Deep convection updraft core signatures in C- and S-band polarimetric radar fields during MC3E

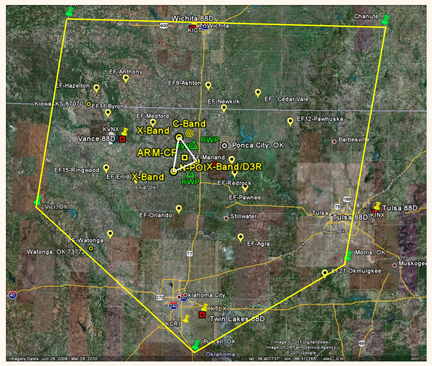
Marcus van Lier-Walqui[1,2], Ann Fridlind[2], Andrew Ackerman[2]
1.Columbia University, New York, NY; 2.NASA Goddard Institute of Space Studies, New York, NY

Science Goals

The microphysics of deep convective updraft cores is still not fully understood. Furthermore, model representation of these features often does not agree with observational understanding. In-situ measurements inside of these features are rare due to difficulty and expense involved.
Expansion of new radar technologies allow for new insights into the 3-dimensional structure of microphysics over broad storm regions. In particular, polarimetric radar observations may lend new insights into the microphysical structure and evolution of convective storm systems.
A general question is: What sort of relationships can be seen between polarimetric variables in strong updraft cores?
A more specific question we seek to answer is: Is there eveidence of liquid phase near the homogeneous freezing level in deep updrafts ($\approx 38°C$)?

ARM MC3E

ARM SGP site during MC3E



C-SAPR

NEXRAD KVNX

Polarimetric variables

ZHH — Horizontal radar reflectivity (dBZ): Related to mass and number concentration of hydrometeors
ZDR — Differential reflectivity (dB): Related to oblateness of hydrometeor. May suffer from differential attenuation in cases where radar attenuation is high (such as with C-band radars)
KDP — Differential specific phase ($°/km$): Related to liquid water content. Unaffected by moderate attenuation.
RHOHV — Cross-polarization correlation coefficient. Low values may indicate a mixture of scatterer types.

Planned methodology

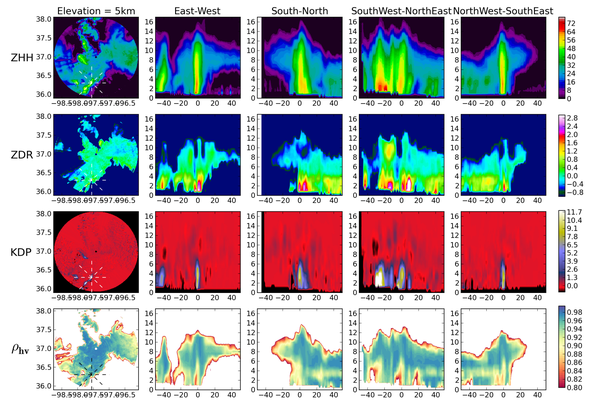
- Perform survey of deep convective updrafts observed during MC3E (as identified by KDP columns)
- Analyze spatial relationships between polarimetric varibles in these updraft regions for both C- and S-band radars
- Categorize updrafts by polarmetric features, likely microphysics and updraft strength
- Search for microphysical processes of interest (such as liquid phase near homogeneous freezing levels)
- Use polarimetric radar observations together with model results to constrain knowledge and model representation of microphysical processes in strong updrafts
- Use uncertainty quantification techniques to rigorously explore microphysical uncertainty

Vertical slices through KDP columns

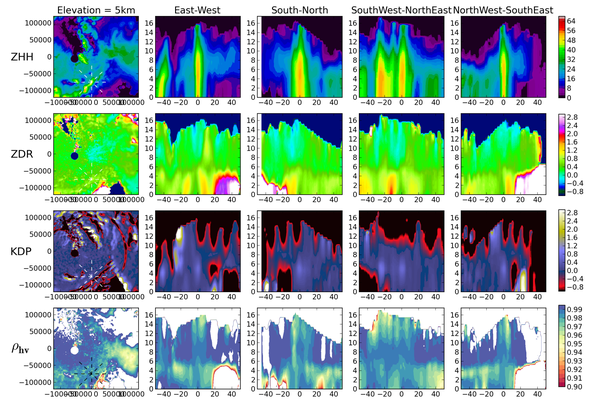
C-band CSAPR

May 20 2011

KDP column no. 2; May 20 2011 -- 08:06:24.

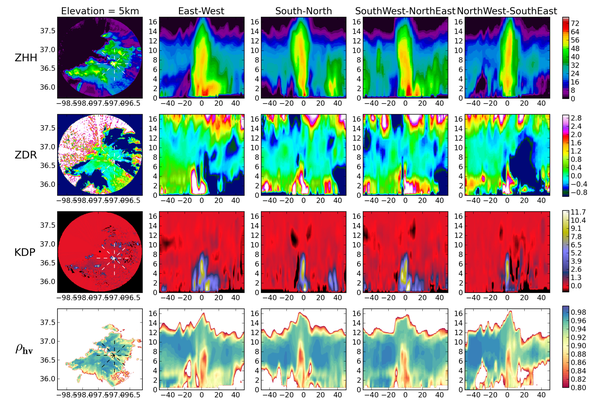


KDP column no. 2; May 20 2011 -- 08:07:13

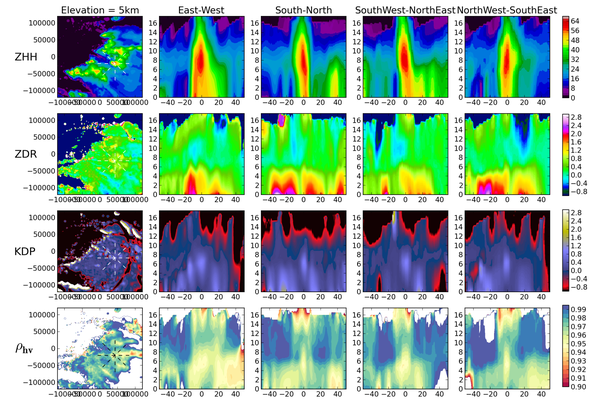


May 23 2011

KDP column no. 2; May 23 2011 -- 22:24:00.



KDP column no. 2; May 23 2011 -- 22:24:00



May 24 2011

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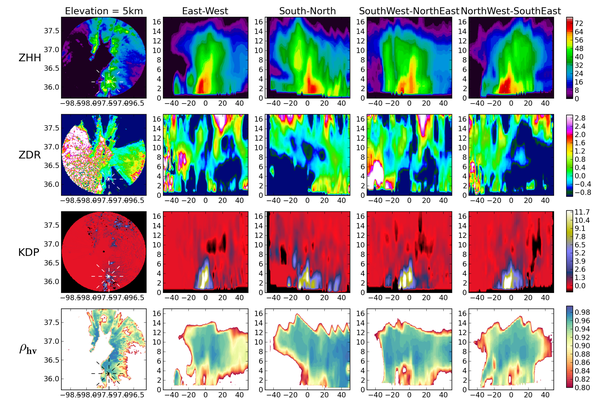
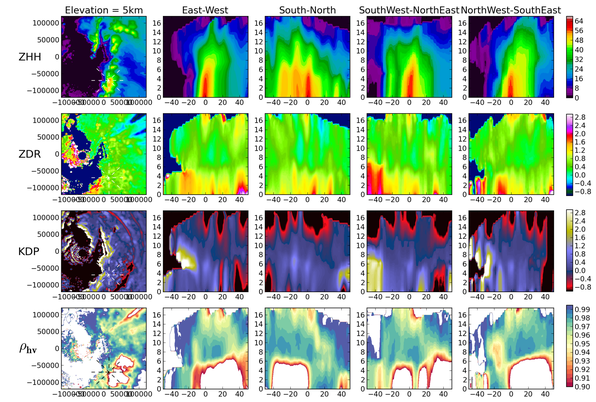


KDP column no. 2; May 24 2011 -- 22:42:54

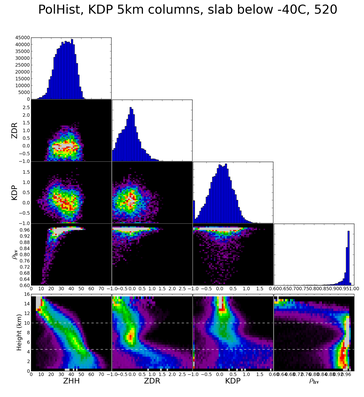


S-band KVNX NEXRAD

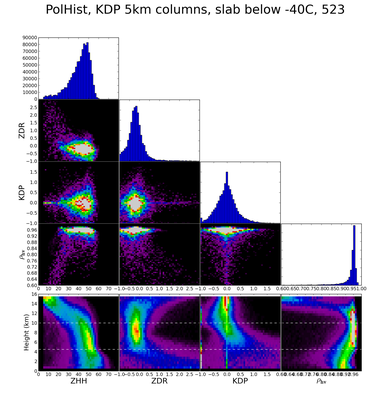
Preliminary statistical analyses

C-band CSAPR

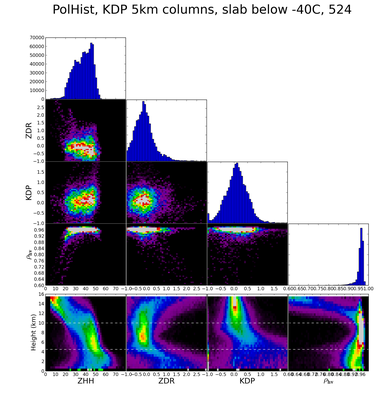
PolHist, KDP 5km columns, slab below -40C, 520



PolHist, KDP 5km columns, slab below -40C, 523



PolHist, KDP 5km columns, slab below -40C, 524



Acknowledgments

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