

Assessing the Value of the Coyote UAS Platform and Observations from the Perspective of Tropical Cyclone Data Assimilation and Prediction

Altug Aksoy^{1,2}

Collaborators:

Joe Cione^{2,3}

Hui Christophersen^{1,2}, Brittany Dahl^{1,2}

¹ Cooperative Institute for Marine and Atmospheric Studies, University of Miami – Miami, Florida

² Hurricane Research Division, NOAA/AOML – Miami, Florida

³ Physical Sciences Division, NOAA/ESRL – Boulder, Colorado

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Coyote Unmanned Aircraft System

A New Tool to Better Observe Tropical Cyclones



The NOAA P-3 Aircraft Typically Penetrates Tropical Cyclones and Collects Data with a Suite of Instruments

The Dropsonde System is Designed to Measure the Vertical Variations in the Atmosphere



The Coyote is a Small Aircraft that Uses the Dropsonde Deployment System and Sensor Suite and is Capable of Remaining Airborne for ~1 h or Longer



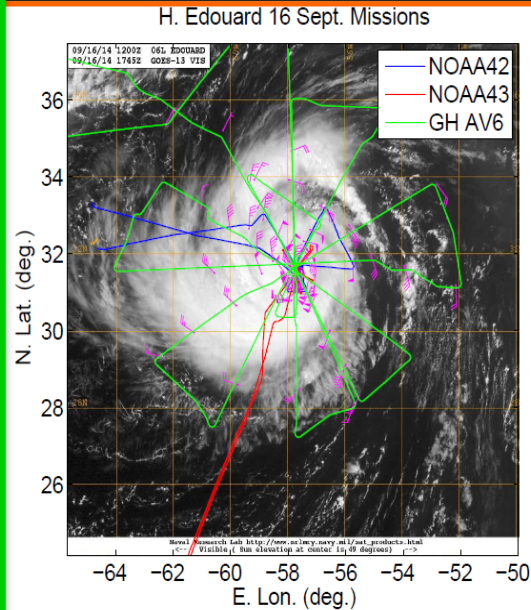
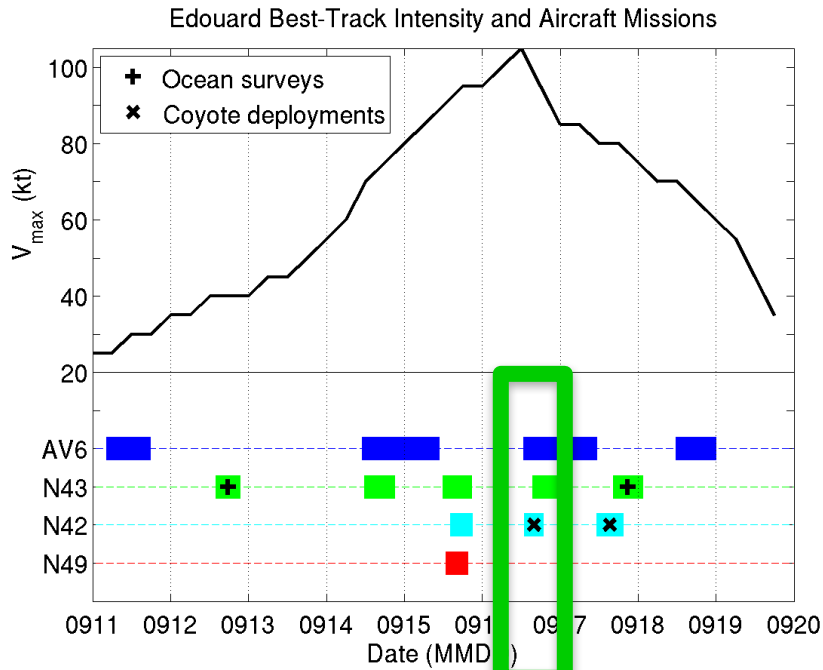
Hurricane Edouard (2014) Aircraft Missions

Coordination of Multiple Aircraft and Coyote Missions

Multiple Aircraft Conducted Successful Missions:

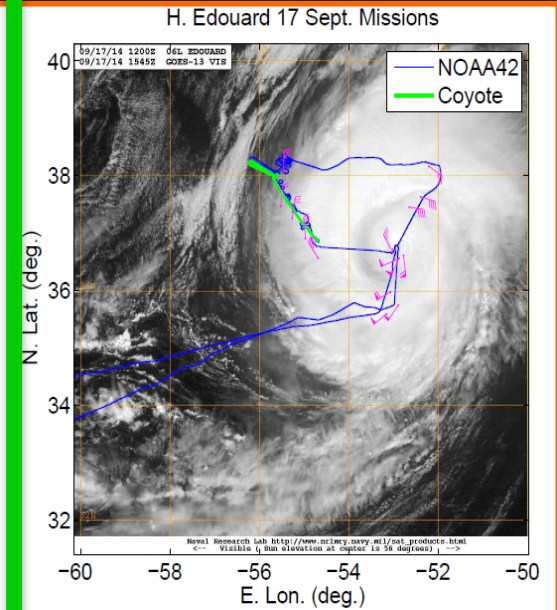
- NASA Global Hawk (AV6)
- NOAA P-3 (N42/N43) and G-IV (N49)
- Ocean Surveys (+)
- Coyote UAS Missions (x)

TODAY'S TALK



1

16 September 2014 1432Z
 Eye/Eyewall Sampling
 28-minute Mission
 Min. Altitude 896 m
 Max. Wind Speed 100 kt



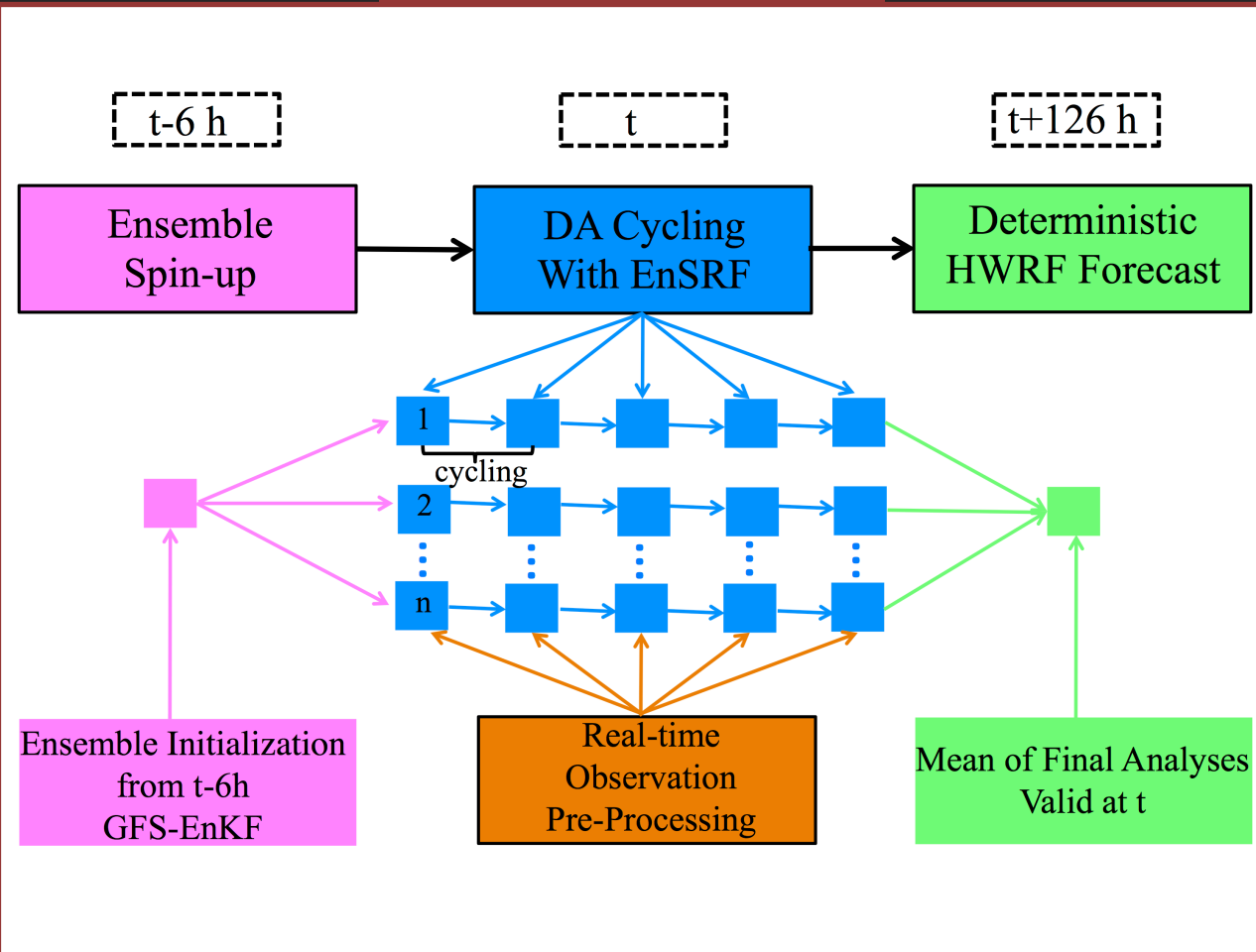
2

17 September 2014 1507Z
 Inflow Channel Sampling
 68-minute Mission
 Min. Altitude 400 m
 Max. Wind Speed 53 kt

Hurricane Ensemble Data Assimilation System (HEDAS)

NOAA/AOML/HRD's Vortex-Scale Data Assimilation System

HEDAS Schematic



HEDAS Characteristics

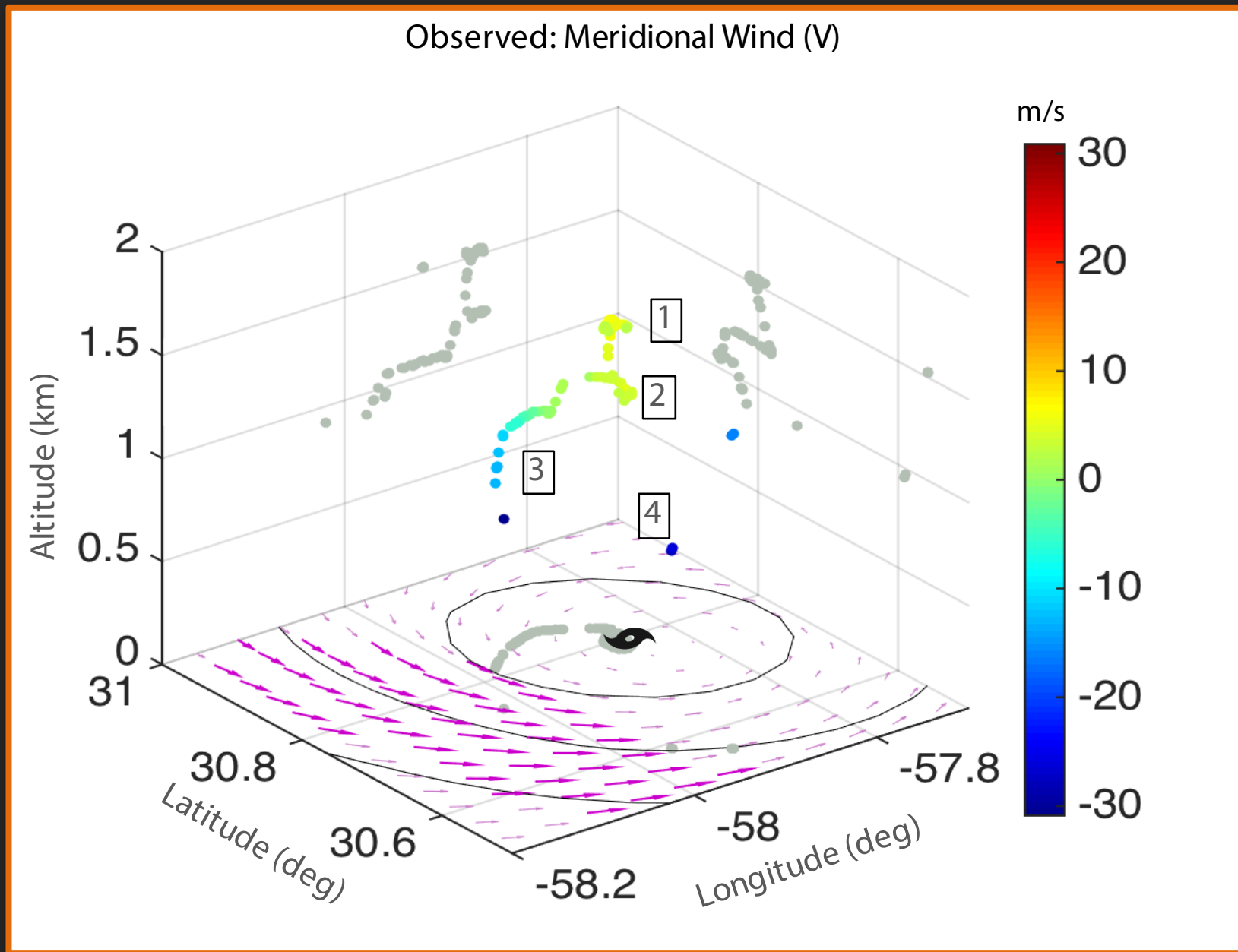
- Focus on tropical cyclone inner-core data assimilation for high-resolution vortex initialization
- Uses the ensemble square-root Kalman filter (Whitaker and Hamill 2002)
- Storm-relative observation processing capability (Aksoy 2013)
- Interfaced with NOAA's HWRF model
- Deterministic HWRF forecasts initialized with the HEDAS mean vortex analysis

Aircraft/Platforms Processed:

NOAA P-3
NOAA G-IV
Air Force Reserve C-130
NASA Global Hawk
Coyote
Satellite AMVs
AIRS & GPS-RO Retrievals

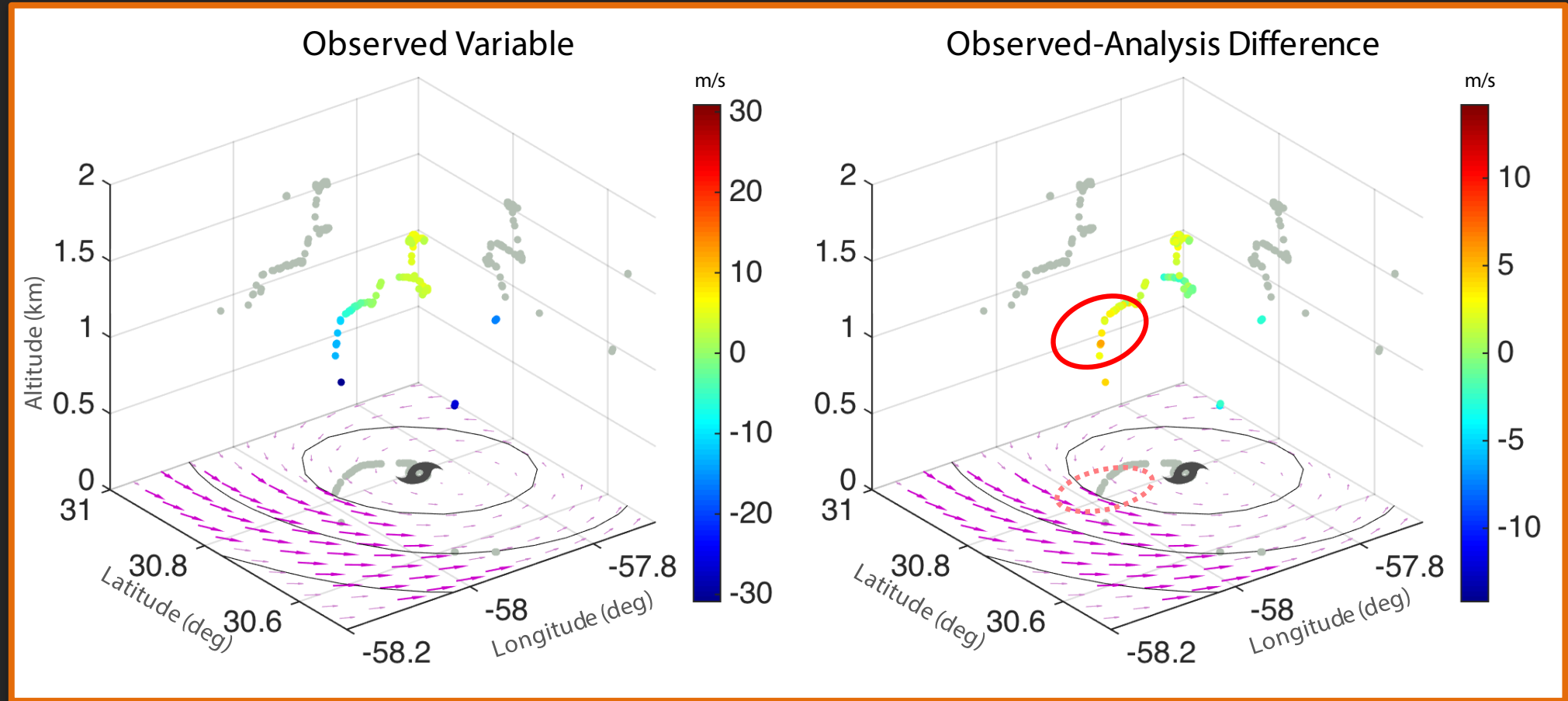
Coyote Mission on 16 September

Closer Look at What Was Observed



Coyote Mission on 16 September

Comparison of Observations to the Final HEDAS Analysis

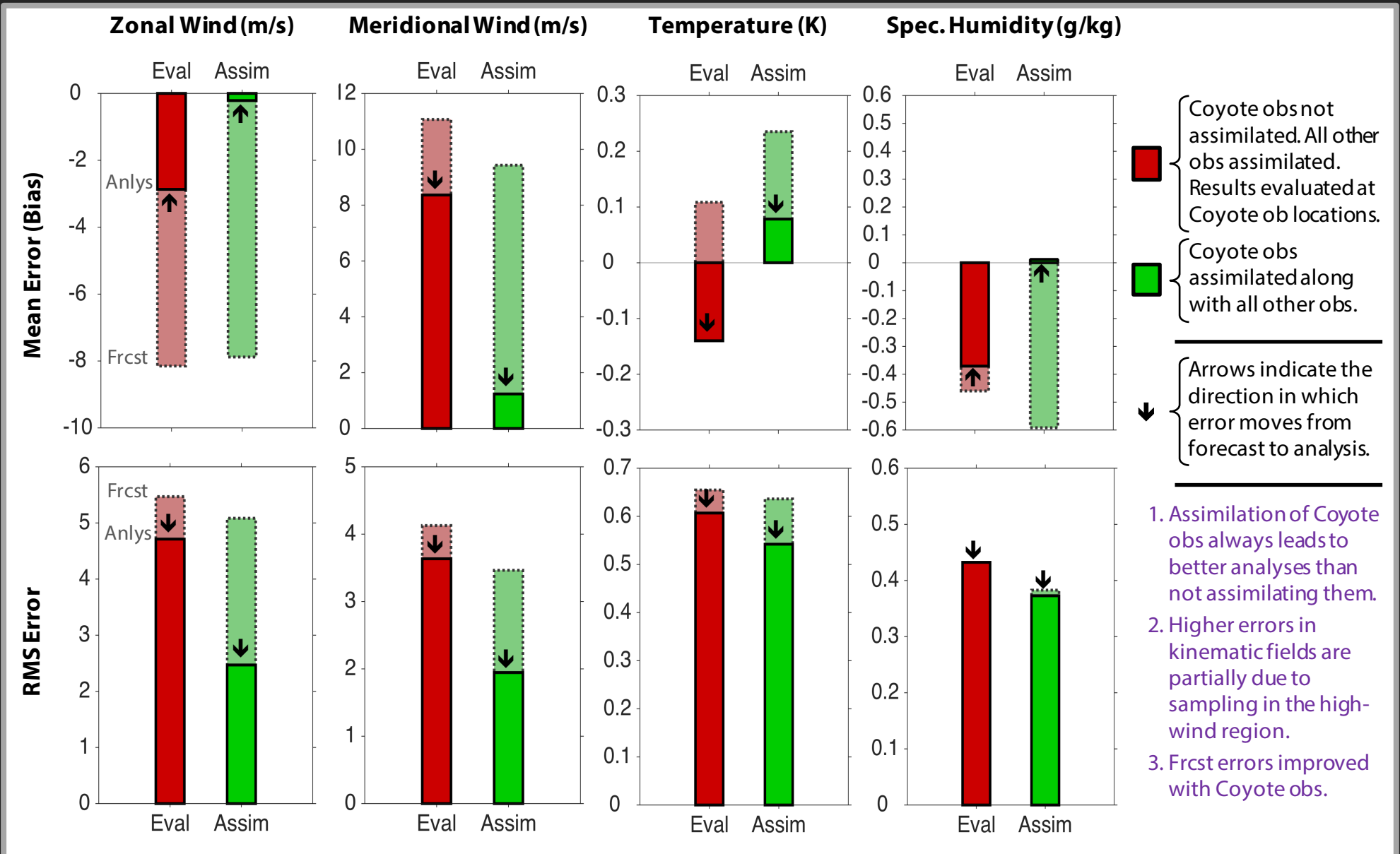


Strongest Analysis Deviations within the High Gradient Region

→ Suggests Potential Improvements in Position; RMW; Wind-Pressure Relationship

Coyote Mission on 16 September

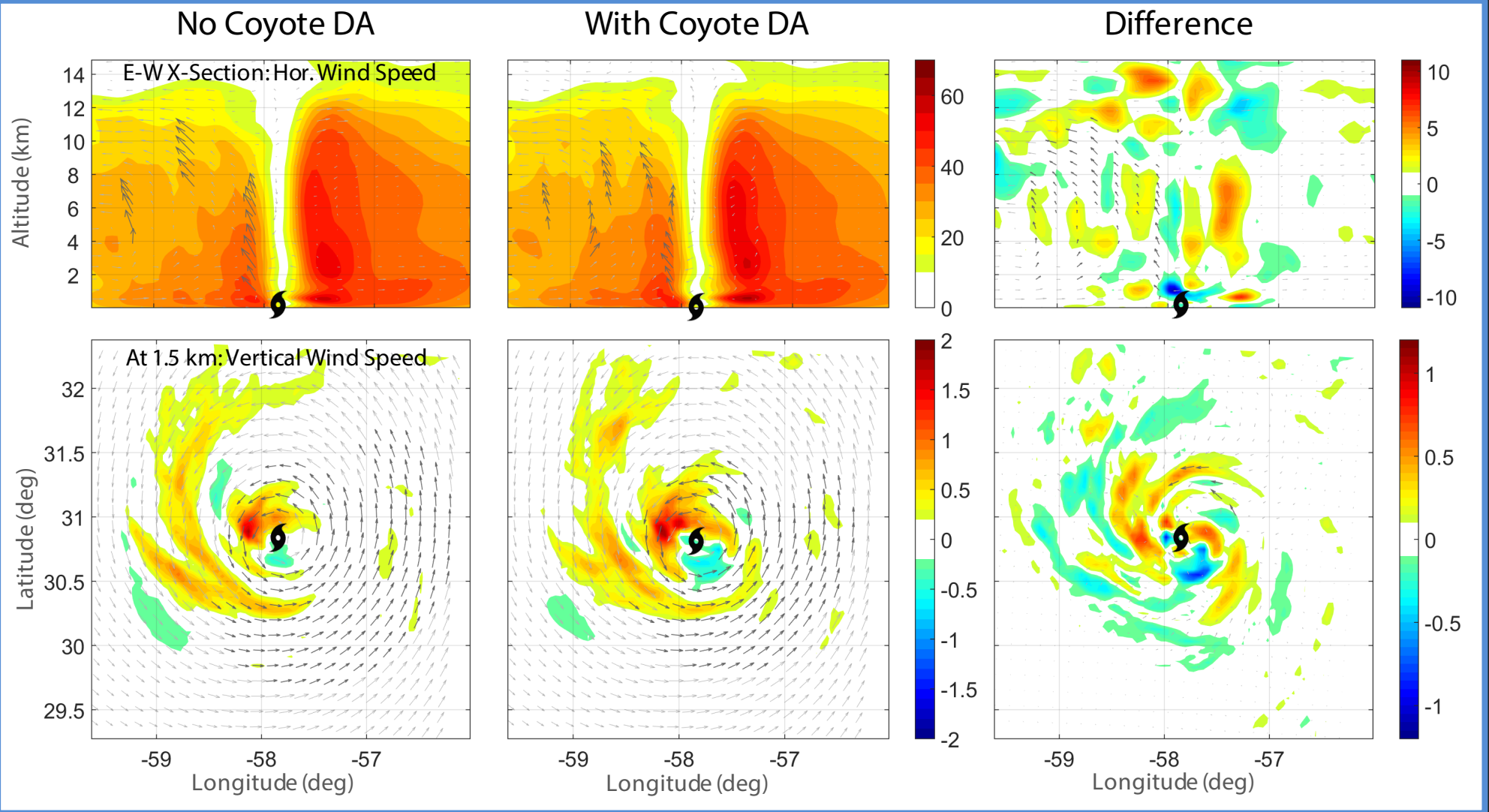
General Observation-Space Performance of HEDAS



Coyote Mission on 16 September

Impact of Coyote Observations in Model Space

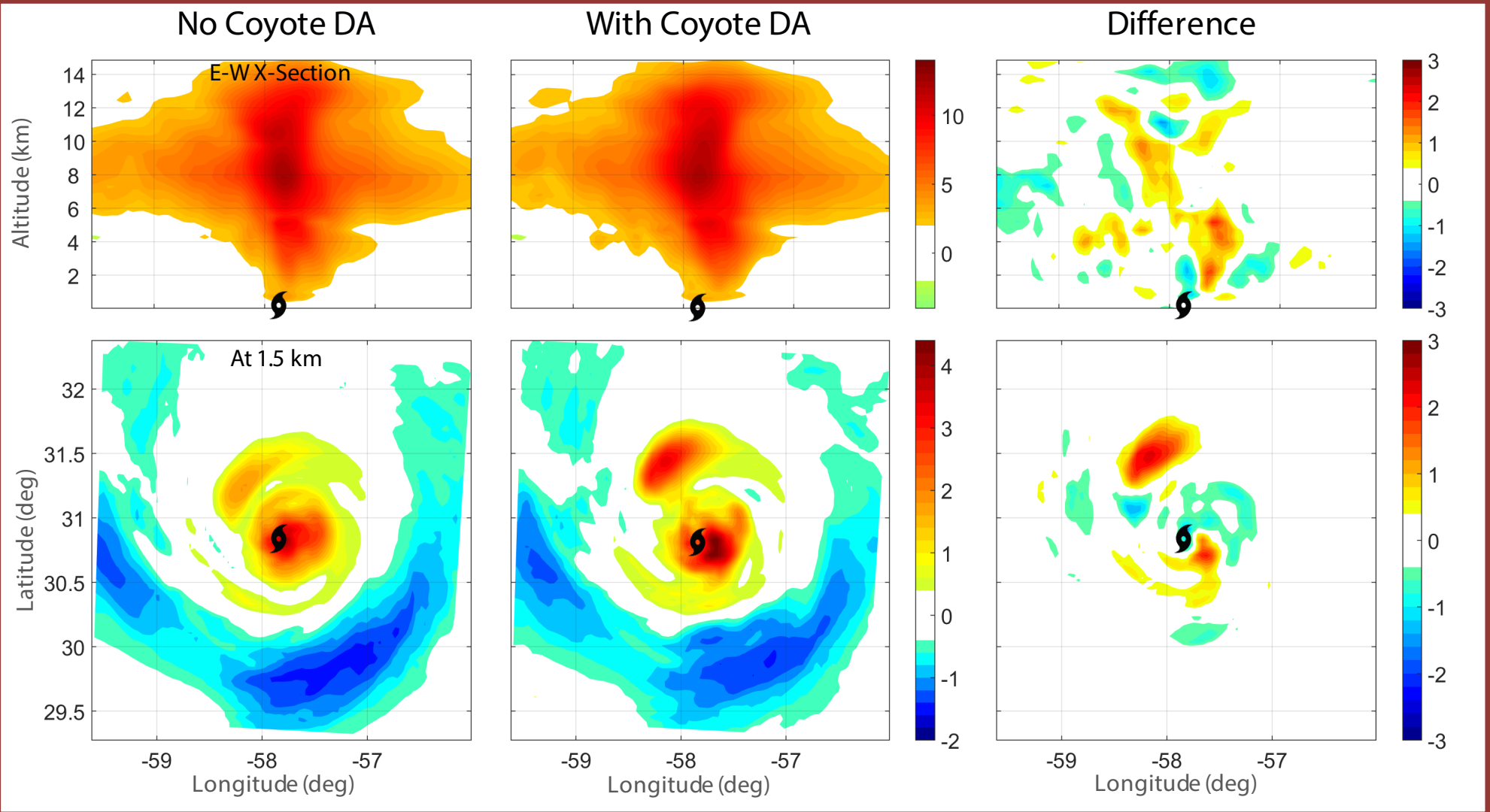
Comparison of Winds (m/s)



Coyote Mission on 16 September

Impact of Coyote Observations in Model Space

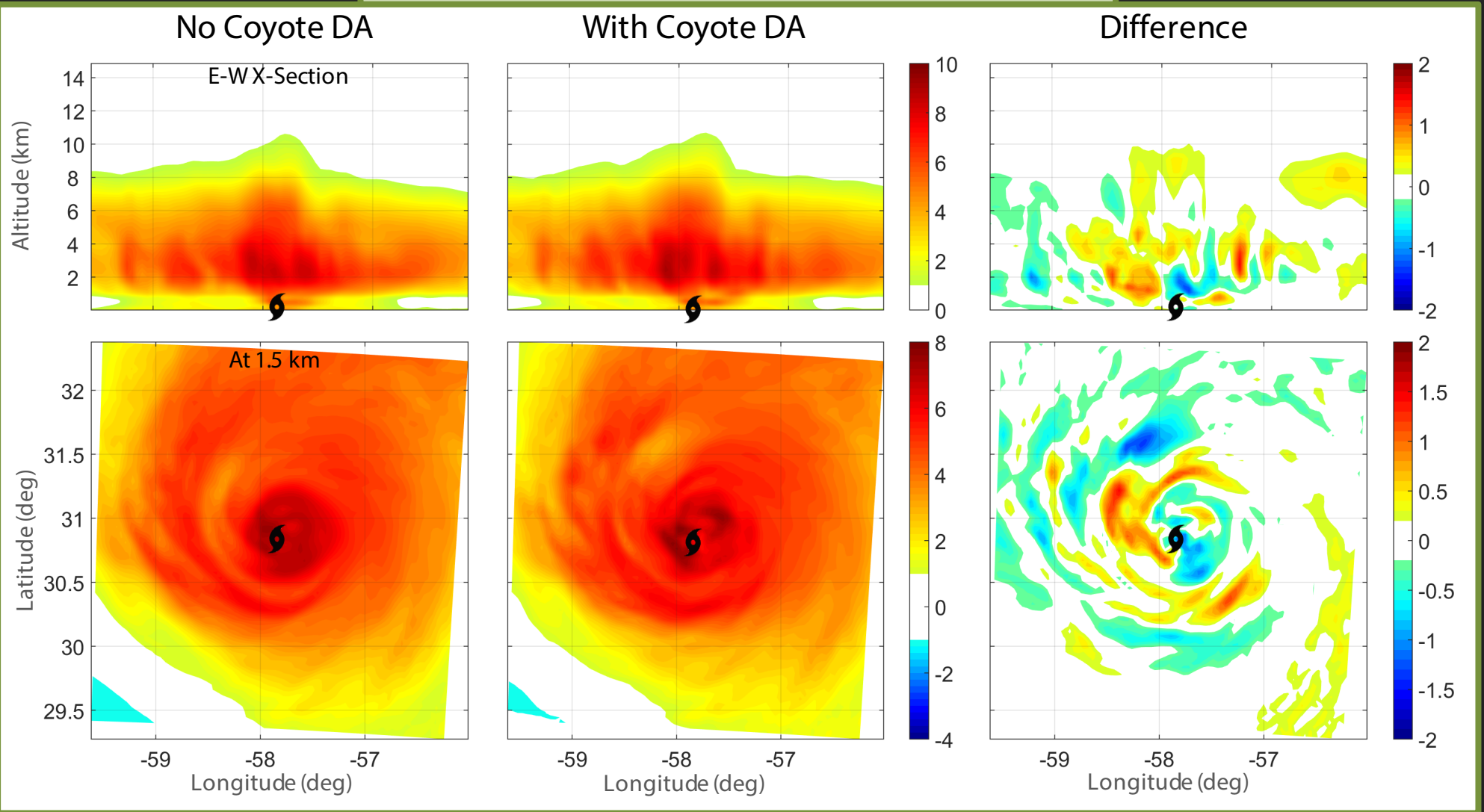
Comparison of Temperature Perturbation (K)



Coyote Mission on 16 September

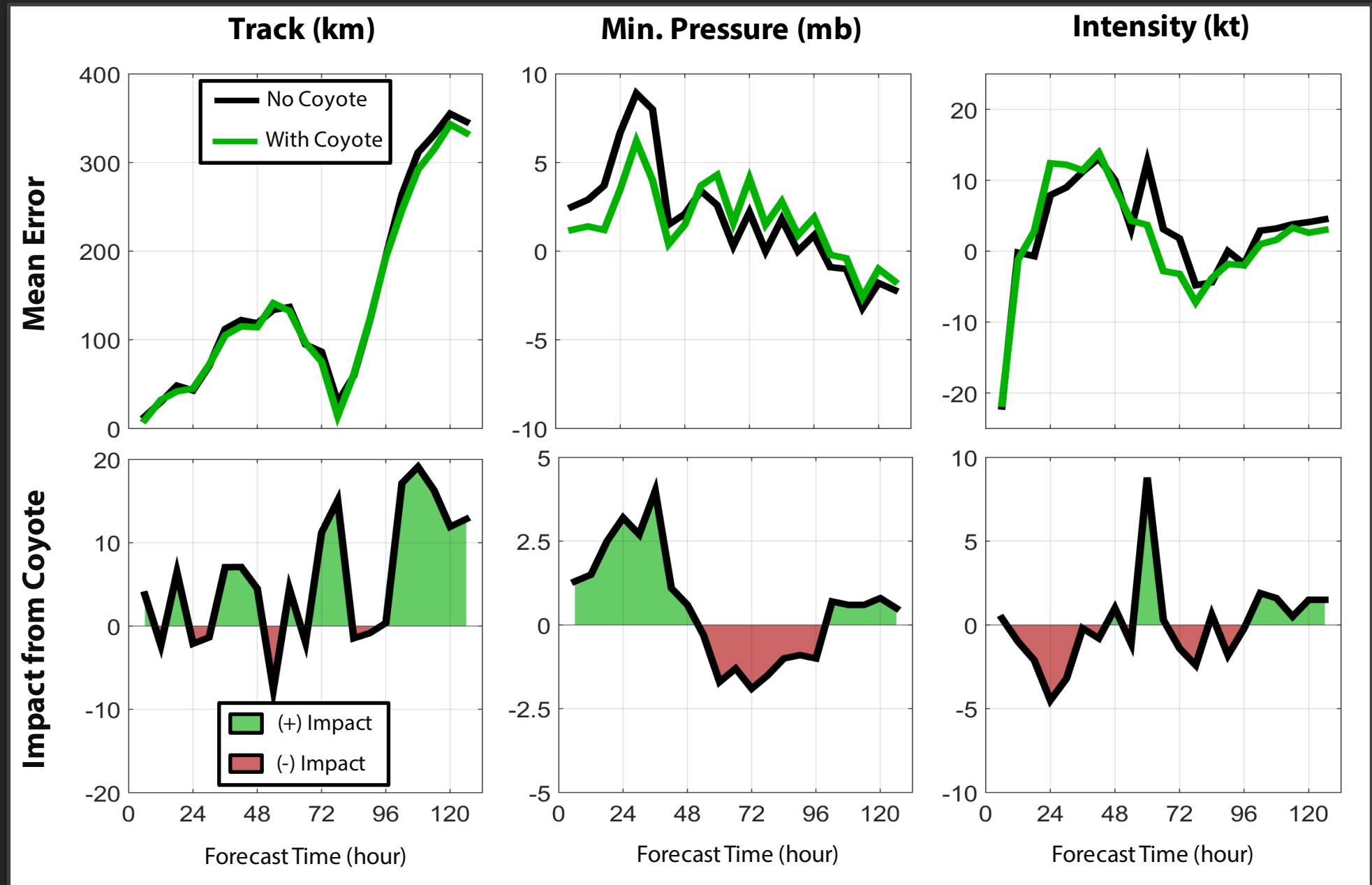
Impact of Coyote Observations in Model Space

Comparison of Spec. Humidity Pert. (g/kg)



Coyote Mission on 16 September

Impact of Observations on Forecast



Summary

- Coyote UAS was successfully deployed twice by NOAA in Hurricane Edouard (2014) – sampled the eye/eyewall region in a 28-min mission
- Assimilation of the Coyote UAS observations in NOAA/HRD's HEDAS generally had slight positive impact on the vortex-scale analysis
 - Most distinct on kinematic fields
 - Noticeable impact on the inner-core structure & primary rainband
- Forecast impact was also slightly positive – but impossible to make conclusions from a single case
- Future research directions:
 - How to assimilate spatially localized datasets in a TC vortex that typically exhibits strong gradients – a new DA paradigm needed?
 - How to design future missions/patterns to maximize impact – ideal for OSSEs