Work Unit 1.3: Enhancements to long lead forecasting

Deliverables:

- Report on the relationship between Atlantic basin-wide and land falling tropical cyclone statistics for the Sandy-impacted area to the different phases of El Nino Southern Oscillation (ENSO)
- Report on techniques for back-testing hurricane landfall models
- Report on how Arctic sea ice decline and North Atlantic warming may impact Atlantic hurricanes and winter storms in New York.
- Report on how hurricane rainfall interacts with and impacts significant wave height during storms.

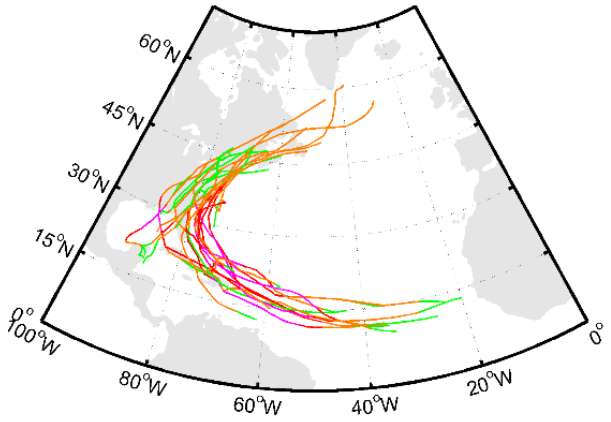
Participants:

- SBU: Edmund Chang, Hyemi Kim, Ping Liu, Albert Yau
- NYU: David Holland, Rajesh Kumar, Xichen Li, Wenchao Chen

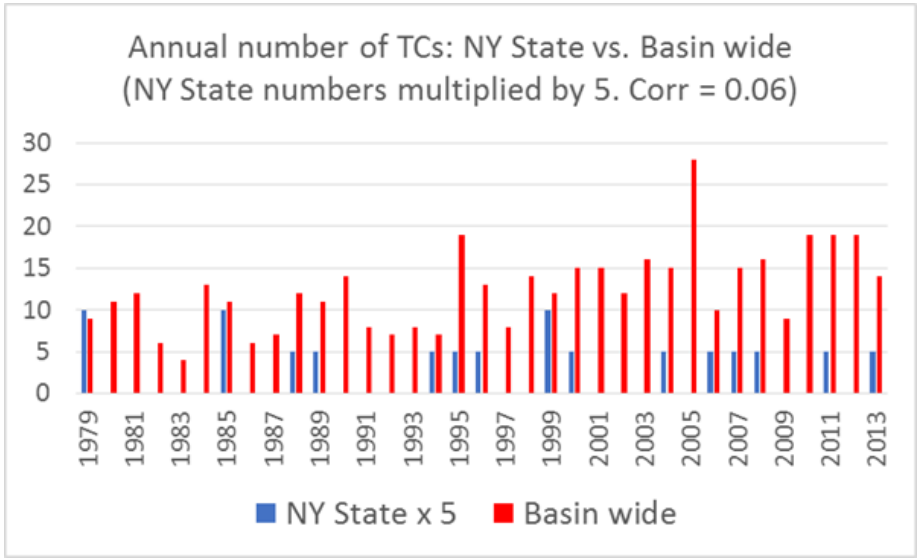
1. The relationship between Atlantic basin-wide and land falling tropical cyclone (TC) statistics for the Sandy-impacted area to the different phases of El Nino Southern Oscillation (ENSO)

Leads: Hyemi Kim and Edmund Chang

- Progress to date:
  - Relationship between basin-wide tropical cyclone (TC) statistics and statistics of TC affecting New York State compared: Correlation < 0.1



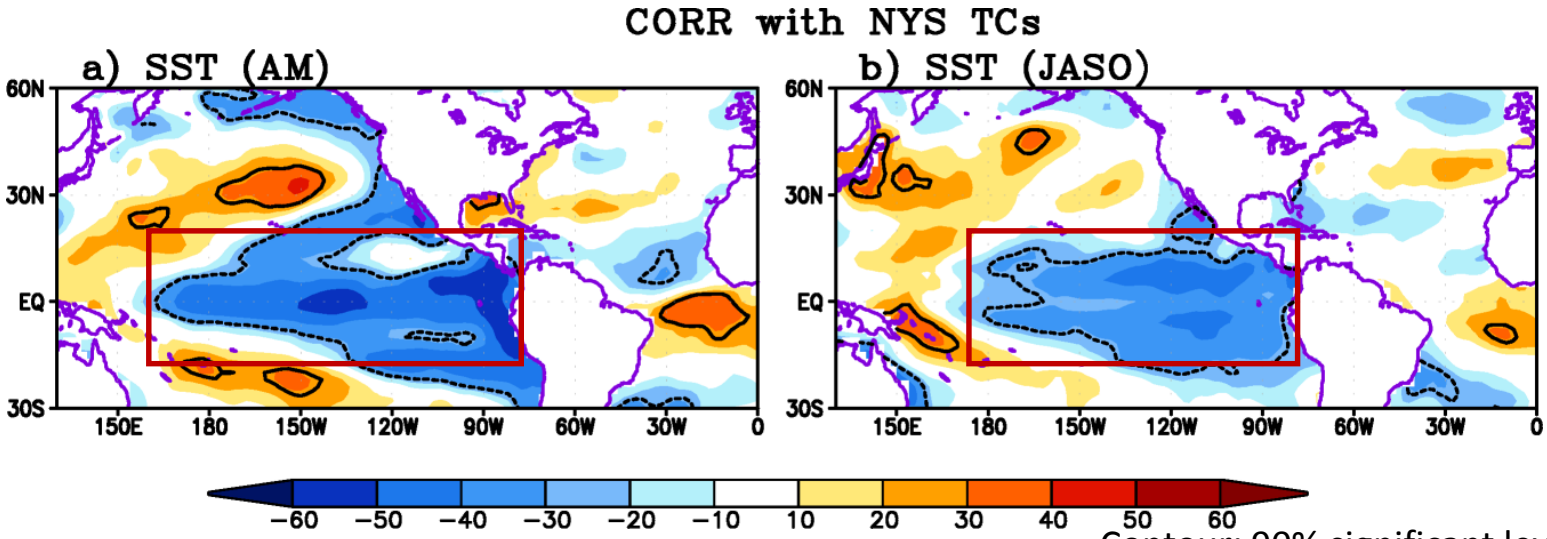
Tracks of all TCs passing through NY State (1979-2013)



Implication: Basin-wide seasonal predictions of TC activity (e.g. NOAA and Colorado State University seasonal forecasts) are not particularly useful for New York State

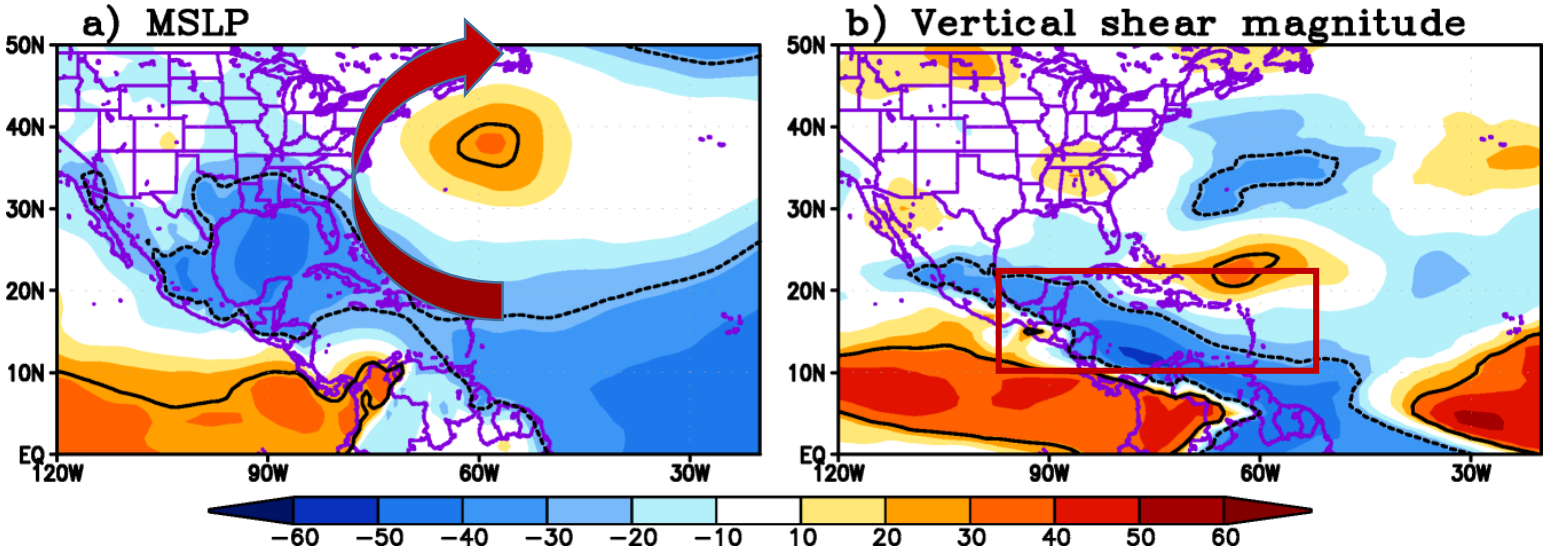
Correlation maps for April-May, June-October

Sea Surface Temperature (SST)



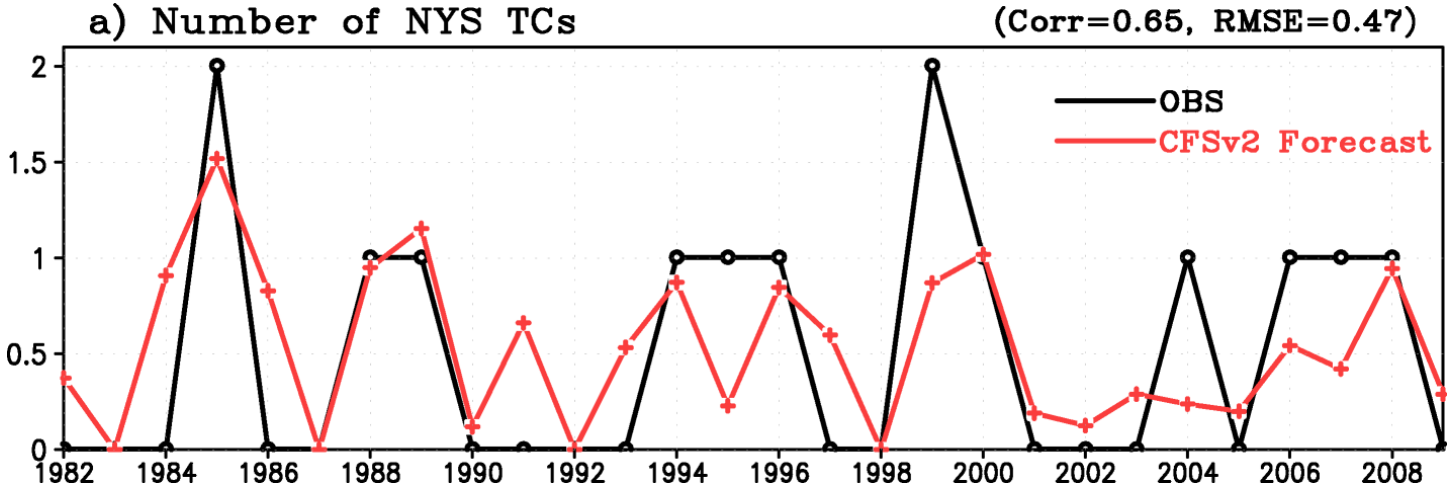
Contour: 90% significant level

Large scale atmospheric circulation: Steering current and vertical wind shear



Statistical-Dynamical Prediction Model

Statistical prediction model developed based on Climate Forecast System version 2 (CFSv2, NCEP) dynamical predictions of large scale atmosphere-ocean conditions from February of each year



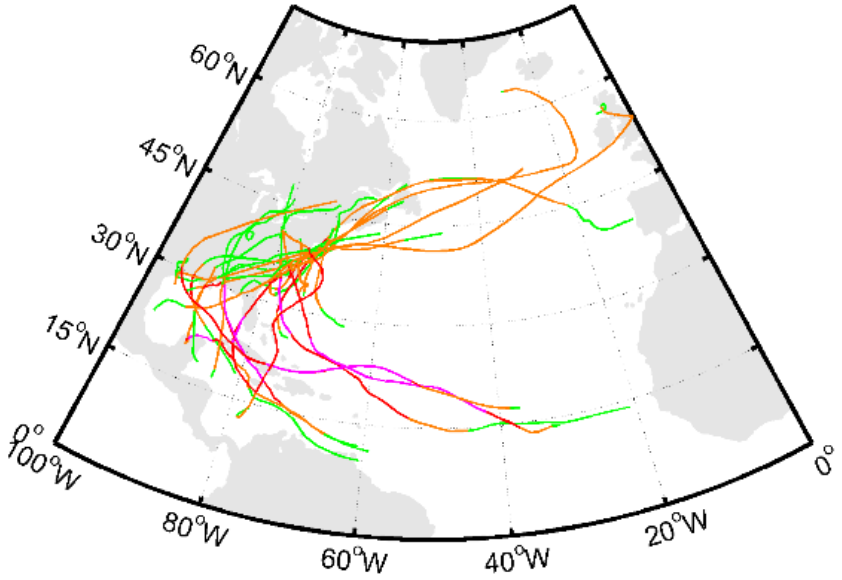
For 2014 season: **Below average activity**:

- Number of TCs passing through NY State: **0.33** (climatology 0.51)
- Probability of one or more TCs passing through NY: **0.30** (climatology 0.43)

For future years:

- Initial seasonal prediction can be ready at beginning of March
- Update ready at beginning of June

- Ongoing work (will be completed before final report)
  - Developing seasonal prediction models for TCs passing within 200 km of NY State:



Tracks of all TCs passing within 200 km of NY State (1979-2013)

- Sandy did not make landfall over NY State!
- Most TCs passing within 200 km of NY State caused significant impacts (high winds, flooding, storm surge)

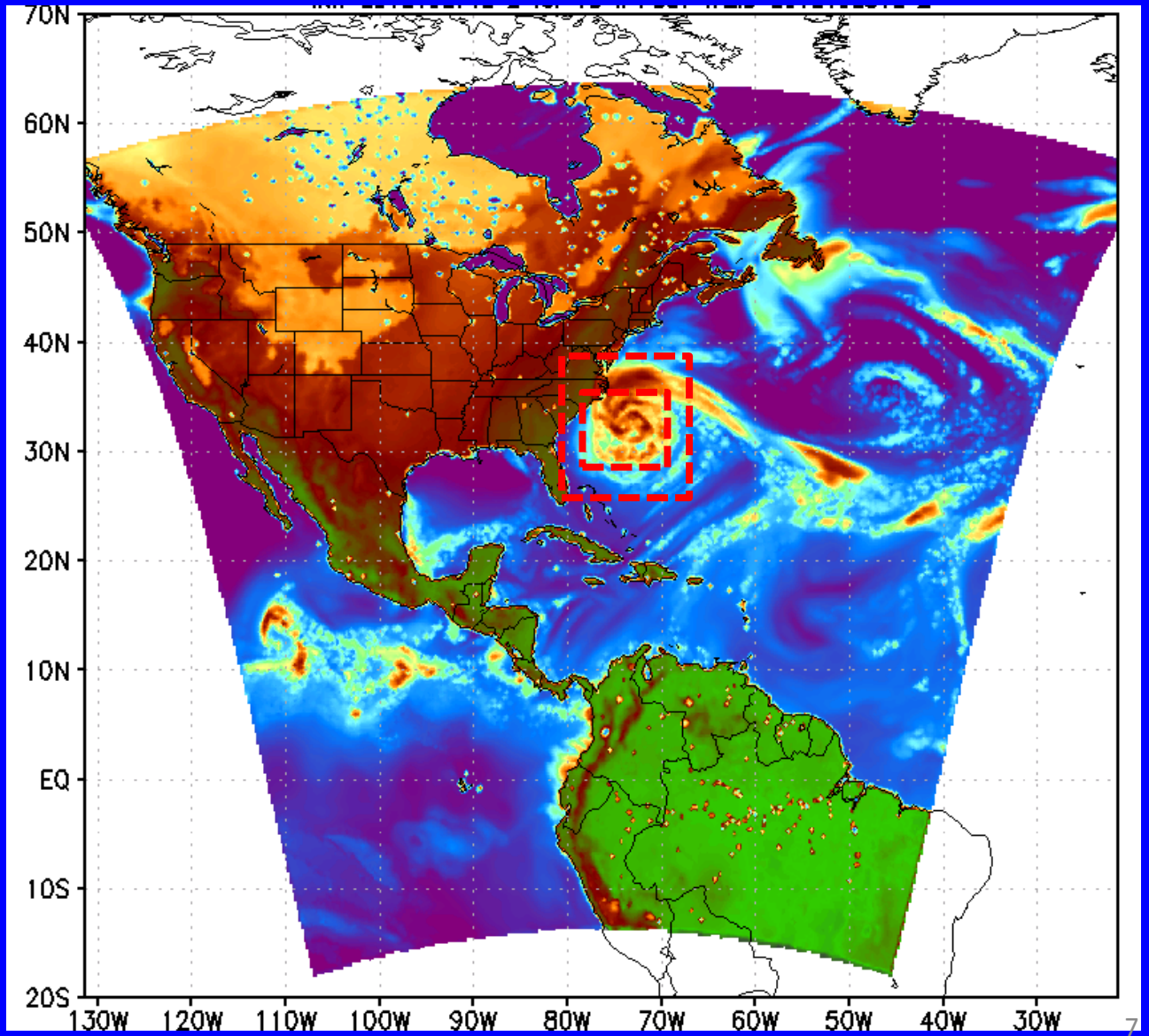
2. Techniques for back-testing hurricane landfall models
Lead: Ping Liu

- Progress to date:
  - Collaboration between SBU and NCEP Environmental Prediction Center scientists established
  - Operational Hurricane Weather Research and Forecasting (HWRF) model set up at SBU
  - Extensive reforecast experiments being conducted to investigate:
    - How Sandy interacted with the planetary-scale steering flow for its rare track
    - How this interaction is sensitive to the different physical packages (moist convection and microphysics) used in HWRF
    - Whether useful forecasts more than 3 days prior to landfall can be made using the HWRF

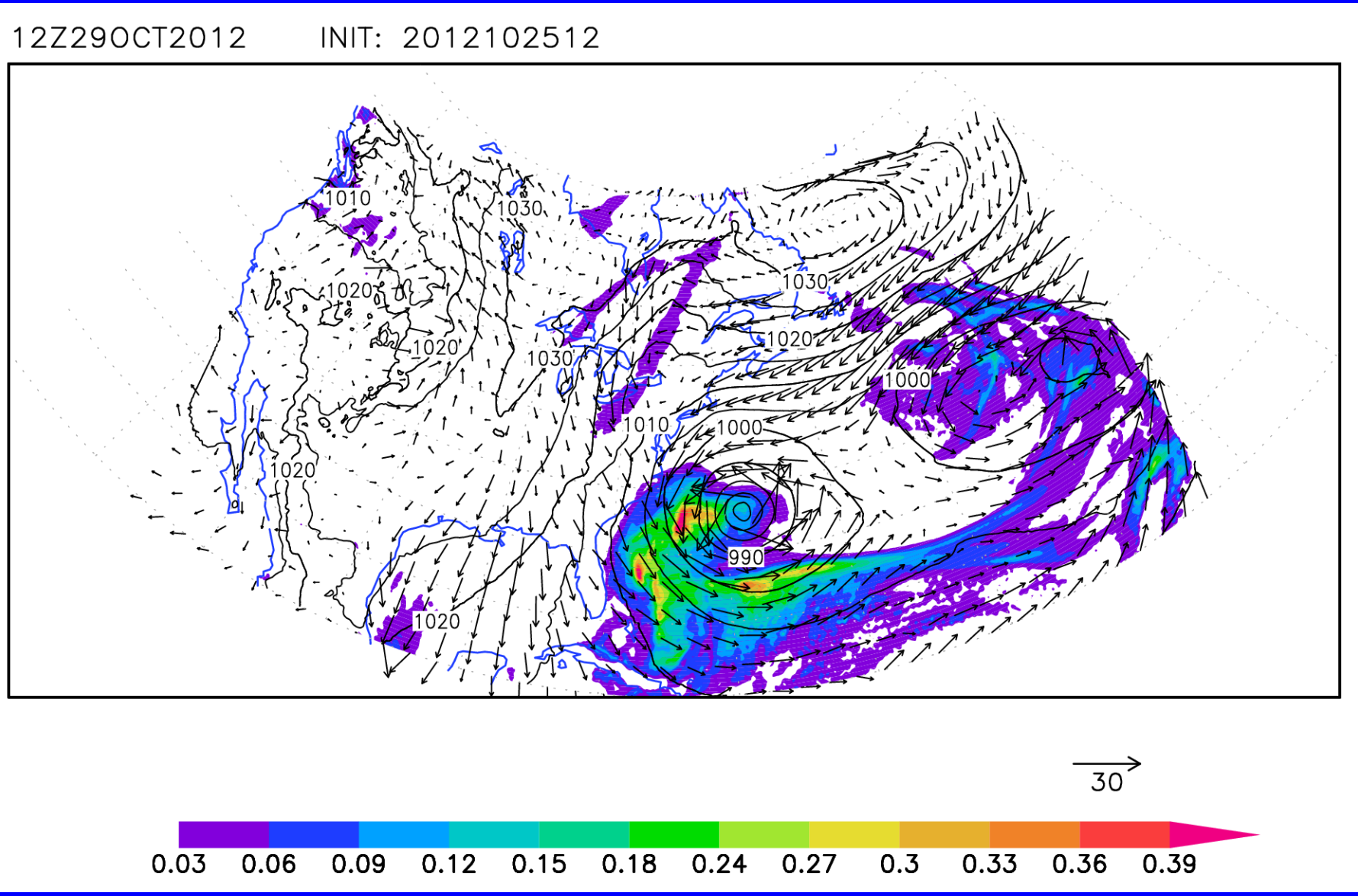
HWRF Nested Domains

3 nested domains
Grid Spacings:
  Outer: 27 km
  Mid: 9 km
  Inner: 3 km

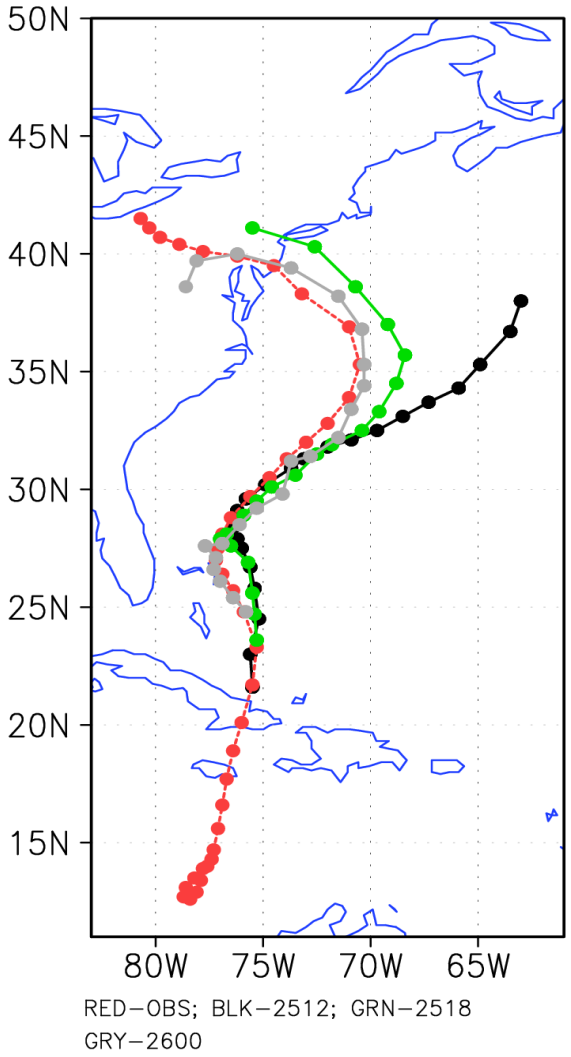
Time step: 45s



Sample Output



Preliminary Results



Red: Observed track

Grey: Forecast 4 days prior to landfall

Green: 4.25 days prior to landfall

Black: 4.5 days prior to landfall

- Why failure to turn when lead time > 4.25 days?
  - Slight differences in upper level flow development
  - Could be related to:
    - Upstream processes?
    - Sandy interaction?
    - Domain size?
    - Initial conditions?