AHW Ensemble Data Assimilation and Forecasting System

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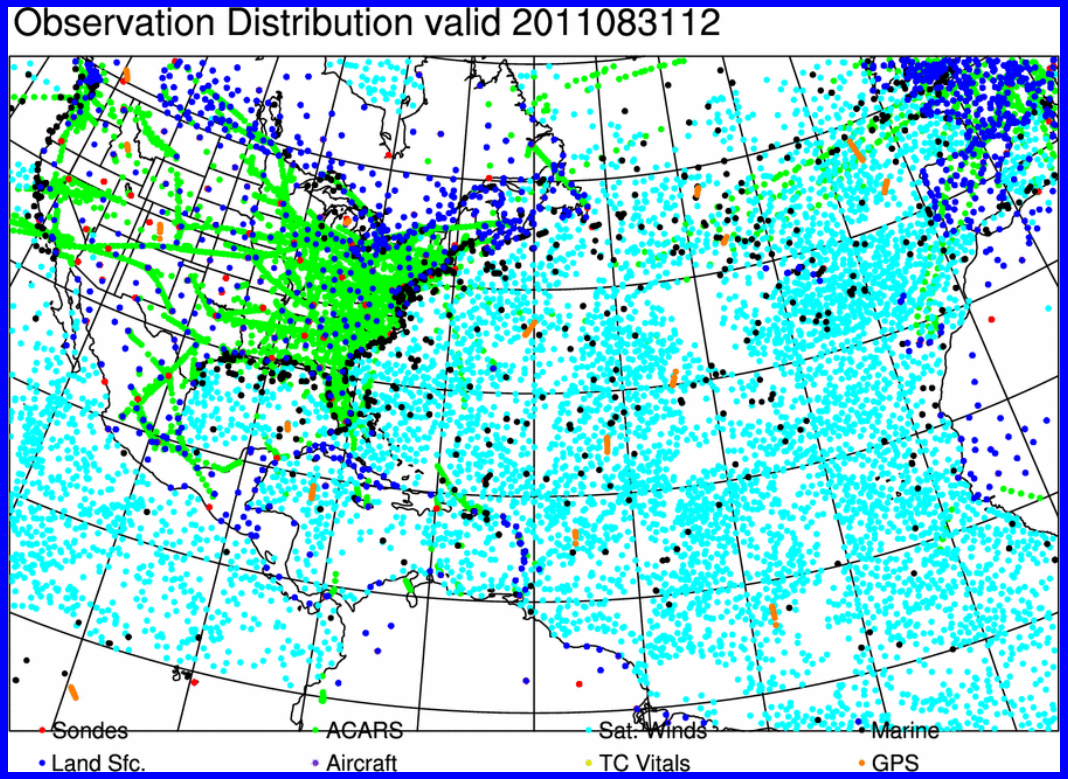
Overview

- Since participation in HFIP HRH test, we have been using cycling EnKF approach to create initial conditions for AHW model
- Wanted initial conditions that:
  - Have a good estimate of environment
  - Have a “decent” estimate of TC structure (wave-0)
  - Does not lead to significant initialization problem
  - HYPOTHESIS: Intensity predictability primarily driven by environment
- Since then, we have upgraded the system based on observed flaws in both model and initial conditions

Assimilation System

- WRF ARW (v3.3), 36 km horizontal resolution over basin, 96 ensemble members, DART assimilation system.
- Observations assimilated each six hours from surface and marine stations (P_{sfc}), rawinsondes, dropsondes > 100 km from TC, ACARS, sat. winds, TC position, MSLP, GPS RO

- Initialized system this year on 29 July, continuous cycling using GFS LBC
- No vortex bogusing or repositioning, all updates to TC due to observations



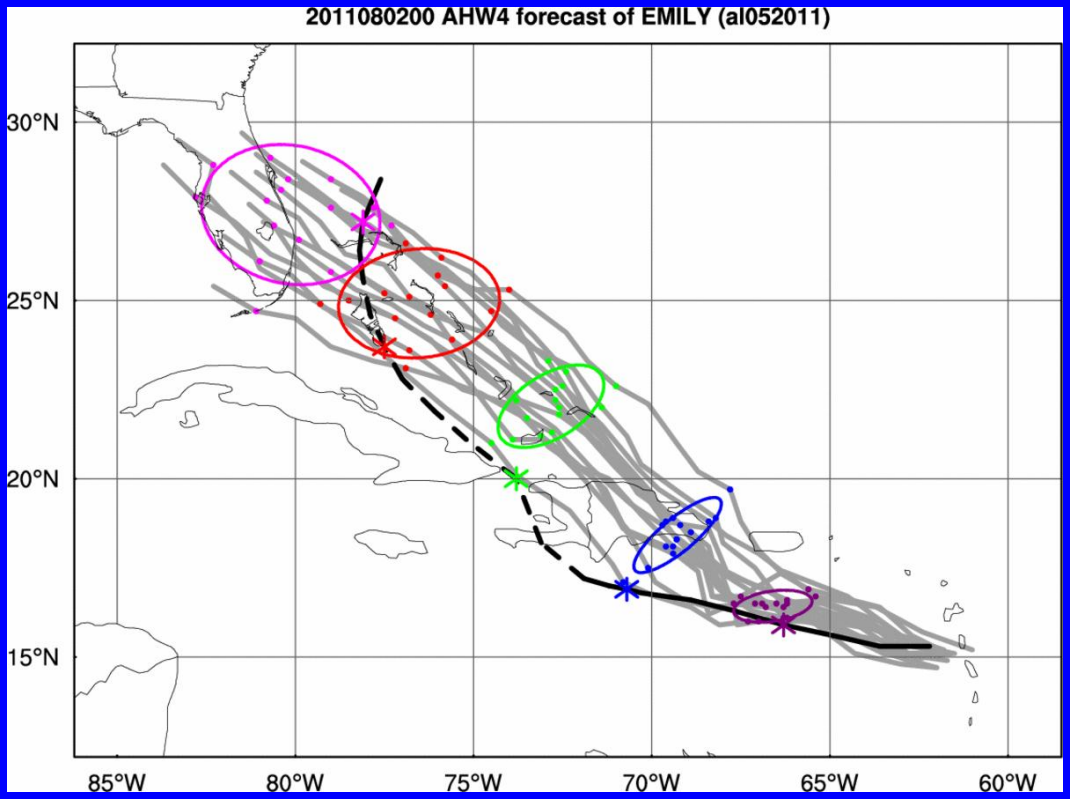
Data Assimilation Nesting Strategy

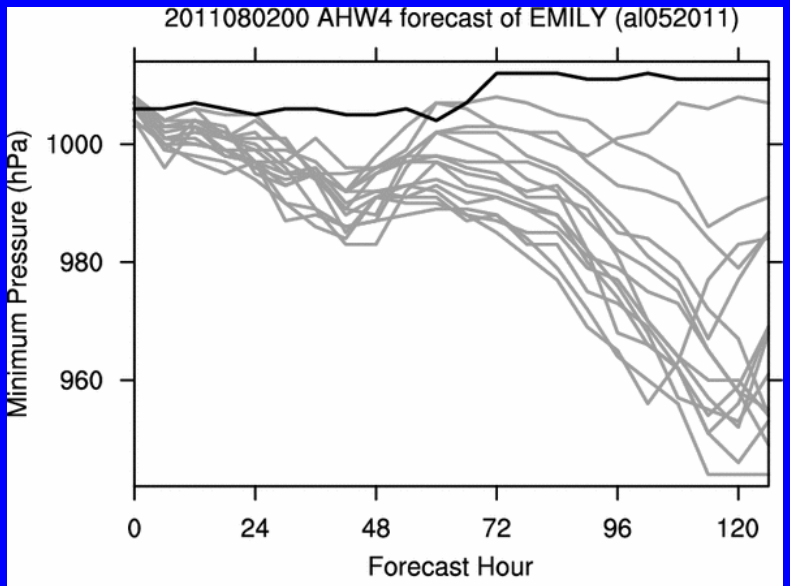
- Each time NHC declares an INVEST area, generate a 12 km resolution two-way interactive nest that moves with the system until NHC stops tracking it (1600 km x 1600 km nest)
- Observations are assimilated on the nested domain each 6 h
- Nest movement determined by extrapolating NHC positions over the previous 6 h
- Works better than vortex-following nests, which have largest covariances associated with differences in land position

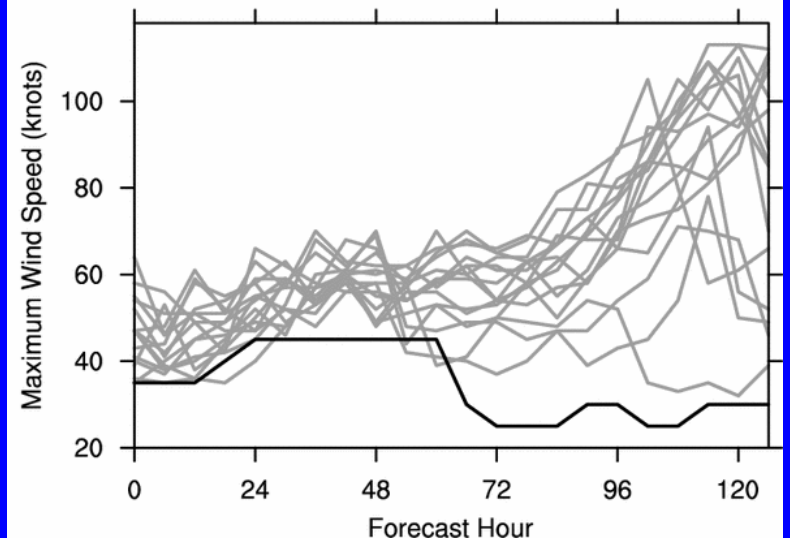
Ensemble Forecasts

- Currently running 15 member ensemble for NHC highest priority TC
- Take first 15 members of the analysis ensemble since all are equally likely
- All members use same lower BC, lateral BC, and model physics (will be relaxed in the future)

0000 UTC 2 Aug. Ensemble

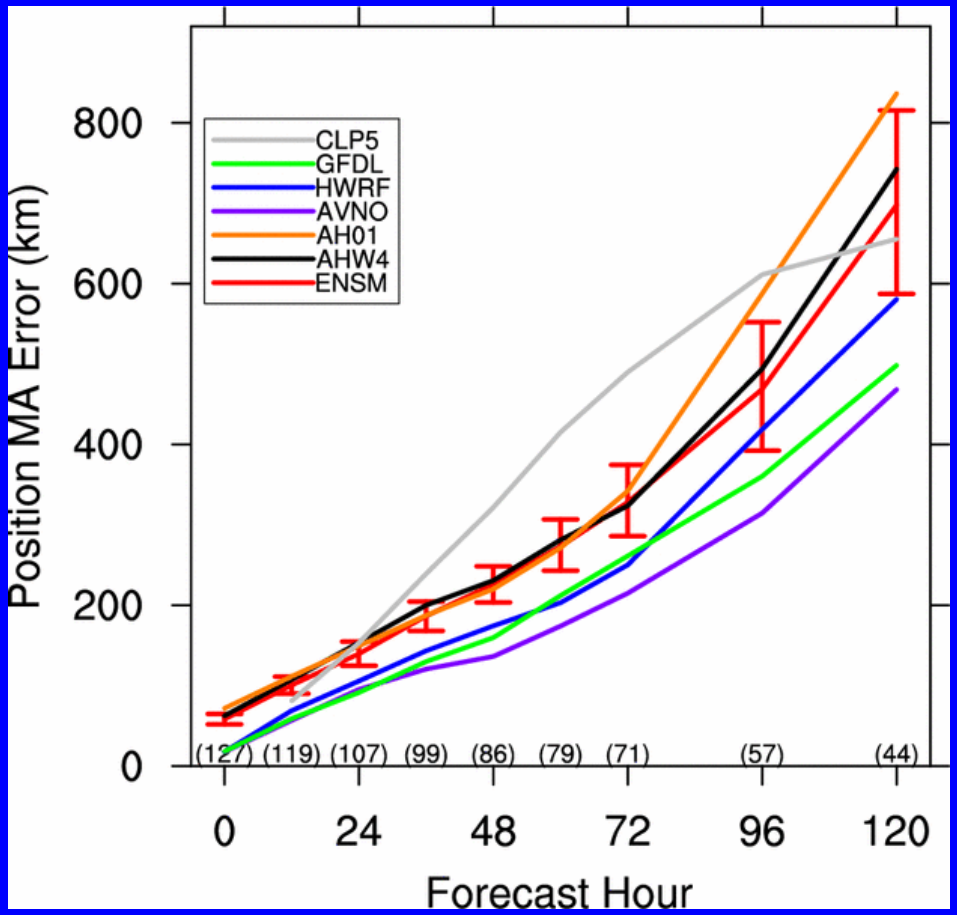




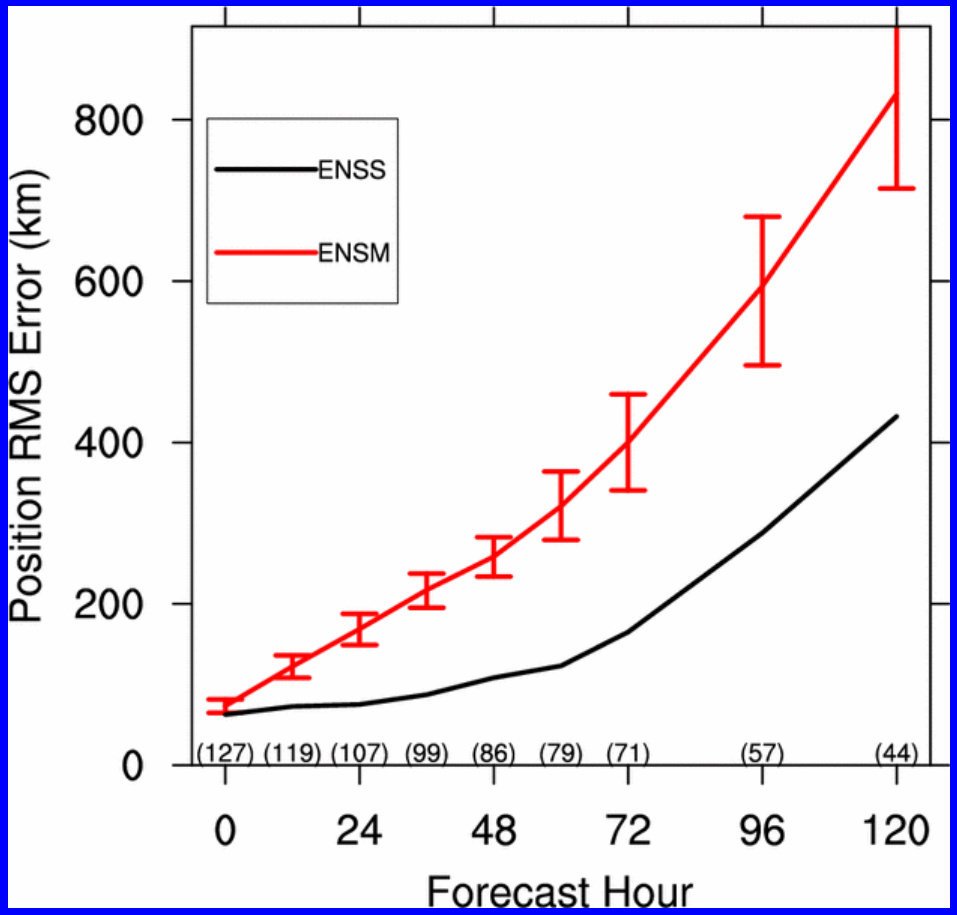


2011 Season Results

Track MA Errors

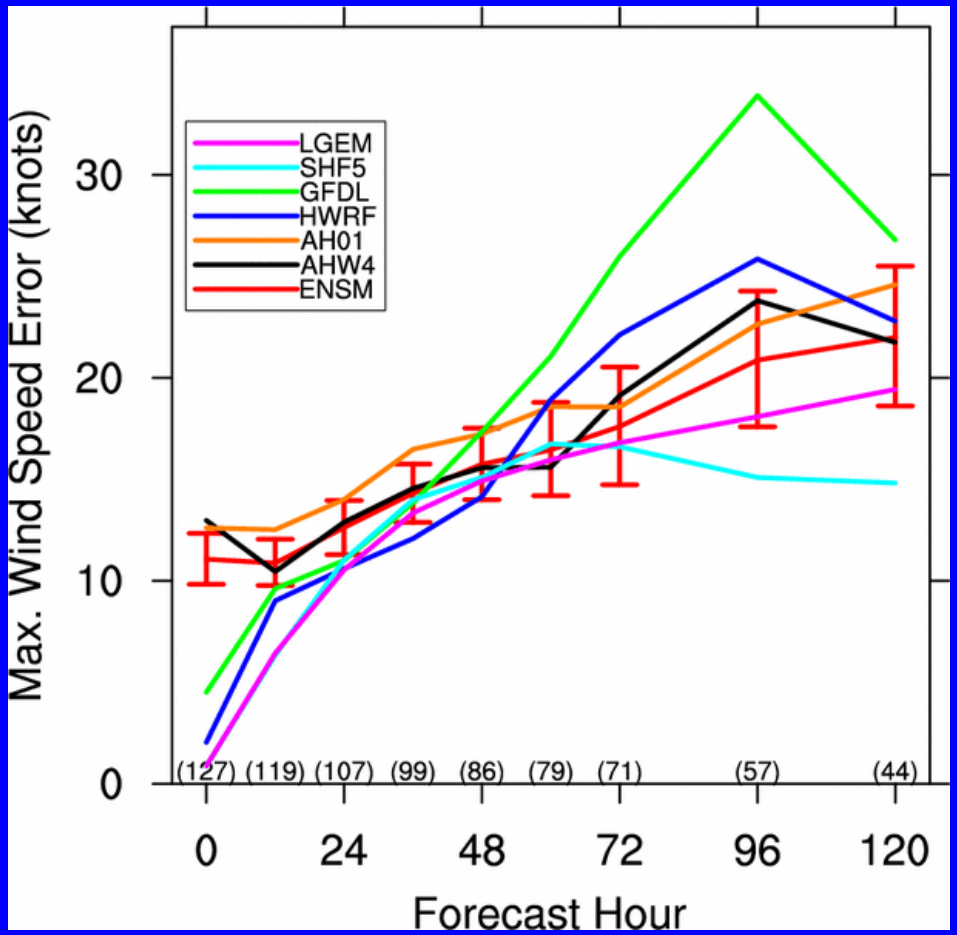


Track RMS Errors

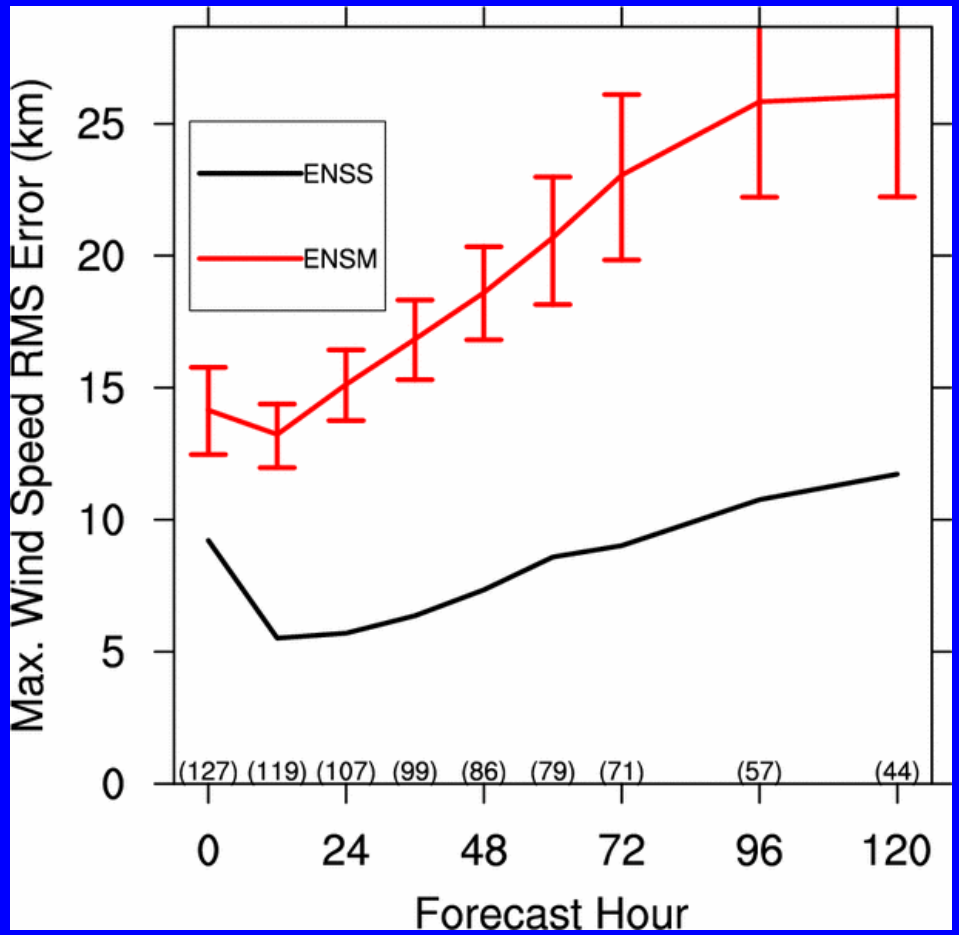


2011 Season Results

Intensity MA Errors



Intensity RMS Errors



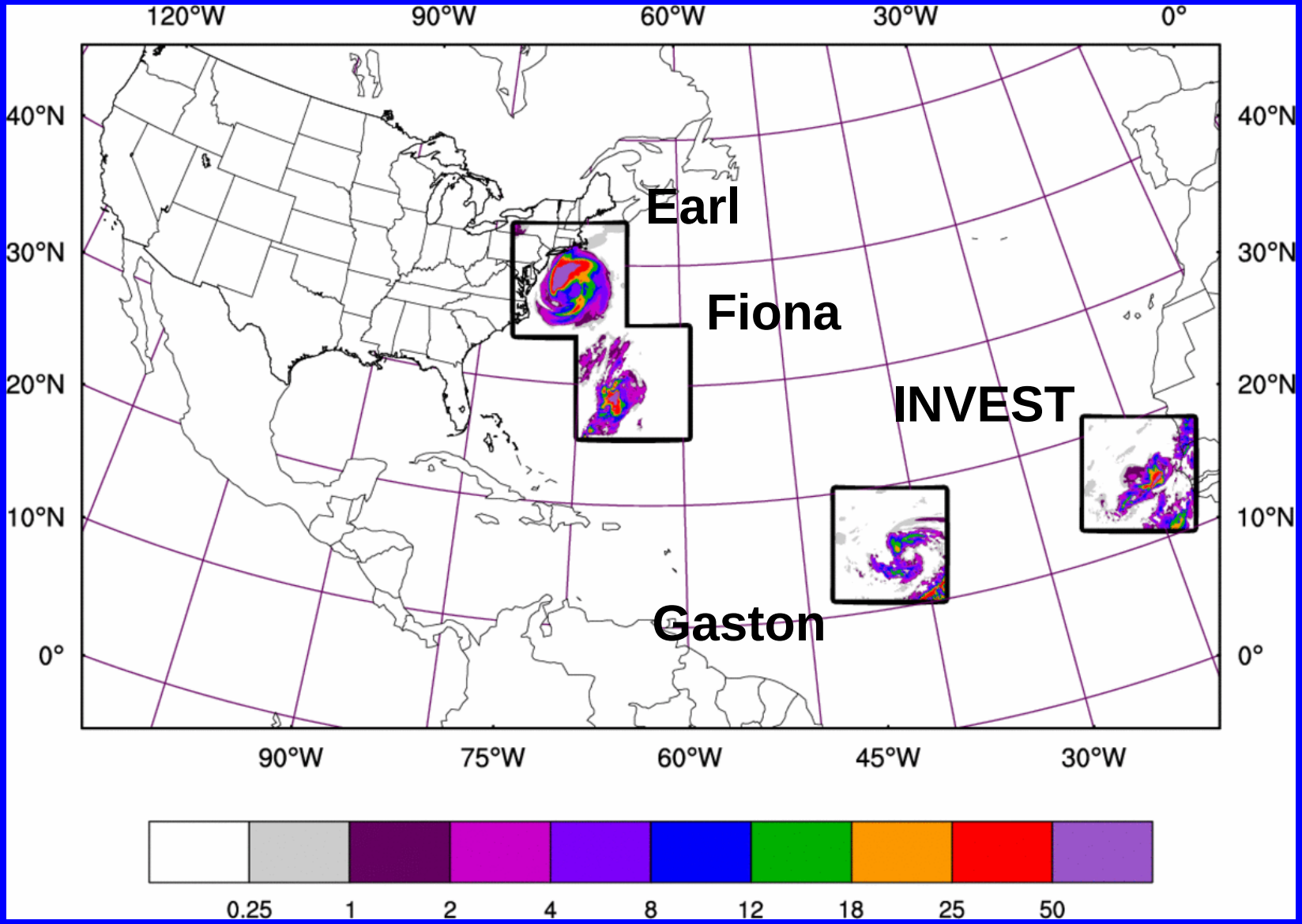
Challenges to TC DA

- Few direct observations of the entire TC (exception is radar).
- Potentially large representativeness errors in observations due to variety of scales contained within
- Likely have to run regional model for longer period of time to establish bias coefficients for radiance assimilation
- Covariances strongly reflect position differences, need to account for position
- Not all observations may have value to intensity forecast. Need to identify potential observations that project onto those modes within the model (i.e., sensitivity analysis)

Requirements

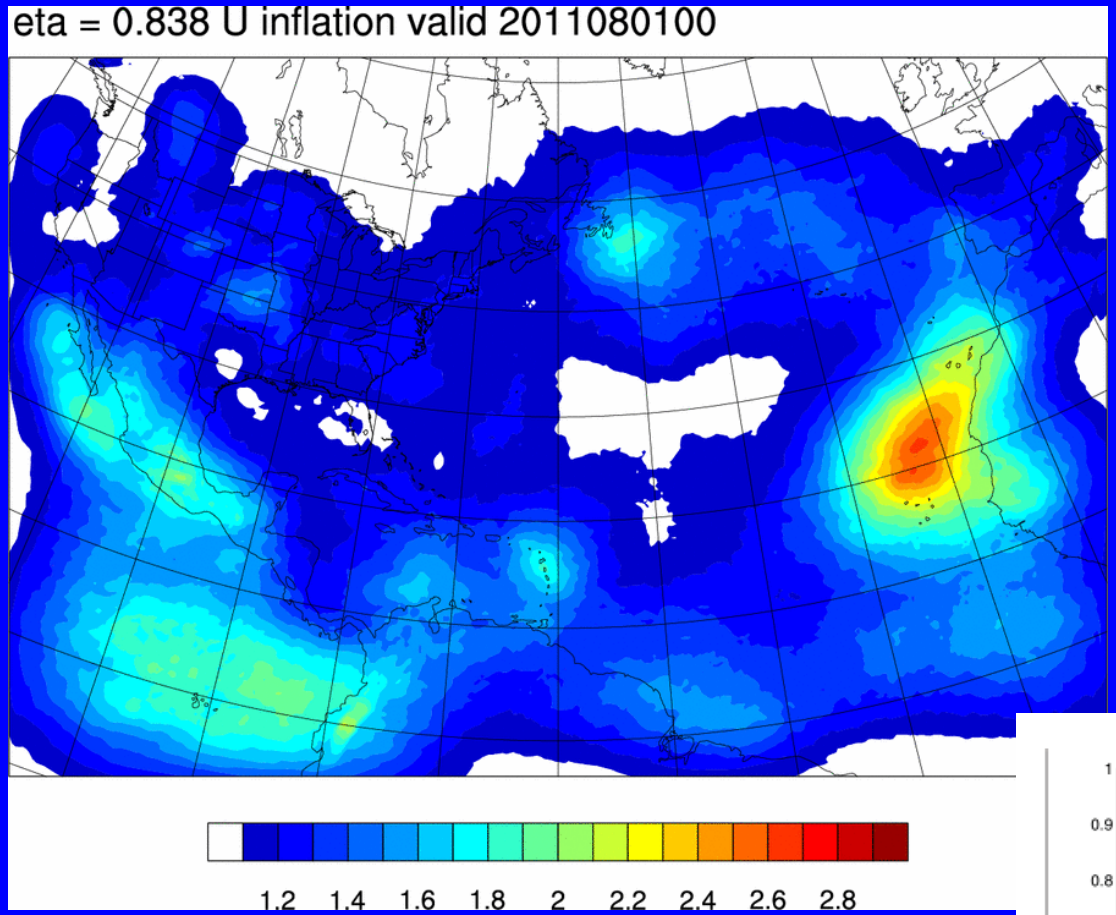
- Ability to assimilate data on multiple nested domains at the same time as the assimilation is being done on the parent domain
- Ability to assimilate TC vitals as position and minimum SLP (not as surface pressure observation)
- Diagnostics output

Nest Example



Requirements

- Statistically robust methods that try to overcome the limitations introduced by using a finite-sized ensemble
  - Adaptive covariance inflation (i.e., Anderson 2009 method)
  - Sampling error corrections that de-emphasize small correlations
  - Adaptive covariance localization that shrink radius based on observation density



Many of these can be taken from the DART system and incorporated into the hybrid as stand-alone subroutines.