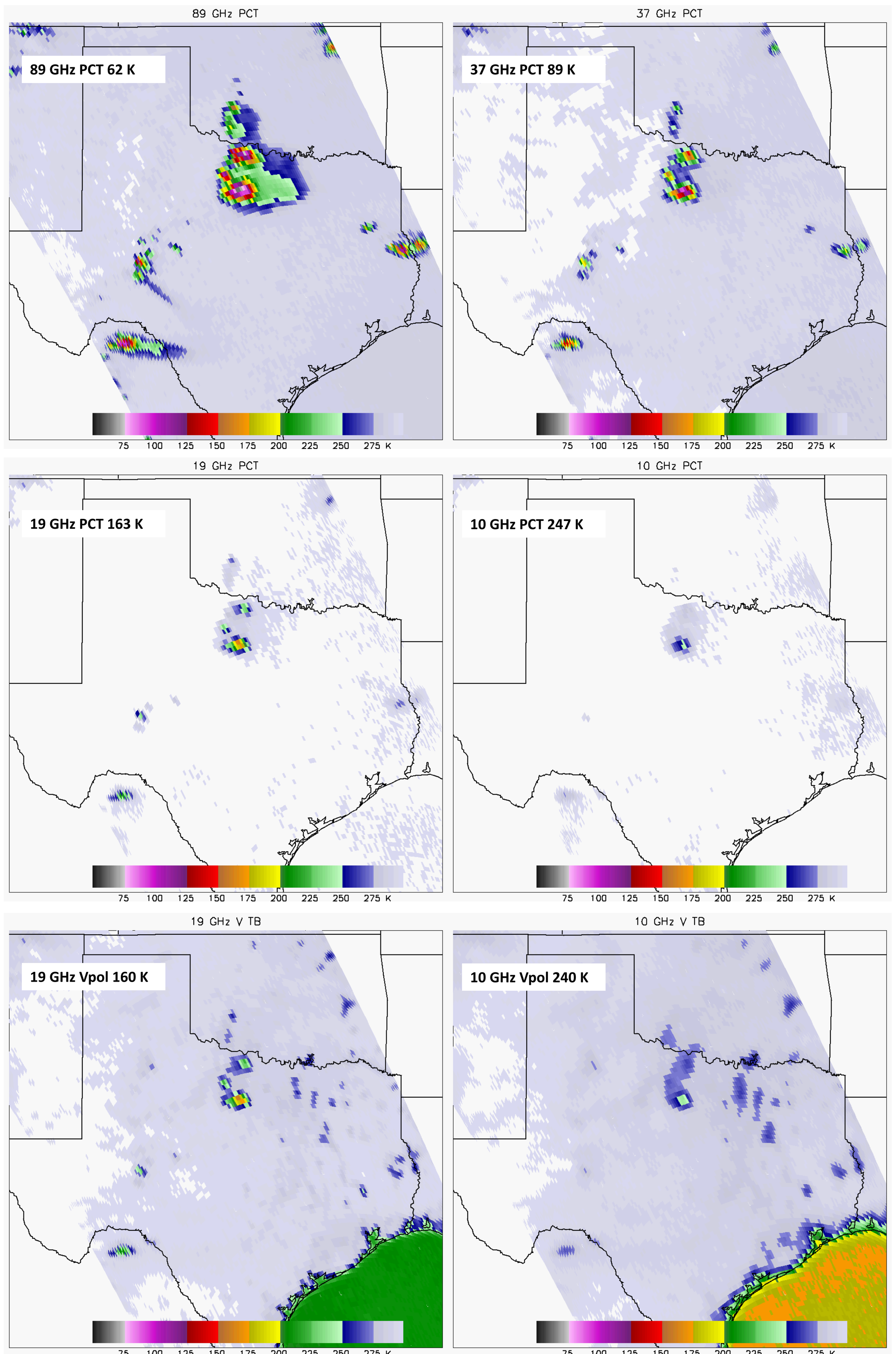
Approach

- Use "Virtual Network" (**VN**) of ground-based dual-polarization radars from GPM GV program (mostly Central and Eastern USA), together with GMI brightness temperatures
  - *Database is constructed using a minimum threshold for raining pixels, so inherently biased toward including precipitation*
- Hydrometeor ID (**HID**) (e.g., hail, high-density graupel, low-density graupel, aggregates, liquid rain, etc.) derived from dual-pol radar data
- Construct joint histograms and probability-of-occurrence for different hydrometeor types as a function of brightness temperature in different channels
- To facilitate use of low-frequency channels over land, construct polarization corrected temperatures (**PCT**) *(more on that later)*

Example – 26 May 2015, west of Ft. Worth

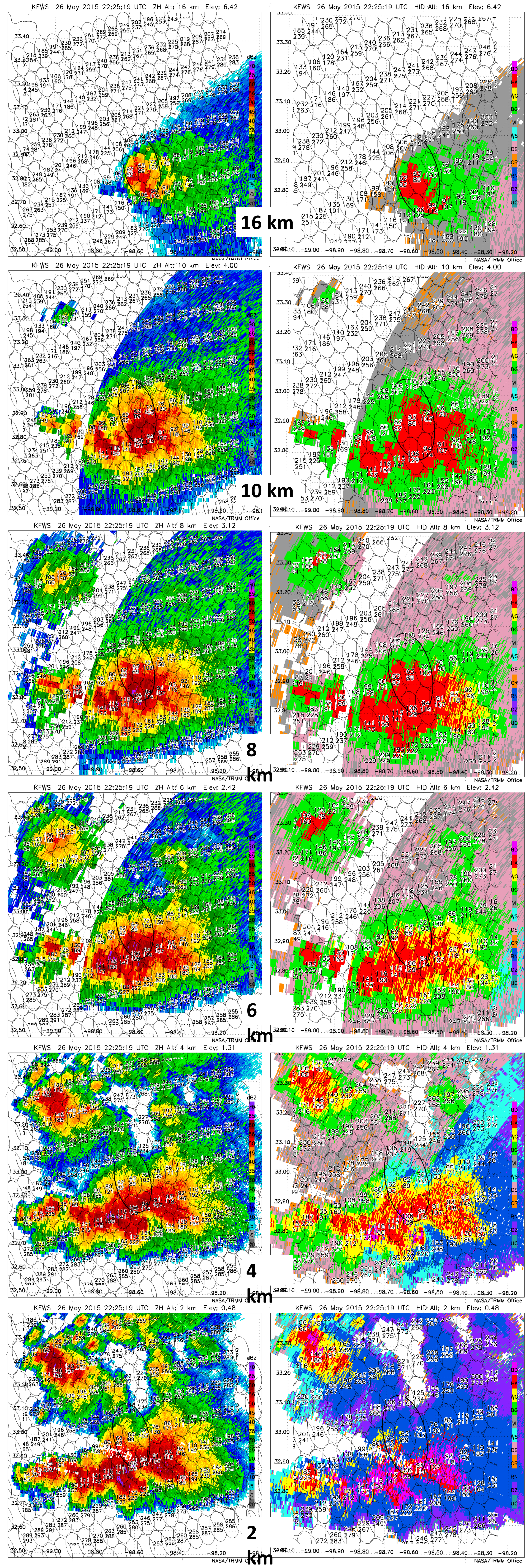


Intense storms in N. Texas stand out; PCT helps distinguish storms from lakes

Above:
Intense storms in North Texas (west of Fort Worth) produced extremely low brightness temperatures as seen by GMI. At 37 GHz, these are among the lowest brightness temperatures seen by GMI or any other spaceborne passive microwave radiometer. (At least one TRMM case did have lower values.) The strongest storm is even apparent in the lower frequency 19- and 10-GHz channels. Using PCT helps distinguish the storms from inland lakes.

Right:
Radar reflectivity and Hydrometeor Identification from the KFWS dual-polarization WSR-88D radar (from the GPM Validation Network – VN). Altitudes range from 2 km (bottom plots) to 15 km (top plots) at the location of the storm. GMI 89 GHz and 37 GHz PCT are printed as digits, with the coldest 37 GHz footprint highlighted. GMI footprint geolocation is adjusted for parallax based on the altitude of each plot.

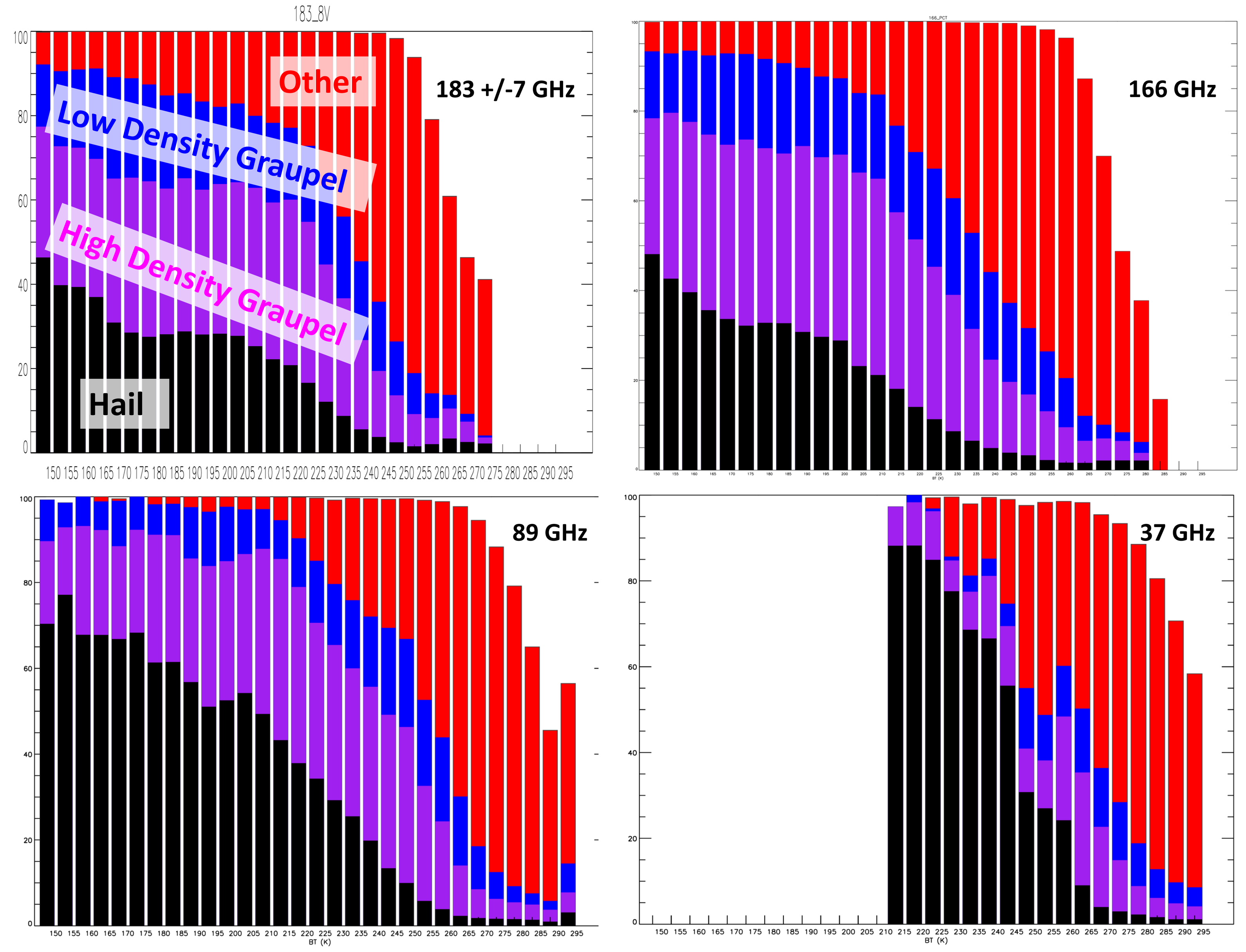
Left: Radar Reflectivity **Right: Hydrometeor Identification (HID)**



Probability of Dominant Hydrometeor Type, as a Function of Brightness Temperature

Given a certain brightness temperature from GMI, what is the probability the vertical column includes:

Hail (black)?
If not hail, then High Density Graupel (purple)?
If none of those, then Low Density Graupel (blue)?
If none of those, then other hydrometeors (red)?



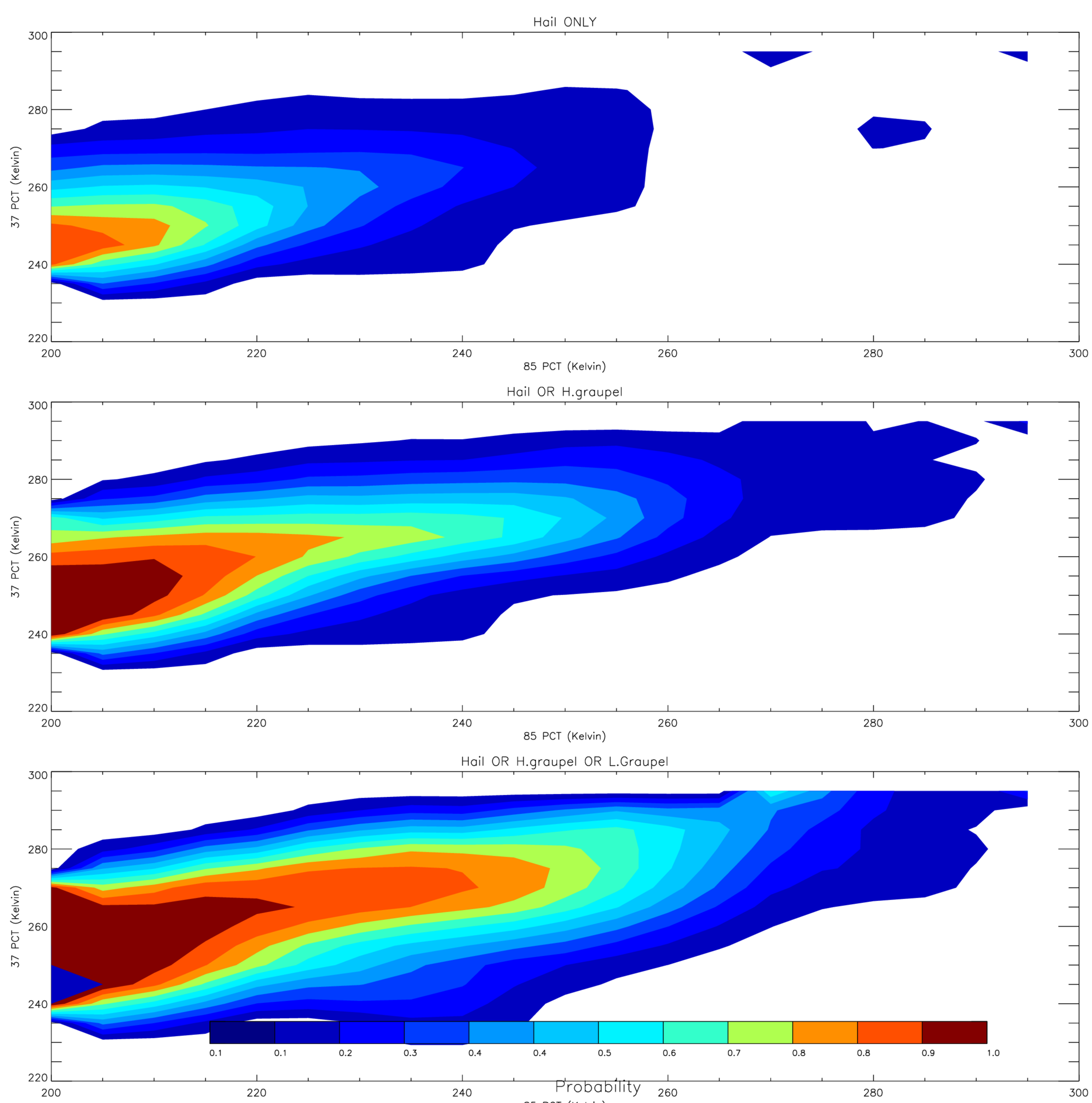
Given a combination of brightness temperatures from the 37 and 89 GHz channels, what is the probability the column includes:

Hail (top)

Hail or High Density Graupel (middle)

Hail, High Density Graupel, or Low Density Graupel (bottom)

Other channel combinations and other hydrometeor types also being examined



Polarization Corrected Temperatures (PCT)

In order to use low frequency (10, 19 GHz) more effectively over land, we are developing Polarization Corrected Temperature (PCT) formulae for those frequencies.

Empirical coefficients are derived to minimize the contrast between land and water surfaces.

This removes much of the precipitation signal, except for accentuating the strongest convective cores having high concentrations of large ice (graupel and hail). This might be useful for looking at strong storms over land.

Using 10 or 19 GHz PCT together with Vertically-polarized channel might be useful for looking at a broader range of precipitation, without having problems associated with land-water boundaries.

We are just now finalizing our assessment of PCT coefficients, with a manuscript forthcoming. Subsequent work will incorporate 10 and 19 GHz PCT into the analysis of hydrometeor types.