# Analysis of storm-to-storm and within-storm variability of C-band and S-band polarimetric signatures in MC3E deep convection updrafts

Marcus van Lier-Walqui

Columbia University
NASA Goddard Institute of Space Studies

November 7, 2013

# Acknowledgements

PI: Ann Fridlind
Co-I: Wei-Kuo Tao
Co-I: Andy Ackerman
Collaborators:

- Scott Collis (ANL)
- Scott Giangrande (BNL)
- Jonathan Helmus (ANL)

Thanks to:

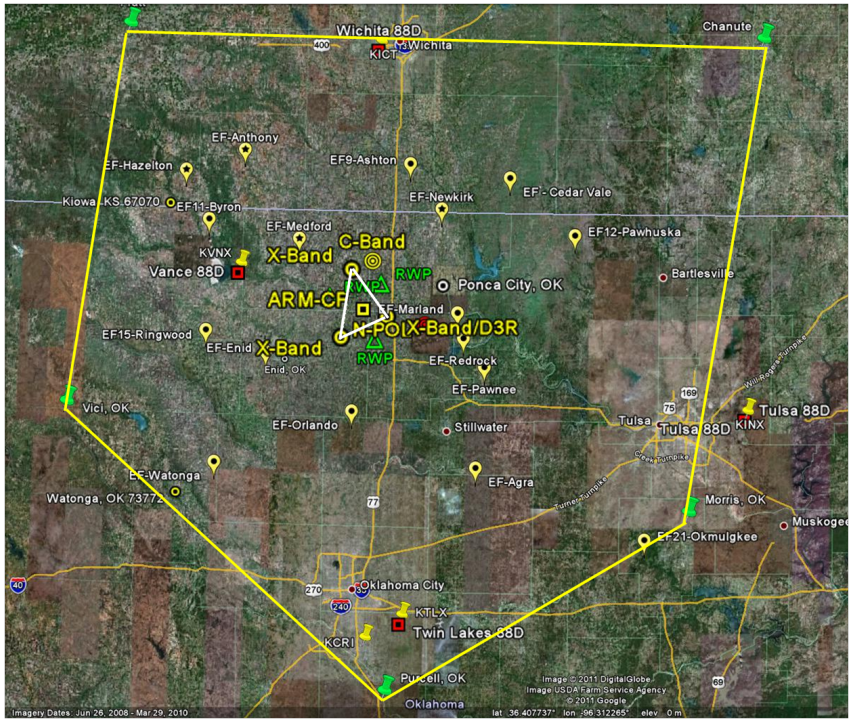
- Alexander Ryzkhov (NSSL/CIMMS)
- Alexander Khain (Hebrew University)
- Kirk North & Pavlos Kolias (McGill)
- Matthew Kumjian (Penn State)

Funding: Department of Energy ASR

# ARM MC3E

Days investigated:

- April 25: MCS with heavy rain & large drops, low melting level
- May 20: Strong, large MCS
- May 23: Very strong updrafts, supercell formation along dryline, hail
- May 24: Supercell formation along dryline, tornados reported, hail



# Observation products used

Observational analysis of updraft cores uses three data sets

1

**CSAPR MMCG**

Gridded C-band polarimetric variables from CSAPR radar (Scott Collis)

# Observation products used

Observational analysis of updraft cores uses three data sets

1

**CSAPR MMCG**

Gridded C-band polarimetric variables from CSAPR radar (Scott Collis)

2

**3-Doppler updrafts**

3-Doppler (X,X,C-band) vertical velocity retrieval with objective identification of contiguous updraft regions (Kirk North)

# Observation products used

Observational analysis of updraft cores uses three data sets

1

**CSAPR MMCG**

Gridded C-band polarimetric variables from CSAPR radar (Scott Collis)

2

**3-Doppler updrafts**

3-Doppler (X,X,C-band) vertical velocity retrieval with objective identification of contiguous updraft regions (Kirk North)

3

**KVNX NEXRAD**

Vance NEXRAD S-band polarimetric varibles, processed and gridded using Py-ART.

# Methodology

Identify updrafts via KDP columns observed extending above the melting layer. Use updraft regions identified by 3-Doppler analysis.

# Methodology

Identify updrafts via KDP columns observed extending above the melting layer. Use updraft regions identified by 3-Doppler analysis.

Identify (microphysically meaningful) common signatures and relationships between polarimetric variables as well as with vertical wind regions.

# Methodology

Identify updrafts via KDP columns observed extending above the melting layer. Use updraft regions identified by 3-Doppler analysis.

Identify (microphysically meaningful) common signatures and relationships between polarimetric variables as well as with vertical wind regions.

Statistically analyze prevalence and variablility (core-to-core, day-to-day) of identified signatures.

# Methodology

Identify updrafts via KDP columns observed extending above the melting layer. Use updraft regions identified by 3-Doppler analysis.

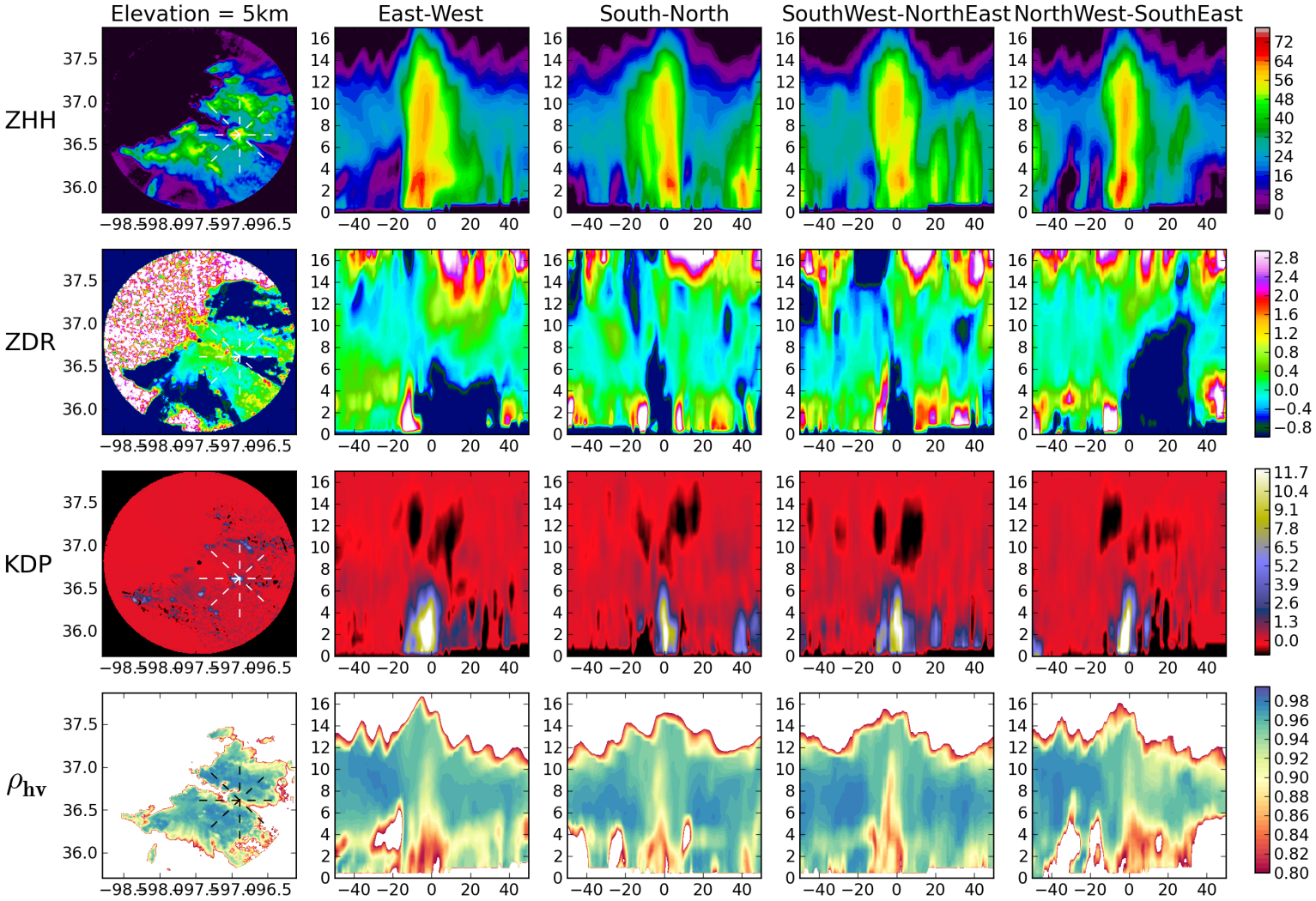
Identify (microphysically meaningful) common signatures and relationships between polarimetric variables as well as with vertical wind regions.

Statistically analyze prevalence and variablility (core-to-core, day-to-day) of identified signatures.

$\rightarrow$ Analyze spectral bin simulations from the perspective of observational targets

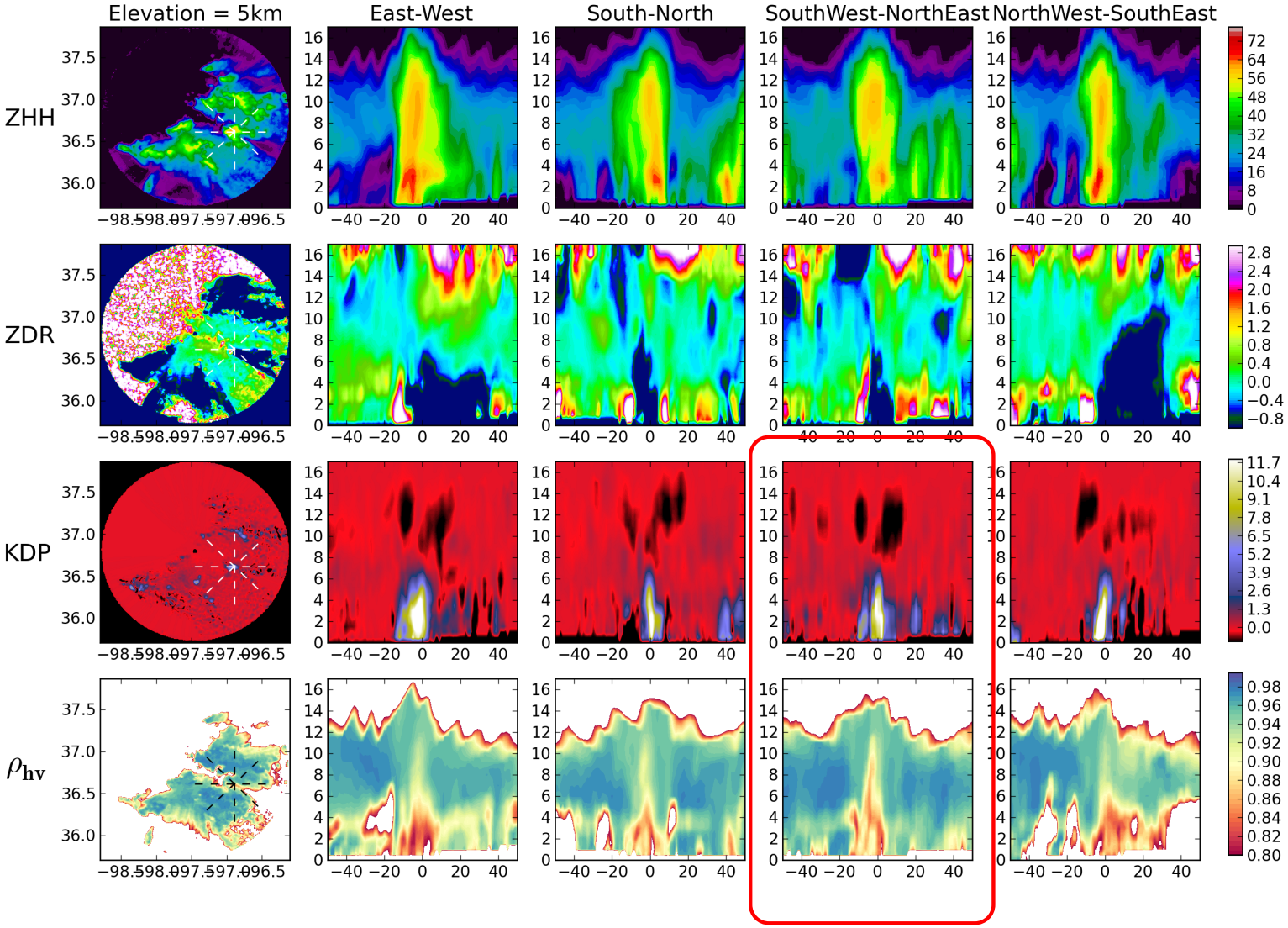
# CSAPR – Slices through KDP columns

KDP column no. 2; May 23 2011 -- 22:30:24.

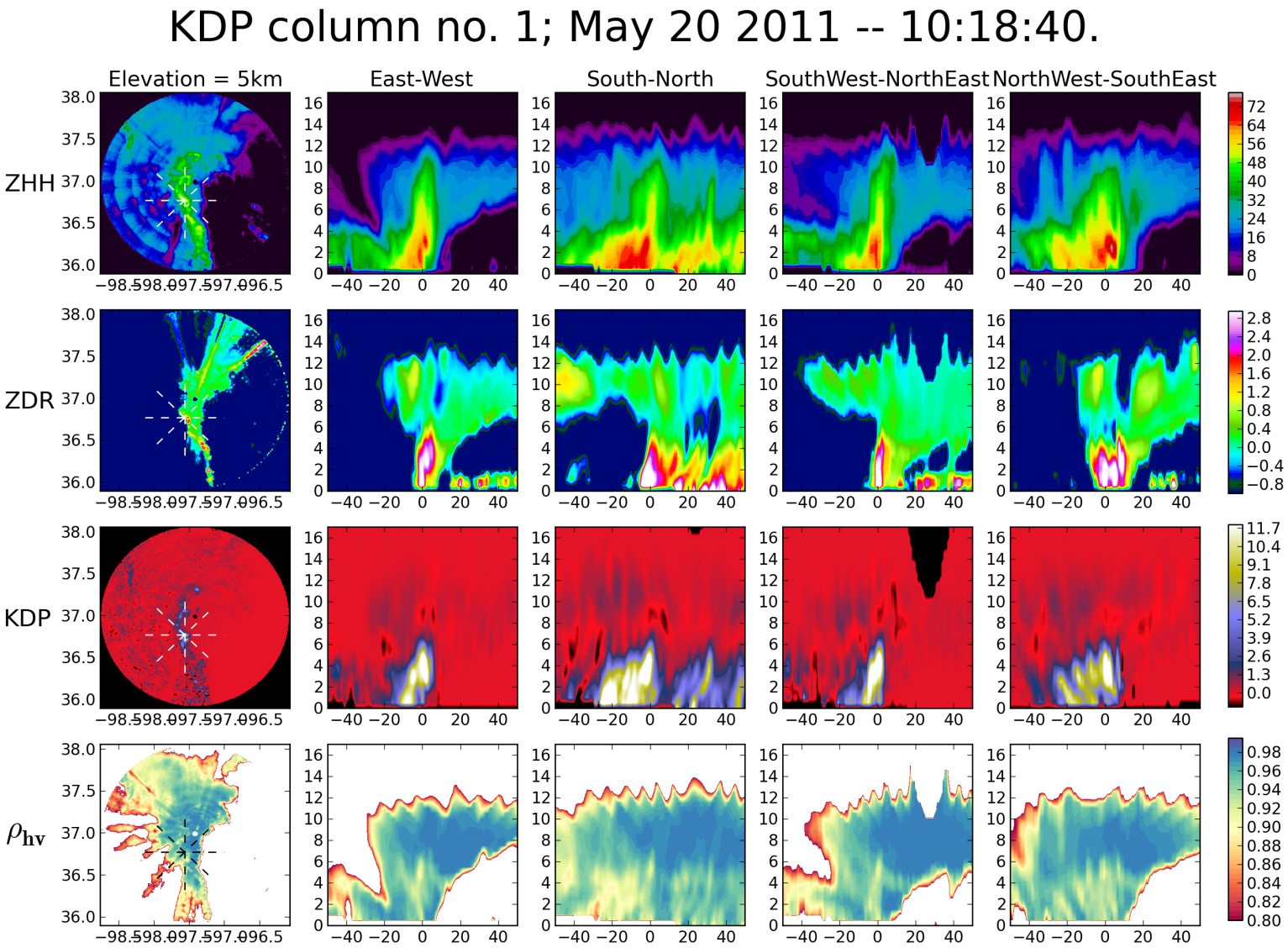


# CSAPR – Slices through KDP columns

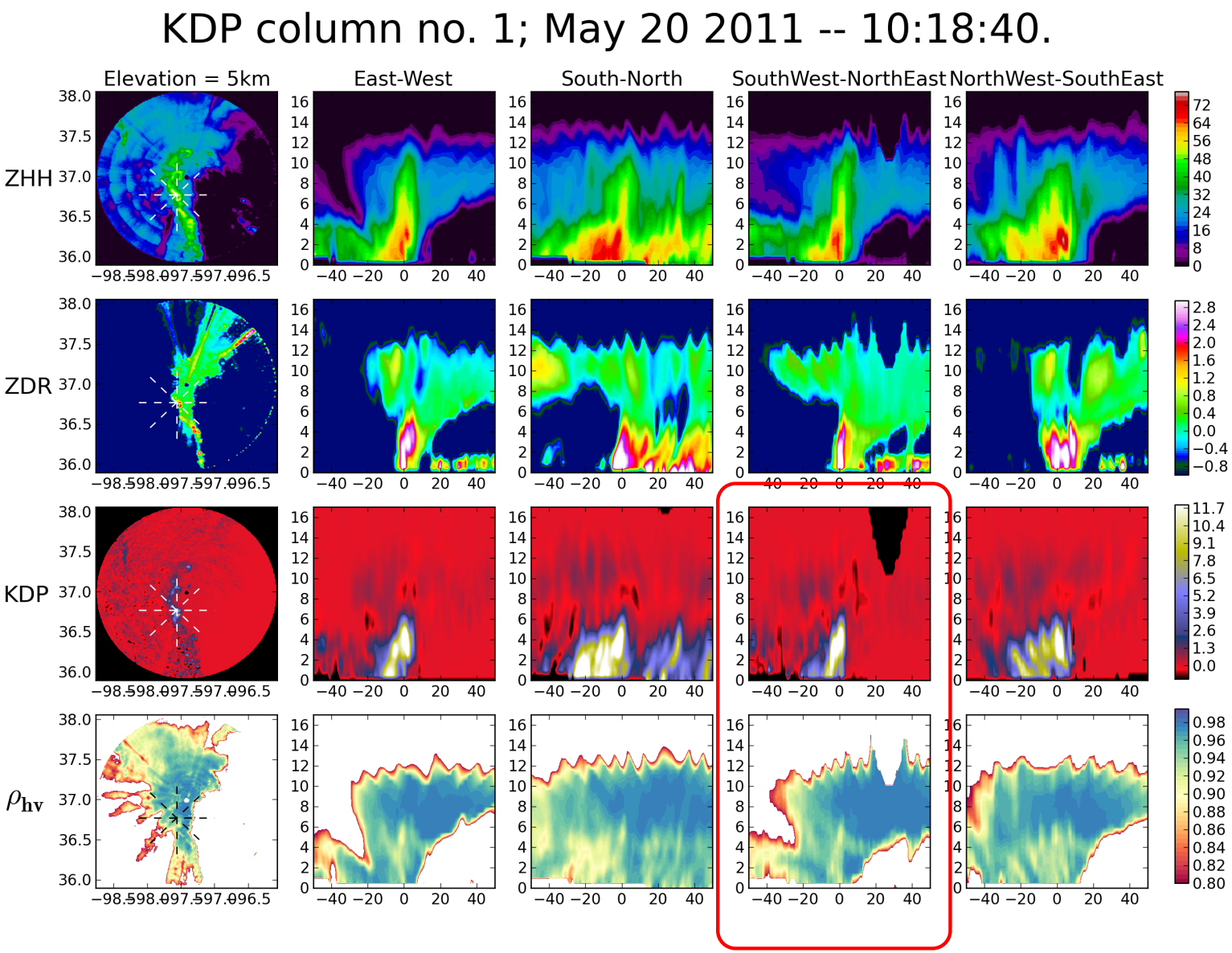
KDP column no. 2; May 23 2011 -- 22:30:24.



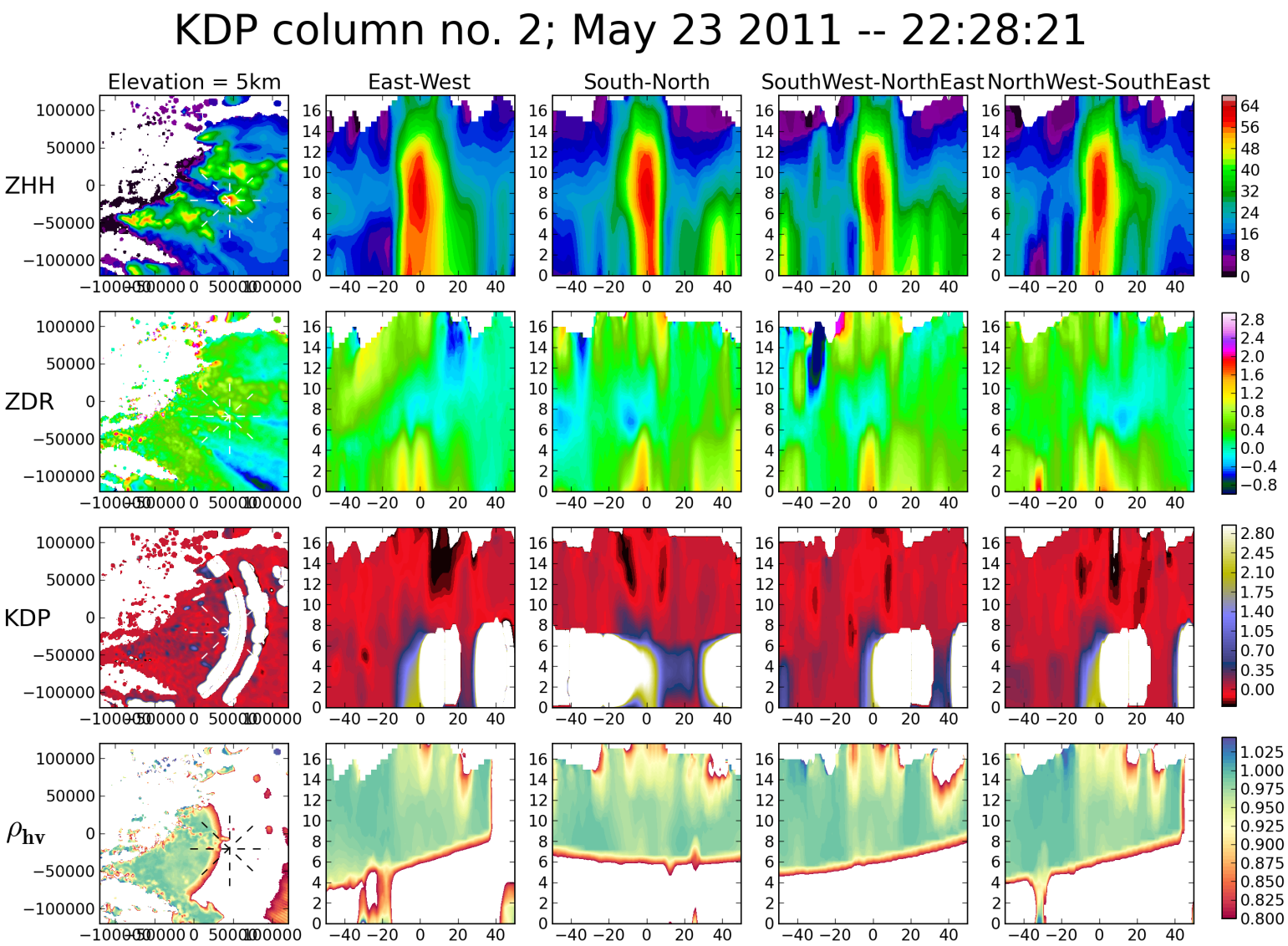
# CSAPR – Slices through KDP columns



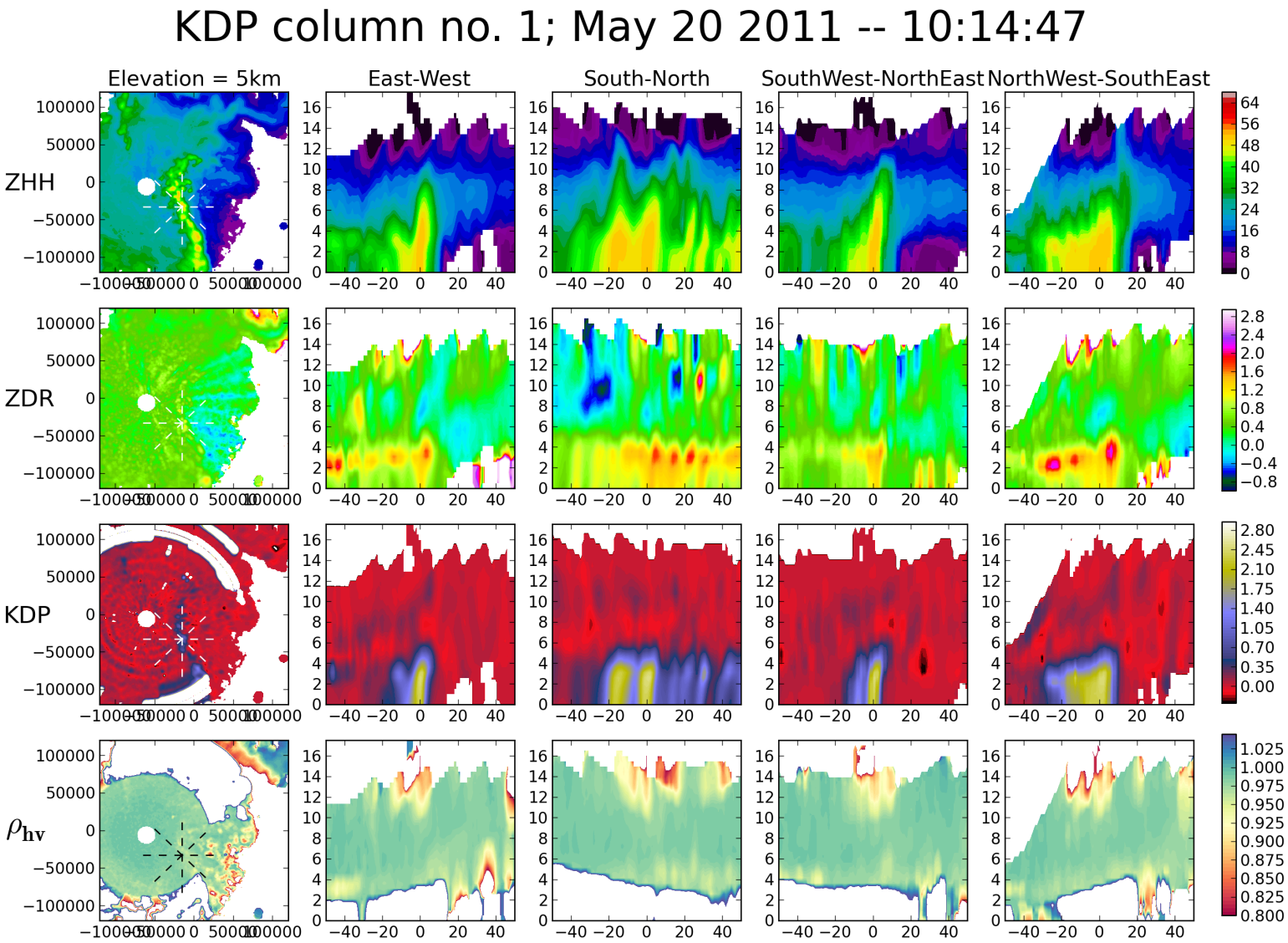
# CSAPR – Slices through KDP columns



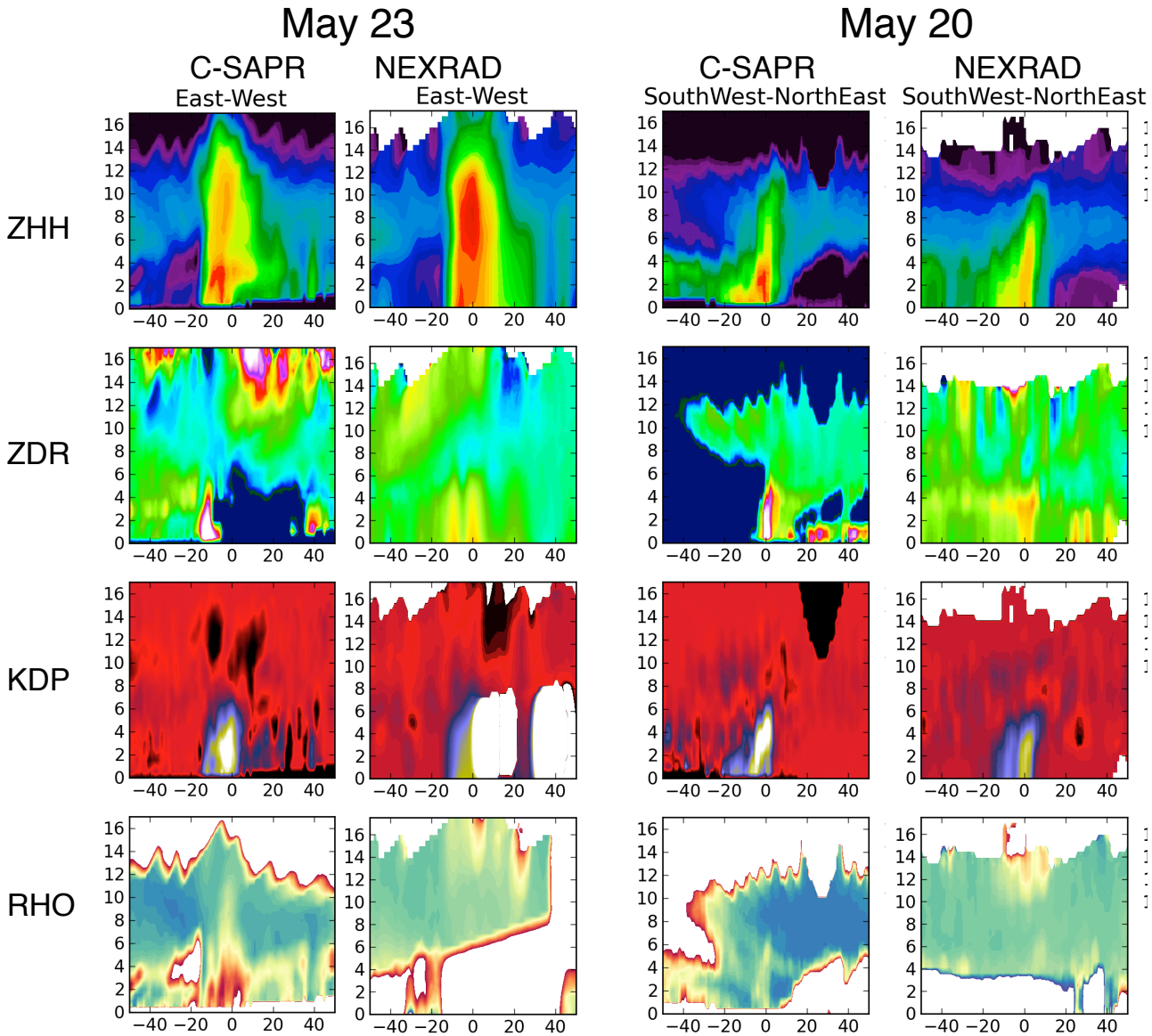
# NEXRAD – Slices through KDP columns



# NEXRAD – Slices through KDP columns

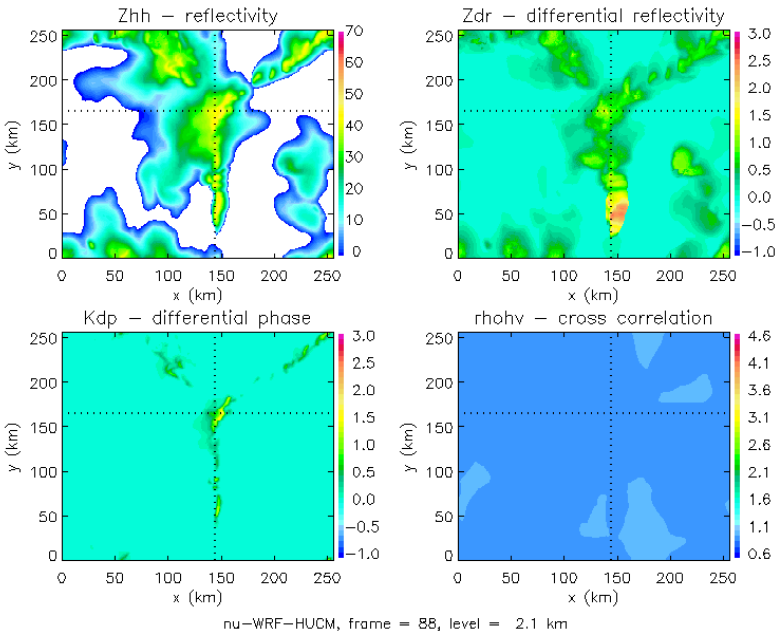


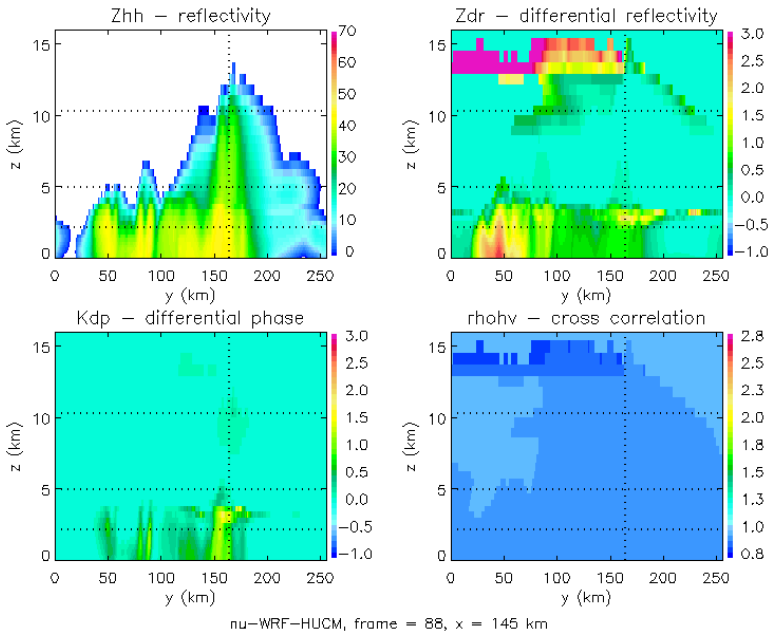
# C-SAPR vs NEXRAD



# Preliminary spectral bin model results

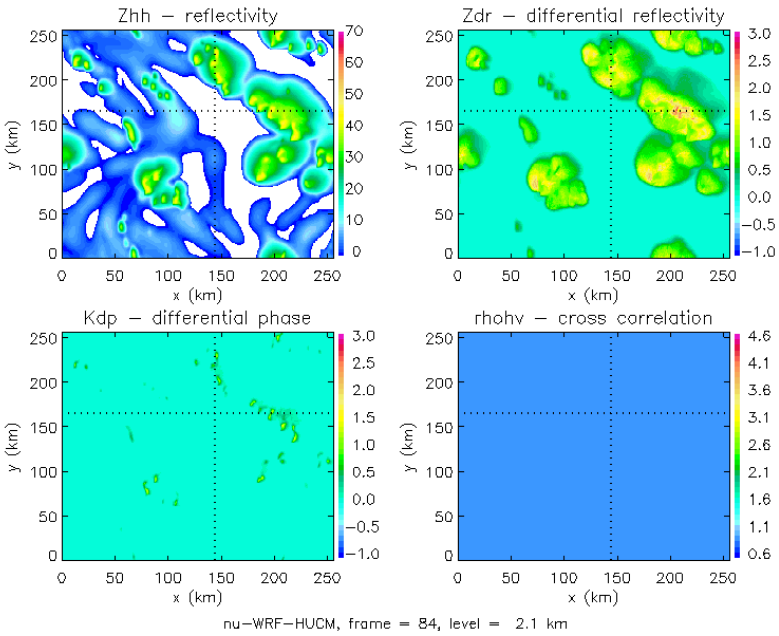
Hot off the press!

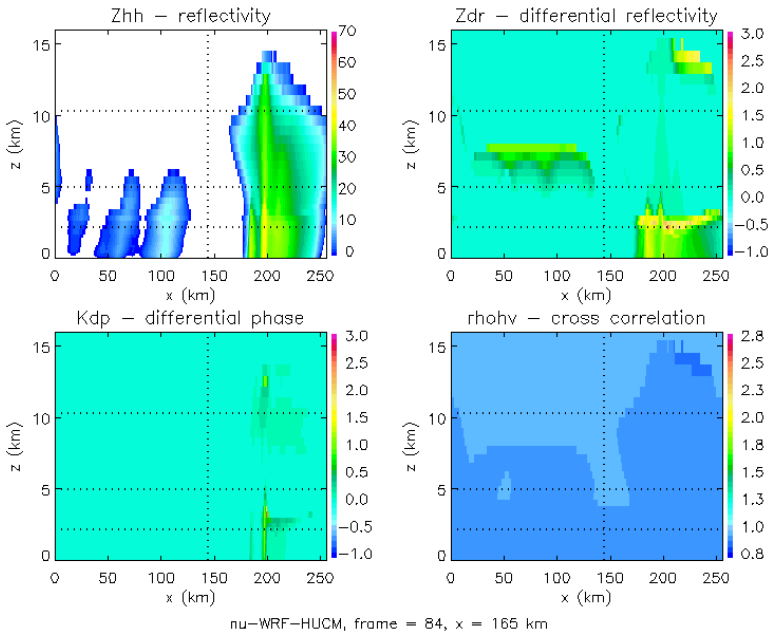


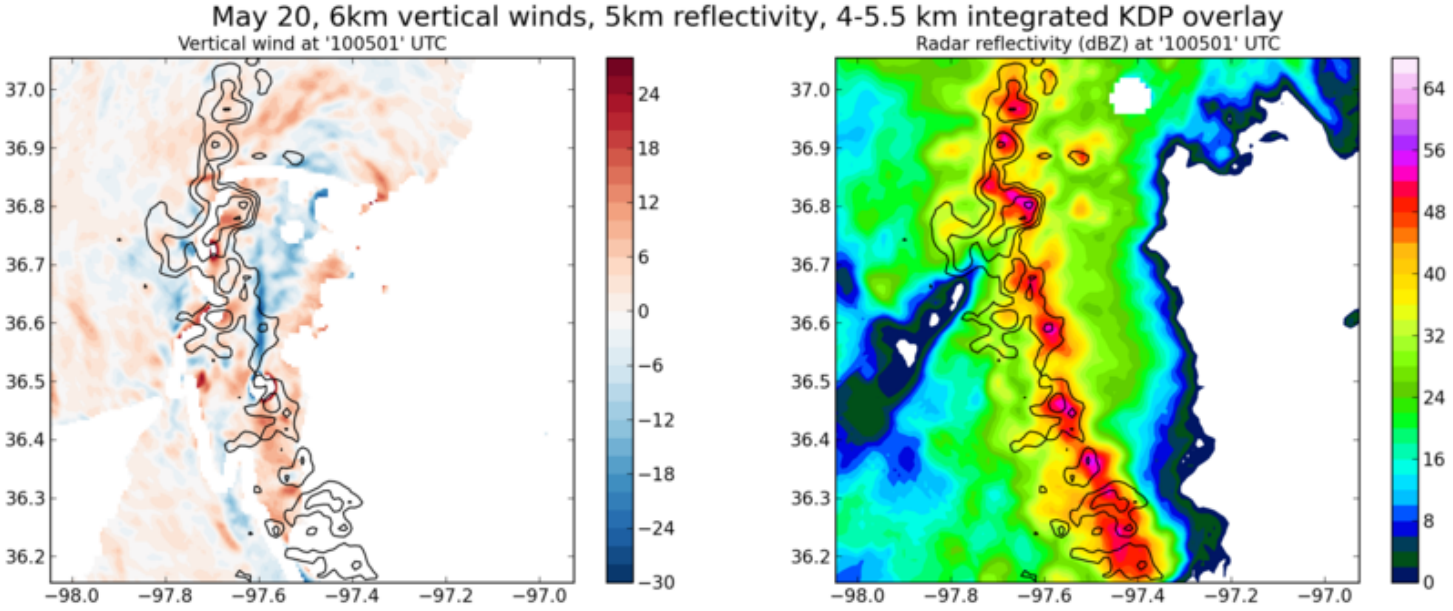
# Preliminary spectral bin model results

Watch this space!

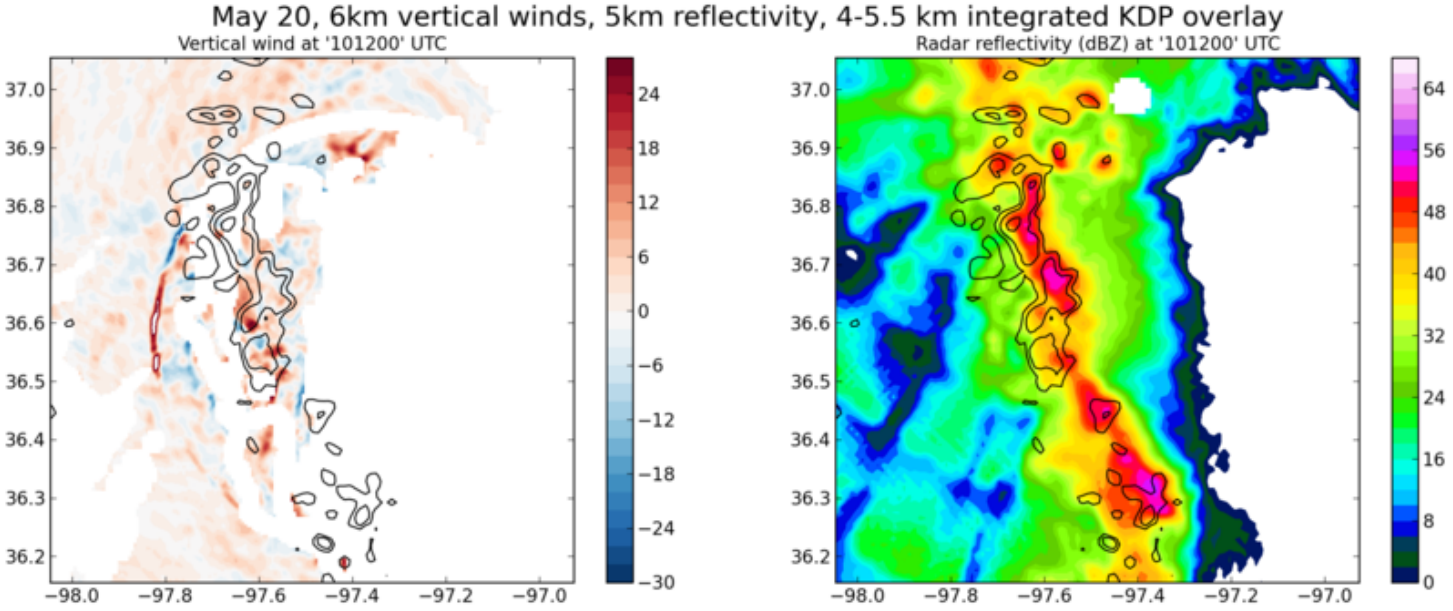


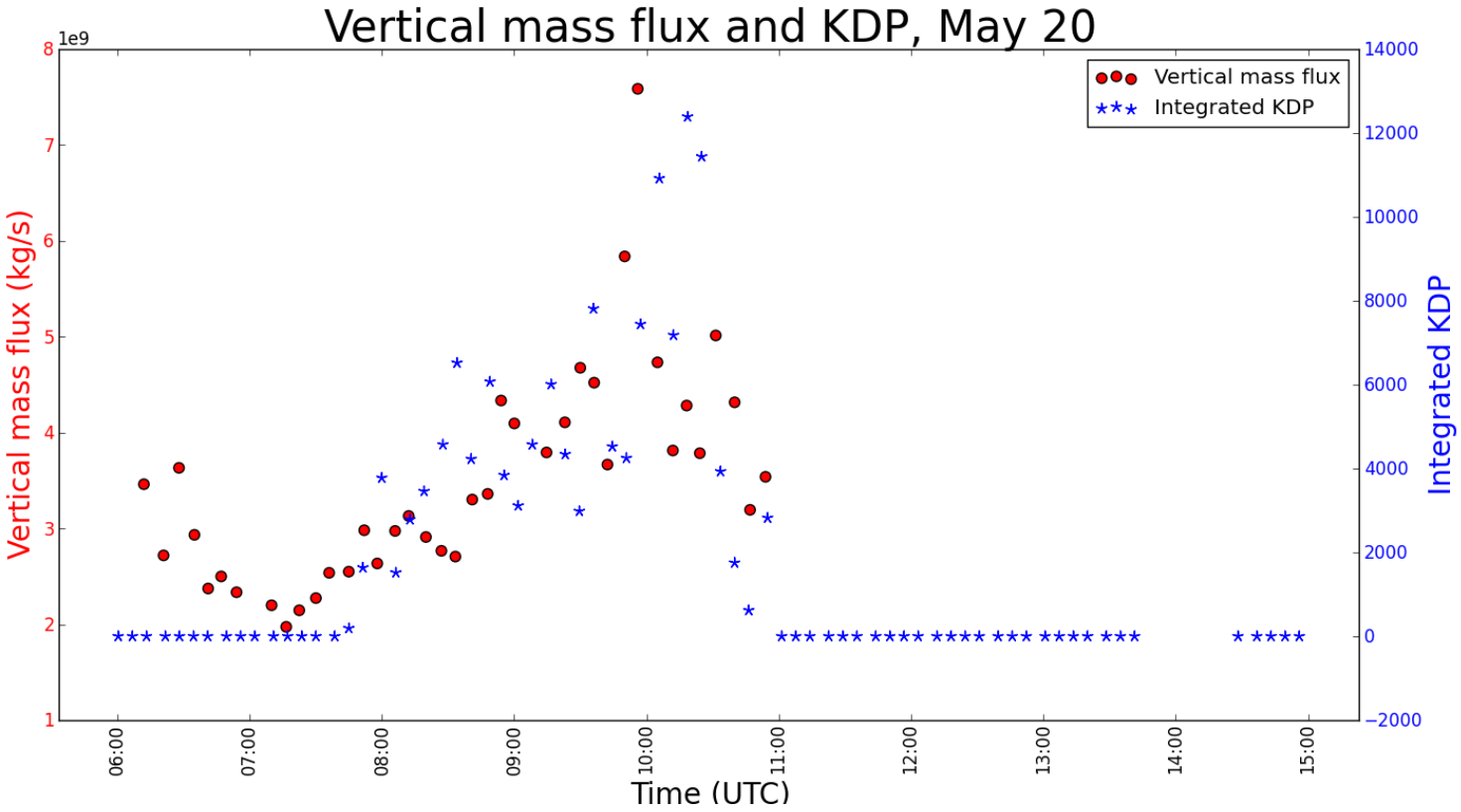
# CONVV vertical winds vs KDP



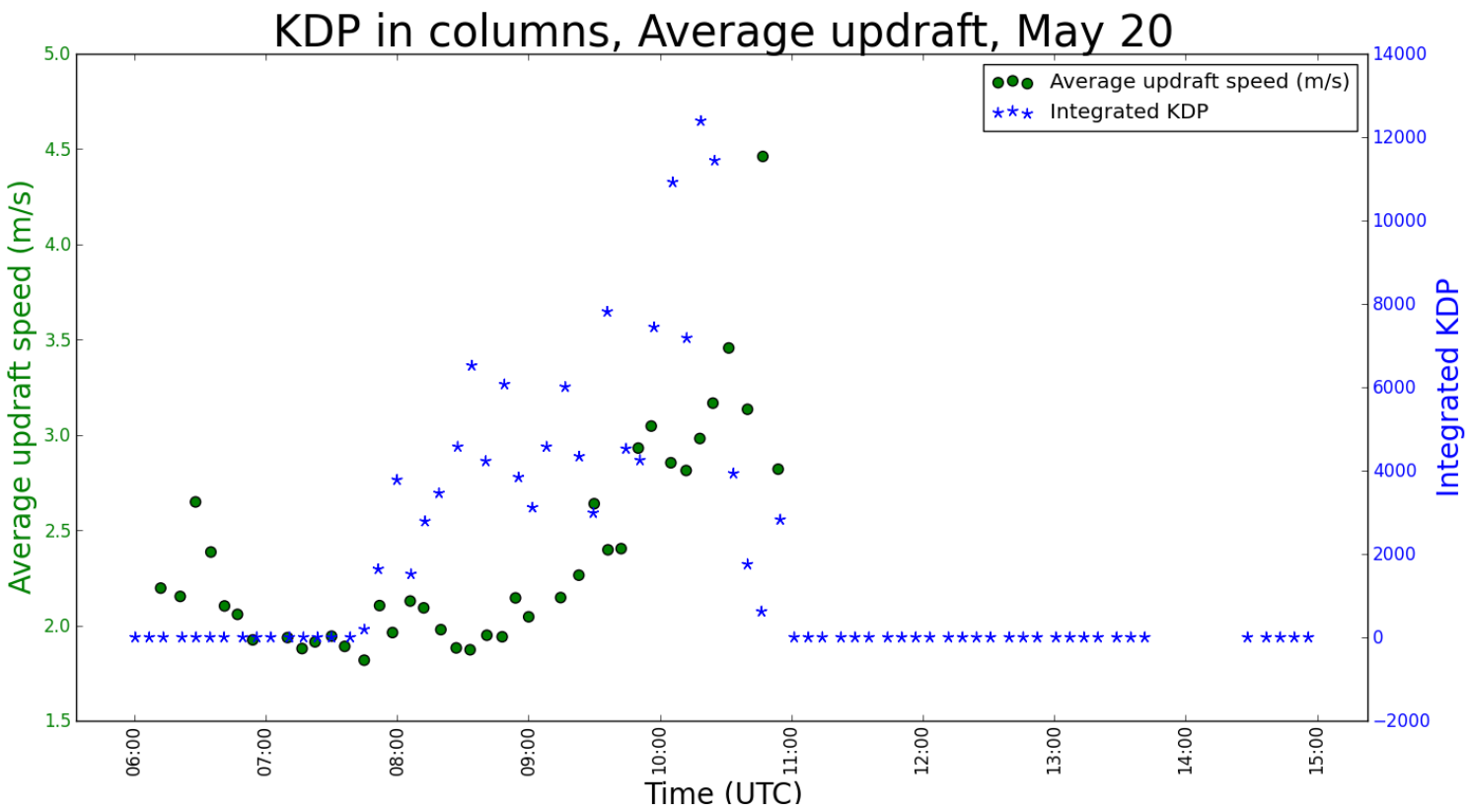
# CONVV vertical winds vs KDP



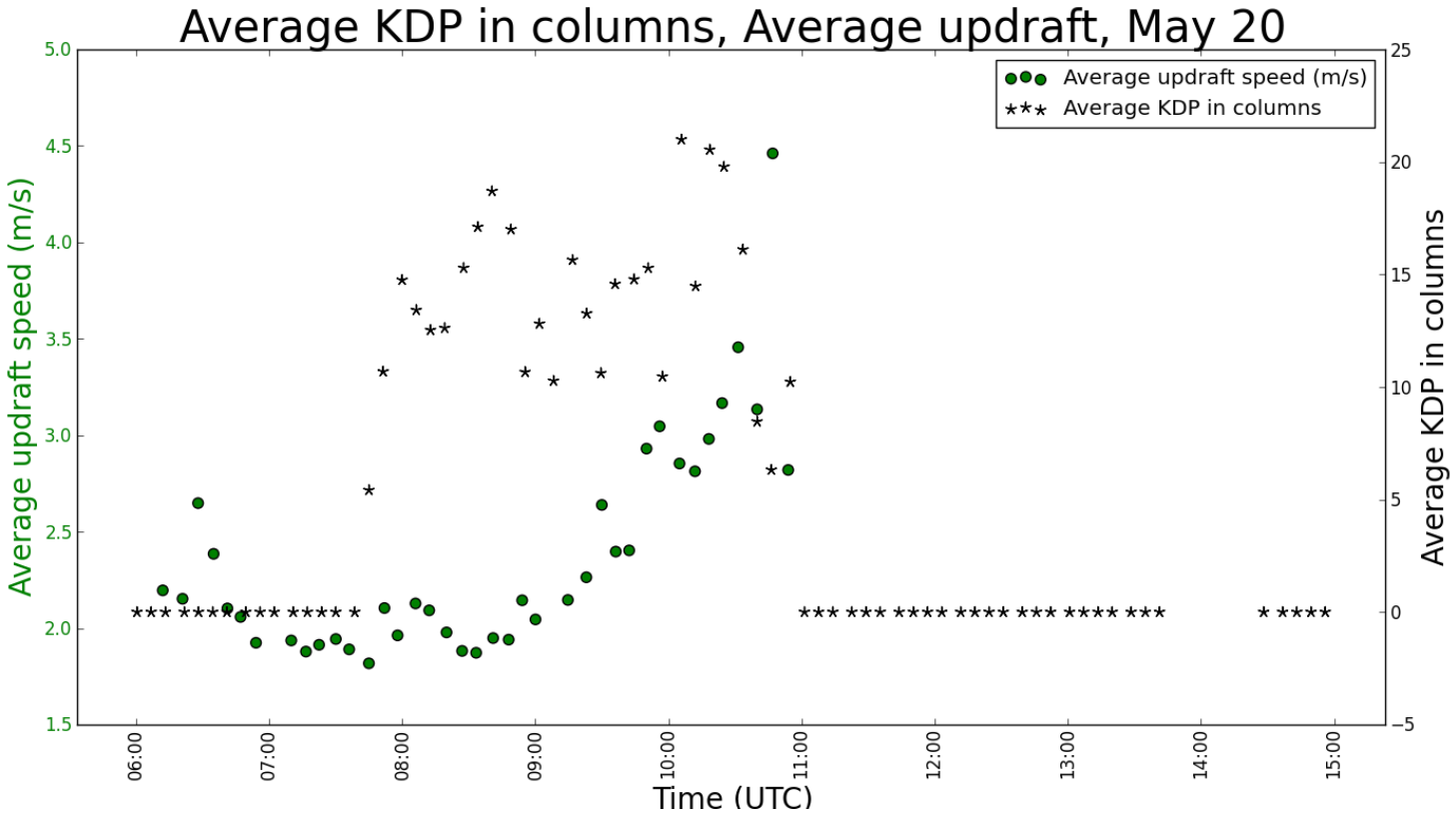
# Vertical mass flux vs. KDP columns



# Vertical mass flux vs. KDP columns



# Vertical mass flux vs. KDP columns



# Preliminary Conclusions & Future Work

## Conclusions

- Variability in updraft depth/strength

# Preliminary Conclusions & Future Work

## Conclusions

- Variability in updraft depth/strength
- Variability in depth/strength of KDP column

# Preliminary Conclusions & Future Work

## Conclusions

- Variability in updraft depth/strength
- Variability in depth/strength of KDP column
- Relationship between vertical mass flux and KDP columns

# Preliminary Conclusions & Future Work

## Conclusions

- Variability in updraft depth/strength
- Variability in depth/strength of KDP column
- Relationship between vertical mass flux and KDP columns

## Continuing Work

- Analyze NEXRAD S-band data

# Preliminary Conclusions & Future Work

## Conclusions

- Variability in updraft depth/strength
- Variability in depth/strength of KDP column
- Relationship between vertical mass flux and KDP columns

## Continuing Work

- Analyze NEXRAD S-band data
- Continue analysis of identified objects

# Preliminary Conclusions & Future Work

## Conclusions

- Variability in updraft depth/strength
- Variability in depth/strength of KDP column
- Relationship between vertical mass flux and KDP columns

## Continuing Work

- Analyze NEXRAD S-band data
- Continue analysis of identified objects
- Diagnose signals observed in bin simulations