**NOAA Hurricane Forecast Improvement Proj**

**High Resolution Hurricane Forecast Test**

**Goals:**
- Evaluate the effect of increasing horizontal resolution within a given model configuration on hurricane intensity forecasts
- Provide a data set that can be used to explore the potential value of a multi-model ensemble for improving hurricane forecasts
DTC Evaluation Team
Louisa Nance
Ligia Bernardet
Barb Brown
Jamie Wolff
Chris Harrop
Laurie Carson
Tara Jensen
John Halley Gotway
Shaowu Bao
Jian-Wen Bao

Vortex Tracker
Tim Marchok (GFDL)

Verification Methods Team
Barb Brown (NCAR)
James Franklin (NHC)
Mike Fiorino (NHC)
Mark DeMaria (CIRA)
Tim Marchok (GFDL)

Case Selection Team
Jack Beven (NHC)
Mark DeMaria (CIRA)
# Modeling Groups

<table>
<thead>
<tr>
<th>Institution</th>
<th>Model</th>
<th>Grid Spacing (km)</th>
<th># of cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>AOML</td>
<td>WRF-NMM</td>
<td>9</td>
<td>69</td>
</tr>
<tr>
<td>NCAR/MMM</td>
<td>Advanced Hurricane WRF (ARW)</td>
<td>12</td>
<td>69</td>
</tr>
<tr>
<td>NRL</td>
<td>COAMPS</td>
<td>9</td>
<td>57</td>
</tr>
<tr>
<td>PSU</td>
<td>WRF-ARW</td>
<td>13.5</td>
<td>9</td>
</tr>
<tr>
<td>University of Rhode Island</td>
<td>GFDL</td>
<td>9</td>
<td>69</td>
</tr>
<tr>
<td>U of Wisconsin – Madison</td>
<td>UW Non-hydrostatic Modeling System</td>
<td>12</td>
<td>15</td>
</tr>
</tbody>
</table>
HRH Test Cases

Criteria: diverse set of storms, as well as time periods for each storm
Ten storms from the 2005 & 2007 hurricane seasons
Number of cases: 69
DTC Evaluation System for HRH

- Model
- Forecast
- DTC Output Module

- Best Track from NHC
- GRIB files: all lead times in 30 min increments
  *Arrive at DTC*

- GFDL Tracker
- Modified A deck (30-min intervals)

- DTC Averager
- Averaged A deck (6-h intervals)

- RI/RW Verification
- Flat files, images

- NHC Verification
- Flat files, images

- Best Track From NHC
Averager

**Issue:** verify representative maximum wind (not instantaneous)

After discussions in entire HRH group, it was decided to:

- Output forecasts every 30 minutes
- Run tracker every 30 minutes
- Compute a running mean of the max wind over a 2h window:
  \[ V_{\text{mean}}(t) = \frac{[V(t+60) + V(t-30) + V(t) + V(t+30) + V(t+60)]}{5} \]
- Use \( V_{\text{mean}} \) for verification of maximum wind
GFDL model: Track error

Errors grow
Outliers present

No differences

Boxplot Description
Median: bold waist
Mean: star
95% CI on median: notch
Sample size: width of box
25% and 75% quartiles: bottom and top of box

# Cases 58 57 54 52 49 42 36 32 28 25 22
GFDL model: Intensity error

Systematic underprediction at lead times 0 and 30 h
Systematic overprediction at lead time 96 h
Only 1 SS difference
96 h low res better

Small growth in time
More outliers at early lead times
Error increases with lead time
Larger growth for 9 km

More variability in difference at longer lead times
Intensity Error - AOML

9 km tends to under predict intensity
3 km exhibits less systematic error
Intensities Absolute Error - AOML

3 km tends to produce better intensity forecast
### Overall Summary

<table>
<thead>
<tr>
<th>Group</th>
<th>AOML</th>
<th>MMM</th>
<th>GFDL</th>
<th>PSU – not significant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Track Error</td>
<td>Improved</td>
<td>Slight degradation</td>
<td>No change</td>
<td>Improved / degradation</td>
</tr>
<tr>
<td>Intensity Error</td>
<td>Reduced systematic under prediction</td>
<td>Reduced systematic under prediction</td>
<td>No change</td>
<td>Reduced systematic under prediction</td>
</tr>
<tr>
<td>Absolute Intensity Error</td>
<td>Improved</td>
<td>No change</td>
<td>No change</td>
<td>Improved (1-3 days)</td>
</tr>
<tr>
<td>RI</td>
<td>Improved</td>
<td>Improved</td>
<td>No change</td>
<td>No change/Improved</td>
</tr>
<tr>
<td>RW</td>
<td>No change</td>
<td>No change</td>
<td>Degradation</td>
<td>No change/No change</td>
</tr>
</tbody>
</table>

Follow-up: extend analysis to all cases and compute additional verification measures