The Utilization of PERiLS Platform Data during IOP 4 in Northern Alabama prior to the Hazel Green Tornado

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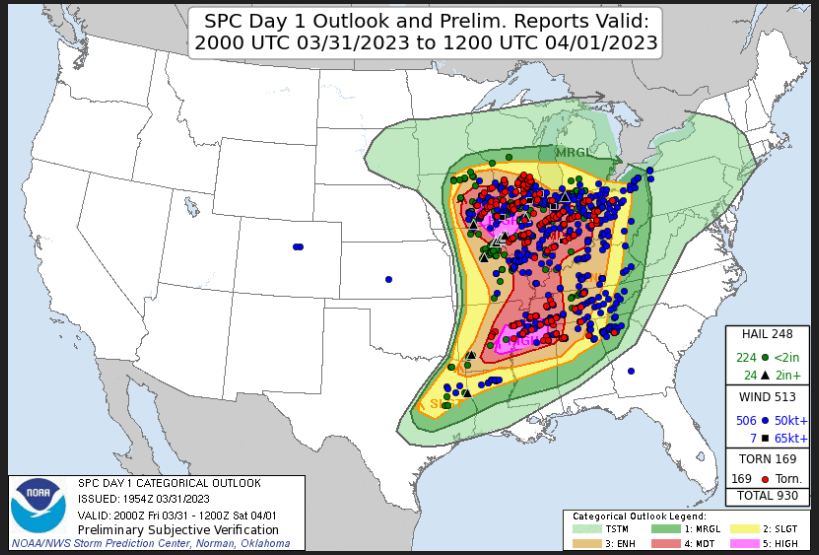
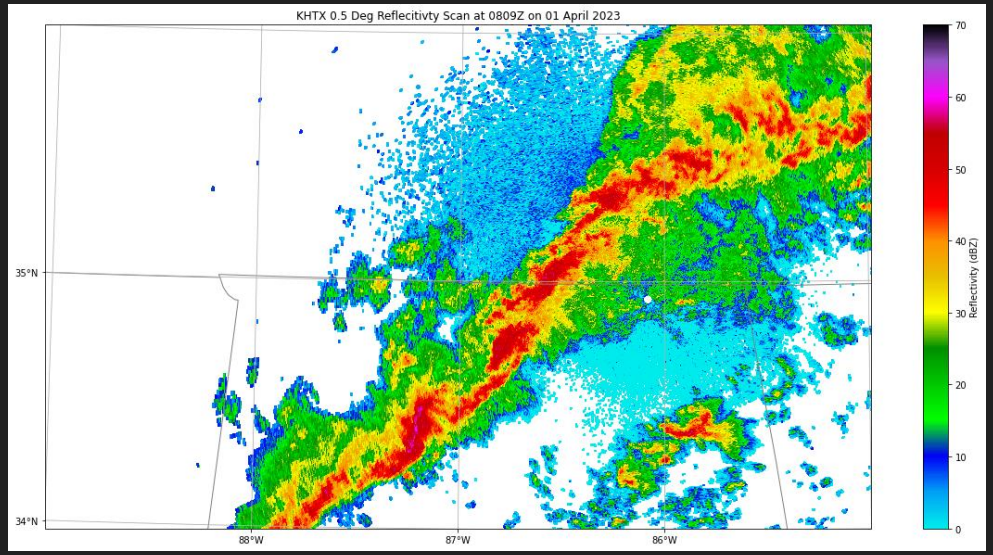
THE UNIVERSITY OF ALABAMA IN HUNTSVILLE

Overview of Event



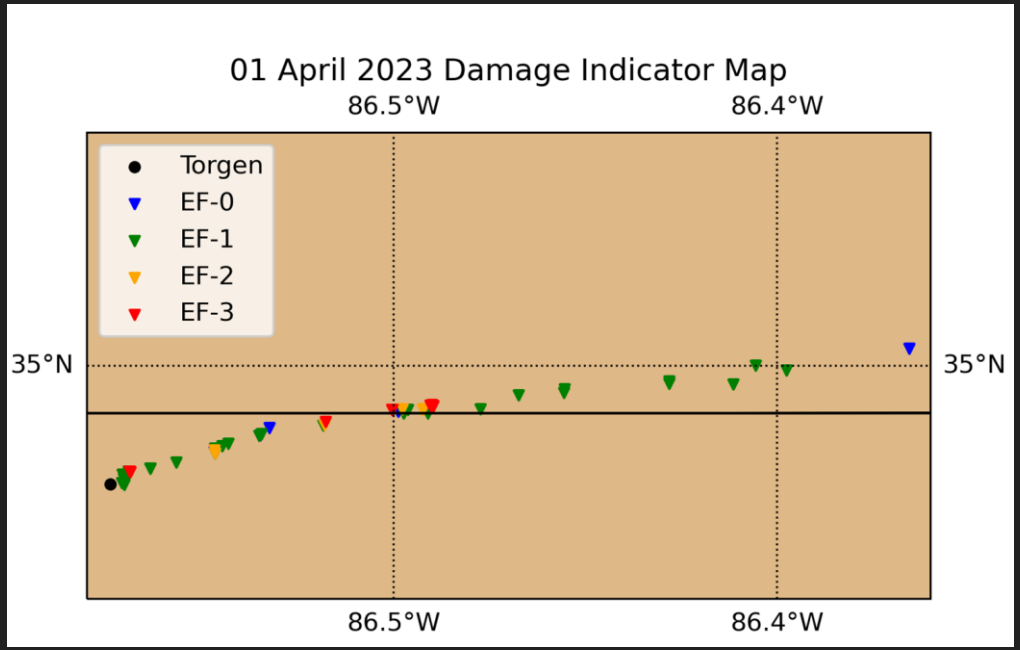
2000Z Day 1 Convective Outlook Verification per the Storm Prediction Center for 01 April 2023



Southern QLCS passing through North Alabama at 0809Z KHTX 0.5° Reflectivity

Tornado Stats and Damage Map

Rating	**EF-3**
Max Est. Winds	**160 mph**
Path Length	12.1 Miles
Path Width	215 Yards
Injuries/Fatalities	**5/1**
Tornadogenesis	0809Z (3:09 a.m.)
Dissipation	0825Z (3:25 a.m.)



Data Provided by:
NOAA Damage Assessment Toolkit and
National Weather Service, Huntsville, AL

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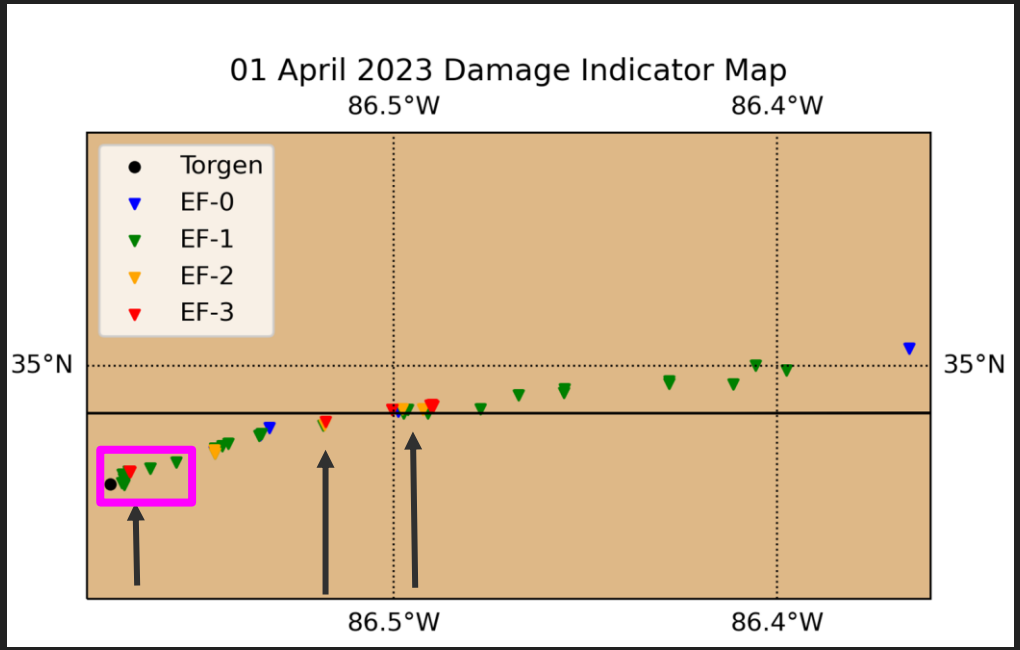

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Early Rapid Intensification

Goals of this Analysis

- Observe the evolution of the Nocturnal Boundary Layer (NBL) and its destabilization in the pre-storm environment using PERiLS platform and balloon data
  - UAH Mobile Atmospheric Profiling Network, MAPNet:
    - X-band dual-polarization radar, two 915 MHz wind profilers, LiDAR, surface stations, and more
    - Soundings launched from each MAPNet site in conjunction with other PERiLS teams

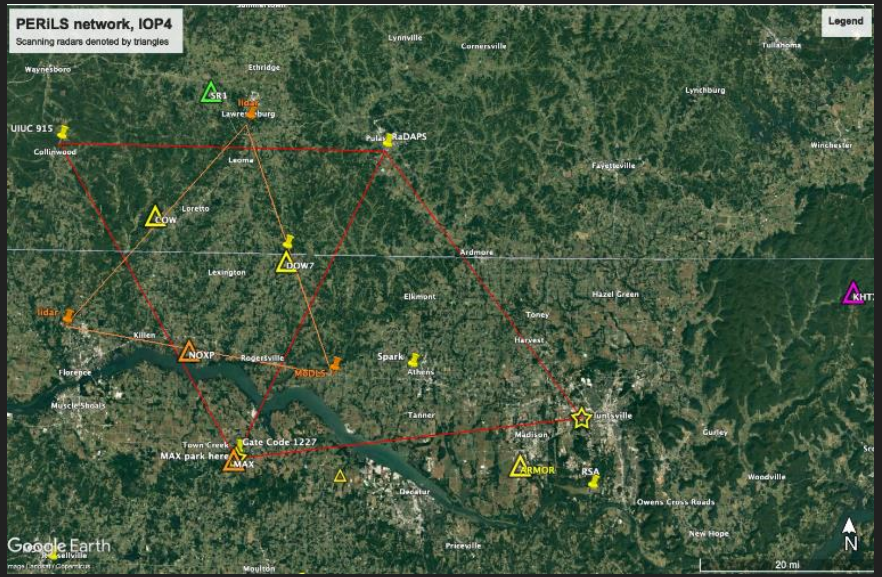
- Re-create a 2D and 3D wind field of the lowest 4 km to infer variations in low-level flow near the time of tornadogenesis through a dual-Doppler Analysis (DDA)
  - Advanced Radar for Meteorological and Operational Research (ARMOR)
  - National Weather Service Weather Surveillance Radar - 1988 Doppler (WSR-88D) in Hytop, AL

PERiLS IOP 4 - North Alabama

Methodologies:

- Assess environmental parameters from soundings and instrumentation
- Compare and contrast radar wind profiles from available 915 and 449 MHz platforms
- Run DDAs using the Hytop, AL WSR-88D (KHTX) and the ARMOR radar located at Huntsville International Airport

Red Triangles - 915 MHz Wind Profilers



PERiLS IOP 4 Set-Up. Photo Provided by Kevin Knupp

Orange Triangle - LiDARs

Environmental Parameters

Pre-Storm Ranges:

0-1 km SRH: 450-700 m^2/s^2

0-6 km Shear: 50 m/s increasing to 70+ m/s

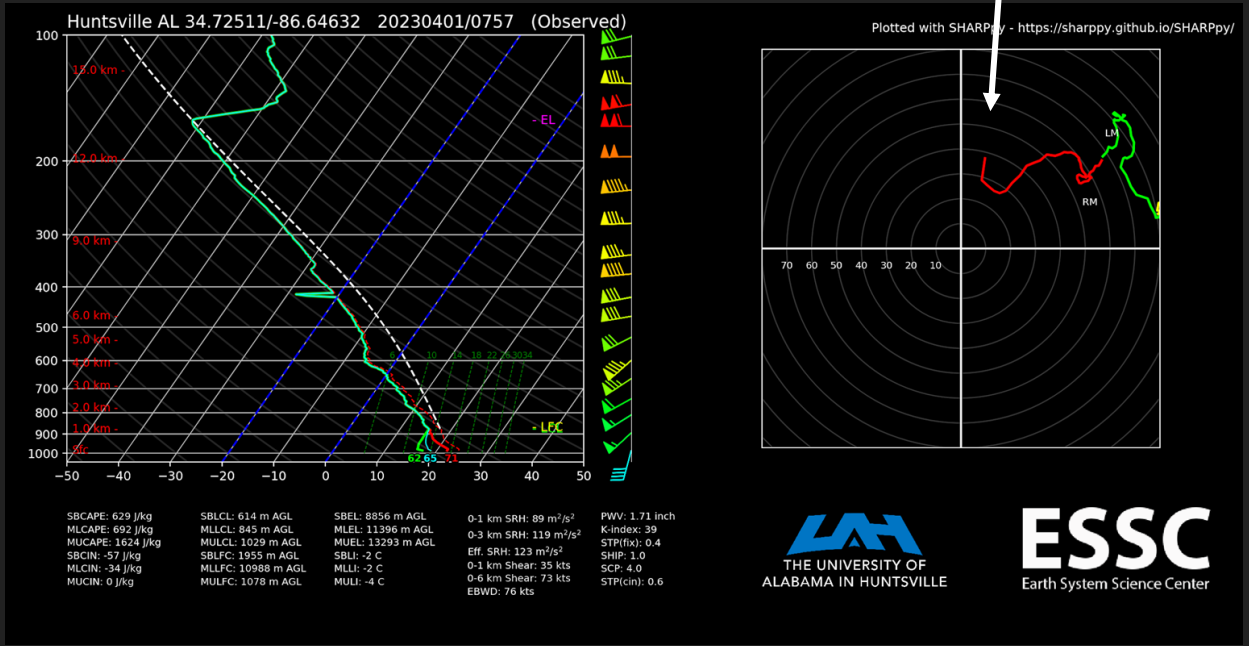
SBCAPE: 400-600 J/kg

MULCL: 1500 m decreasing to ~1000 m

MULFC: 2000 m decreasing to near 1000 m

SWIRLL 08Z Sounding

Shift in Hodograph Shape



Typical High Shear-Low CAPE (HSLC) QLCS in the Southeast Cool Season

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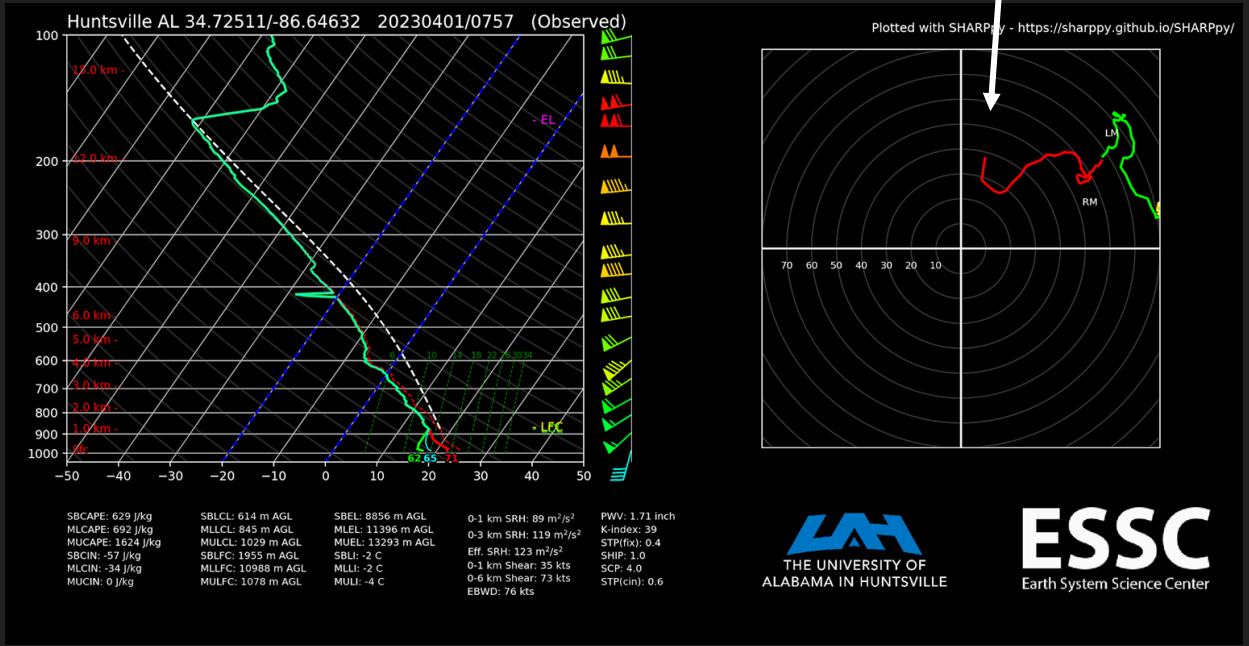

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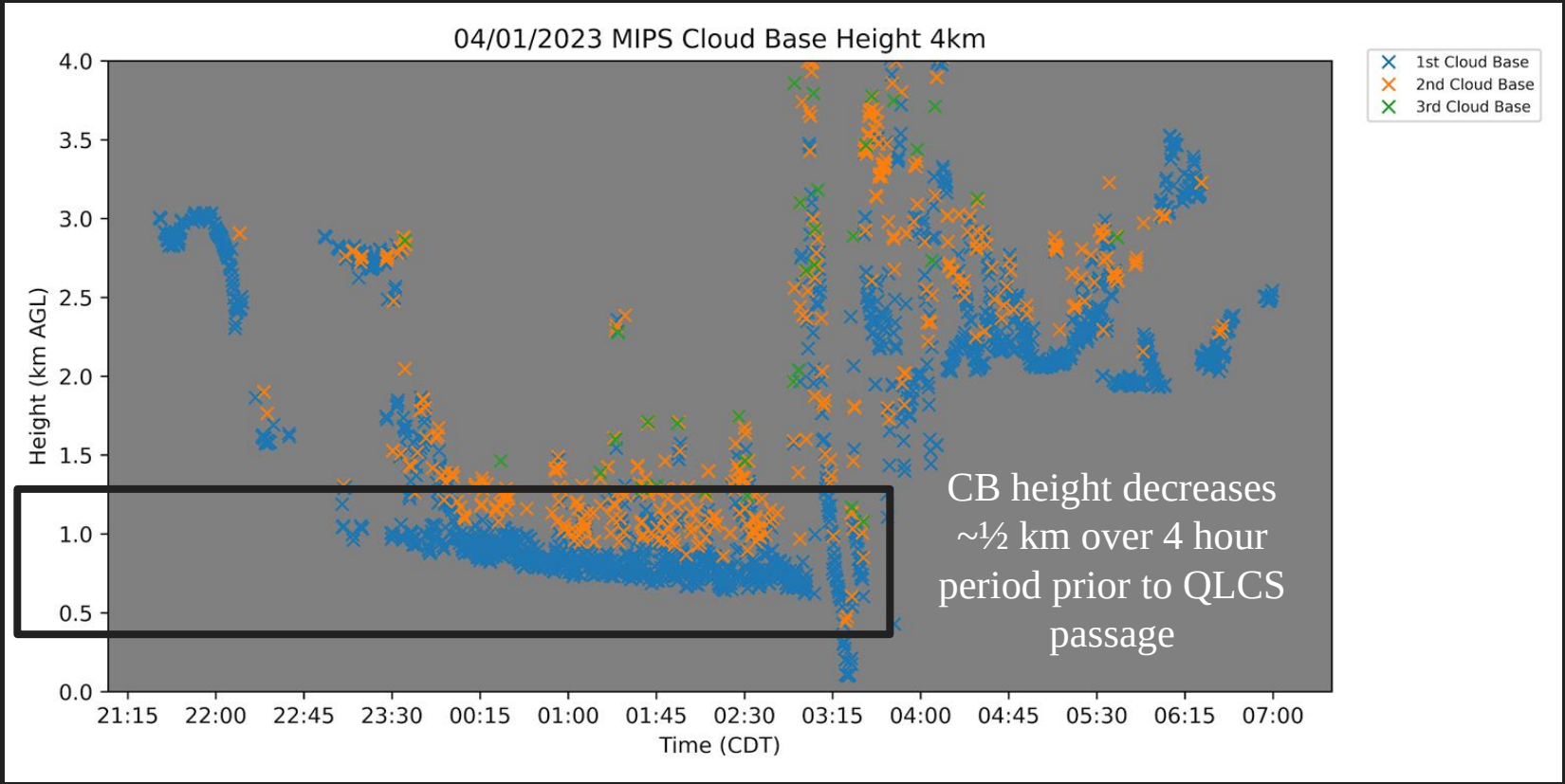
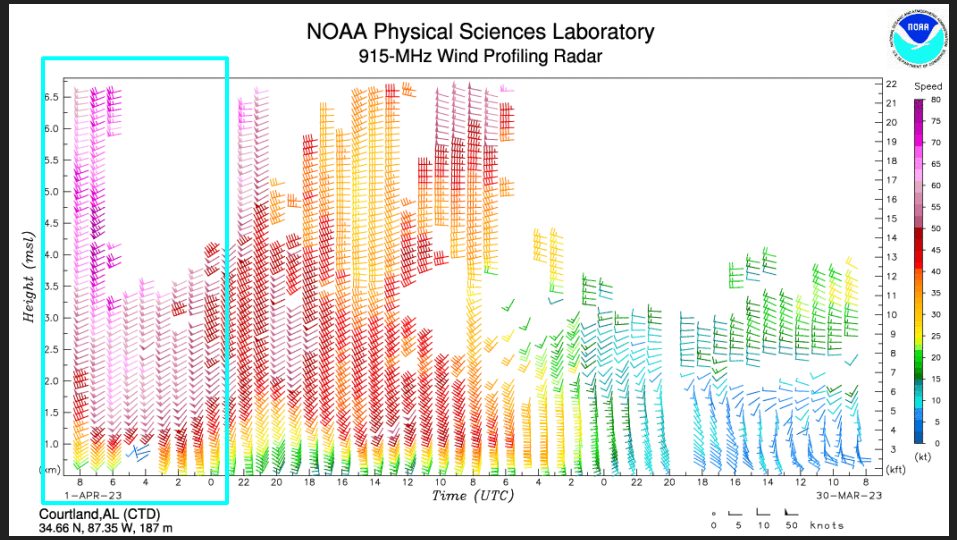
Early Findings - Consistent Cloud Base Lowering

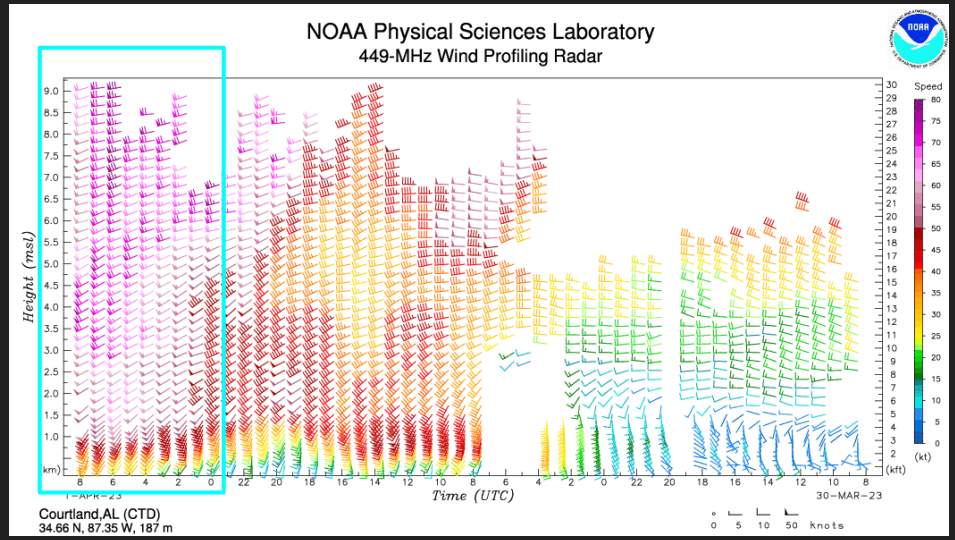


MIPS Ceilometer Cloud Base Height from the UAH Campus

449 and 915 MHz Radar Wind Profilers

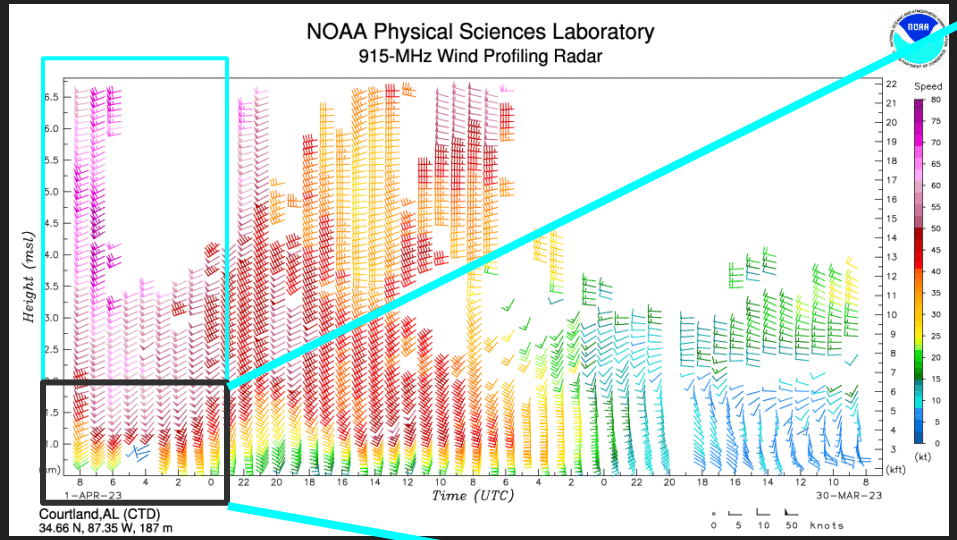


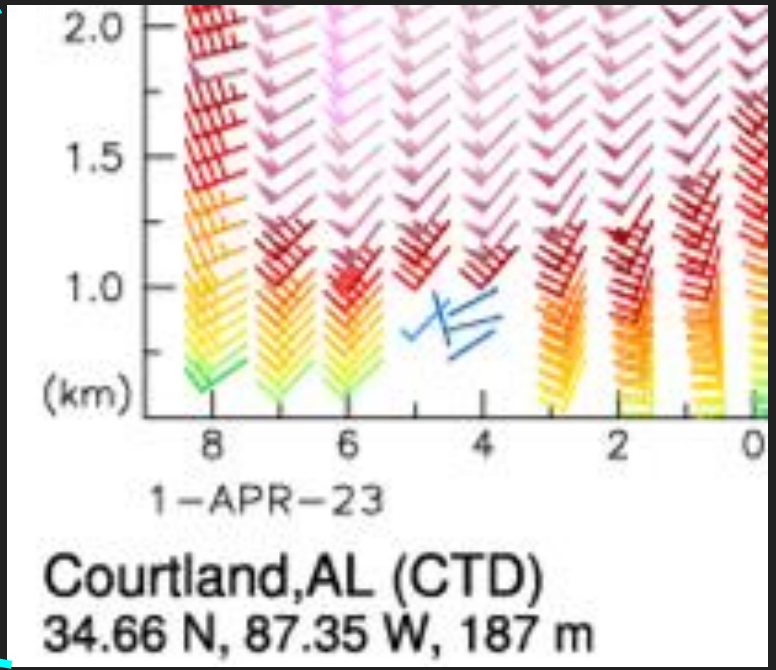
Courtland, AL 915 MHz RWP for 01 April 2023
Data Provided by the NOAA Physical Sciences Laboratory



Courtland, AL 449 MHz RWP for 01 April 2023
Data Provided by the NOAA Physical Sciences Laboratory

449 and 915 MHz Radar Wind Profilers





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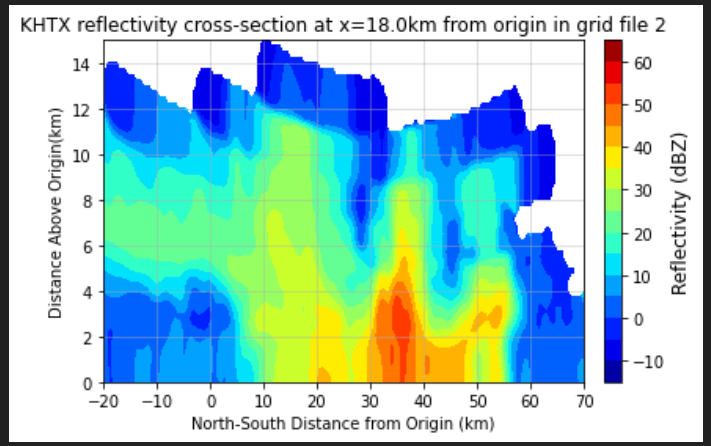
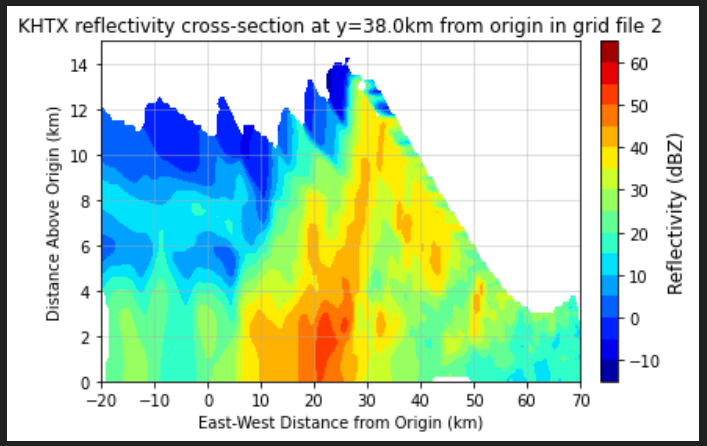
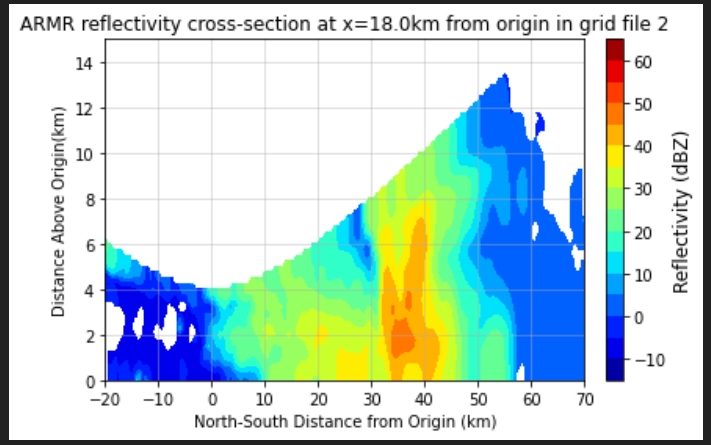
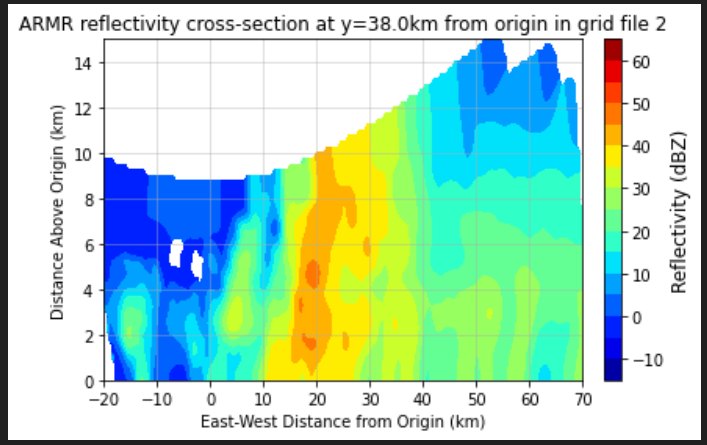
Shallow Storm Depth - In Progress DDA





KHTX YZ (left) and XZ (right)





ARMOR YZ (left) and XZ (right)

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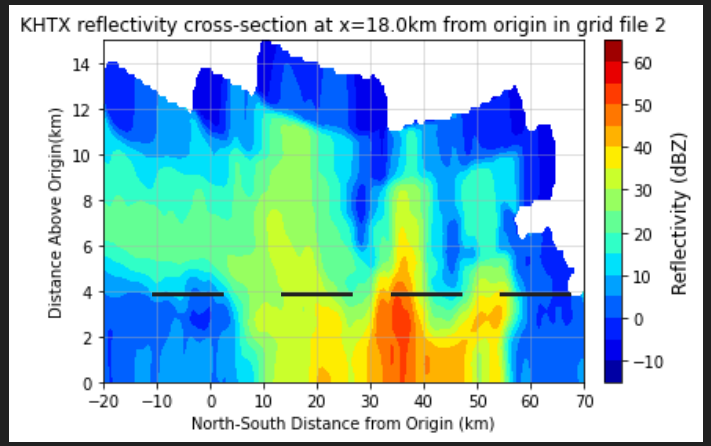
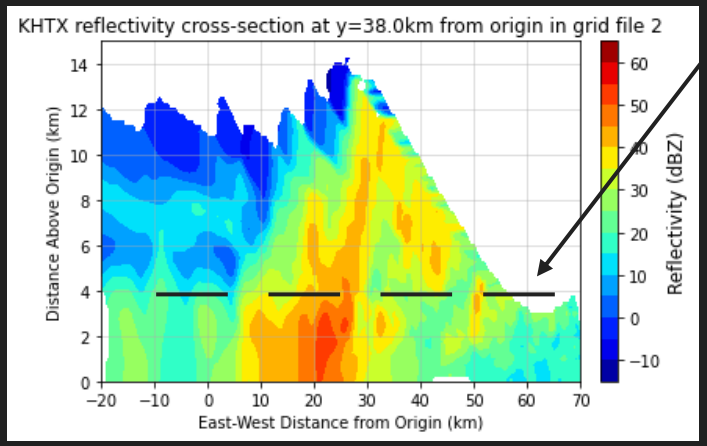
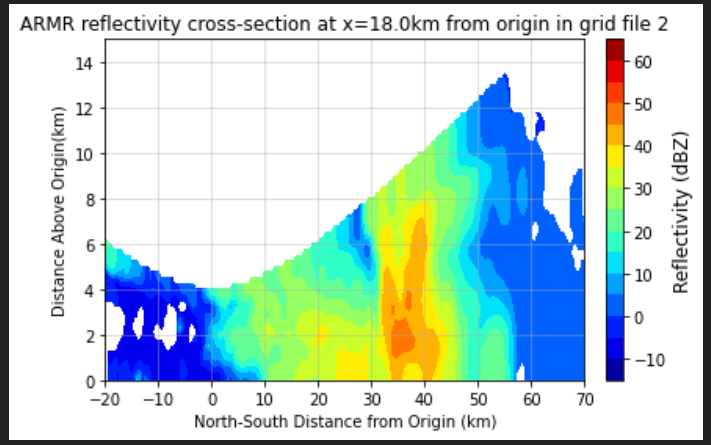
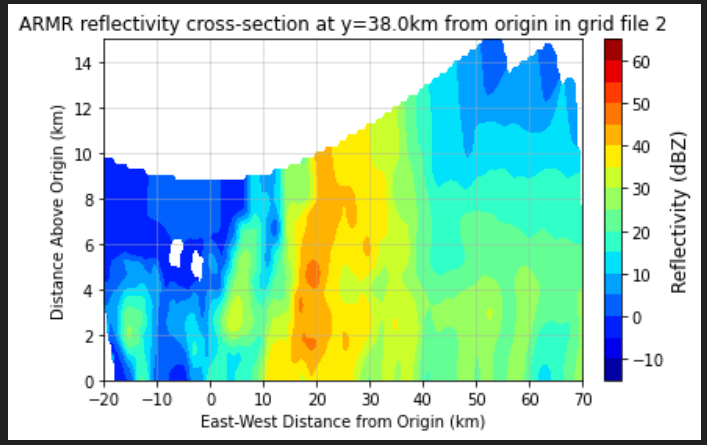




Storm core below 4 km from KHTX

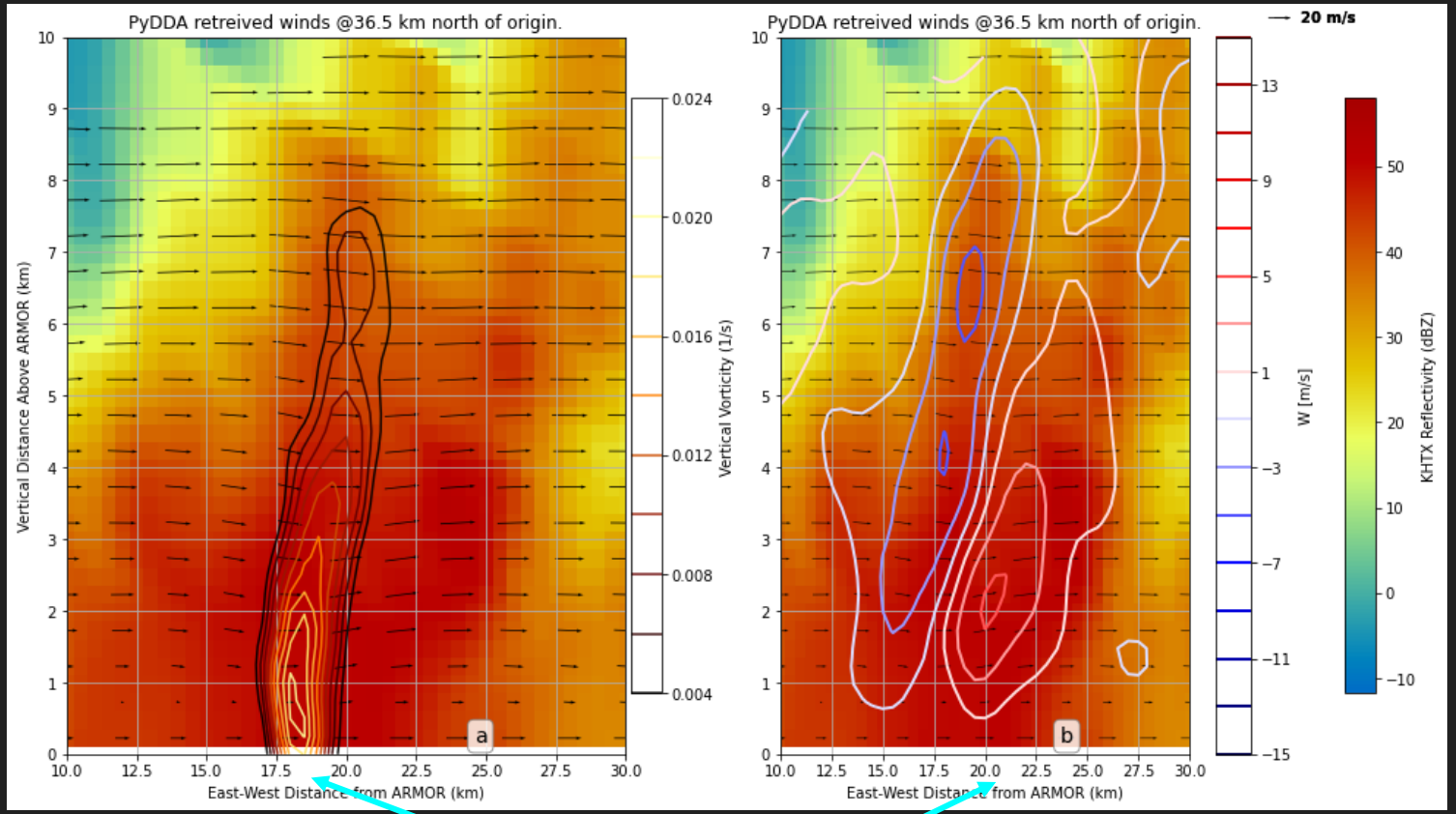
KHTX YZ (left) and XZ (right)





ARMOR YZ (left) and XZ (right)

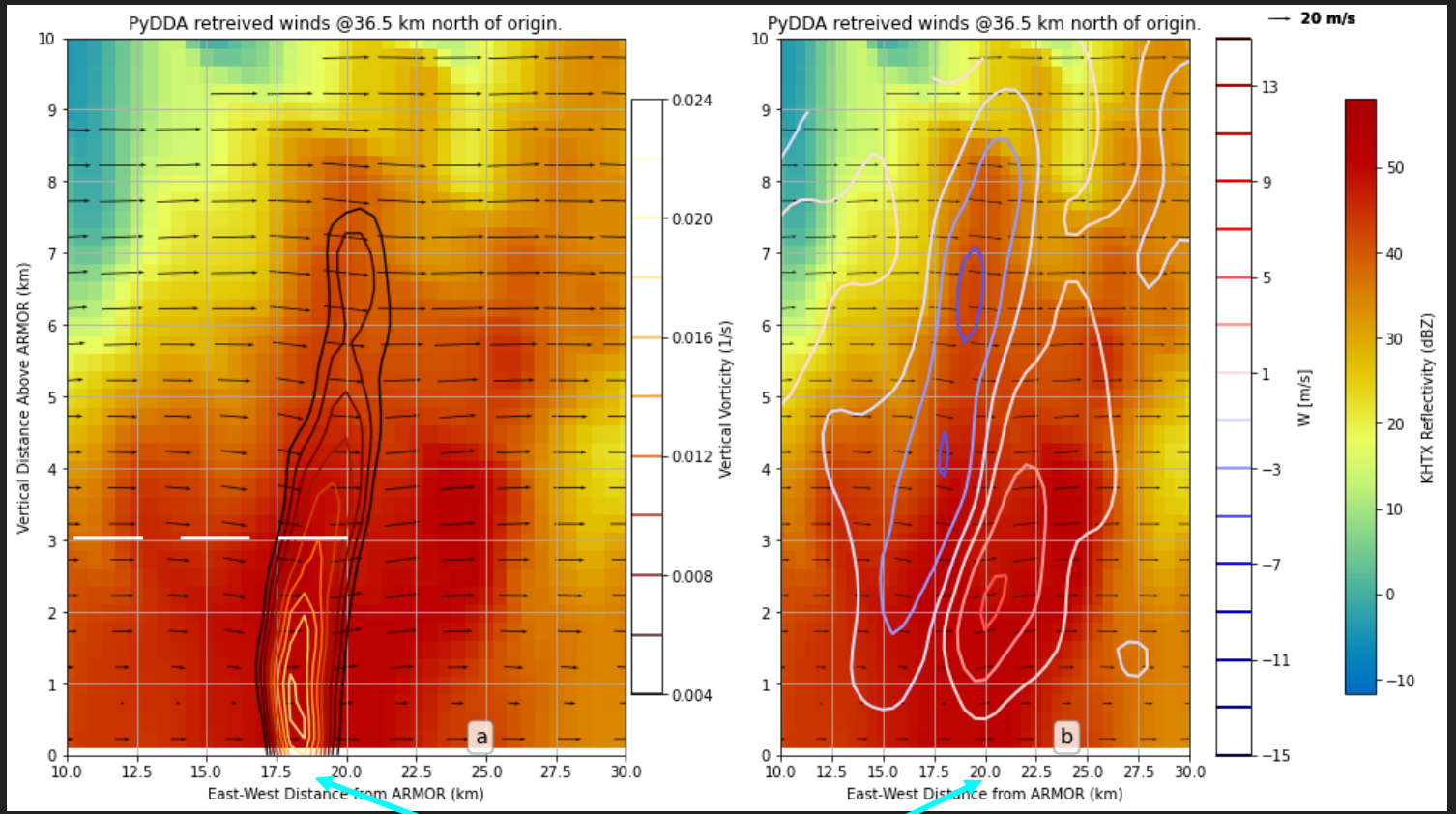
Ongoing DDA Attempt - XZ Vorticity and Vertical Motion



Offset in vorticity and updraft values

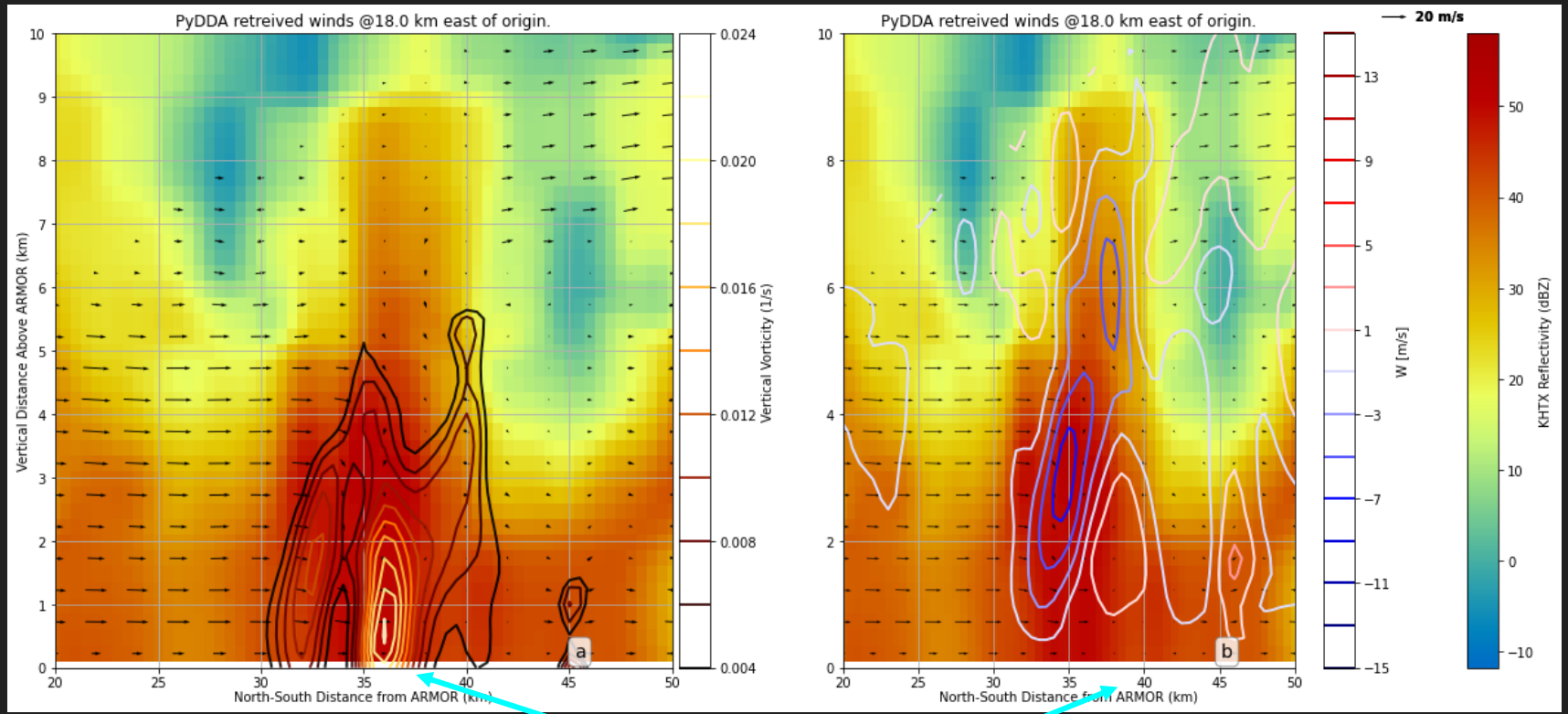
Ongoing DDA Attempt - XZ Vorticity and Vertical Motion

0.014 s^{-1} confined to lowest 3 km



Offset in vorticity and updraft values

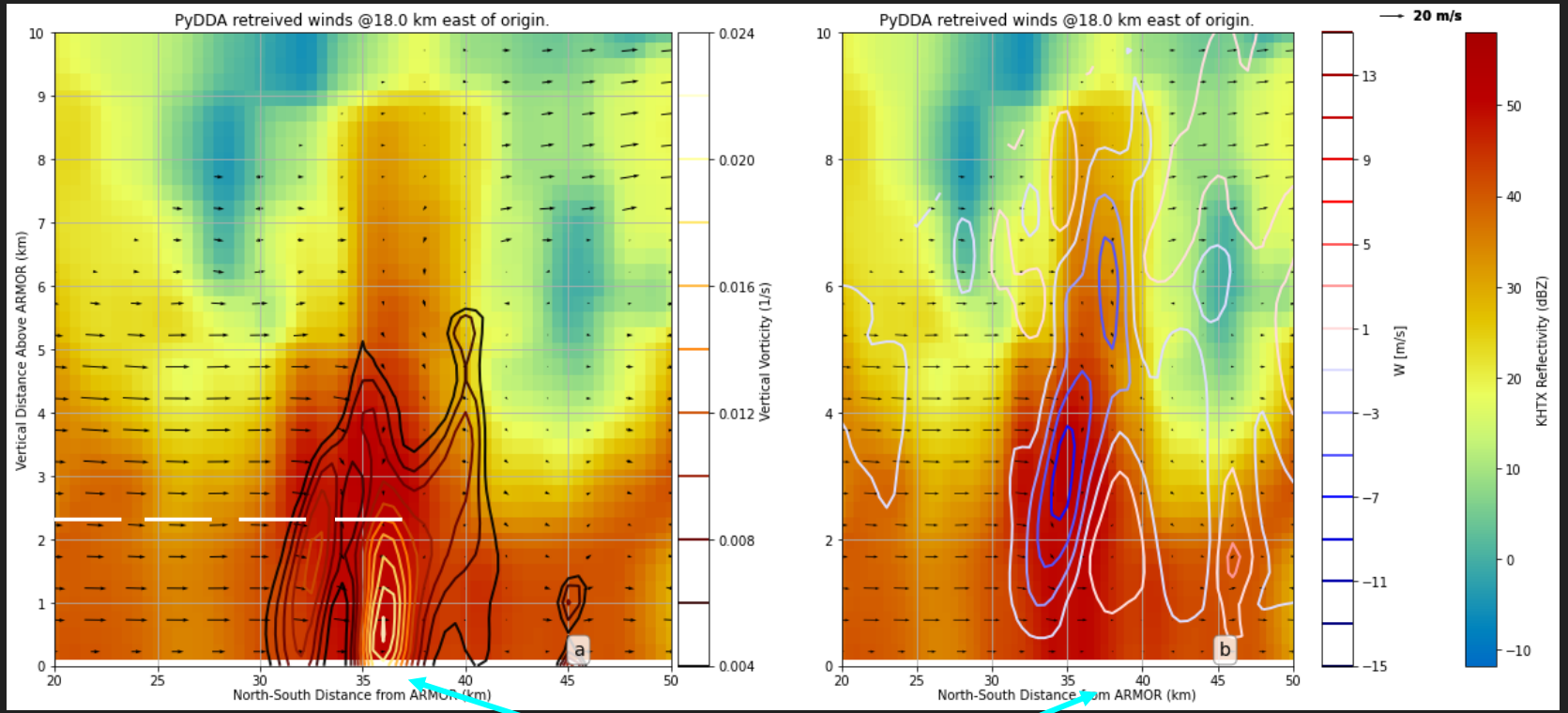
Ongoing DDA Attempt - YZ Vorticity and Vertical Motion



Offset in vorticity and updraft values

Ongoing DDA Attempt - YZ Vorticity and Vertical Motion

0.014 s^{-1} confined to lowest ~2.2 km



Offset in vorticity and updraft values

Future Work

- Incorporation of more PERiLS instrumentation beyond UAH to document the QLCS as it entered North Alabama
  - LiDAR, 915 and 449 MHz Wind Profilers, Micro Rain Radar (MRR) and soundings

- Utilization of PERiLS instrumentation to document the evolving environment ahead of and behind the QLCS with an emphasis on spatial and temporal variability
  - Cold Pool Properties and Influence of the Rear Inflow Jet

- Create multiple DDAs of the storm from ~30 minutes prior to tornadogenesis to track storm and environment evolution
  - Proposed work using the Diabatic Lagrangian Analysis for buoyancy retrieval from Ziegler (2013a,b)

- Identify wave propagation and evolution across the PERiLS domain

Acknowledgements

Contact Information:
Joshua Huggins
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- Dr. Kevin Knupp
- All Universities, People and Government Entities on the PERiLS Field Campaign
  - NSF Grant AGS-2113247
  - NOAA Grant NA21OAR4590323
- National Weather Service Huntsville, Alabama
  - Namely Todd Barron and Chelly Amin
- The Severe Weather Institute - Radar and Lightning Laboratories (SWIRLL)
  - Preston Pangle, Emily Wisinski, Zeb Leffler, Melissa González-Fuentes, Caleb Kiser, Sydney Rau
- Adam Weiner and Dean Meyer (UAH M.S. 2022) for their extensive assistance with the code for DDAs and the pre-processing steps

For more information on MAPNet, visit www.nsstc.uah.edu/mapnet/index.php