

National Hurricane Center Forecast Verification: Quantifying Forecast Uncertainty

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L311 Hurricane Readiness for Coastal Communities

26 March 2012



NHC Forecast Verification

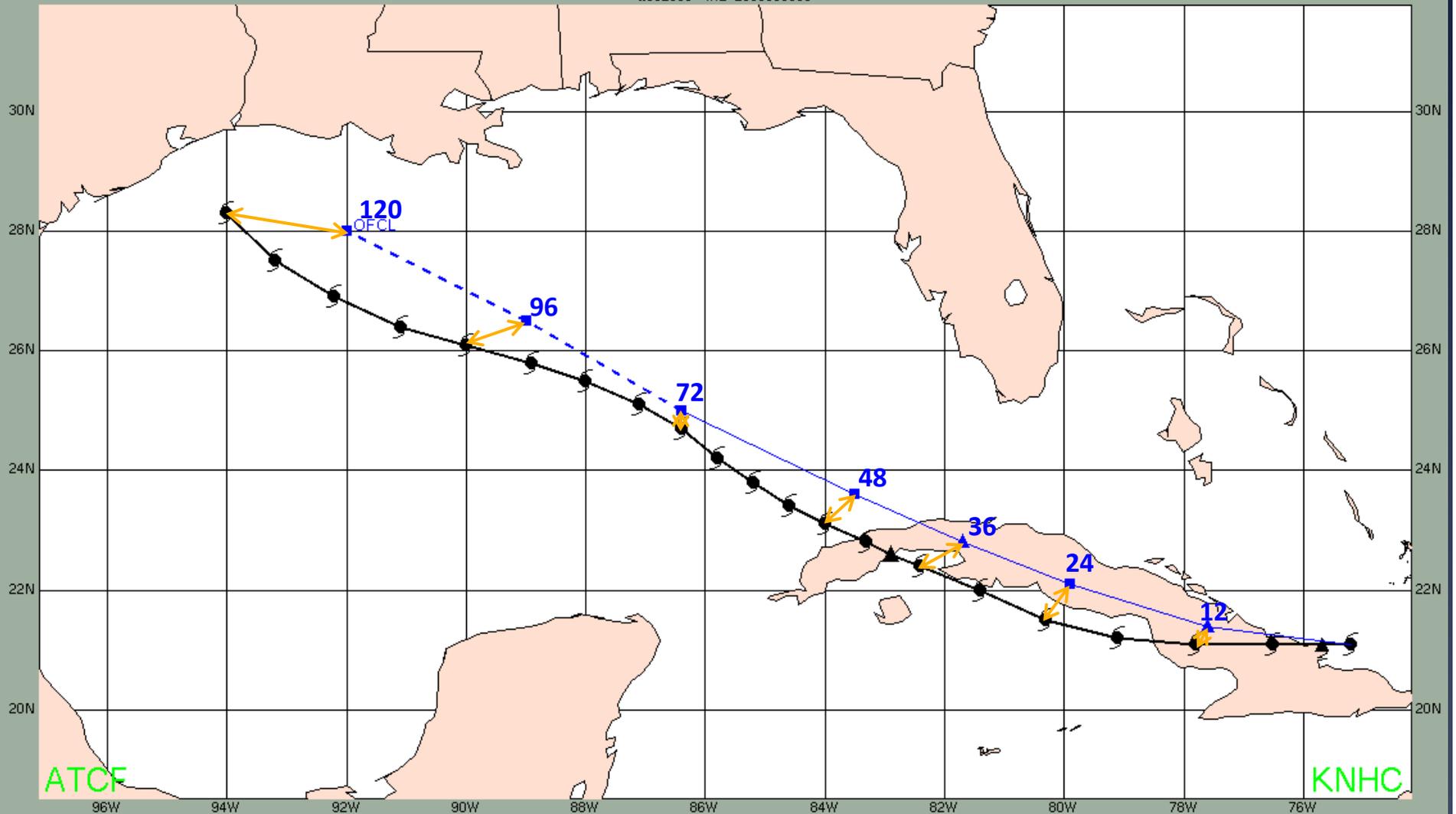
- NHC verifies all official tropical cyclone track and intensity forecasts each year
- Why verify forecasts?
 1. Monitor performance and progress
 - Government Performance and Results Act (GPRA)
 2. Understanding forecast errors help forecasters and modelers to reduce them
 3. Identify critical issues for the research community
 4. Basis for the development of certain products
 - Wind speed and storm surge probabilities
 5. Helps decision makers use NHC products more effectively

NHC Forecast Verification

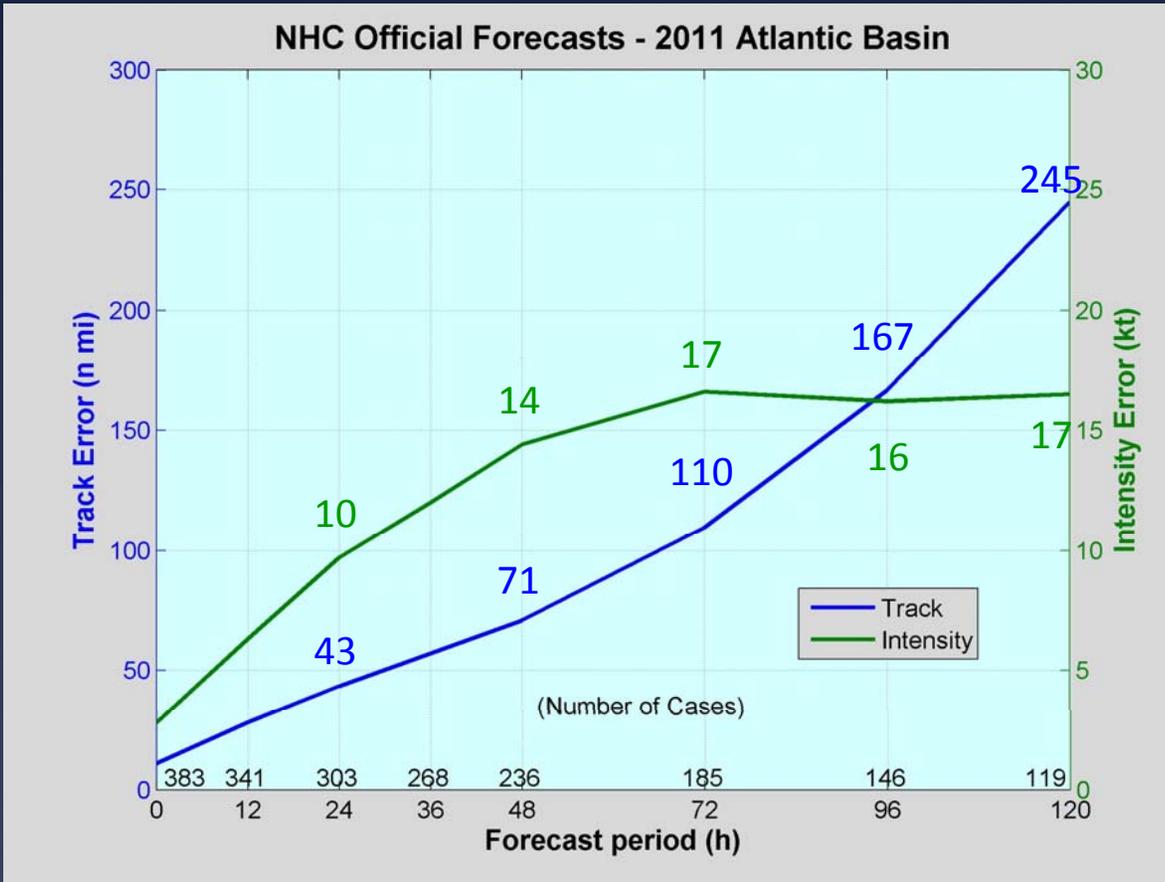
- System must be a tropical or subtropical cyclone at both forecast initial time **and** verification time
- Special advisories ignored (original advisory is verified instead)
- Definitions:
 - Track error: great-circle distance between the forecast location and the actual location of the storm center (n mi)
 - Intensity error: difference between the forecast and actual intensity (kt)
 - Forecast SKILL is computed by comparing forecast error to the error from a Climatology-Persistence model (CLIPER, Decay-SHIFOR)

Track Error Definition

092008 - IKE 2008090800



2011 Atlantic Verification



VT (h)	NT	TRACK (n mi)	INT (kt)
000	383	9.7	1.7
012	339	28.2	6.3
024	297	43.4	9.7
036	260	57.1	12.0
048	226	70.8	14.4
072	176	109.7	16.6
096	140	166.6	16.2
120	113	244.7	16.5

Values in green exceed all-time records

48-hour GPRA error targets

Track: 87 n mi (met)

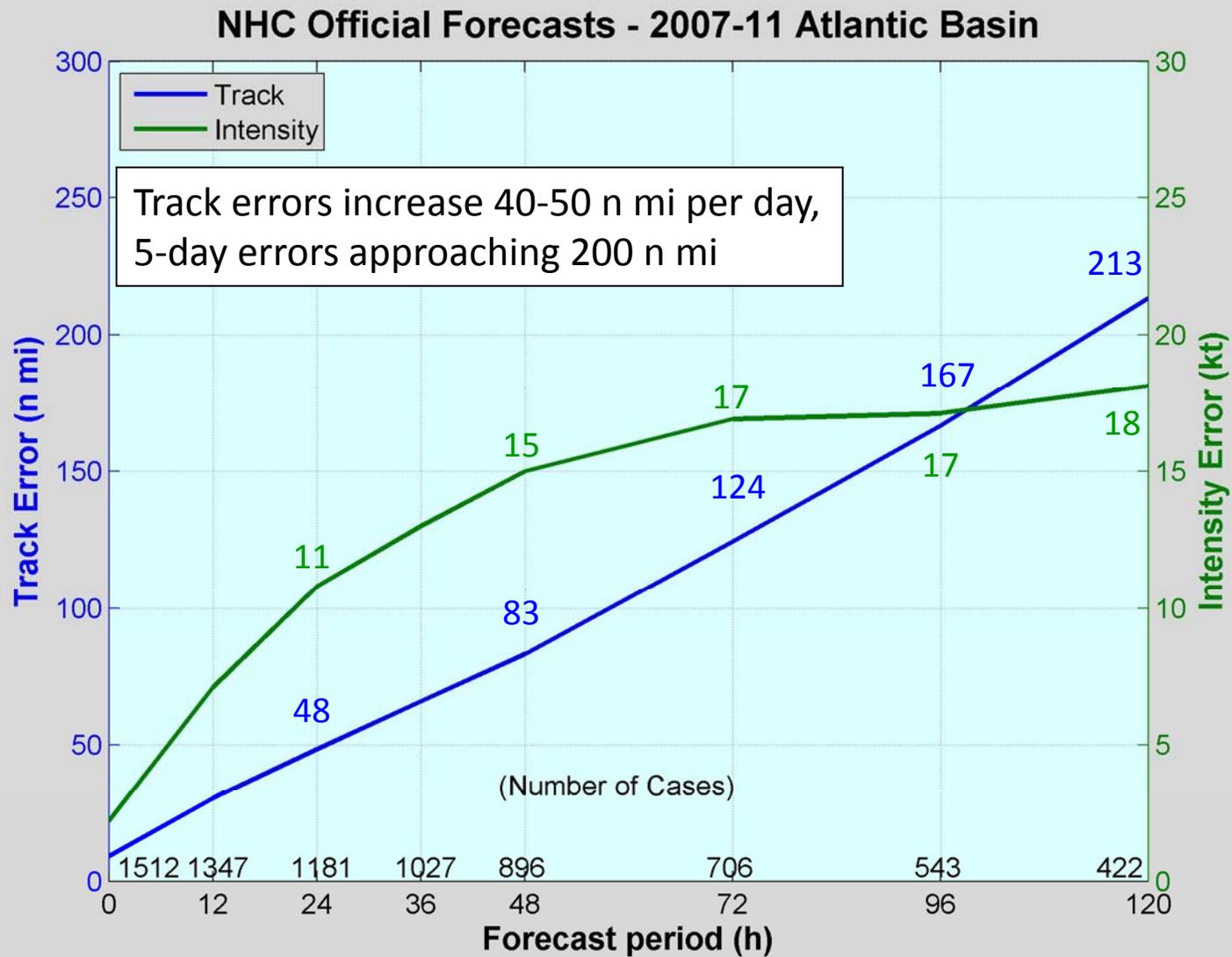
Intensity: 13 kt (missed)

Nothing new here...

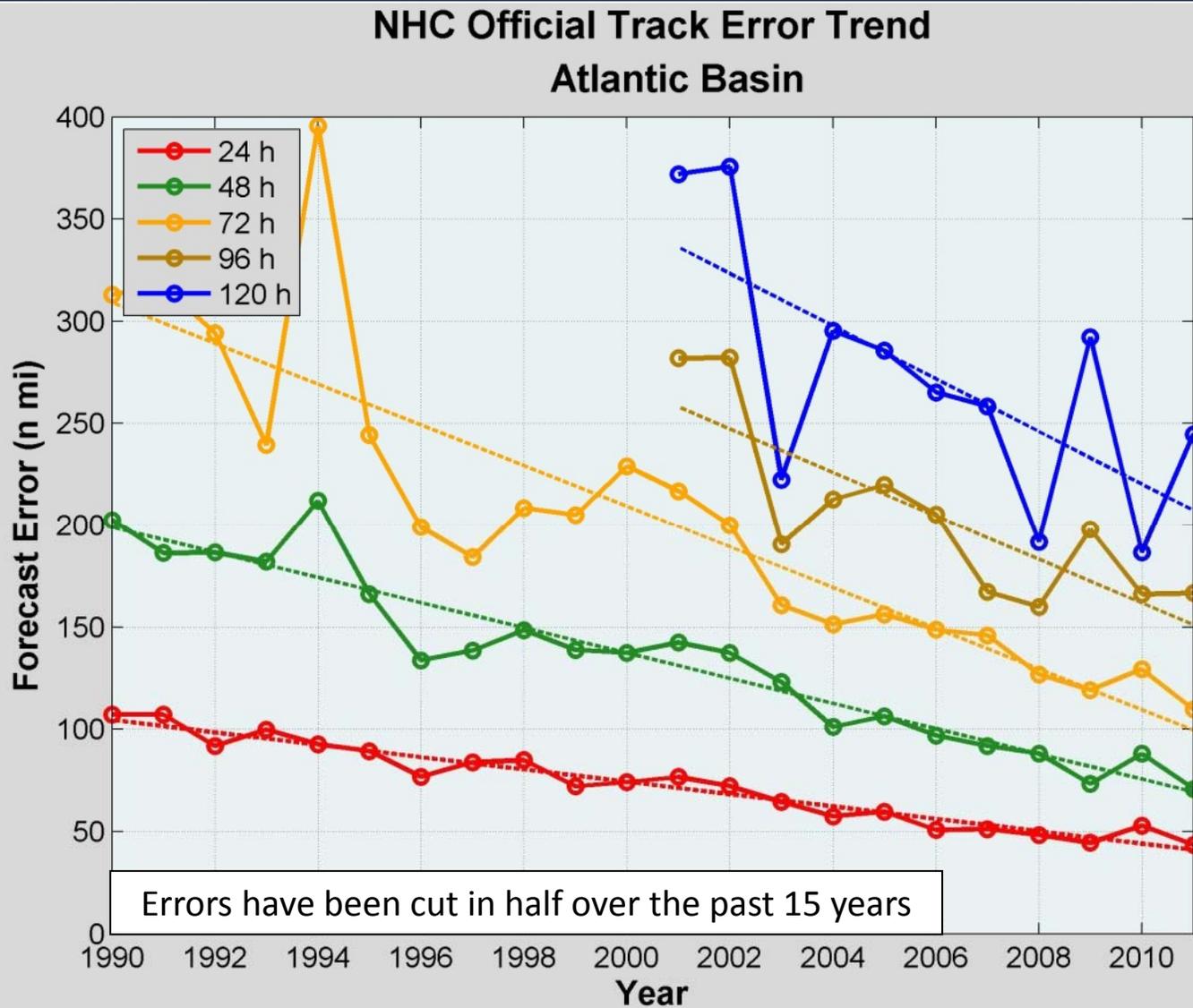
Two records set for track and 48-h track error was near 70 n mi

No change in intensity error, still grows quickly through 2-3 days and levels off

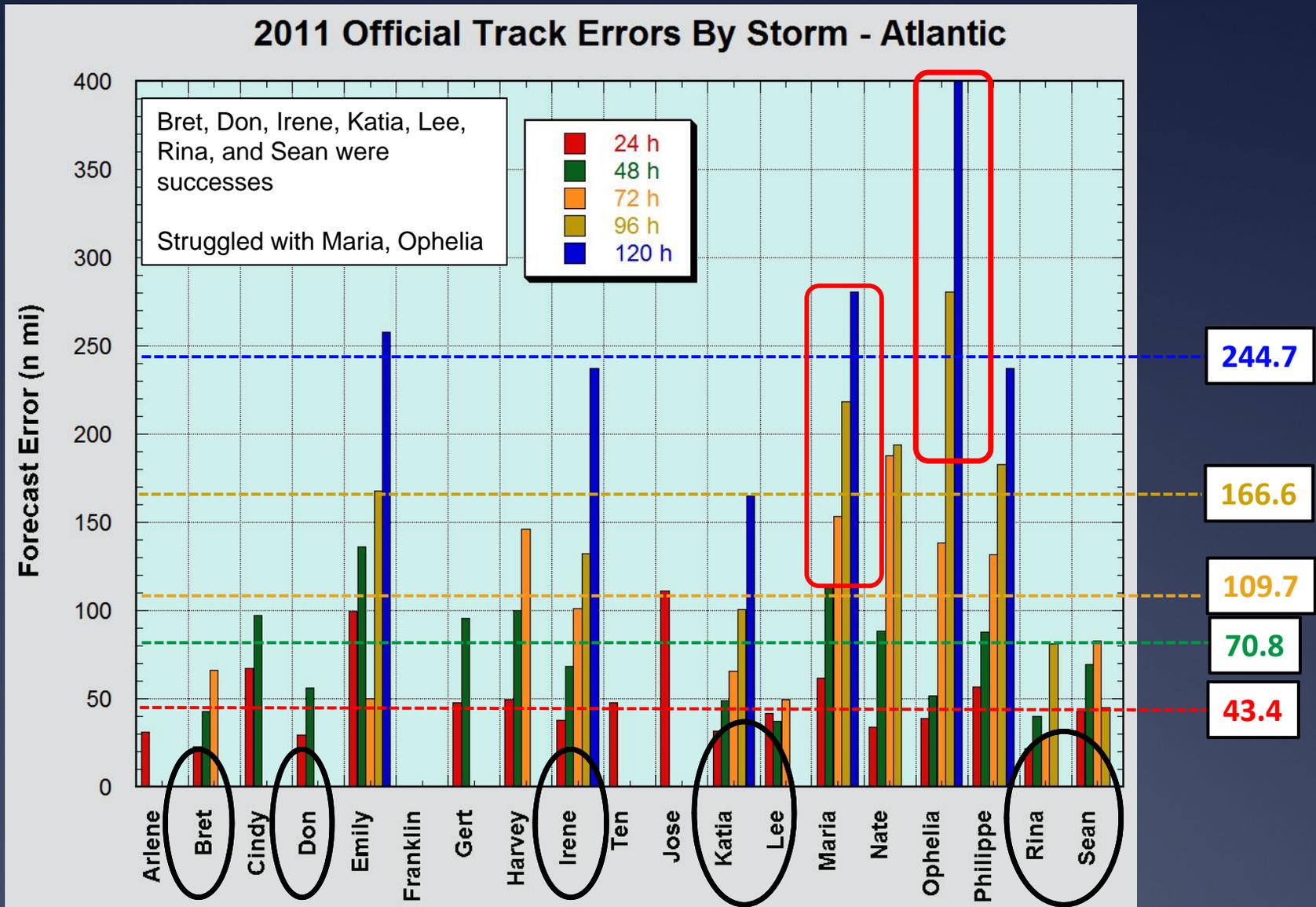
Atlantic 5-Year Mean Errors



Atlantic Track Error Trends

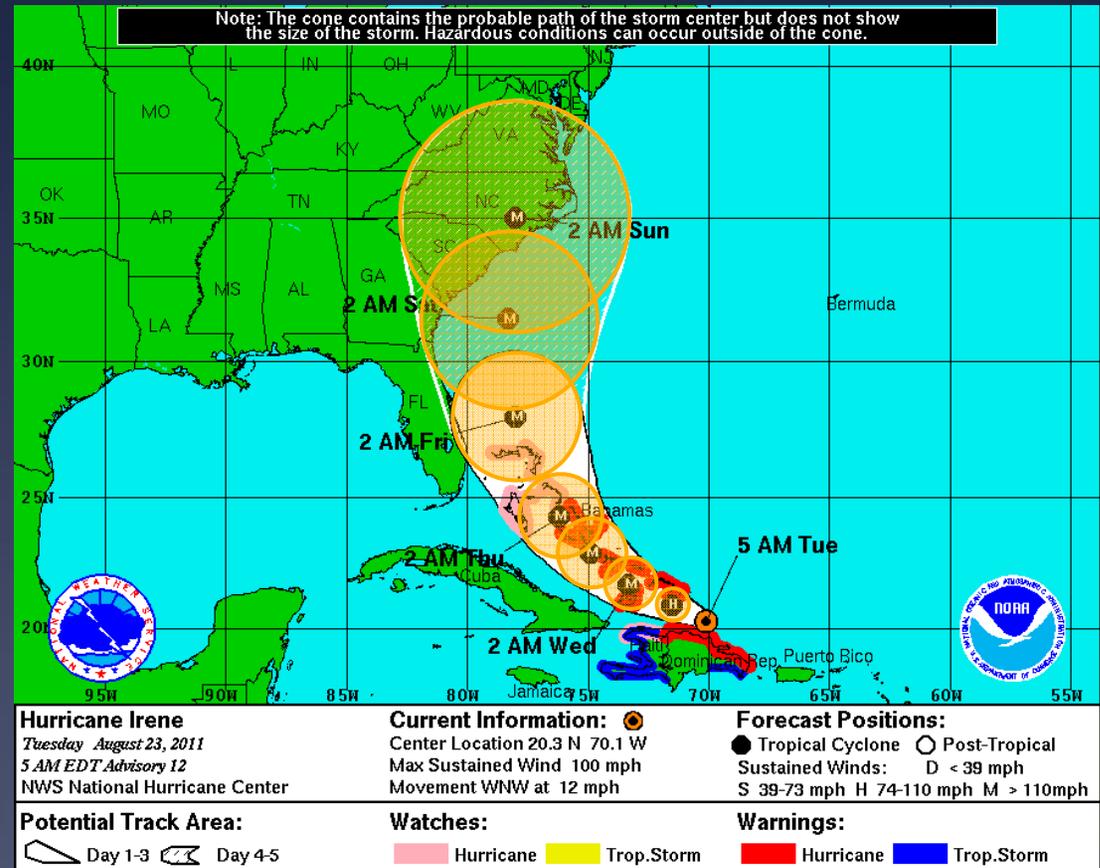


2011 Atlantic Track Errors by Storm



NHC Forecast Cone

- Represents probable track of tropical cyclone center – but does not tell you anything about impacts!
- Formed by connecting circles centered on each forecast point (at 12, 24, 36 h, etc.)
- Size of the circles determined so that, for example, the actual storm position at 48 h will be within the 48-h circle 67% of the time



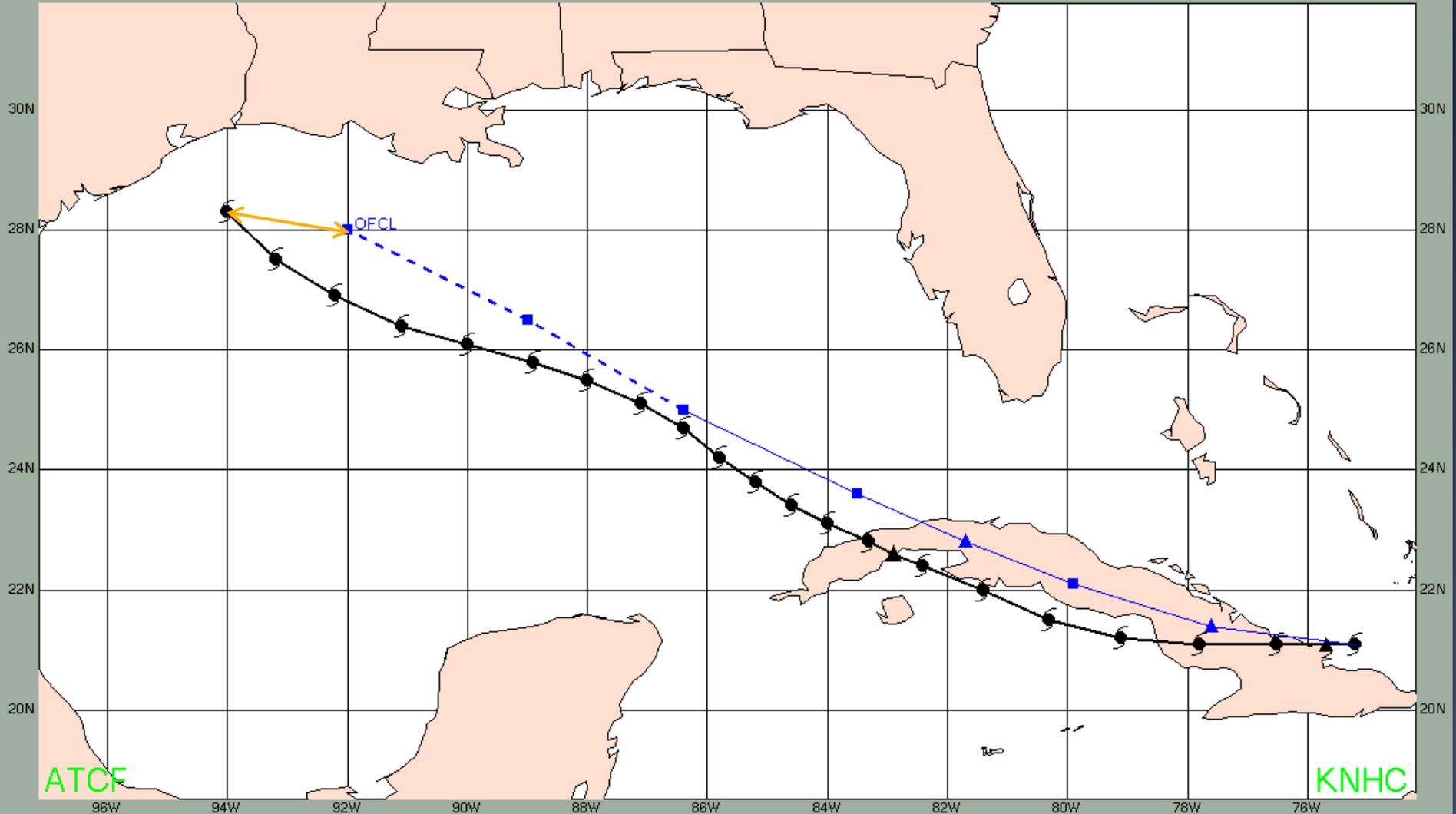


Atlantic Cone Radii – 2012 vs. 2011

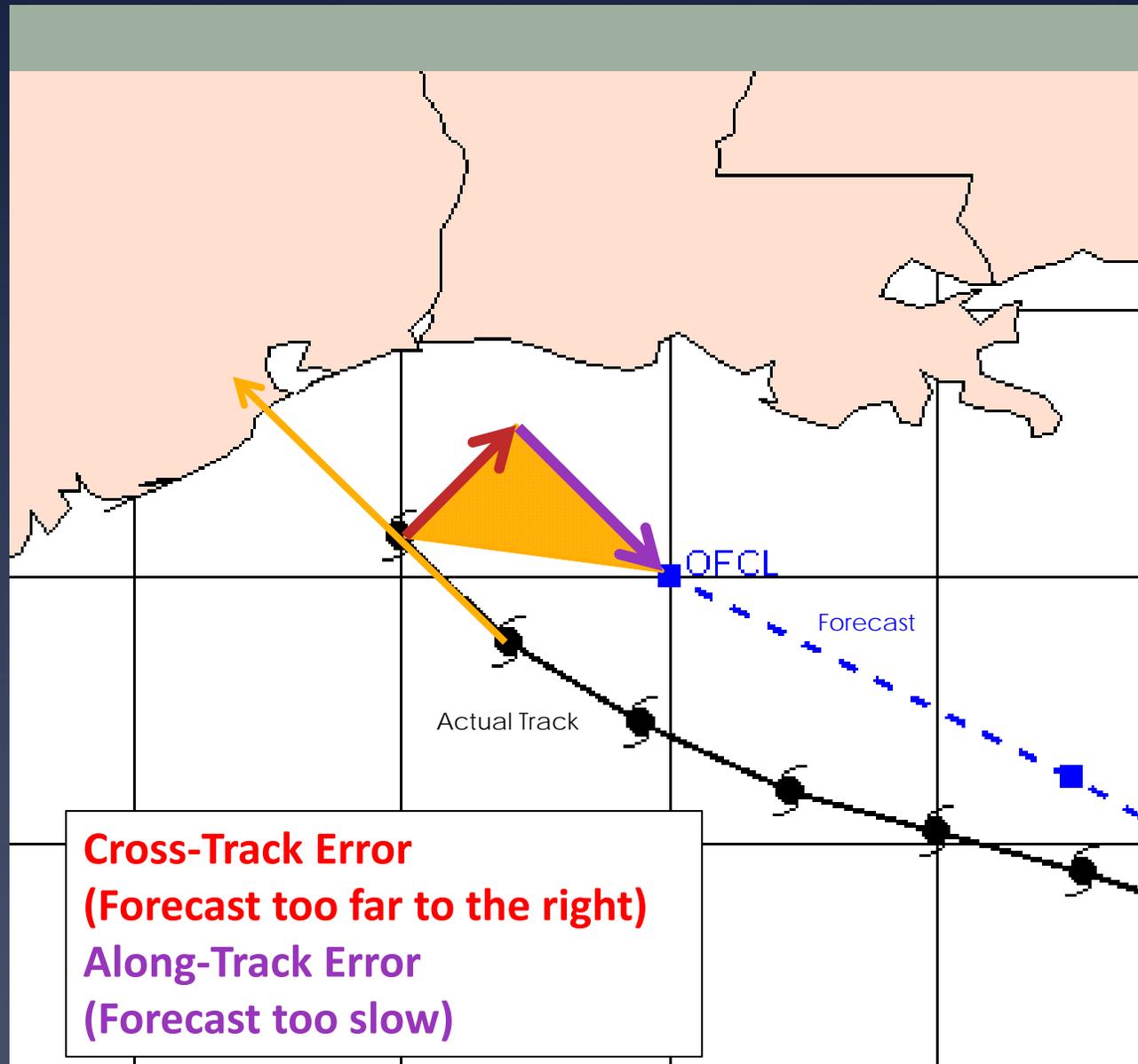
Forecast Period (h)	2011 Circle Radius (n mi) ('06 – '10 errors)	2012 Circle Radius (n mi) ('07 – '11 errors)	Percent Change
12	36	36	0%
24	59	56	-5%
36	79	75	-5%
48	98	95	-3%
72	144	141	-2%
96	190	180	-5%
120	239	236	-1 %

Along- and Cross-Track Errors (Timing vs. Location)

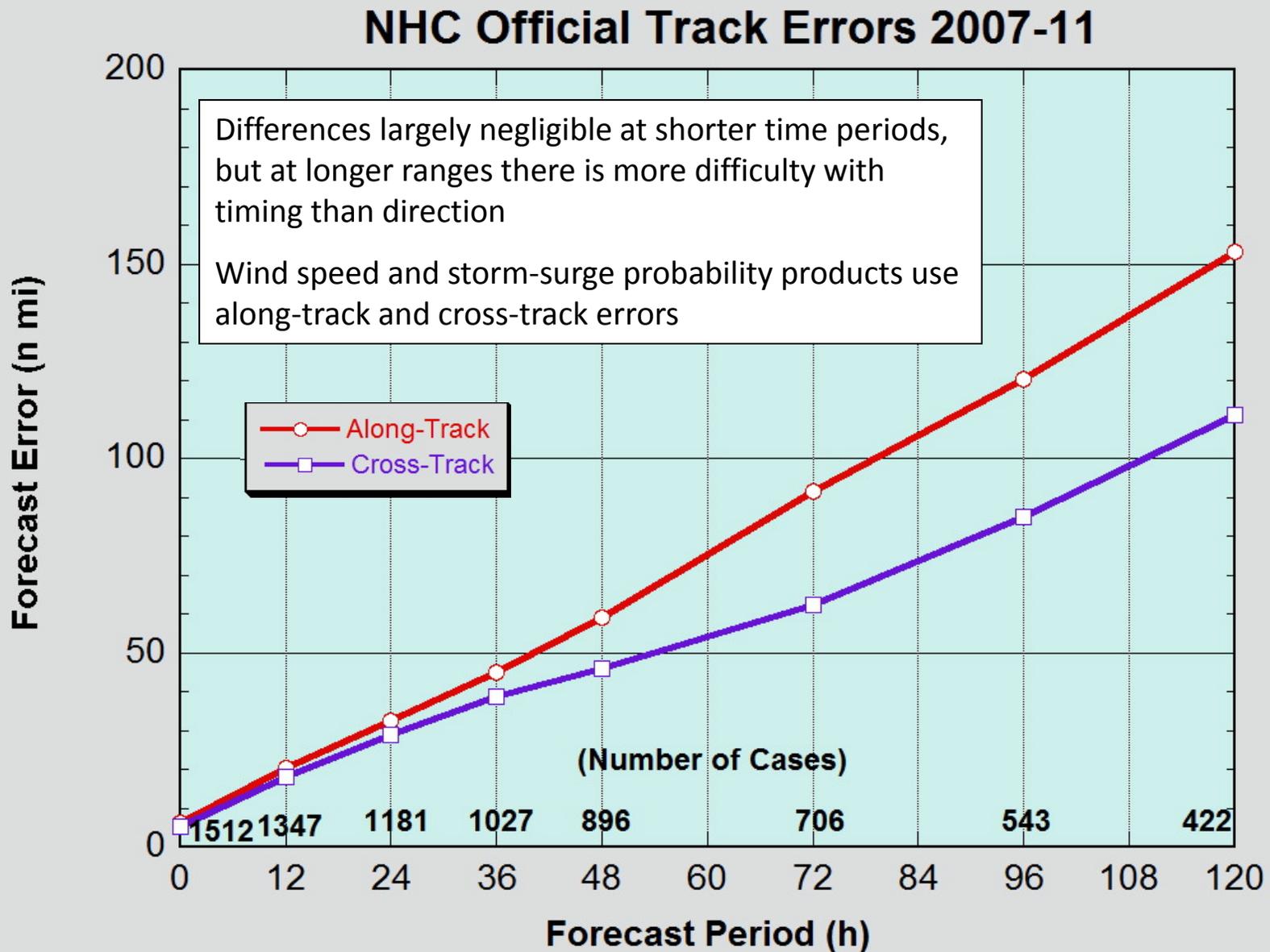
092008 - IKE 2008090800



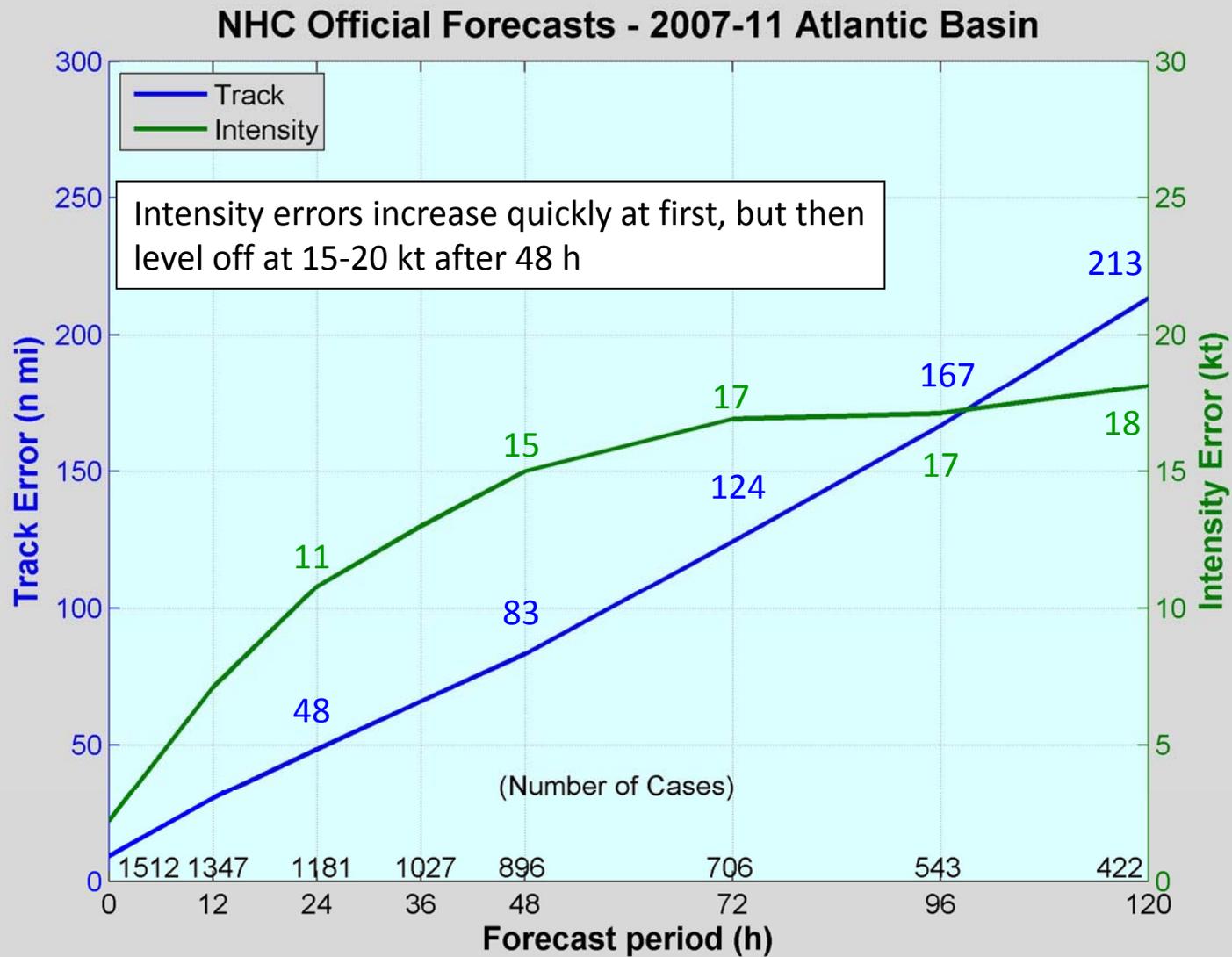
Along- and Cross-Track Errors



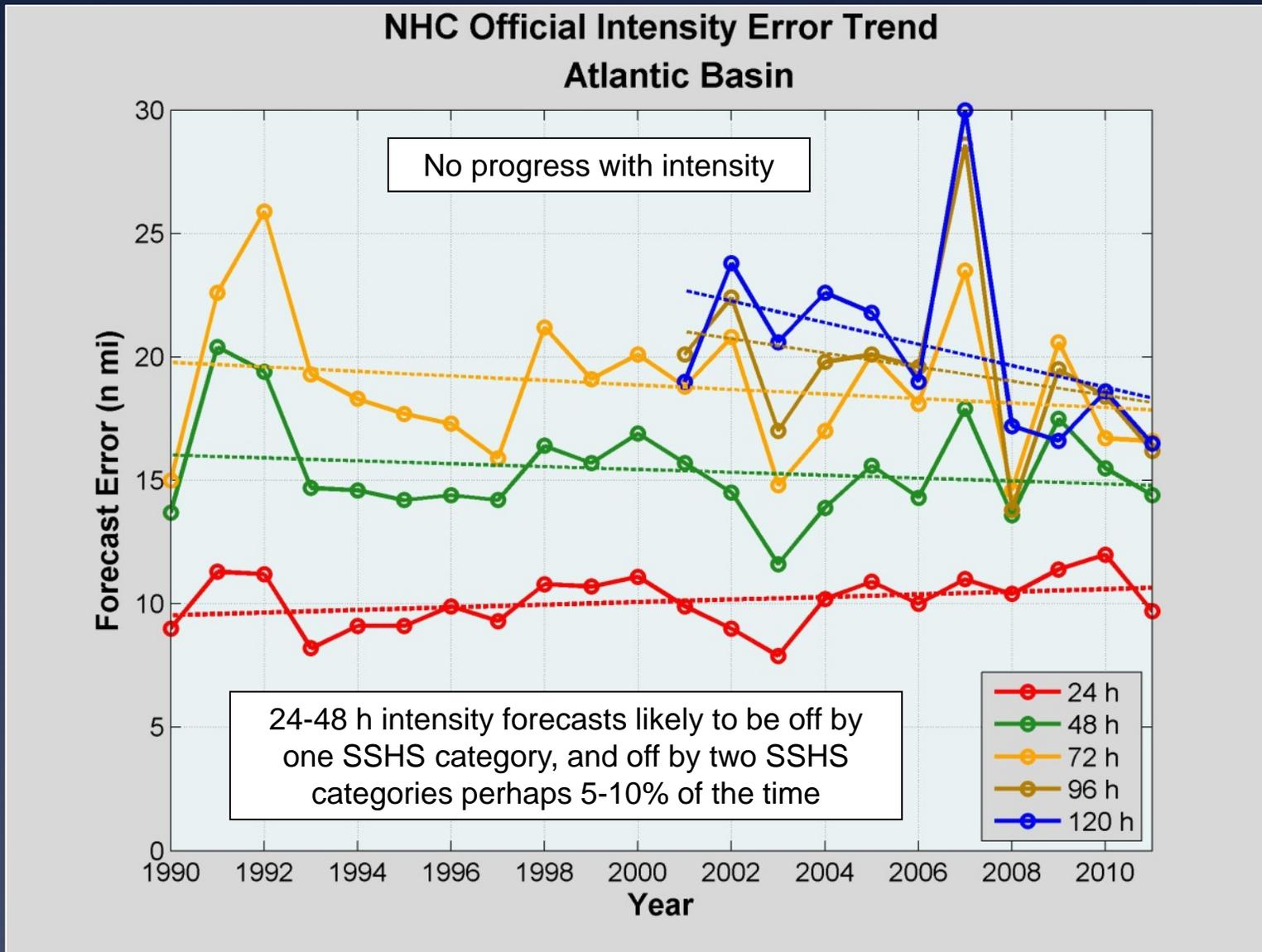
Along- and Cross-Track Errors



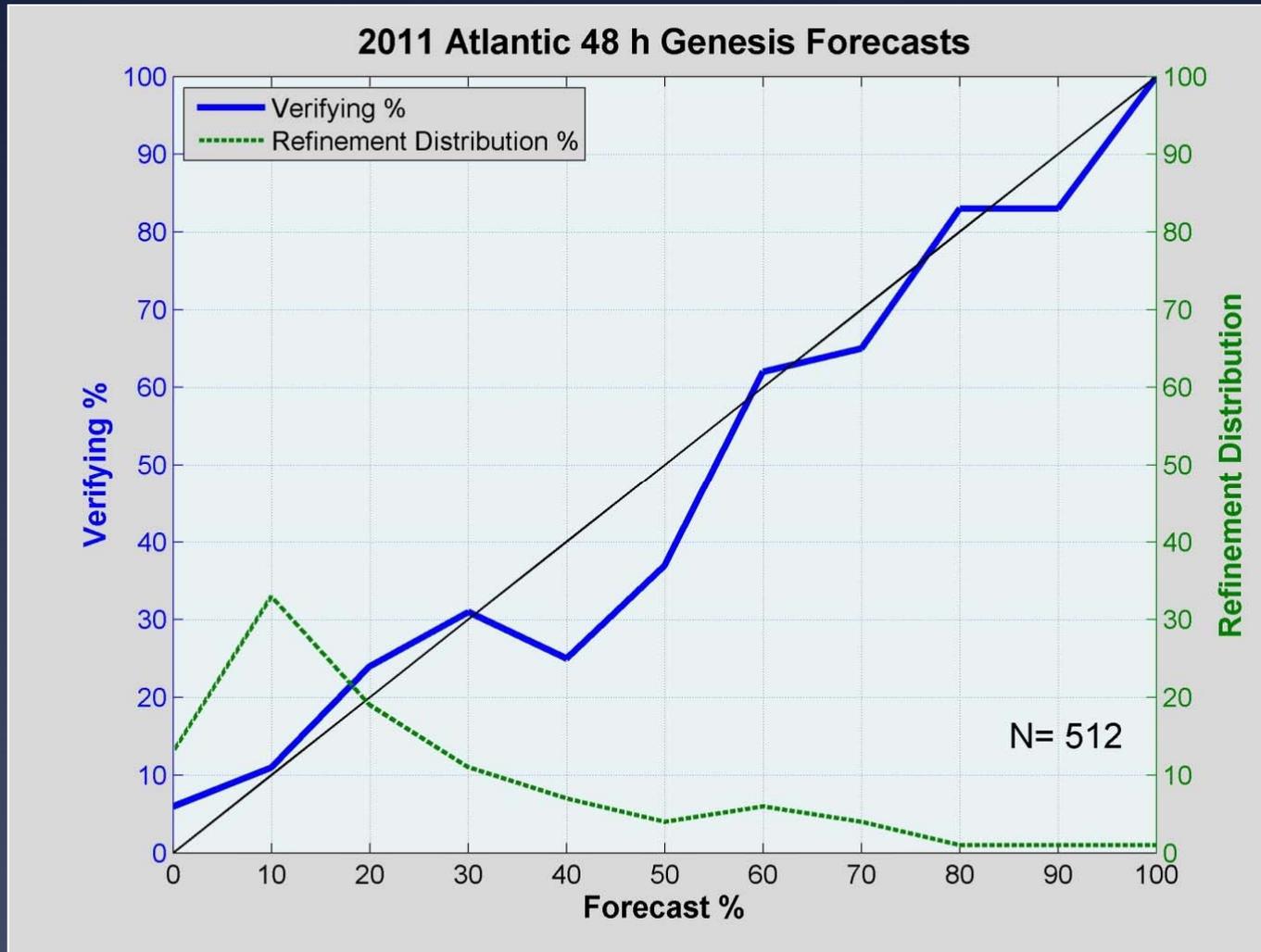
Atlantic 5-Year Mean Errors



Atlantic Intensity Error Trends

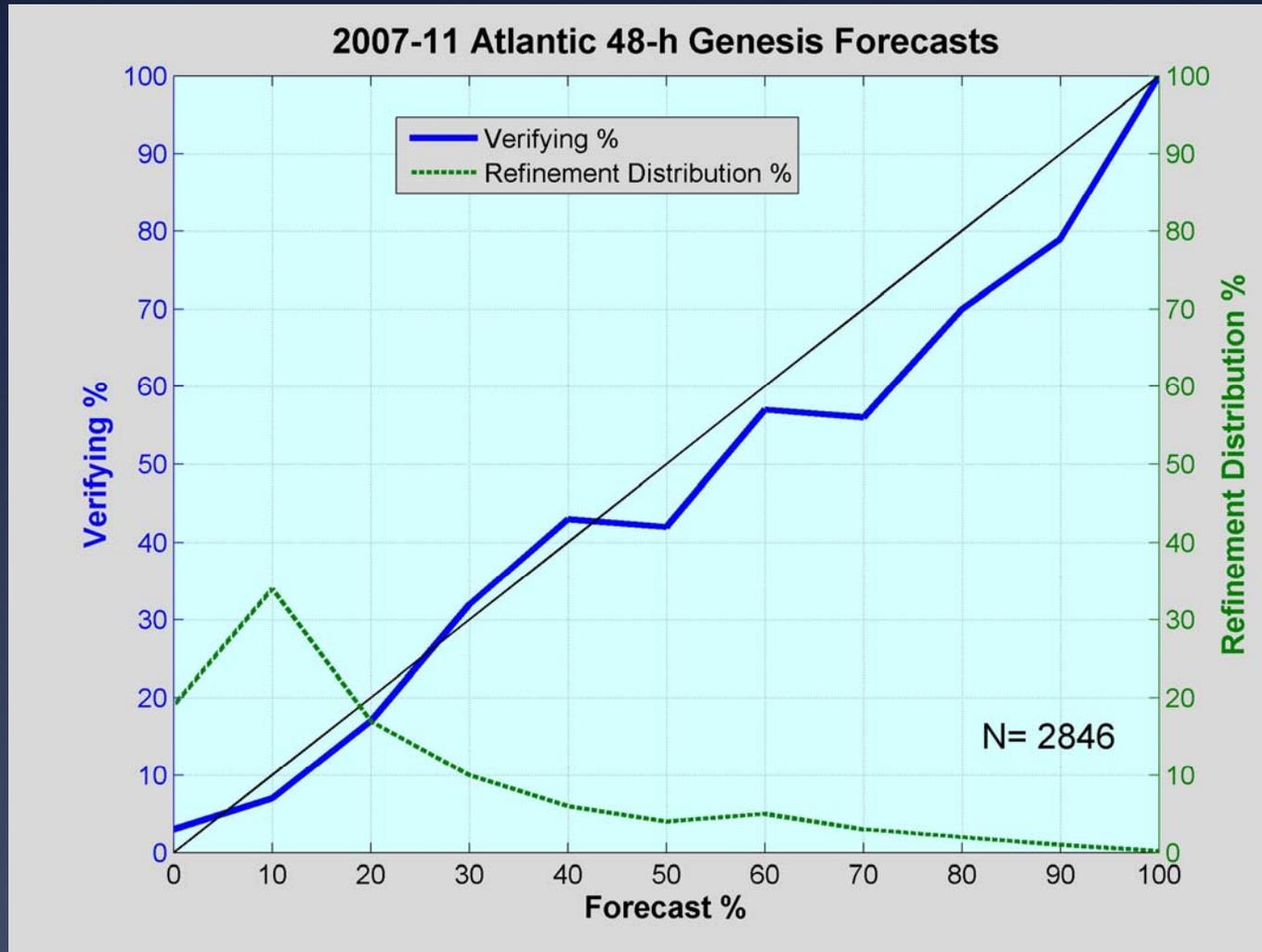


2011 Genesis Forecast Verification



Atlantic forecasts well calibrated throughout – much improved this year

5-year Atlantic Genesis Forecast Verification



5-year sample shows good reliability through the probability range, with a slight under-forecast bias at 70% and above

Verification Web Page

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National Hurricane Center

weather.gov

Home News Organization Search NWS All NOAA Go

Local forecast by "City, St" or "ZIP"
 Go

Alternate Formats
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Past Advisories
Audio/Podcasts
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Atlantic and E Pacific
Gridded Marine
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Tools & Data
Satellite | Radar
Analysis Tools
Aircraft Recon
GIS Datasets
Data Archive

Development
Experimental
Research
Forecast Accuracy

Outreach & Education
About Cyclones
Cyclone Names
Wind Scale
Storm Surge
Prepare
Most Extreme
Forecast Models
Breakpoints
Hurricane Hunters
Resources
Glossary | Acronyms
Frequent Questions

Our Organization
About NHC
Mission | Staff
Visitors | Virtual Tour
Library Branch
NCEP | Newsletter

Contact Us
Comments

NHC Data Archive

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Contents

- Tropical Cyclone Reports
- Tropical Cyclone Advisories
- Graphical Tropical Weather Outlook (GTWO)
- Marine & Advisory Text Products
- Best Track Data (HURDAT)
- Past Track Seasonal Maps
- Past Track Maps of U.S. Landfalls
- Tropical Cyclone GIS Data
- Storm Wallet Scanning Project
- Tropical Cyclone Monthly Summaries
- Tropical Cyclone Annual Summaries (Atlantic)
- Tropical Cyclone Seasonal Outlooks
- Tropical Cyclone Climatology
- Tropical Cyclone Forecast Verification
- Aircraft Reconnaissance Archive
- Deadliest, Costliest, Most Intense Atlantic Storms
- Central Pacific Hurricane History

Tropical Cyclone Reports

The National Hurricane Center's Tropical Cyclone Reports (formerly called Preliminary Reports) contain comprehensive information on each storm, including synoptic history, meteorological statistics, casualties and damages, and the post-analysis best track (six-hourly positions and intensities).

Atlantic, Caribbean, and the Gulf of Mexico

2011

Eastern Pacific (out to 140°W)

2011

* Note: 1958-1994 for the Atlantic, Caribbean, and the Gulf of Mexico and 1988-1994 for the Eastern Pacific are scanned images of the printed reports.

[An XML index file is also available for all the Tropical Cyclone Reports.](#)

Summary

- Atlantic basin track errors increase by 40–50 n mi each day
 - Forecasts have been steadily getting better over the past two decades (and longer)
- NHC uncertainty cone made up of circles that enclose actual storm position about two-thirds of the time
 - Error cone will be only about 5% smaller in 2012, so little perceivable change
 - However, as the cone has shrunk over the years, impacts become more likely to occur *outside* the cone!
- Actual track forecast errors aren't quite circular about the forecast point
 - Along-track (timing) errors tend to be larger than cross-track (directional) errors at 48 h and beyond

Summary

- Intensity errors 24-48 h in advance are regularly off by one Saffir-Simpson category
- Intensity errors begin to level off around 72 h
- No appreciable change in intensity forecast error over the past two decades
- 48-h genesis forecasts show ability to distinguish between systems that clearly will or will not develop
 - Genesis forecasts struggle with systems in the 30-70% probability ranges, but have shown signs of improvement