Experimental 5-day genesis forecasts

Eric Blake
National Hurricane Center

2013 National Hurricane Conference
March 28 2013
Outline

• Extending period of Tropical Weather Outlook
• Science behind the longer-term outlooks
• Prototypes of new graphical/text formats
• Timeline
Background

• Transitioning TWO into a probability-based product has been very successful
• Users are also very interested in a forecast beyond 48 hours
• Our ability at medium-range genesis forecasts is now well documented and we are ready to make them available to the public
Tropical Weather Outlook

- General assessment of activity in the tropics, pertaining to tropical cyclone formation
- Discusses areas of disturbed weather and their potential, including probabilities, for genesis during the next 48 hours
- Issued every 6 hours during the hurricane season
  - 0000, 0600, 1200, 1800 UTC
  - 2 AM, 8 AM, 2 PM, 8 PM EDT
Verification Results for 2-Day Genesis Forecasts

Sometimes substantial interannual variation in results

Long-term results have been quite promising
Extend Lead Time of Genesis Forecasts

- Since 2009, NHC has experimented with medium range (1-5 and 3-5 day) genesis forecasts
Verification of 2009-12 Genesis Probabilities

2009-12 Atlantic Genesis Forecasts

- 0-5 Day
- 3-5 Day
- 0-2 Day

Forecast % vs. Verifying %
<table>
<thead>
<tr>
<th>Approximate Hours Prior to Formation</th>
<th>-48</th>
<th>-36</th>
<th>-24</th>
<th>-12</th>
<th>36</th>
<th>24</th>
<th>12</th>
<th>36</th>
<th>24</th>
<th>12</th>
<th>36</th>
</tr>
</thead>
<tbody>
<tr>
<td>40</td>
<td>30</td>
<td>30</td>
<td>40</td>
<td>20</td>
<td>40</td>
<td>20</td>
<td>70</td>
<td>40</td>
<td>20</td>
<td>70</td>
<td>40</td>
</tr>
<tr>
<td>10</td>
<td>30</td>
<td>10</td>
<td>40</td>
<td>0</td>
<td>40</td>
<td>0</td>
<td>40</td>
<td>0</td>
<td>40</td>
<td>0</td>
<td>40</td>
</tr>
<tr>
<td>10</td>
<td>0</td>
<td>20</td>
<td>0</td>
<td>20</td>
<td>0</td>
<td>20</td>
<td>0</td>
<td>20</td>
<td>0</td>
<td>20</td>
<td>0</td>
</tr>
<tr>
<td>10</td>
<td>20</td>
<td>20</td>
<td>50</td>
<td>20</td>
<td>30</td>
<td>20</td>
<td>0</td>
<td>20</td>
<td>0</td>
<td>20</td>
<td>0</td>
</tr>
<tr>
<td>10</td>
<td>20</td>
<td>50</td>
<td>60</td>
<td>70</td>
<td>60</td>
<td>50</td>
<td>60</td>
<td>50</td>
<td>60</td>
<td>50</td>
<td>50</td>
</tr>
<tr>
<td>30</td>
<td>20</td>
<td>60</td>
<td>30</td>
<td>50</td>
<td>60</td>
<td>50</td>
<td>60</td>
<td>50</td>
<td>60</td>
<td>50</td>
<td>50</td>
</tr>
<tr>
<td>30</td>
<td>20</td>
<td>60</td>
<td>30</td>
<td>50</td>
<td>40</td>
<td>40</td>
<td>30</td>
<td>30</td>
<td>20</td>
<td>30</td>
<td>20</td>
</tr>
<tr>
<td>30</td>
<td>10</td>
<td>60</td>
<td>10</td>
<td>60</td>
<td>50</td>
<td>40</td>
<td>30</td>
<td>30</td>
<td>20</td>
<td>30</td>
<td>20</td>
</tr>
<tr>
<td>30</td>
<td>20</td>
<td>30</td>
<td>60</td>
<td>40</td>
<td>30</td>
<td>30</td>
<td>20</td>
<td>30</td>
<td>20</td>
<td>30</td>
<td>20</td>
</tr>
<tr>
<td>20</td>
<td>30</td>
<td>30</td>
<td>40</td>
<td>30</td>
<td>30</td>
<td>30</td>
<td>20</td>
<td>30</td>
<td>20</td>
<td>30</td>
<td>20</td>
</tr>
<tr>
<td>20</td>
<td>30</td>
<td>40</td>
<td>40</td>
<td>30</td>
<td>40</td>
<td>30</td>
<td>20</td>
<td>30</td>
<td>20</td>
<td>30</td>
<td>20</td>
</tr>
<tr>
<td>20</td>
<td>20</td>
<td>40</td>
<td>40</td>
<td>30</td>
<td>40</td>
<td>30</td>
<td>20</td>
<td>30</td>
<td>20</td>
<td>30</td>
<td>20</td>
</tr>
<tr>
<td>10</td>
<td>10</td>
<td>10</td>
<td>30</td>
<td>0</td>
<td>10</td>
<td>10</td>
<td>20</td>
<td>10</td>
<td>10</td>
<td>20</td>
<td>10</td>
</tr>
<tr>
<td>10</td>
<td>10</td>
<td>10</td>
<td>30</td>
<td>0</td>
<td>10</td>
<td>10</td>
<td>20</td>
<td>10</td>
<td>10</td>
<td>20</td>
<td>10</td>
</tr>
<tr>
<td>20</td>
<td>20</td>
<td>20</td>
<td>40</td>
<td>10</td>
<td>20</td>
<td>20</td>
<td>40</td>
<td>10</td>
<td>20</td>
<td>20</td>
<td>40</td>
</tr>
<tr>
<td>20</td>
<td>20</td>
<td>20</td>
<td>40</td>
<td>10</td>
<td>20</td>
<td>20</td>
<td>40</td>
<td>10</td>
<td>20</td>
<td>20</td>
<td>40</td>
</tr>
<tr>
<td>20</td>
<td>20</td>
<td>20</td>
<td>40</td>
<td>10</td>
<td>20</td>
<td>20</td>
<td>40</td>
<td>10</td>
<td>20</td>
<td>20</td>
<td>40</td>
</tr>
<tr>
<td>20</td>
<td>20</td>
<td>20</td>
<td>40</td>
<td>10</td>
<td>20</td>
<td>20</td>
<td>40</td>
<td>10</td>
<td>20</td>
<td>20</td>
<td>40</td>
</tr>
</tbody>
</table>
## 2010 Atlantic 1-5 day Genesis Fcsts

### 120 h Prior to TC Formation

**Approximate Hours Prior to Formation**

<table>
<thead>
<tr>
<th></th>
<th>-6</th>
<th>-3</th>
<th>0</th>
<th>3</th>
<th>6</th>
<th>9</th>
<th>12</th>
<th>15</th>
<th>18</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>40</td>
<td>30</td>
<td>40</td>
<td>20</td>
<td>60</td>
<td>20</td>
<td>70</td>
<td></td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>30</td>
<td>10</td>
<td>40</td>
<td>0</td>
<td>40</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>30</td>
<td>10</td>
<td>0</td>
<td></td>
<td>20</td>
<td>0</td>
<td>20</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>40</td>
<td>0</td>
<td>10</td>
<td></td>
<td></td>
<td>20</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>50</td>
<td>0</td>
<td>30</td>
<td>20</td>
<td>20</td>
<td>40</td>
<td>10</td>
<td>60</td>
<td></td>
<td></td>
</tr>
<tr>
<td>60</td>
<td>0</td>
<td>50</td>
<td></td>
<td>60</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>70</td>
<td>0</td>
<td>50</td>
<td></td>
<td></td>
<td>60</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>80</td>
<td>0</td>
<td>50</td>
<td>30</td>
<td>50</td>
<td>40</td>
<td>40</td>
<td>50</td>
<td></td>
<td></td>
</tr>
<tr>
<td>90</td>
<td>0</td>
<td>60</td>
<td>60</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>100</td>
<td>0</td>
<td>60</td>
<td>60</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>110</td>
<td>0</td>
<td>60</td>
<td>60</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>120</td>
<td>0</td>
<td>60</td>
<td>60</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The table above presents the approximate hours prior to formation based on various models and inputs, with specific focus on the 120-hour lead time. Each cell represents a projection of days before the formation of a tropical cyclone, indicating the probability or forecast of such an event.
TC Genesis Forecasting at the NHC

- Primary guidance comes from global models
- GFS and ECMWF seem to have greatest skill, but more systematic verification is needed
- Models appear to have some geographical biases, and perform better in the eastern Atlantic, and worse in the subtropics.
- Genesis forecasts are also more problematic in Gulf of Mexico since models have difficulty depicting genesis in that region (smaller-scale processes play a bigger role?)
- Considerable subjectivity involved in NHC genesis forecasts
Genesis Probability by Dvorak Number

- Uses Dvorak intensity estimates from all invests/disturbances (both developing and non-developing) from 2001-2011.
- Example: Invest with a 1.0 TAFB CI Number has 35% chance of genesis within 48 h.
- Real-time guidance at moe.met.fsu.edu/genesis
CIRA – Tropical Cyclone Formation Probability Guidance Product

 Developed by the Regional and Mesoscale Meteorology Branch at CIRA
 Cooperative Research Program | Office of Research and Applications/Center for Satellite Applications and Research

Atlantic Basin

Products Last Updated 2013 MAR 15 06UTC

96-Hour Loop of Real-Time Formation Probability

Real-Time

Climatological

Anomaly

Probability of TC Formation within 24 Hours

850 hPa Circulation (kt)
TC Formation Threshold > 2.91kt

Current Week Circ

http://www.ssd.noaa.gov/PS/TROP/TCFP/atlantic.html
TIME SERIES OF TC GENESIS PARAMETERS -- 2012
Model Genesis Page Now Includes Global Model Ensembles

Sandy: forecasts from 2012102012 (24h prior to genesis) -- Hit
Important intraseasonal predictors for the 5 day genesis forecasts

Blue—favorable upper-level conditions (lower shear and more unstable)

Magenta dots are TC genesis points in early 2012

Unlike conventional tropical waves, this signal moves from west to east
TROPICAL WEATHER OUTLOOK
NWS NATIONAL HURRICANE CENTER MIAMI FL
806 PM EDT WED OCT 10 2012

FOR THE NORTH ATLANTIC...CARIBBEAN SEA AND THE GULF OF MEXICO...

A VIGOROUS TROPICAL WAVE ACCOMPANIED BY A BROAD LOW PRESSURE SYSTEM IS LOCATED ABOUT 475 MILES EAST-SOUTHEAST OF THE WINDWARD ISLANDS. SHOWERS AND THUNDERSTORMS HAVE BECOME A LITTLE BETTER ORGANIZED THIS EVENING...AND REPORTS FROM BUYS W.W. NORTH OF THE CIRCULATION CENTER INDICATE TROPICAL-STORM-FORCE WINDS HAVE BEEN OCCURRING IN SOME OF THE HEAVIER SQUALLS. ALTHOUGH UPPER-LEVEL WINDS ARE CURRENTLY ONLY MARGINALLY FAVORABLE...SOME SLOW DEVELOPMENT OF THIS LARGE DISTURBANCE WILL BE POSSIBLE DURING THE NEXT COUPLE OF DAYS AS ENVIRONMENTAL CONDITIONS GRADUALLY BECOME MORE CONDUCIVE. THIS SYSTEM HAS A MEDIUM CHANCE...40 PERCENT...OF BECOMING A TROPICAL CYCLONE DURING THE NEXT 48 HOURS.

A WELL-DEFINED LOW PRESSURE SYSTEM LOCATED ABOUT 250 MILES EAST OF THE CENTRAL BAHAMAS HAS CONTINUED TO BECOME BETTER DEFINED OVER THE PAST SEVERAL HOURS. HOWEVER...ENVIRONMENTAL CONDITIONS ARE ONLY MARGINALLY CONducive FOR DEVELOPMENT DURING THE NEXT DAY OR SO BEFORE THE LOW MERGES WITH A COLD FRONT THURSDAY NIGHT OR FRIDAY. THIS SYSTEM HAS A LOW CHANCE...20 PERCENT...OF BECOMING A TROPICAL CYCLONE DURING THE NEXT 48 HOURS AS IT MOVES LITTLE. ENVIRONMENTAL CONDITIONS WILL BECOME HOSTILE FOR ANY SIGNIFICANT DEVELOPMENT TO OCCUR BY FRIDAY AS THE LOW MOVES SOUTHWARD INTO A REGION OF STRONG UPPER-LEVEL WINDS. THIS SYSTEM HAS A LOW CHANCE...20 PERCENT...OF BECOMING A TROPICAL CYCLONE DURING THE NEXT 5 DAYS.

AN EXPERIMENTAL 5-DAY FORMATION PROBABILITY IS ALSO INCLUDED IN THIS PRODUCT FOR THE 2013 HURRICANE SEASON.

FIVE-DAY FORMATION PROBABILITIES ARE EXPERIMENTAL IN 2012.

55
FORECASTER STEWART
NNNN

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.
FOR THE NORTH ATLANTIC...CARIBBEAN SEA AND THE GULF OF MEXICO...

THE NATIONAL HURRICANE CENTER IS ISSUING ADVISORIES ON TROPICAL STORM NADINE...LOCATED ABOUT 250 MILES SOUTHWEST OF THE AZORES.

SHOWERS AND THUNDERSTORMS ASSOCIATED WITH AN AREA OF LOW PRESSURE LOCATED ABOUT 1175 MILES EAST-NORTHEAST OF THE NORTHERN LEEWARD ISLANDS HAVE BECOME A LITTLE BETTER ORGANIZED. ALTHOUGH UPPER-LEVELS WINDS ARE ONLY MARGINALLY FAVORABLE FOR DEVELOPMENT...THEY ARE EXPECTED TO BECOME MORE FAVORABLE DURING THE NEXT DAY OR TWO. THIS SYSTEM HAS A MEDIUM CHANCE...40 PERCENT...OF BECOMING A TROPICAL CYCLONE DURING THE NEXT 48 HOURS AS IT MOVES WEST-NORTHWESTWARD AT 10 MPH. AFTER THAT TIME...ENVIRONMENTAL CONDITIONS APPEAR FAVORABLE...AND THIS SYSTEM HAS A HIGH CHANCE...80 PERCENT...OF BECOMING A TROPICAL CYCLONE DURING THE NEXT 5 DAYS AS IT TURNS NORTHWESTWARD.

A BROAD LOW PRESSURE AREA ASSOCIATED WITH A TROPICAL WAVE IS LOCATED ABOUT 450 MILES SOUTHWEST OF THE CAPE VERDE ISLANDS. WHILE THIS SYSTEM IS PRODUCING A LARGE AREA OF CLOUDINESS AND SCATTERED SHOWERS...ENVIRONMENTAL CONDITIONS ARE ONLY MARGINALLY FAVORABLE FOR DEVELOPMENT. THIS SYSTEM HAS A MEDIUM CHANCE...40 PERCENT...OF BECOMING A TROPICAL CYCLONE DURING THE NEXT 48 HOURS AS IT MOVES GENERALLY WESTWARD AT 10 TO 15 MPH. HOWEVER...THESE CONDITIONS ARE FORECAST TO BECOME MORE CONDUICIVE FOR DEVELOPMENT DURING THE NEXT SEVERAL DAYS...AND THIS SYSTEM HAS A HIGH CHANCE...80 PERCENT...OF BECOMING A TROPICAL CYCLONE AS IT CONTINUES GENERALLY WESTWARD.

AN AREA OF DISTURBED WEATHER HAS FORMED IN ASSOCIATION WITH A BROAD LOW PRESSURE AREA ABOUT 700 MILES NORTHEAST OF THE NORTHERN LEEWARD ISLANDS. SLOW DEVELOPMENT OF THIS SYSTEM IS POSSIBLE DURING THE NEXT SEVERAL DAYS AS THE LOW MOVES GENERALLY WESTWARD AT ABOUT 10 MPH. THIS LOW HAS A LOW CHANCE...NEAR 20 PERCENT...OF BECOMING A TROPICAL CYCLONE DURING THE 48 HOURS AS IT TURNS NORTHWESTWARD. BEYOND 48 HOURS...ENVIRONMENTAL SHOULD REMAIN MARGINALLY FAVORABLE FOR DEVELOPMENT...AND THIS SYSTEM HAS A MEDIUM CHANCE...30 PERCENT...OF BECOMING A TROPICAL CYCLONE DURING THE NEXT 5 DAYS AS THE LOW GRADUALLY TURNS NORTHWARD.

OTHER SYSTEMS WITH FORMATION POTENTIAL BEYOND 48 HOURS

THE REMANT CIRCULATION OF HURRICANE ISAAC IS LOCATED OVER THE OHIO VALLEY. THIS SYSTEM IS FORECAST TO GENERALLY DRIFT SOUTHWARD AND REACH THE WATERS OF THE NORTH-CENTRAL GULF OF MEXICO IN A FEW DAYS. ENVIRONMENTAL CONDITIONS ARE EXPECTED TO BE FAVORABLE IN THE GULF OF MEXICO FOR SOME SLOW DEVELOPMENT. THERE IS A LOW CHANCE...NEAR 0 PERCENT...OF THIS SYSTEM REFORMING DURING THE NEXT 48 HOURS. HOWEVER...THERE IS A MEDIUM CHANCE...40 PERCENT...OF THIS SYSTEM REFORMING DURING THE NEXT 5 DAYS AS IT MOVES LITTLE OVER THE GULF OF MEXICO.

ALTHOUGH THE NORTHWESTERN CARIBBEAN SEA IS CURRENTLY QUIET...AN AREA OF LOW PRESSURE IS EXPECTED TO FORM IN THAT AREA IN 3 TO 5 DAYS. ENVIRONMENTAL CONDITIONS APPEAR CONDUICIVE FOR DEVELOPMENT DURING THAT TIME AS THE LOW MOVES SLOWLY NORTHWARD. THERE IS A LOW CHANCE...NEAR 0 PERCENT...OF THIS SYSTEM BECOMING A TROPICAL CYCLONE DURING THE NEXT 48 HOURS. HOWEVER...THERE IS A HIGH CHANCE...NEAR 60 PERCENT...OF THIS DISTURBANCE BECOMING A TROPICAL DURING THE NEXT 5 DAYS.

B&B
AN EXPERIMENTAL 5-DAY FORMATION PROBABILITY IS ALSO INCLUDED IN THIS PRODUCT FOR THE 2013 HURRICANE SEASON. COMMENTS ON THE EXPERIMENTAL PORTION OF THIS PRODUCT CAN BE SENT TO TPC.HURR@NOAA.GOV.

FIVE-DAY FORMATION PROBABILITIES ARE EXPERIMENTAL IN 2013.

$$
FORECASTER KIMBERLAIN
NNNN
Graphical Prototype

Atlantic Tropical Weather Outlook

800 PM EDT THU SEP 20 2012
(click on shaded areas for details)

5-Day Tropical Cyclone Formation Potential:
- Low < 30%
- Medium 30-50%
- High > 50%
Also available system-by-system

Individual episode of tropical cyclone development from the disturbance initially located at X if exists. The storm can be formed anywhere inside the loop with the indicated probability (%) within five days.
Graphical Tropical Weather Outlook

Area 1: 80% Chance of Tropical Cyclone Formation (click to zoom)

Shower and thunderstorm activity associated with the remnants of Gaston continue to show signs of organization. Environmental conditions are conducive for re-development of this system and a tropical depression could re-form in this area at any time. There is a high chance...80 percent...of this system becoming a tropical cyclone again during the next 48 hours as it moves westward at about 10 mph.
Timeline

May 15– Produce text products in-house for further testing

July 15-August 31– If technical considerations are worked out, issue text 5-day genesis forecasts

Graphical product is dependent on resources but we are hopeful to have it functional with text
Conclusions

• New 5-day genesis forecasts are accurate enough to be issued publically

• Technically considerations due to understaffing are the biggest concern to prevent experimental issuance

• Optimistic that this will be in place during the busiest part of the hurricane season

• Note that this product will also be issued for the eastern Pacific (where the skill is a bit higher)
National Hurricane Center – Hurricane Specialist Unit

...the faces behind the forecasts