

ENHANCEMENTS TO CLOUD OVERLAP RADIATIVE EFFECTS FOR WEATHER FORECASTING AND TROPICAL CYCLONE PREDICTION



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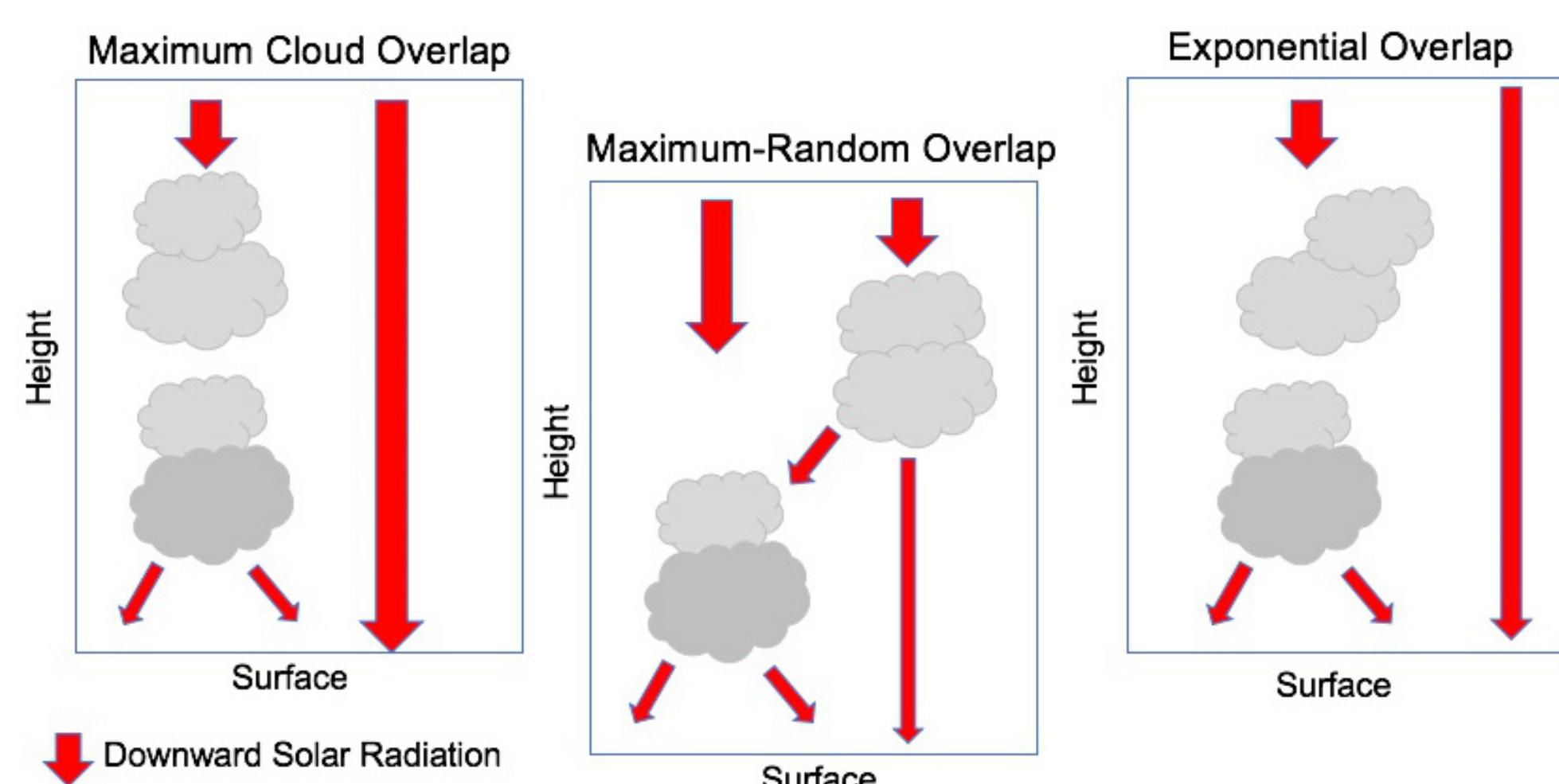
Cloud Overlap Background

Definition: Vertical orientation of sub-grid fractional clouds specified for calculations of radiative fluxes and heating rates in a column.

Investigation: Cloud overlap method can significantly affect radiative fluxes and heating rates. Does this effect noticeably influence tropical cyclone and global weather predictions?

Cloud Overlap Methods:

- Random
- Maximum
- Maximum-Random (MR)
- Exponential (EXP)
- Exponential-Random (ER)



New Cloud Overlap Testing in HWRf and GFS:

- EXP and ER require a decorrelation length defined as a constant (EXPcon, ERcon) or varying by latitude and day of year (EXPlat, ERlat)

Accomplishments:

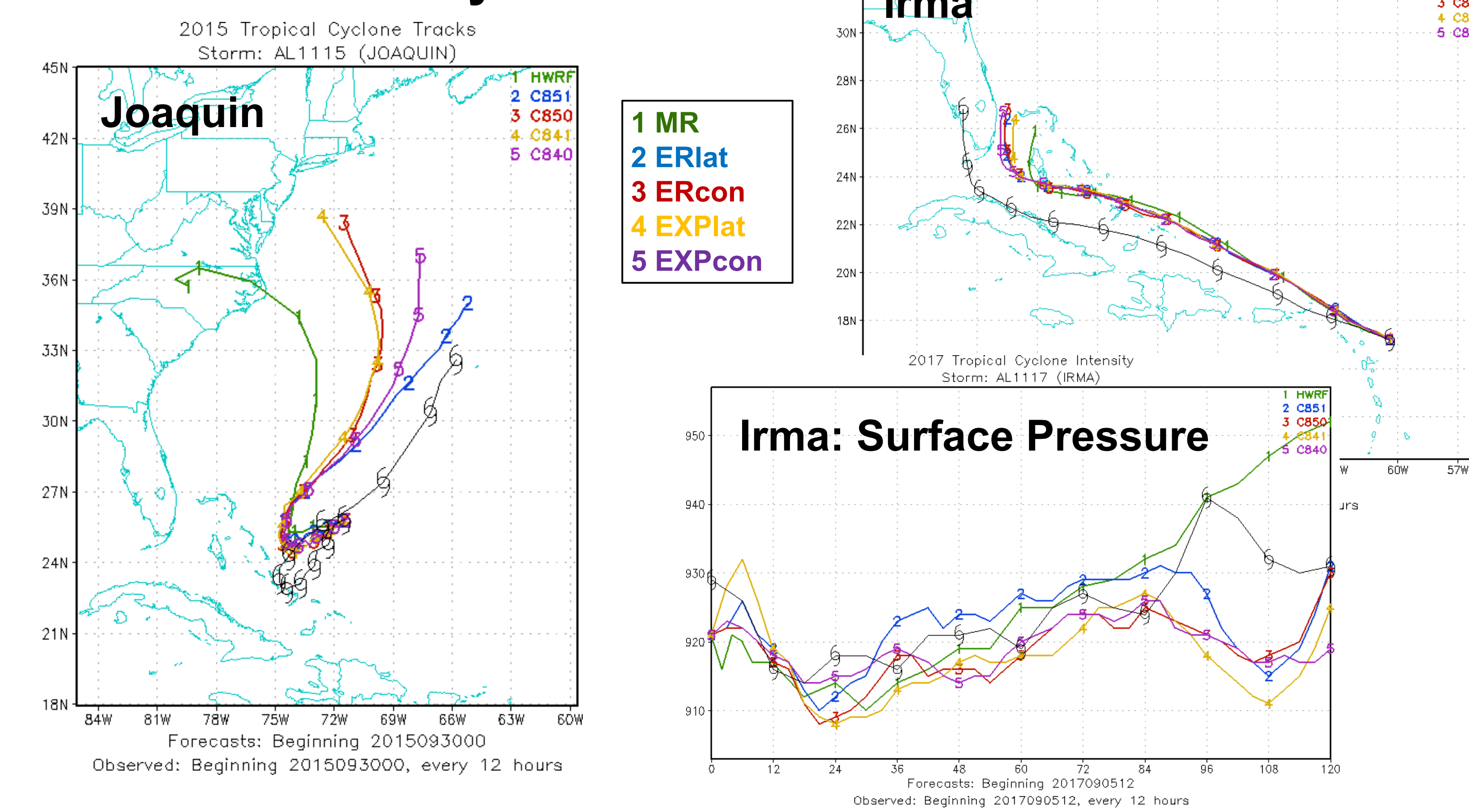
- EXPcon adopted by NOAA in operational 2018 HWRf
- Testing of other methods for HWRf 2020 and GFS/UFS is ongoing

Project support:

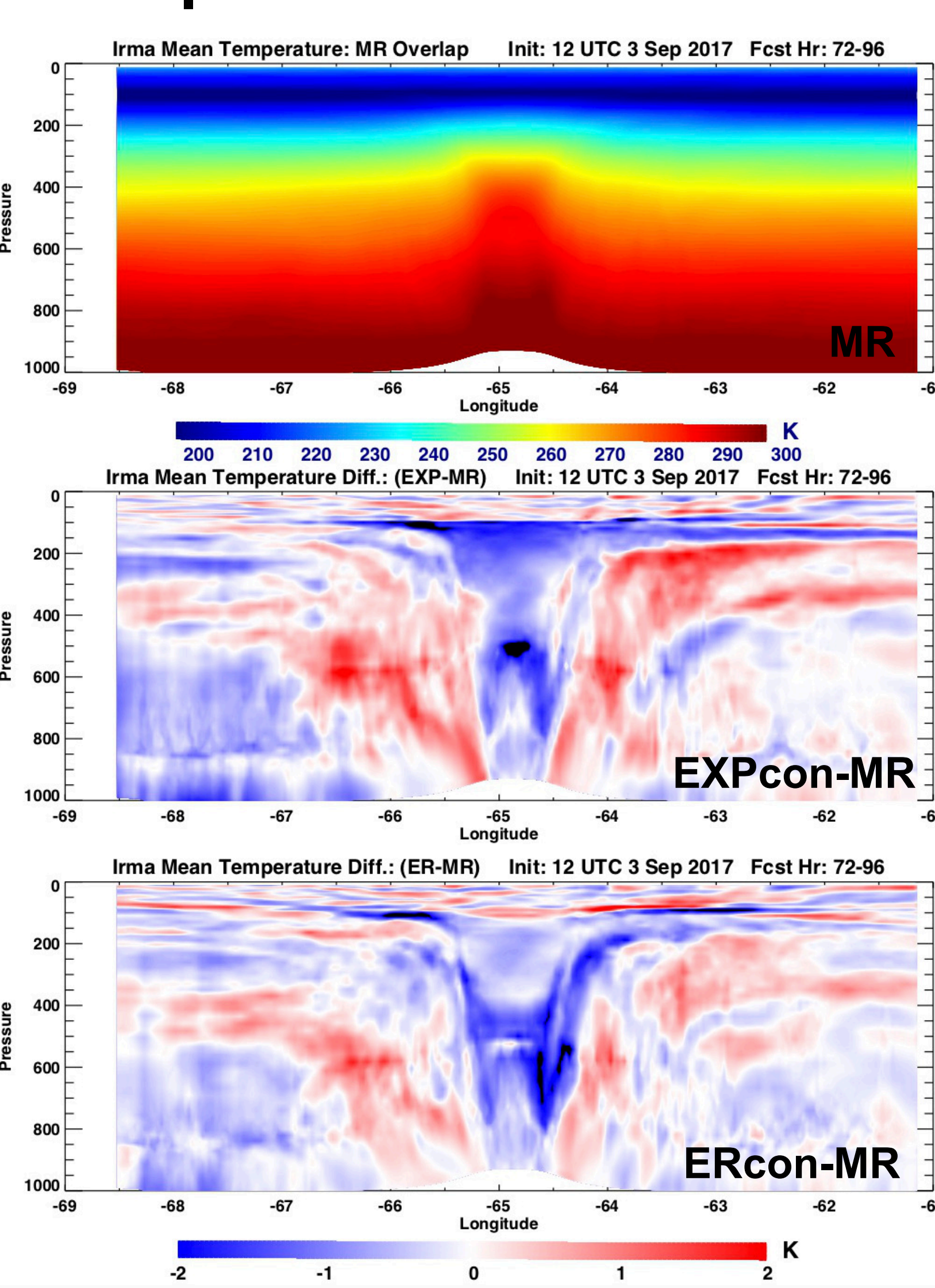
- HWRf: Developmental Testbed Center (DTC) Visitor Program
- GFS: NOAA NGGPS Research to Operations (R2O) Program

HWRf Tropical Cyclone Prediction Impacts

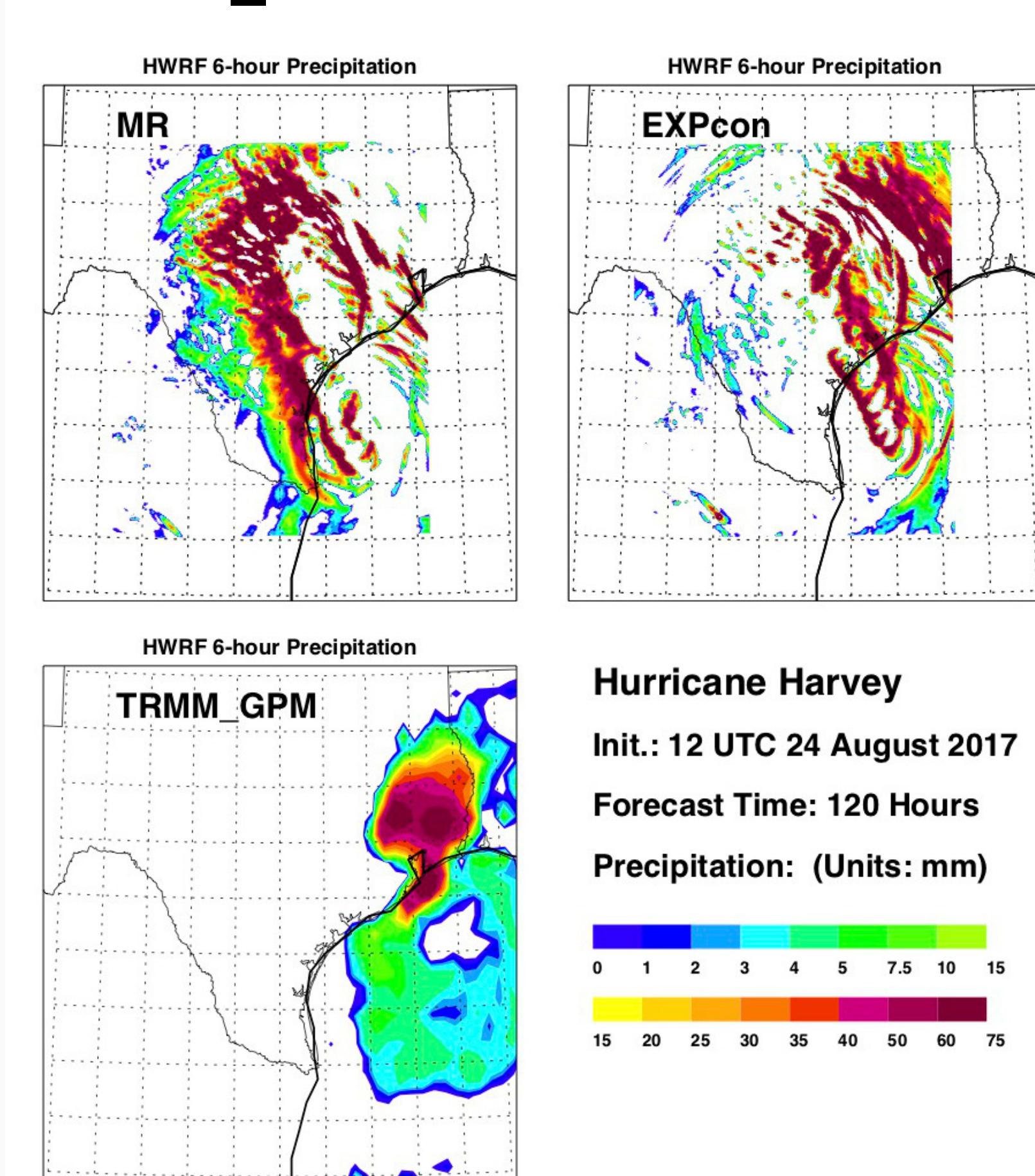
Track and Intensity Verification



Temperature: Irma

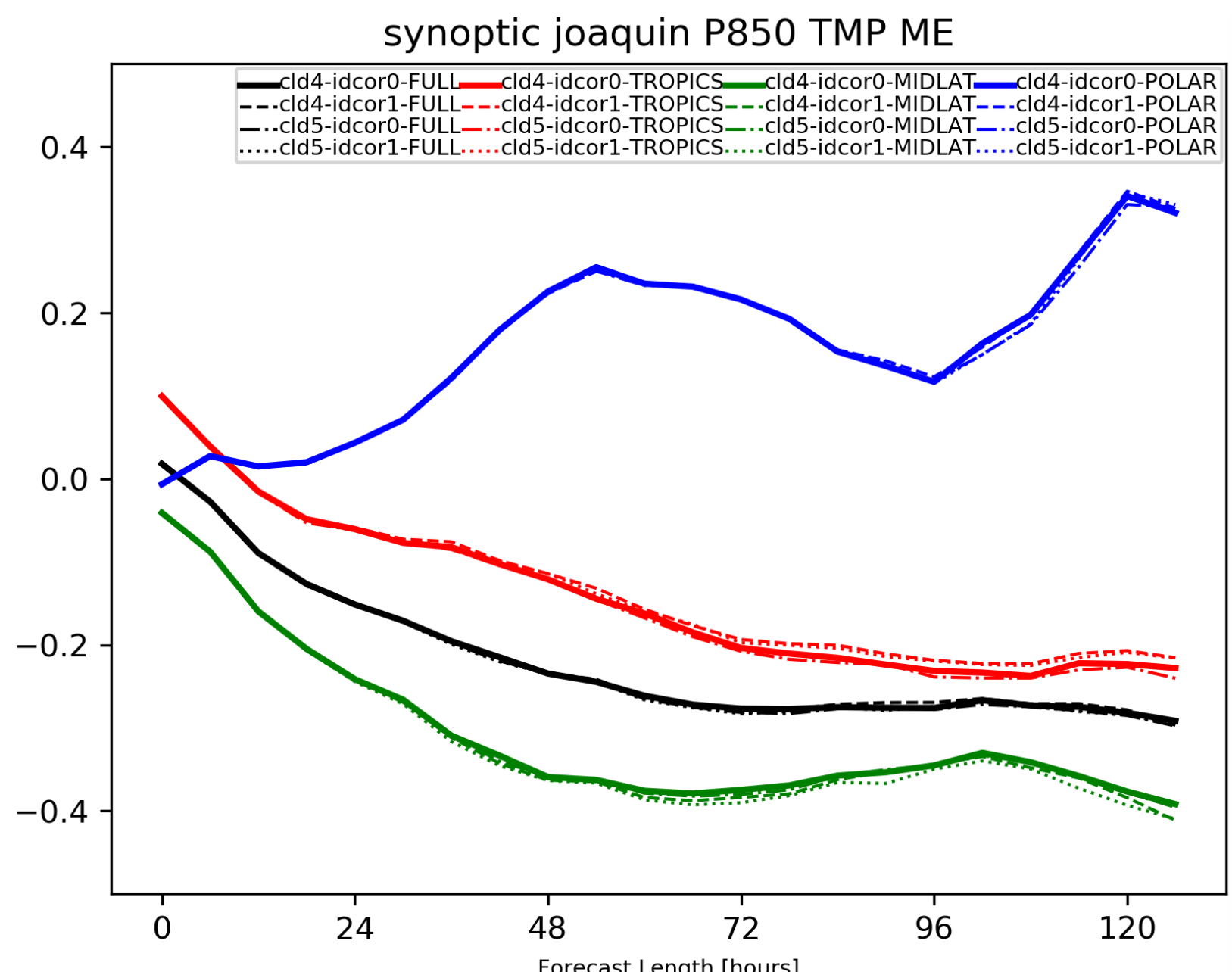


Precipitation: Harvey

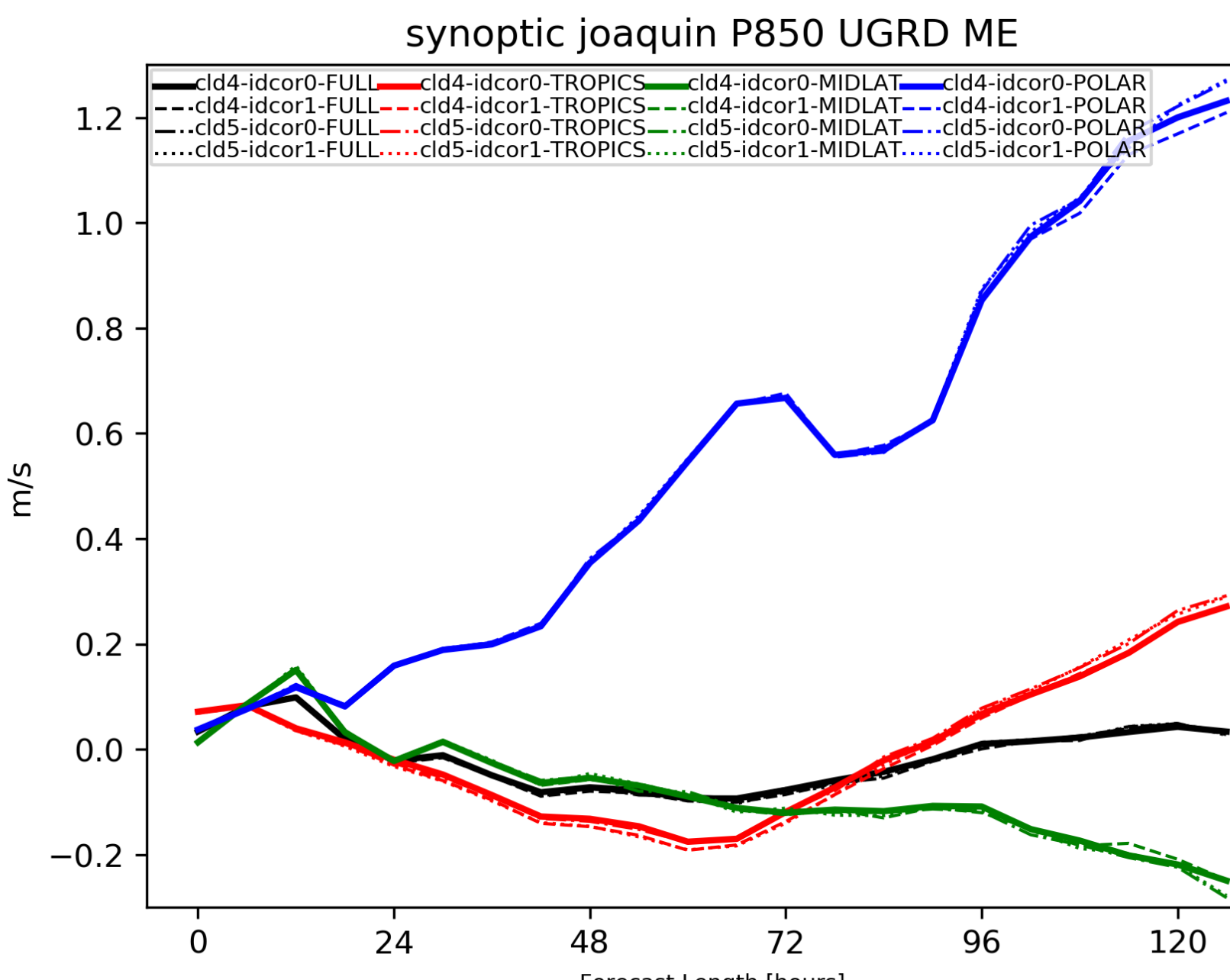


Hurricane Joaquin Statistics:

850 mb Temperature Mean Error



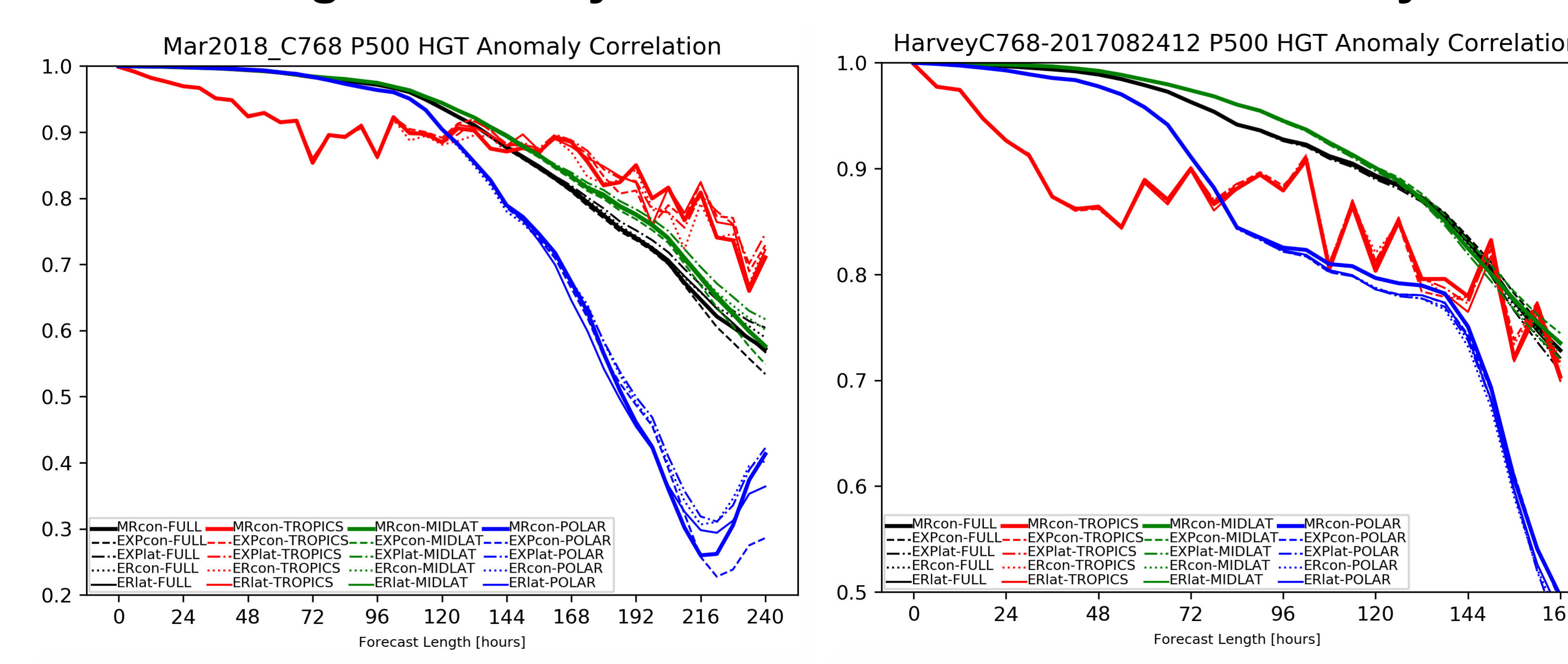
850 mb Zonal Wind Mean Error



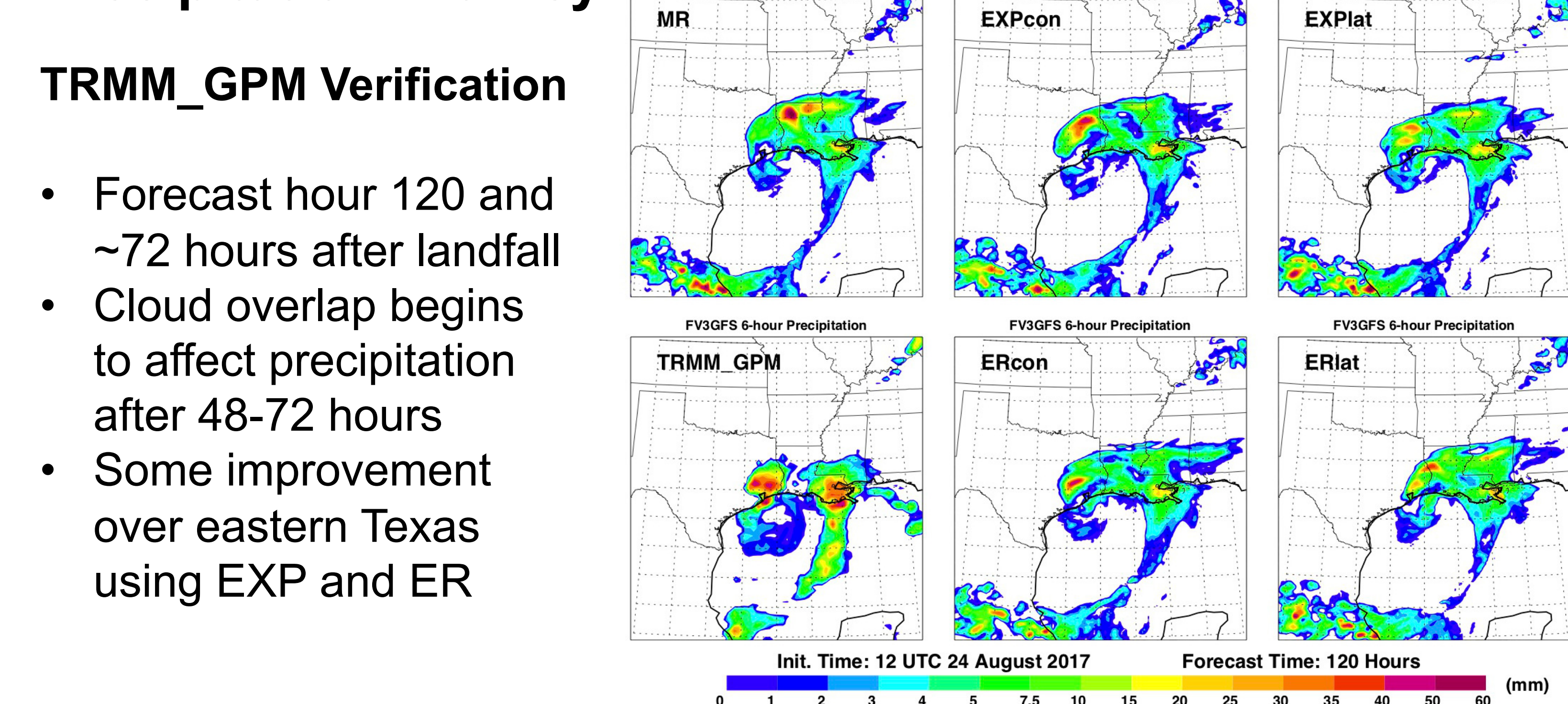
- Color = region; line style = cloud overlap (EXPcon, EXPlat, ERcon, ERlat)
- Means are over multiple forecast cycles and over the synoptic domain
- Errors are relative to 0.25-degree GFS analysis

FV3GFS Global Weather Forecast Verification

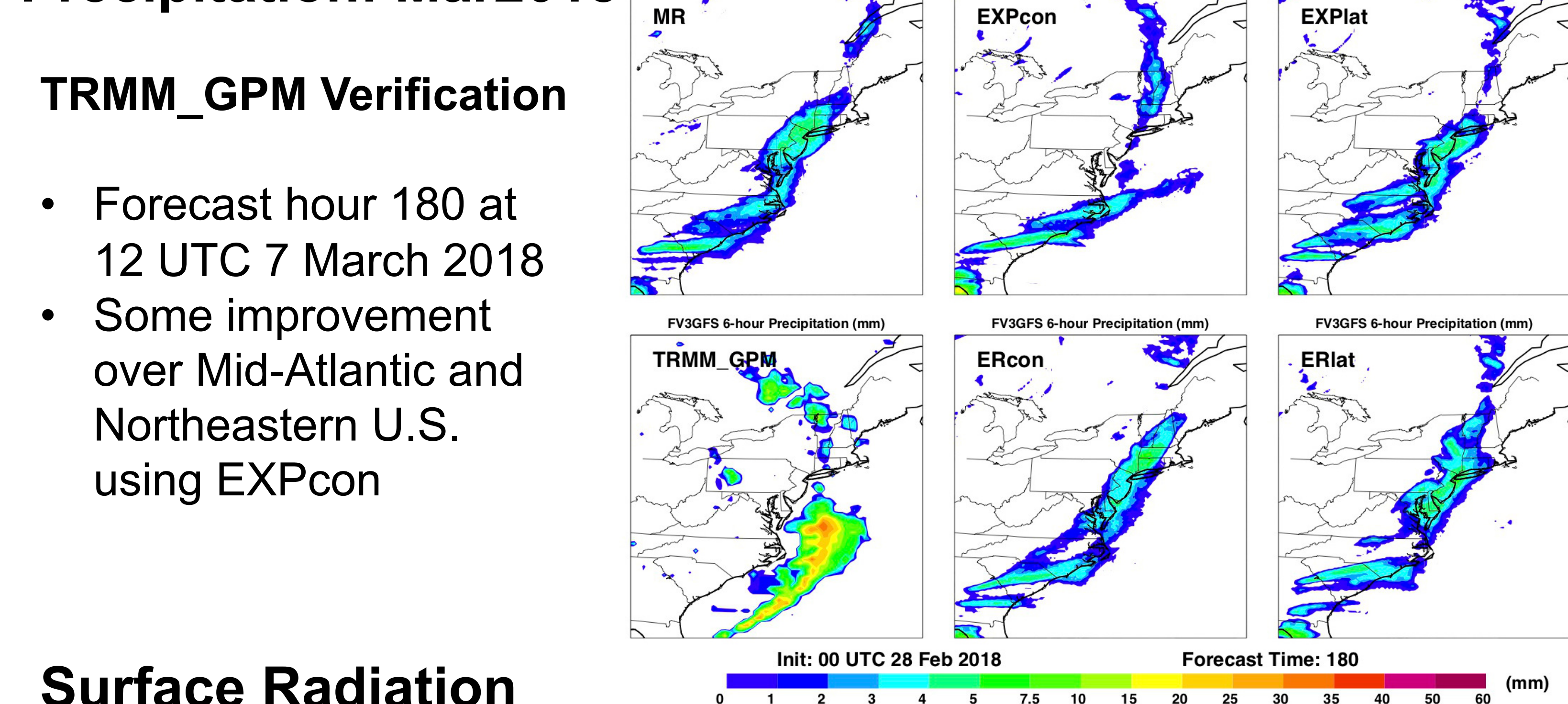
500 mb Height Anomaly Correlation: March 2018 / Harvey



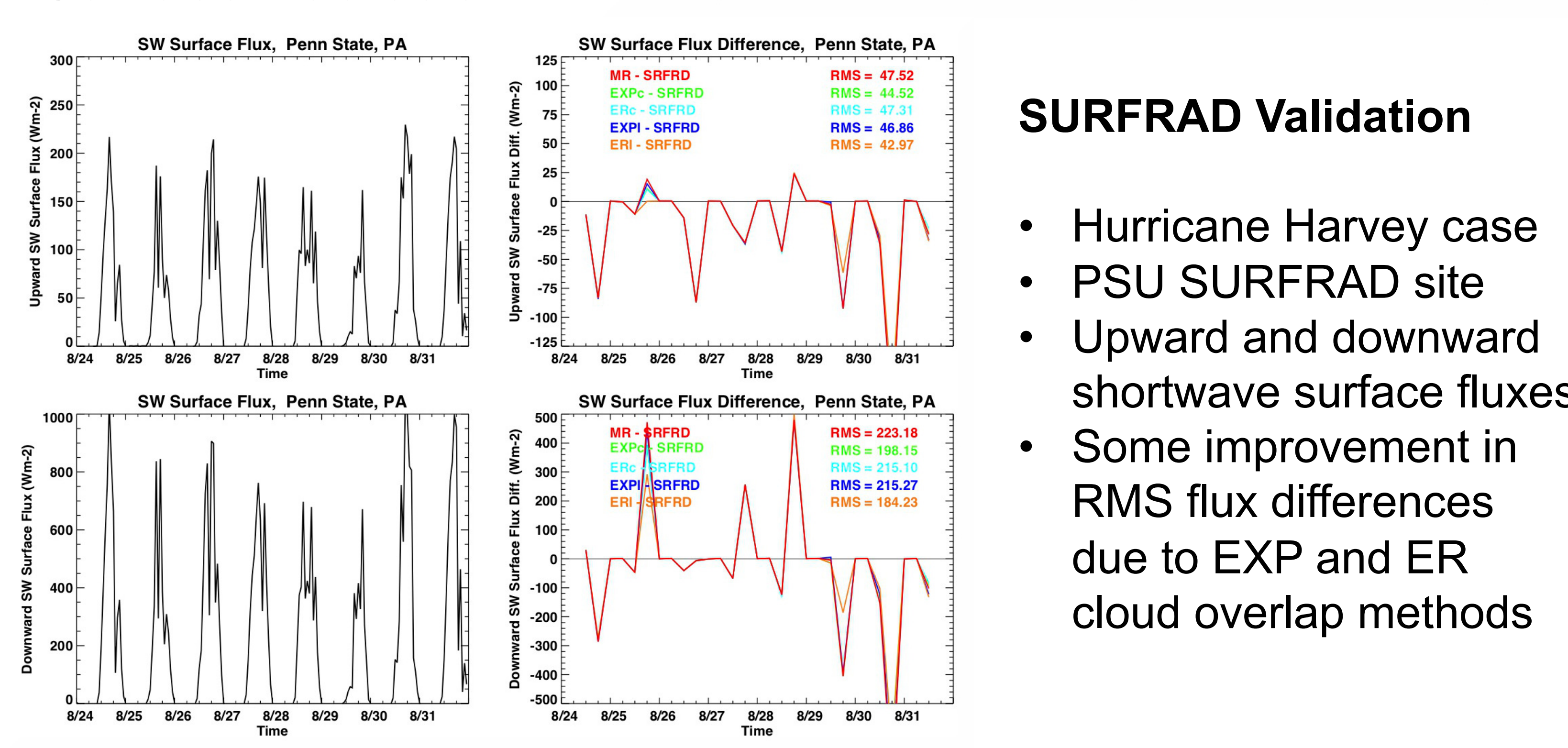
Precipitation: Harvey



Precipitation: Mar2018



Surface Radiation



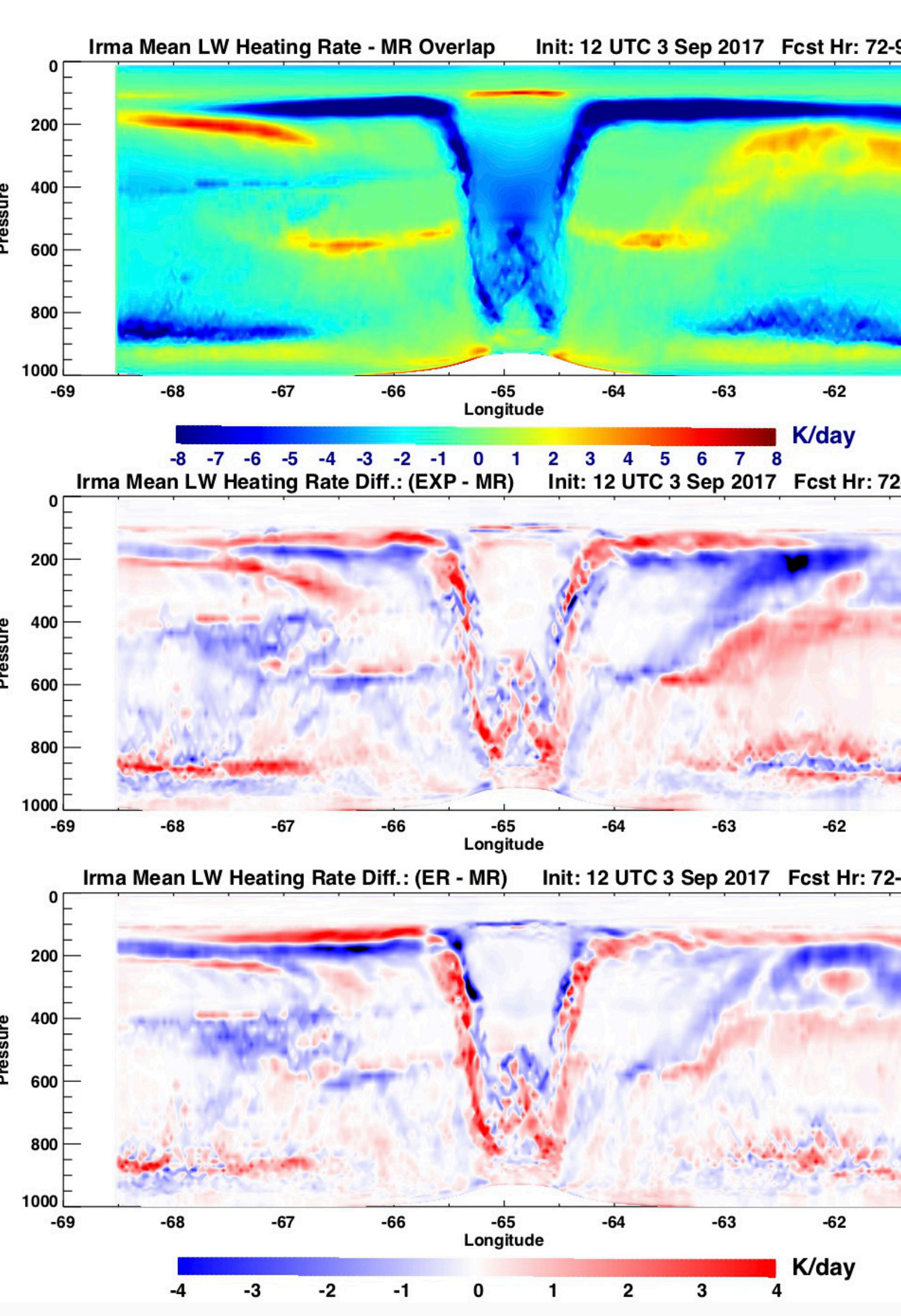
SURFRAD Validation

- Hurricane Harvey case
- PSU SURFRAD site
- Upward and downward shortwave surface fluxes
- Some improvement in RMS flux differences due to EXP and ER cloud overlap methods

HWRf Tropical Cyclone Prediction Impacts

HWRf Testing: Several tropical cyclone cases over multiple forecast cycles, including Hurricanes Joaquin (2015), Harvey (2017) and Irma (2017)

Longwave Heating Rate: Irma



Shortwave Heating Rate: Irma

