2012 Atlantic Verification
Good News- Lots of Accuracy Records Set

Values in red exceed all-time records.

<table>
<thead>
<tr>
<th>VT (h)</th>
<th>NT (n mi)</th>
<th>TRACK (ft)</th>
<th>INT (kt)</th>
</tr>
</thead>
<tbody>
<tr>
<td>012</td>
<td>404</td>
<td>24.6</td>
<td>5.4</td>
</tr>
<tr>
<td>024</td>
<td>364</td>
<td>39.7</td>
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<td>036</td>
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<td>53.6</td>
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<td>048</td>
<td>289</td>
<td>68.8</td>
<td>12.3</td>
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<tr>
<td>072</td>
<td>232</td>
<td>100.6</td>
<td>13.1</td>
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<tr>
<td>096</td>
<td>188</td>
<td>142.8</td>
<td>11.8</td>
</tr>
<tr>
<td>120</td>
<td>148</td>
<td>194.4</td>
<td>12.7</td>
</tr>
</tbody>
</table>
NHC Atlantic Track Error Trends

Reduction in Track Errors Continues

NHC Official Track Error Trend
Atlantic Basin

Error Reduction since 1990
72 h: 67%
48 h: 65%
24 h: 58%
Atlantic Intensity Error Trends
Little Progress Overall - But a Very Recent Downward Trend
Still Some Forecast Challenges

Successes: Beryl, Gordon, Michael, Sandy

Challenges: Debby, Isaac, Kirk, Nadine

2012 Official Track Errors By Storm - Atlantic

Forecast Error (n mi)

- 24 h
- 48 h
- 72 h
- 96 h
- 120 h

120 h avg. error
96 h avg. error
72 h avg. error
Debby- Formation well anticipated but where would it go
Tropical Storm Debby Track Guidance
June 23, 2012 5 PM Advisory

Debby Forms Diverging Forecast Guidance
Texas or Florida?

European Model
UK Met Model
HWRF

U.S. GFS Model
GFS Ensemble
GFDL
Debby Advisory #2
Still Texas or Florida

Tropical Storm Debby Track Guidance
June 23, 2012 11 PM Advisory

Consensus Models Split the Difference
Debby Advisory #4
Landfall indicated in 2-3 days by all models, but from Louisiana to Florida
Tropical Storm Debby Track Guidance
June 24, 2012 11 PM Advisory

Debby Advisory #6
NHC Forecasts
First 4 forecasts head toward Texas, shift toward Florida was required
Debby Tornadoes

• 24 tornadoes reported in Florida
• Most occurred during an outbreak on June 24
• Strongest were EF-2s in Venus (Highlands Co.) and Winter Haven (Polk Co.)

St. Petersburg, FL (Oriana Sofia)

Lake Placid, FL (Skip Dent)
Debby Storm Surge: 2 to 4.5 ft *above* normal levels

Inundation: 1 to 3 ft *above* ground
Hurricane Isaac

Storm Surge
- less than 2 ft.
- 2 to 4 ft.
- 4 to 6 ft.
- 6 to 8 ft.
- 8 to 10 ft.
- greater than 10 ft.
Five-day NHC forecast and guidance showed Isaac a threat to Florida.
Guidance Shifted Westward-
But large spread in potential landfall
locations about 4 days out
Many Challenges During Sandy
But the Track and Intensity Forecasts Were Better than Average
Rapid Intensification: A Recurring Challenge

• Sandy intensified rapidly between Jamaica and Cuba, and this was poorly forecast.
• Despite ongoing efforts (e.g. the Hurricane Forecast Improvement Program), forecasting rapid intensification remains a major problem.
Warning Challenge in Sandy

• The dynamical models forecast Sandy to become extratropical before landfall, although the timing varied.

• Once warnings are issued, it is difficult to switch between TC and non-TC warnings.

• There were several combinations of possible warnings and storm evolution, all of which were problematic.

• TC warnings were eventually issued for coastal North Carolina, with non-TC warnings for the rest of the affected area.

• During Sandy, the extratropical transition process did not reduce the threat at all!
Meeting the Warning Challenges for 2013 and Beyond

- The NWS has broadened the tropical storm and hurricane watch and warning definitions to allow them to be used for post-tropical cyclones that pose a significant risk to life and property.

- NHC will have the option to continue advisory products on post-tropical cyclones that pose a risk to life/property and when the transfer of responsibility to another office would result in an unacceptable discontinuity in service.

- For several years, the NWS has been developing a storm surge warning that could be used independently of the expected winds and of the type of weather system producing it. This could be operational by 2015.
Prototype of Storm Surge Warning

Hurricane Irene, Advisory #22
Storm Surge Warning PROTOTYPE

27 August 2011
2 PM EDT
Category 2

National Hurricane Center
Storm Surge Unit

Hurricane Irene Adv #22 Forecast Track

NWS/NHC Storm Surge Warning
Potential Storm Surge Inundation Graphic
2013 Changes

• Definitions of TS and hurricane watches/warnings have been broaden and issuance criteria of advisories have changed to allow NHC the option to use both for post-tropical cyclones that pose a significant threat to life and property (discussed a couple of slides ago)

• New use of NHC’s Tropical Cyclone Update (TCU) product replaces need for Position Estimate (TCE)

• Planned extension of Tropical Weather Outlook to 5 days

• Cone size has again been reduced
HURRICANE IRENE TROPICAL CYCLONE POSITION ESTIMATE
NWS NATIONAL HURRICANE CENTER MIAMI FL AL092011
1000 PM EDT SAT AUG 27 2011

AT 1000 PM EDT...0200 UTC...THE CENTER OF HURRICANE IRENE WAS ESTIMATED BY AN AIR FORCE RESERVE HURRICANE HUNTER AIRCRAFT AND NOAA DOPPLER WEATHER RADAR TO BE NEAR LATITUDE 37.1 NORTH...LONGITUDE 75.5 WEST.

....SUMMARY OF 1000 PM EDT INFORMATION...
LOCATION...37.1N 75.5W
ABOUT 270 MI...435 KM...SSW OF NEW YORK CITY
MAXIMUM SUSTAINED WINDS...80 MPH.
PRESENT MOVEMENT...NNE OR 20 DEGREES AT 16 MPH
MINIMUM CENTRAL PRESSURE...952 MB
$$
FORECASTER BRENNAN

This product is issued between 2-hourly intermediate public advisories.
TROPICAL STORM CLAUDETTE TROPICAL CYCLONE UPDATE  
NWS TPC/NATIONAL HURRICANE CENTER MIAMI FL   AL042009  
1215 PM EDT SUN AUG 16 2009

...DEPRESSION BECOMES TROPICAL STORM CLAUDETTE...

DATA FROM THE NOAA DOPPLER RADAR IN TALLAHASSEE FLORIDA INDICATE THAT SURFACE WINDS ASSOCIATED WITH THE DEPRESSION HAVE INCREASED TO 40 MPH...65 KM/HR...MAKING THE DEPRESSION TROPICAL STORM CLAUDETTE.

....SUMMARY OF 1215 PM AST INFORMATION...
LOCATION...28.7N 84.6W  
MAXIMUM SUSTAINED WINDS...40 MPH  
PRESENT MOVEMENT...NORTHWEST OR 320 DEGREES AT 14 MPH  
MINIMUM CENTRAL PRESSURE...1011 MB

$$
FORECASTER ROBERTS/BRENNAN
This system has a medium chance... 40 percent...of becoming a tropical cyclone during the next 48 hours...

This system has a high chance... 80 percent...of becoming a tropical cyclone during the next 5 days.

- NHC still has some development and testing to complete.

- This addition to the TWO is not planned to occur until July or August.
Prototype 5-day Graphic
Might be available sometime in 2013
New Graphic Shows 5-day Potential Formation Area

- Overview graphic shows entire basin, with single disturbance graphics to aid in display when overlapping areas
- Indicates initial location of disturbance (X), if existing at issuance time
- Existing 2-day graphical Outlook will remain unchanged
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 – 2013 vs. 2012

**Improving track accuracy = smaller cone size**

<table>
<thead>
<tr>
<th>Forecast Period (h)</th>
<th>2012 Circle Radius (n mi) (’07 – ’11 errors)</th>
<th>2013 Circle Radius (n mi) (’08 – ’12 errors)</th>
<th>Percent Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>12</td>
<td>36</td>
<td>33</td>
<td>-8%</td>
</tr>
<tr>
<td>24</td>
<td>56</td>
<td>52</td>
<td>-7%</td>
</tr>
<tr>
<td>36</td>
<td>75</td>
<td>72</td>
<td>-4%</td>
</tr>
<tr>
<td>48</td>
<td>95</td>
<td>92</td>
<td>-3%</td>
</tr>
<tr>
<td>72</td>
<td>141</td>
<td>128</td>
<td>-9%</td>
</tr>
<tr>
<td>96</td>
<td>180</td>
<td>177</td>
<td>-2%</td>
</tr>
<tr>
<td>120</td>
<td>236</td>
<td>229</td>
<td>-3%</td>
</tr>
</tbody>
</table>

**Storm size has not changed = more impacts outside cone**
Isaac Advisory 13 with 2008 Cone

**Tropical Storm Isaac**
- **Friday August 24, 2012**
- **5 AM EDT Advisory 13**
- **NWS National Hurricane Center**

**Current Information:**
- Center Location: 16.1 N 70.0 W
- Max Sustained Wind: 45 mph
- Movement: W at 15 mph

**Forecast Positions:**
- Tropical Cyclone
- Post-Tropical
- Sustained Winds: D < 39 mph, S 39-73 mph, H 74-110 mph, M > 110 mph

**Potential Track Area:**
- **Watches:**
  - Hurricane
  - Trop.Storm
- **Warnings:**
  - Hurricane
  - Trop.Storm

**Note:** The cone contains the probable path of the storm center but does not show the size of the storm. Hazardous conditions can occur outside of the cone.
Other Potential NHC Forecast Enhancements- 2013 and Beyond

- Storm Surge Warning (2015) and Inundation Graphic

- Track and intensity forecasts for disturbances
  - Watches/Warning before formation

- Extension of tropical cyclone forecasts to 7 days
Pre-Tropical Cyclone Track & Intensity Forecasts

• **Motivation:** Issued for systems prior to genesis in support of the watch/warning process

• In 2011, the NHC began making forecasts only for tropical disturbances with a high chance of formation in the Tropical Weather Outlook

• Forecasts include predictions of track, intensity, wind radii, and system status (e.g. “TD/TS/HU”, or “DB”) out to 5 days
• NHC conducted an in-house experiment during the 2012 season by issuing Pre-TC watches/warnings

• Could take a few years to have enough cases to evaluate

• NHC exploring ways to issue and communicate pre-TC watches & warnings
  – Through graphical and text TWO?
  – Through advisory-like products?
  – New products?
NHC 6- and 7-day forecasts had lower mean errors than the ECMWF and GFS models.

Day 6 mean error about 240 n mi
Day 7 mean error about 300 n mi
2012 verification results indicate the 6- and 7-day forecasts were about as good as NHC 4- and 5-day forecasts were when introduced a decade ago.
6- and 7-day Forecasts for Sandy Were Initially Out to Sea

Good model agreement through 72 h. More spread at days four through seven
Forecasts Shifted Westward about 6 Days Before Landfall

Large spread in track in track guidance at days 5, 6, and 7. ECMWF shows U.S. landfall, GFS on eastern edge of envelope.
Models in Better Agreement
About 5-days from Landfall

Guidance in much better agreement.
All models show U.S. landfall.

0000 UTC October 26
Social Media and NHC

• NHC Facebook & Twitter feed began in 2011

• Hurricane Awareness Week—Public Service Announcements
Social Media and NHC

- Over 208,000 Facebook followers
  - One of the most followed government Facebook pages
- Currently over 111,000 Twitter followers
- Significantly increase of followers during hurricane threats

Peaks of new NHC Facebook followers during 2012 hurricane season:
- Debby
- Ernesto
- Isaac
- Sandy
- Leslie
Thanks for your time!

NHC Hurricane Forecasters

Brown  Roberts  Blake  Pasch  Beven  Landsea

Berg  Avila  Cangialosi  Kimberlain  Brennan  Stewart  Franklin

Questions?