

# Relating Polarimetric Radar Measurements to QLCS Cold Pool Properties & Damage Potential



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## Cold Pool Development:

- All processes affecting negative buoyancy production (i.e. evaporation, melting, and precipitation loading) are related to hydrometeors in the storm.

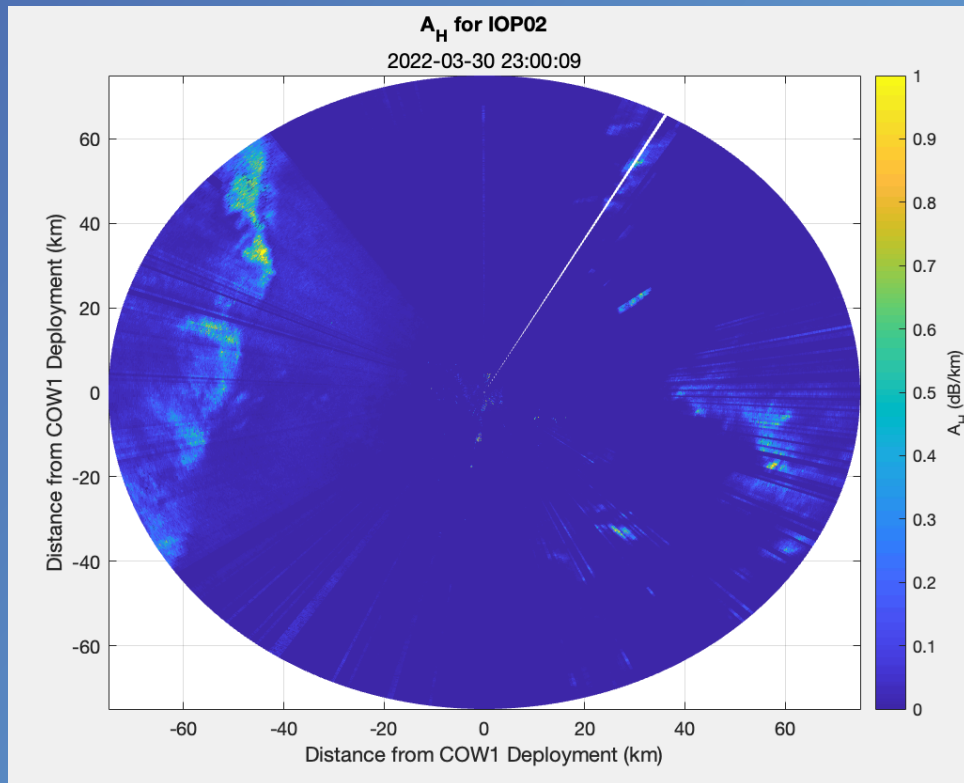
## Hypotheses:

- Estimates of specific attenuation ( $A_H$ ) are a polarimetric radar proxy for cold pool strength.
- Estimates of  $A_H$  and  $A_H - Z_{DR}$  separation vectors provide information on the sources of horizontal vorticity that are thought to be important for tornadogenesis.

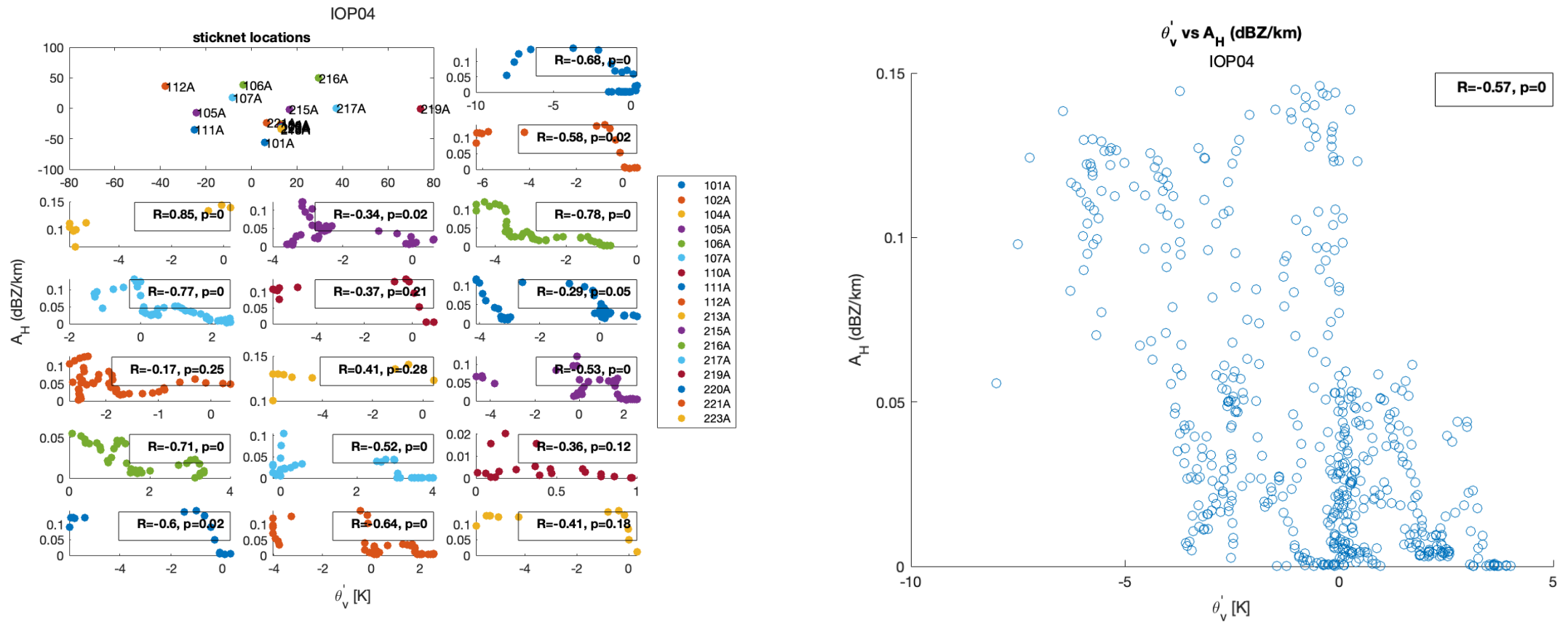


# + Specific Attenuation As Proxy For Cold Pool Strength

- **Specific Attenuation** ( $A_H$ ): extinction of radar signal power (**per unit distance**) through areas of precipitation
  - Caused by absorption and scattering of microwave radiation by hydrometeors
  - **Raindrops**  $\ll \lambda \rightarrow$  “**absorption loss**” dominates
    - signal loss  $\propto$  **hydrometeor concentration**
      - For raindrops  $\equiv$  rain rate
    - **More closely related to hydrometeor mass**
- Mass of storm precipitation  $\propto$  amount of negative buoyancy production
- Radar-estimated specific attenuation field is nearly a linear function of rain rate
  - $\therefore$  Illuminates cold pool strength

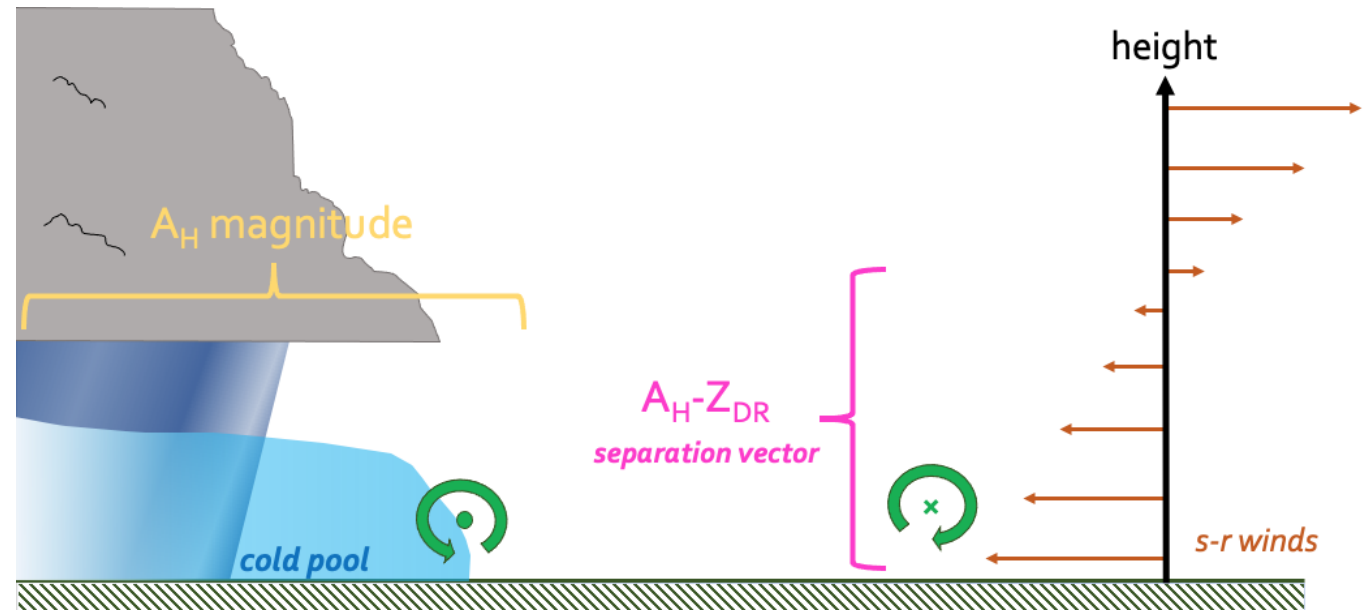
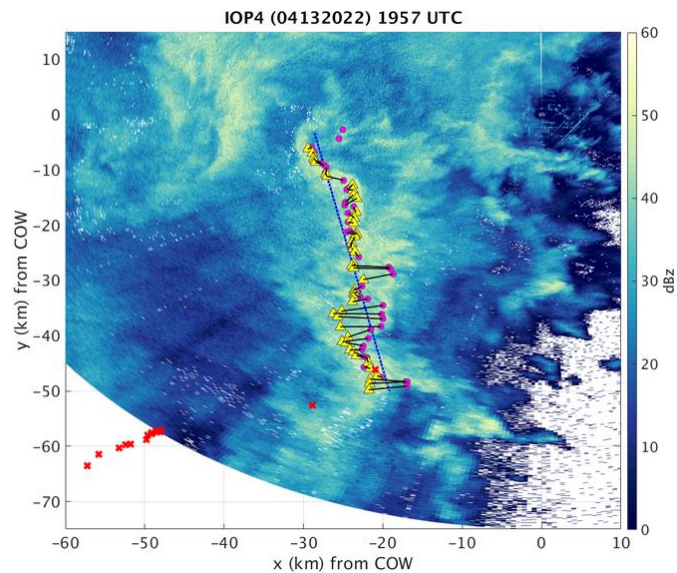


# Relationship between $A_H$ & Virtual Potential Temperature Perturbations ( $\theta'_v$ )



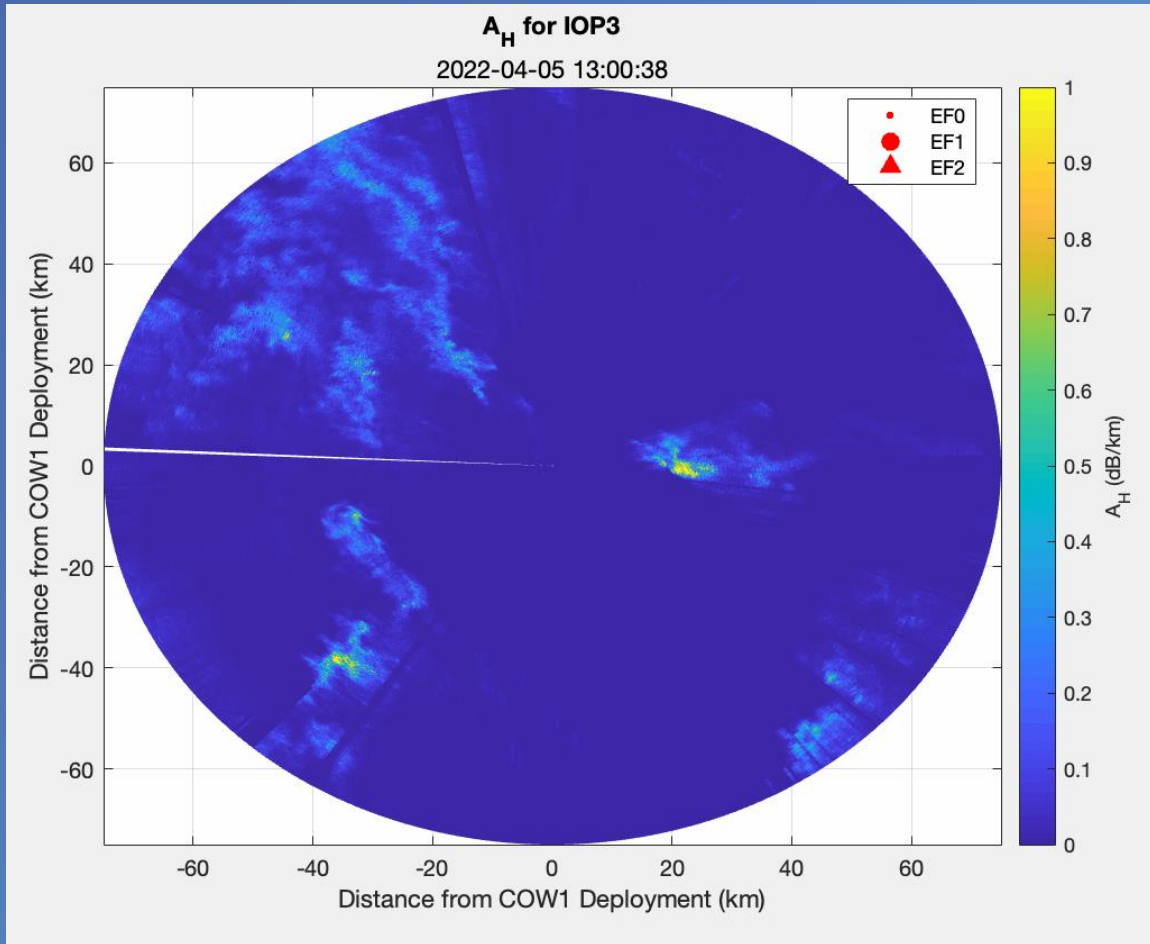
Radar-estimated  $A_H$  field is negatively correlated with  $\theta'_v$  in storm cold pools

# $A_H - Z_{DR}$ Separation Vector



- Radar-estimated  $A_H - Z_{DR}$  enhancement region separation vector correlated with mean storm-relative winds over the lowest few km, analogous to the Loeffler & Kumjian (2018)  $Z_{DR} - K_{DP}$  separation vector.

# $A_H$ and Damage Potential



- Both the  $A_H$  field and the  $A_H$ - $Z_{DR}$  enhancement region separation vector are related to sources of horizontal vorticity:
  - environmental horizontal vorticity associated with vertical wind shear
  - baroclinic vorticity generation along the gust front
- These radar-based metrics could indicate favorable conditions for tornado development, providing advance notice.
- Future work to include analysis of variations in time and space of separation vectors for all IOPs.