NOAA Satellites and Information
National Environmental Satellite, Data, and Information Service

CIRA

RAMMB
Regional and Mesoscale Meteorology Branch

Development of a Real-Time Automated Tropical Cyclone Surface Wind Analysis:

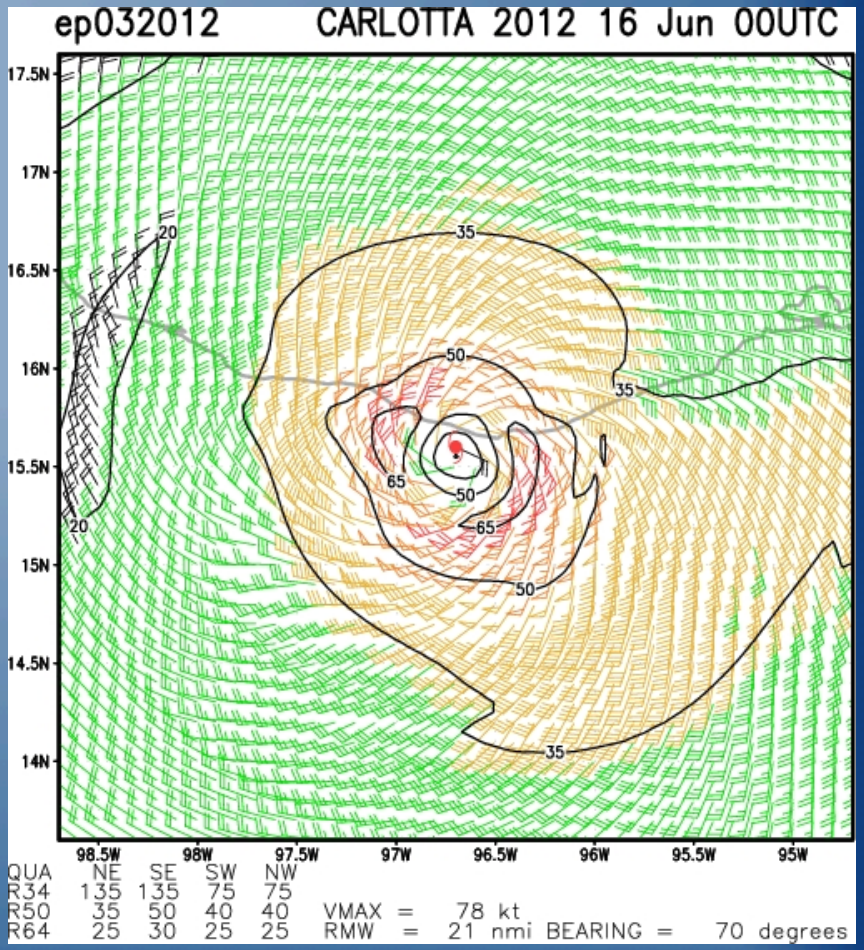
A Year 2 Joint Hurricane Testbed Project Update

Presented by
John A. Knaff
NOAA NESDIS, Fort Collins, CO

Renate Brummer, Mark DeMaria, Chris Landsea,
Michael Brennan, Robbie Berg and Jessica Schauer

Purpose

- This project seeks to create **a real-time and fully automated surface wind analysis system** at the National Hurricane Center (NHC) by combining the existing satellite-based six-hourly multi-platform tropical cyclone surface wind analysis (MTCSWA) and aircraft reconnaissance data.
- Attempt to mimic how Hurricane Specialists would analyses observations using NHC's proceedures



In Year 1

- **What input data?**
  1. Reconnaissance
     - Flight-level winds
     - SFMR wind speeds
  2. Multi-platform tropical cyclone wind analyses
     - Satellite winds at 700 hPa
- **Analysis Issues?**
  - Determination of sufficient data
  - For the polar variational analysis
    - Data weighting
    - Filter coefficients
  - Automated Quality control/RMW determination
  - Determination of wind radii
- **Data Issues?**
  - How to handle data at multiple levels
  - Reduce analysis to a 10-m estimated wind
- **When to run the analysis?**
  - Before (T-0:30)
  - Early (T)
  - After (T +1:30)
- **How to distribute results?**
  - ATCF fix
  - N-AWIPS grids

Flight-level to Surface Reduction

Assumptions

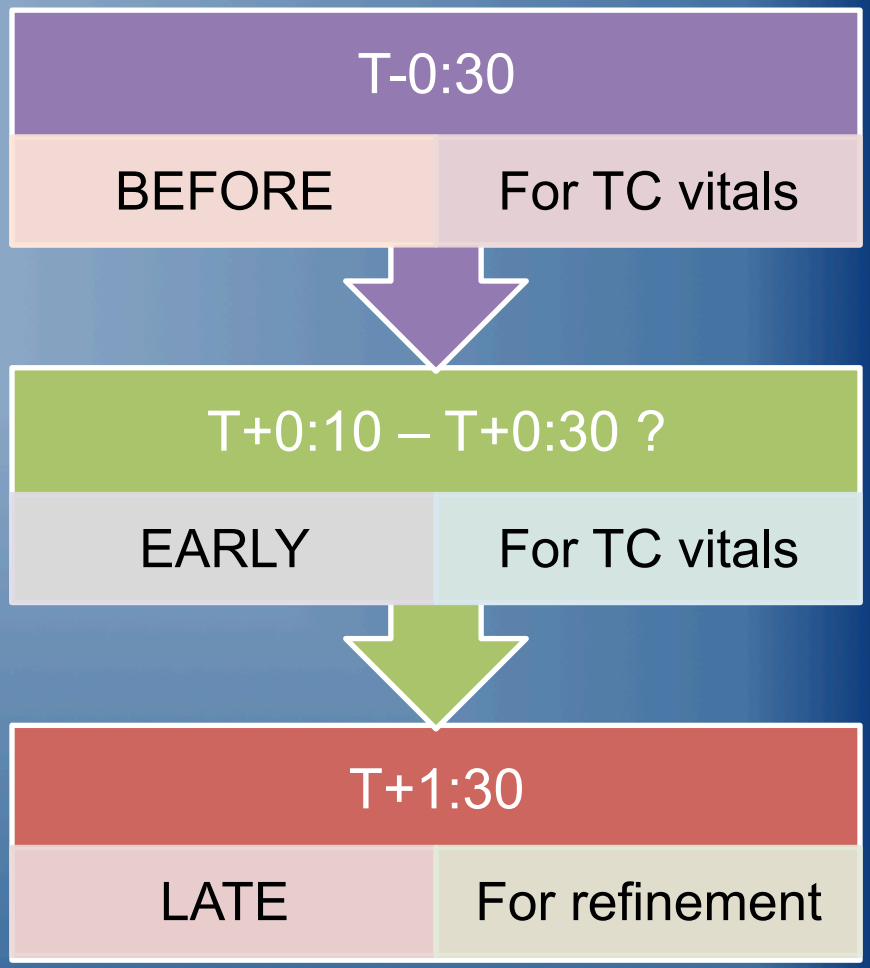
- Two regions
  - Eyewall [r ≤ min(2 * rmw, 20 n.mi)]
  - Outer vortex (r ≥ 4 * rmw)
- 4 % azimuthal variation of reduction factors
- 4 (17) % azimuthal asymmetry with maximum-left and minimum-right in the eyewall (outer vortex)
- Six-hour storm direction is used for the asymmetry
- 20 degree inflow angle
- Over land, additional 20 degree inflow and 20% reduction

Reduction Factors

Level (hPa)	Eyewall	Outer Vortex
600-800	0.88	0.83
800-900	0.78	0.78
900-990	0.73	0.73
990-Sfc	0.77	0.77

When/How to Run

- **(BEFORE)** Just before the synoptic time (T) for assistance with the TC vitals (Bogus)
- **(EARLY)** Just after T for assistance with generating the TC vitals prior to requesting model guidance be run.
- **(LATE)** After the TC vitals has been prepared and after the model guidance has been submitted.



Process Run at CIRA in 2012

1. Active storms?
2. Gather track information

1. Gather HDOBS
2. Gather MTCSWA
3. Motion relative framework
4. Sufficient Data?

1. Correct data to common level (using rmw=50km)
2. Analyze
3. QC (50%)
4. Repeat 2&3 (40%)

1. Analyze
2. Find observed rmw
3. Re-correct data to common level (700 hPa)
4. Final analysis

1. Flight-level-to-surface reduction
2. Diagnostics
3. Fix generation
4. Gridding and display

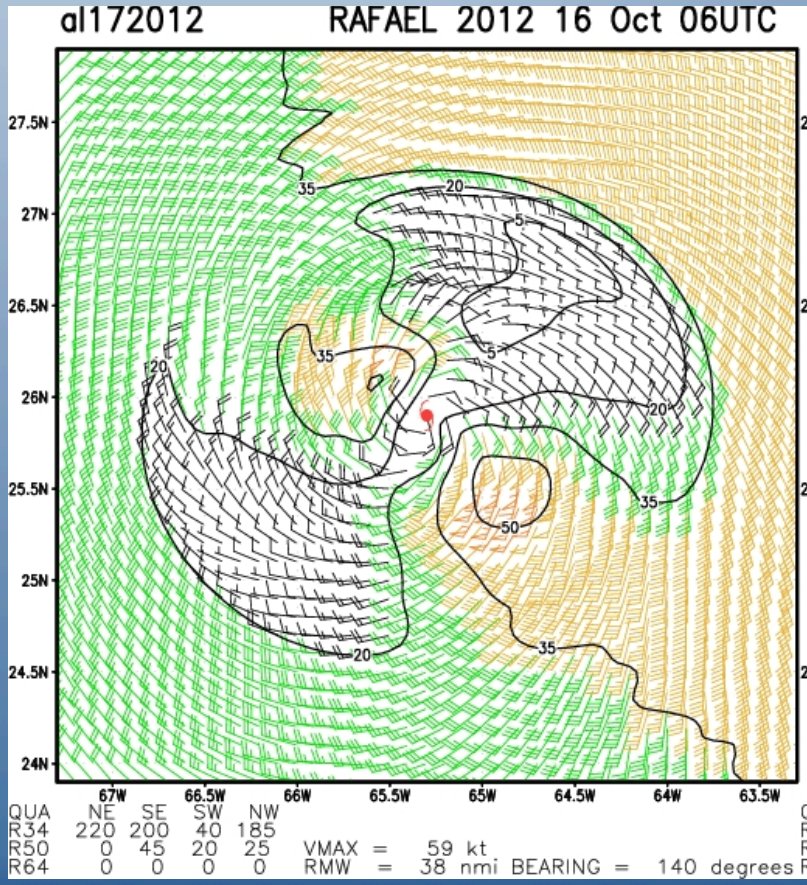
Outputs provided on the RAMMB ftp server.

Summary of the Real-Time Testing

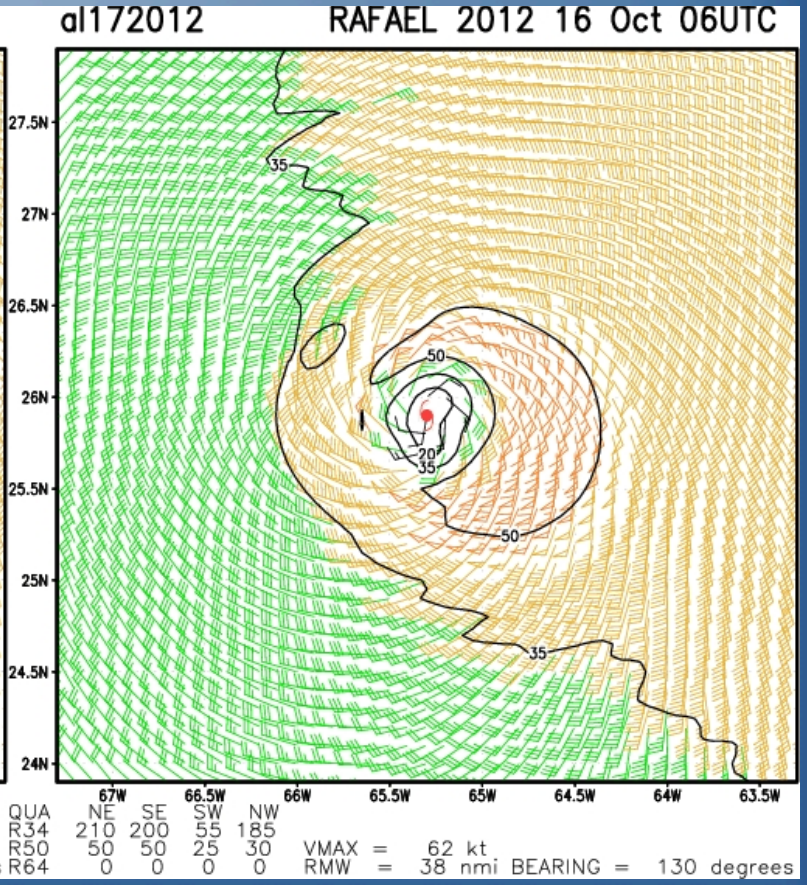
- Before synoptic time there is often not enough data to create an analysis (Could the aircraft be tasked earlier?)
- There were some "odd" analyses resulting from:
  1. Coding error resulting in negative data weights to the MTCSWA inputs.
  2. Quality control too stringent for weak systems
  3. Azimuthal filter weights were to small in some cases.
  4. Wind radii estimates in Sandy… logical error.
- Solutions:
  - Fix the coding error that caused negative data weights
  - Reduce initial quality control constraint
  - Make Azimuthal filter weights larger and sometimes dynamic
  - Fix the logical error in the wind radii estimates.

2010-2012 Analyses are viewable at
http://rammb.cira.colostate.edu/research/tropical_cyclones/tc_surface_wind_analyses/

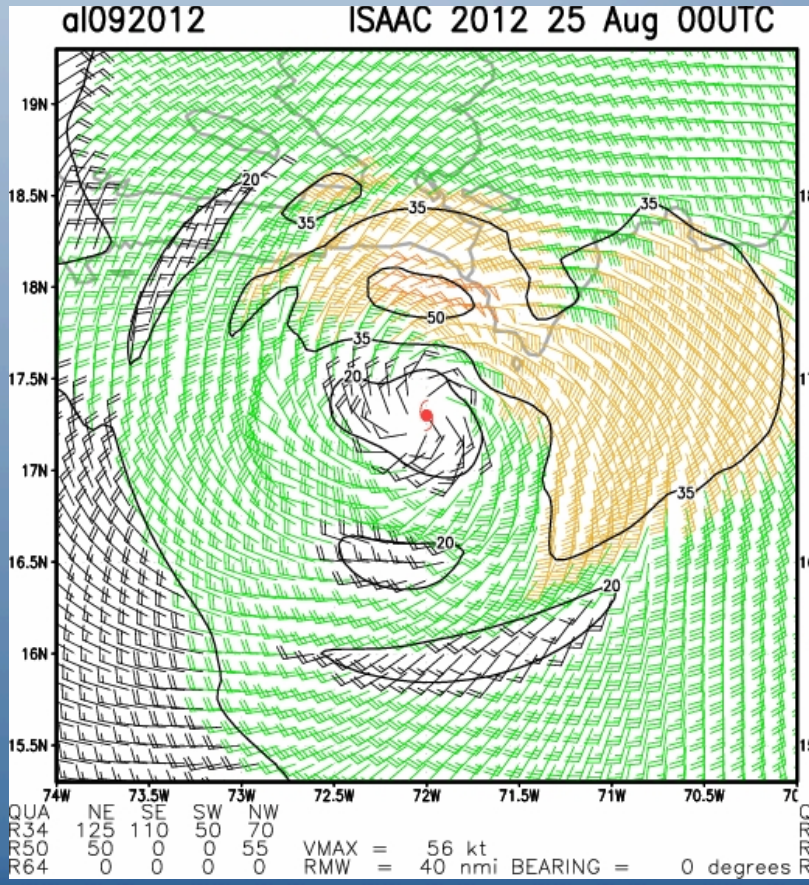
REAL-TIME



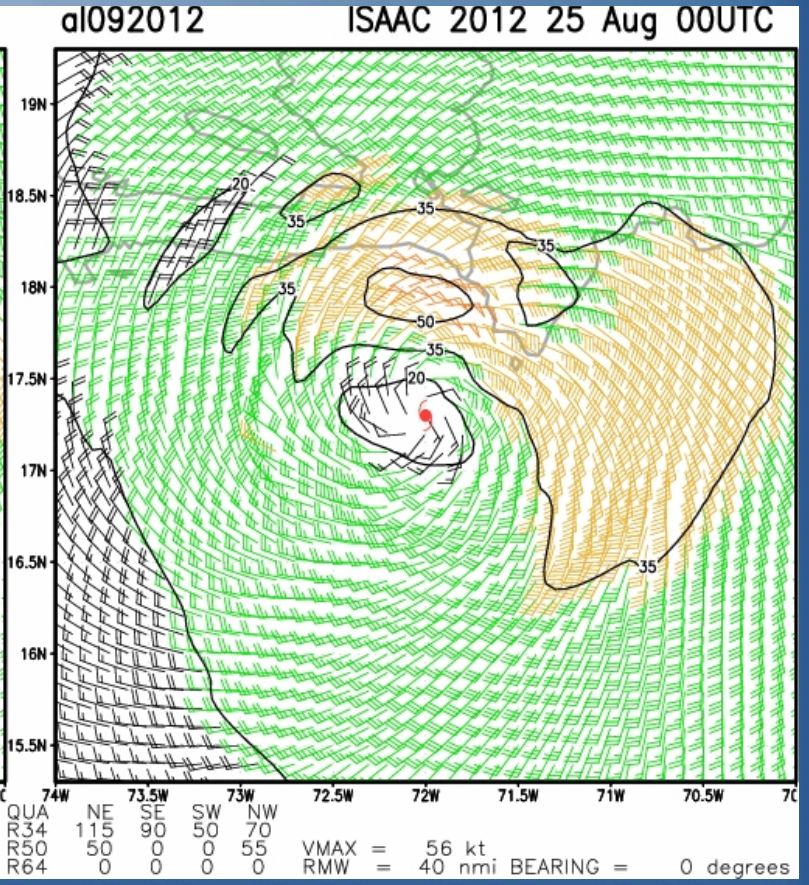
RE-RUN



REAL-TIME

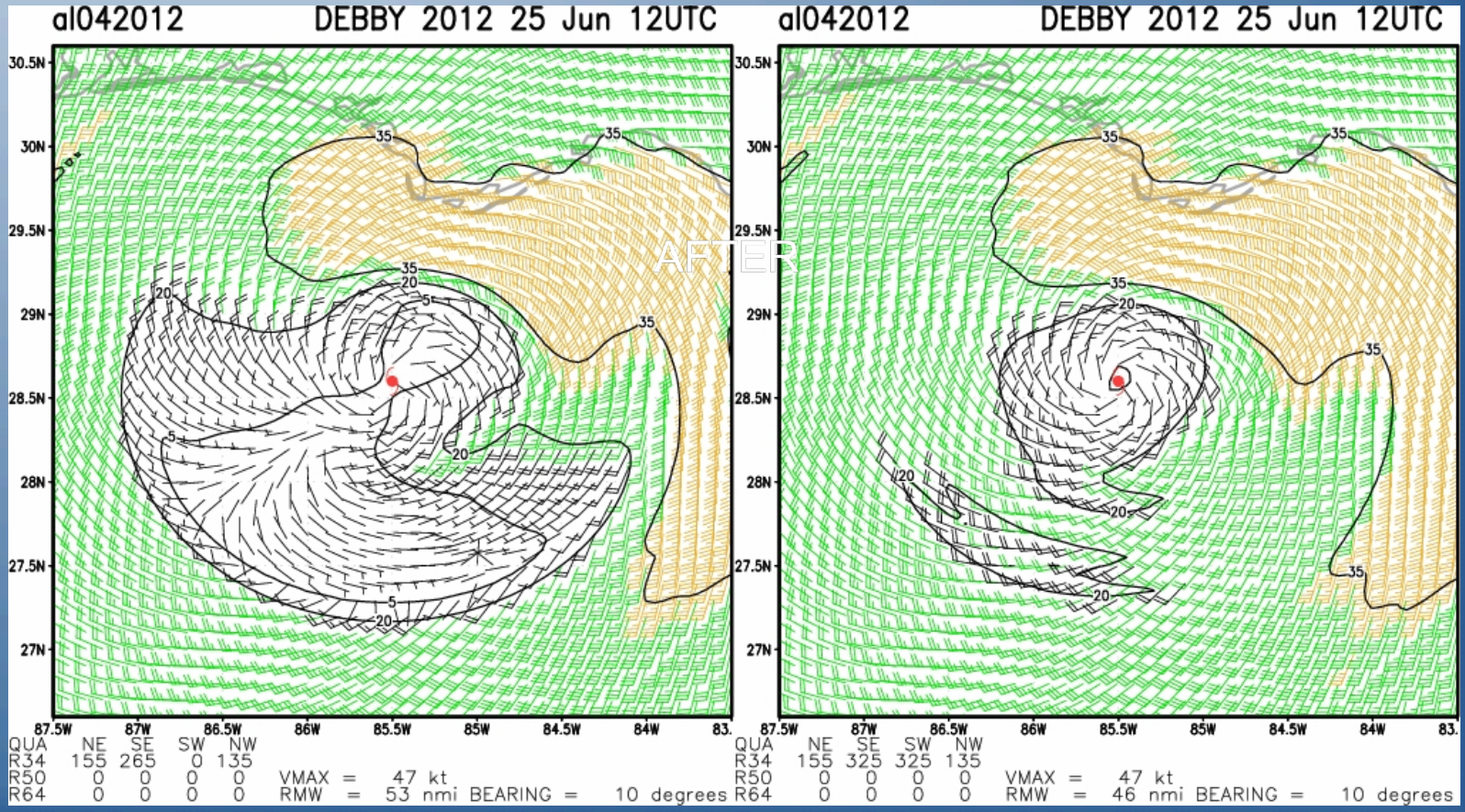


RE-RUN



REAL-TIME

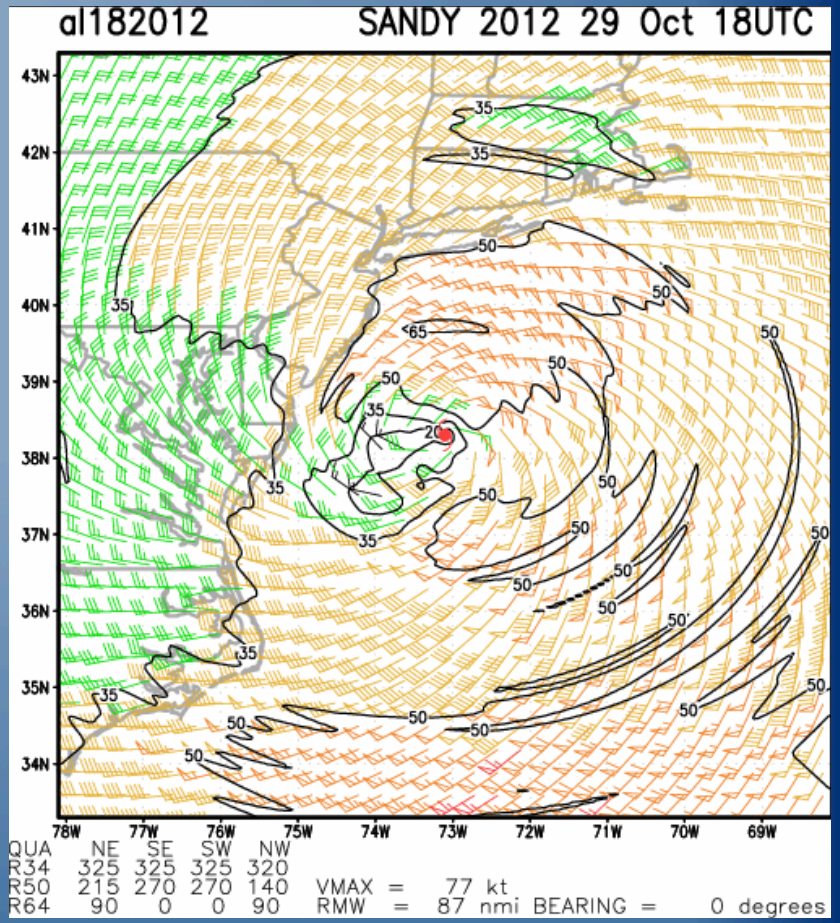
RE-RUN



AFTER

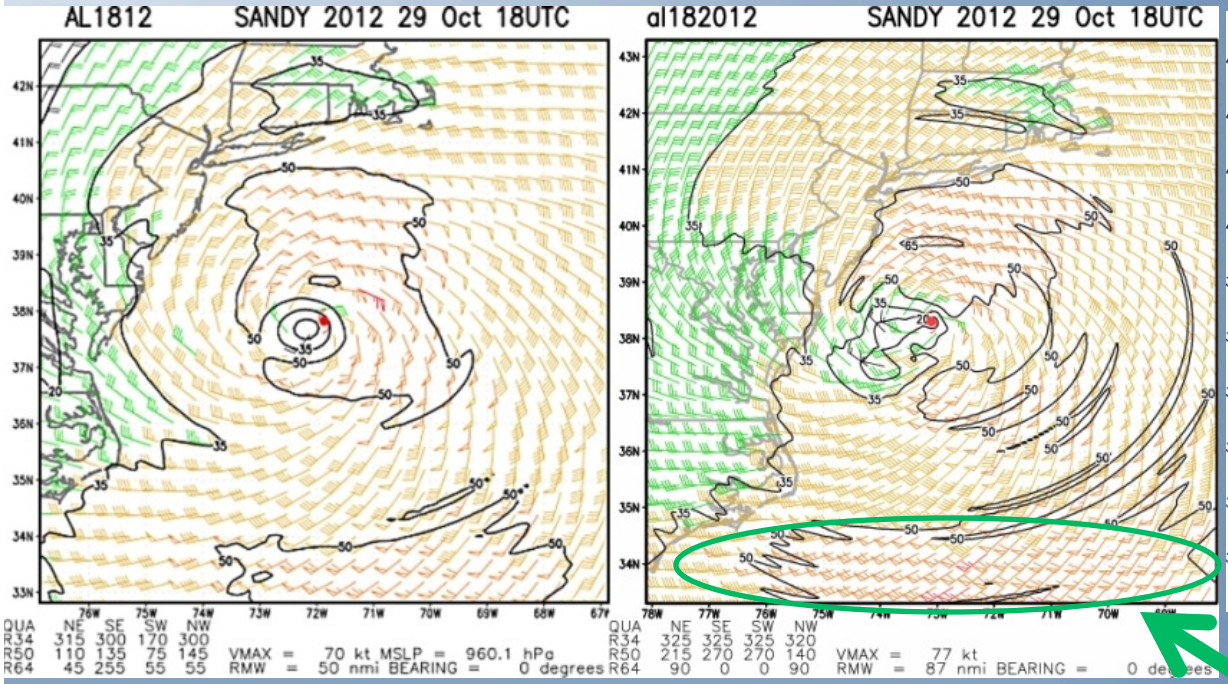
Unique Issues with Sandy

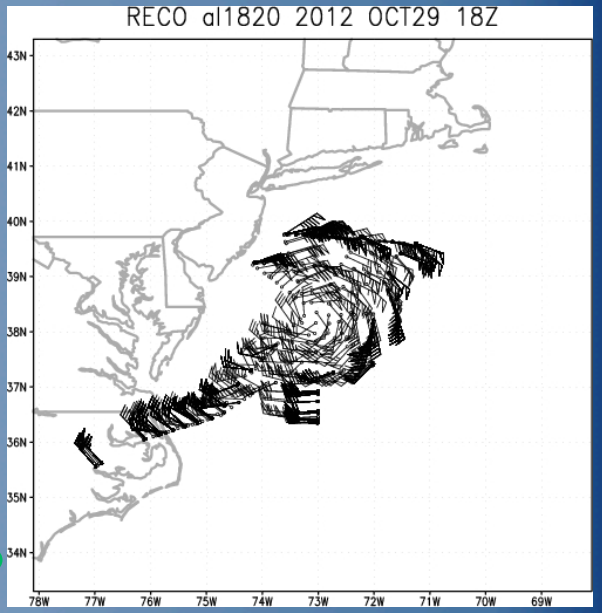
- **Winds beyond 200 km radius rely on MTCSWA and reduction to surface**
  - Should reduction factors be larger beyond some radius?
  - Should we truncate the analysis domain?
- **Wind radii beyond the analysis domain**
  - Do we try to separate storm from its environment?

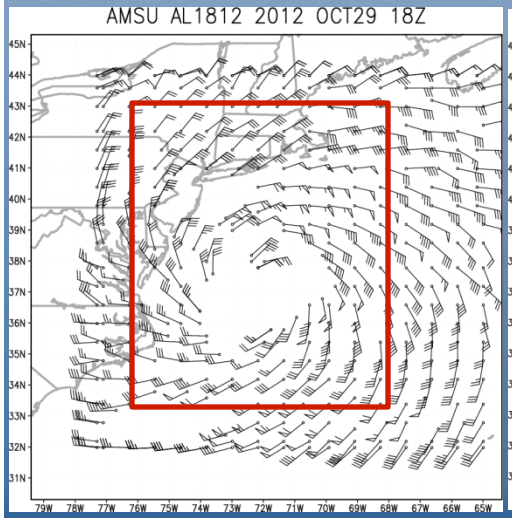


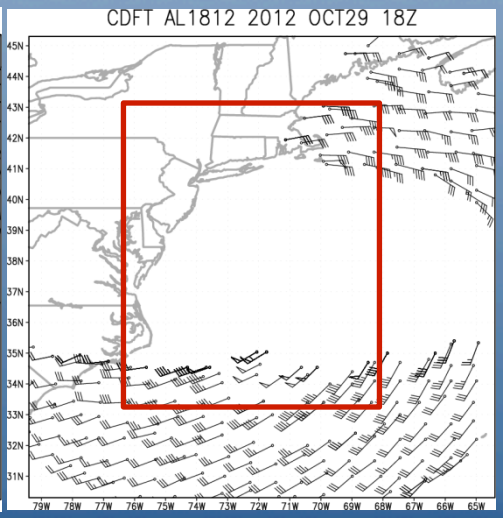
MTCSWA

JHT-TCWA









No surface observations in this area

It is doubtful the wind speeds are as large as indicated in the analysis

Remaining Milestones

- May 2013 – Prepare the analysis for a full season of real time testing
- Jun 2013 – Gather feedback and make appropriate changes to the analysis system
- Jun 2013 – Transition the analysis to NHC control, if approved for implementation
- Jun 2013 – Project ends

Next Steps

Setting things up

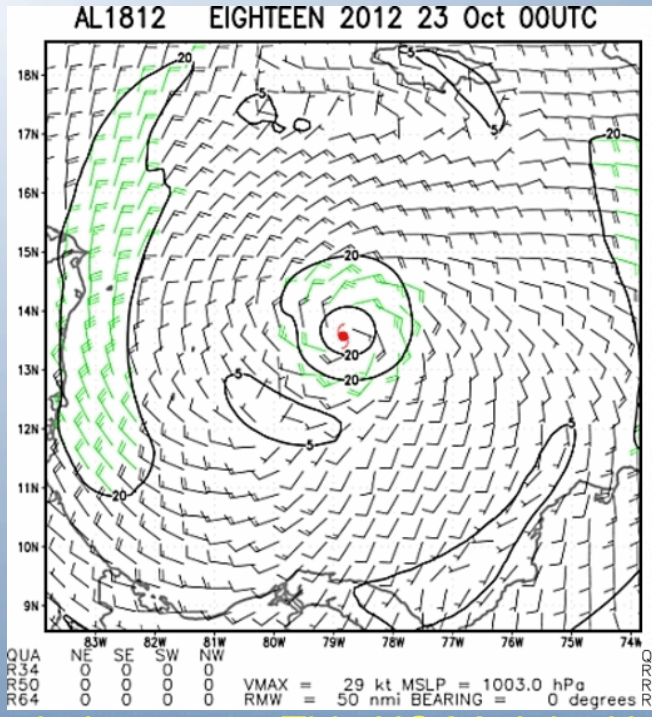
- Housekeeping
  - Clean up FORTRAN Code
  - Clean up scripts add python control scripts
  - Work with NHC on display
  - Fixes or data to ATCF
  - Run in real-time for 2013
- Port Code to NHC
  - Ingest MTCSWA
  - Ingest HDOBS
  - HDOBS decoders
  - FORTRAN
- Questions
  - Flight-level to surface reduction beyond 200km

Concerns

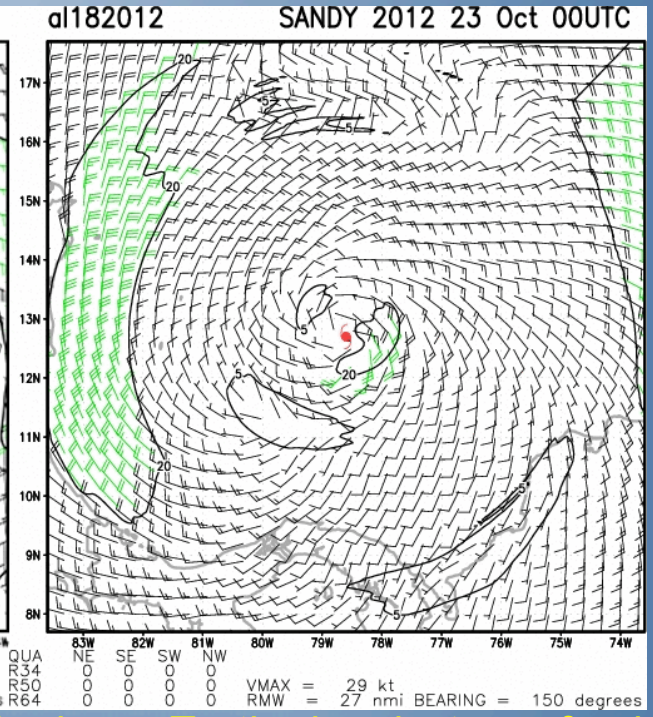
- Data availability
  - Is there enough data to provide EARLY/BEFORE analyses
- NAWIPS and ATCF
  - Pick-up and regular display
    - ATCF Fixes
    - NAWIPS grids
- AWIPS-II?

Questions?

MTCSWA



JHT-TCWA



Acknowledgements: This NOAA Joint Hurricane Testbed project was funded by the US Weather Research Program in NOAA/OAR's Office of Weather and Air Quality.

USWRP Joint Hurricane Testbed