Advanced R&D

Improving Hurricane Forecasts with the Joint Numerical Testbed: Reducing errors, saving lives & livelihoods

Winter 2015

I. Description

Hurricanes often prove both deadly and economically costly, frequently causing billions of dollars in damages through high wind, storm surge, flooding, coastline erosion, and post-landfall cleanup. Improved forecast accuracy, reliability, and warning lead times are imperatives for increasing safety and reducing property and infrastructure losses from these severe storms. In 2009 the National Oceanic and Atmospheric Administration (NOAA) and other U.S. agencies created HFIP, the Hurricane Forecast Improvement Project, to coordinate the hurricane research needed to improve guidance for hurricane track, intensity, and storm surge. A 10-year effort, HFIP’s goal is to accelerate improvement in 1-to-5-day forecasts and reduce the average error by 50% for hurricane track and intensity.

As part of the HFIP initiative, scientists at NCAR’s Joint Numerical Testbed Program are assessing the performance of operational and experimental computer models used for hurricane forecasts. They are also examining the efficacy of data brought back by “hurricane hunter” aircraft to feed the models.

II. Stage of Research

NCAR’s meteorological, statistical, and modeling experts are identifying which model innovations are showing the most promise by evaluating how well these innovations work when applied to case studies and large samples of forecasts of past events and when used in real-time hurricane forecasting. Because forecasts require data on the initial conditions of storms, the team is also studying how reconnaissance by “hurricane hunter” aircraft affects model performance. The aircraft data include measurements of temperature, pressure, humidity, and winds collected by releasing dropsonde sensors that parachute slowly toward the surface, as well as observations collected from instrumentation fixed onto the aircraft, such as Doppler radar. By evaluating how such observations advance or even potentially worsen the forecasts, the scientists are providing critical insights that can improve hurricane forecasting.
III. Advantages

- Deploying expertise in software engineering, statistical methods, and meteorology, NCAR scientists both evaluate and identify areas where it is possible to advance forecast models.
- The expertise provided by NCAR complements that of colleagues at NOAA’s National Hurricane Center, who monitor and predict storm threat. The two groups work closely to define the essential research questions to be answered and to set up evaluations to address these questions.
- The expertise provided by NCAR complements and impacts that of model developers in the research community and at NOAA’s Environmental Modeling Center, who work to advance the forecast skill of hurricane forecast models. By thoroughly evaluating new model innovations, NCAR is able to provide feedback on which innovations show the most promise.

IV. Applications

- Expert evaluation of innovations proposed for tropical cyclone forecast systems.
- "Fair broker" model evaluation, verifying model improvement and assessing level of improvement.
- Identifying hurricane events where models did not do well and providing critical feedback to model developers on the strengths and weaknesses of their model.
- Testing improved models, using experimental methodology on a robust sample size.

V. Funding and IP Status

Primary: National Oceanic and Atmospheric Administration (NOAA)

**New funding** would allow additional evaluation approaches to be developed that have a greater diagnostic focus, supplying critical feedback to model developers. Additional funds would also extend evaluation beyond track and intensity to such important parameters as, for example, precipitation and storm structure.

VI. Research Partners

<table>
<thead>
<tr>
<th>Naval Research Laboratory</th>
<th>NOAA/National Hurricane Center</th>
</tr>
</thead>
<tbody>
<tr>
<td>NOAA/National Centers for</td>
<td>NOAA/NOAA National Hurricane Center</td>
</tr>
<tr>
<td>Environmental Prediction</td>
<td>NOAA/Hurricane Research Division</td>
</tr>
<tr>
<td>NOAA/Earth System Research Lab</td>
<td>NOAA/National Weather Service</td>
</tr>
<tr>
<td>NOAA/National Environmental Satellite, Data &amp; Information Svc</td>
<td>Office of Science and Technology</td>
</tr>
<tr>
<td>UCAR University Member</td>
<td></td>
</tr>
</tbody>
</table>

**Contact**

**Scott Rayder,** UCAR Senior Advisor for Development and Partnerships  
+1 303-497-1673 | rayder@ucar.edu | president.ucar.edu/development