Joint Hurricane Testbed Semi-Annual Report for Year 1
April 1, 2007-September 30, 2007*

Project title: *An Improved Wind Probability Estimation Program*
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Affiliation: Kidder (CIRA), DeMaria (NESDIS) and Haar (NPS)
Project dates: April 2007-March 2009
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1. Background Information

Under Previous JHT support a new program for estimating the probability of occurrence of 34, 50 and 64 kt winds was developed. A Monte Carlo (MC) method was utilized to combine the uncertainty in the track, intensity and wind structure forecasts.

In the current proposal, three improvements are proposed to the MC model, as follows:

Topic1: The MC wind probability estimates will be refined by making the underlying track error distributions a function of the forecast uncertainty. The current MC model uses basin-wide error statistics but recent research has shown that the spread of track forecasts from various models can provide information about the expected track error. J. Goerss from NRL developed a real-time tool to quantitatively estimate the track forecast uncertainty (the Goerss Predicted Consensus Error, GPCE), which will be incorporated into the MC model.

Topic 2: The timeliness of the MC model will be improved by optimizing and modifying the code.

Topic 3: The code that calculates the track and intensity error distributions for the MC model will be generalized to also update the "stand-alone" experimental intensity probability product utilized by NHC. This product is provided in real time as the "wind speed probability table" on the NHC web site, and was developed from data from 1988-1997. The current version of this product only extends to 72 hr even though the NHC official forecasts were extended to 120 hr in 2003.

The timeline and deliverables for Year 1 of this project are listed below in the Appendix.

*The funds for this project did not arrive at CIRA until early October of 2007, more than 6 months after the estimated starting date of the project. Thus, some of the tasks in the timeline will be behind schedule. Every effort will be made to catch up to the original schedule now that the project has started. CSU/CIRA has the authority to begin spending of research funds a few months before the actual arrival of the support. Thus, some preliminary work was done on the project before the arrival of the project funding in October of 2007. The results from this preliminary work are summarized in this report.

2. Accomplishments

Topic 1: Initial correspondence with P. Haar from NPS has begun to plan for this part of the project. He will provide a preliminary set of GPCE values for the past few hurricane seasons so they can be incorporated into the MC probability distribution generation code and tested as predictors of the track error.

Topic 2: Using advance funding, a CIRA programmer (R. DeMaria) was supported to work on optimization of the MC code. A profiler was run on the code and it was found that about 80% of the CPU was utilized on just two routines that are involved in distance calculations. These routines determine whether a point is inside or outside the radii of the various wind speed thresholds (34, 50 or 64 kt) at each time step of each MC realization. Based on this result, the programmer suggested a modification to the code that takes advantage of the 2 dimensional aspects of the large grid used for most of the probability products. A new routine was written to automatically determine whether the input grid points are in a 2-dimensional form. If so, a masking algorithm is applied before any of the distance calculations occur so that only those points that have a finite chance of being inside the wind radii are checked. This procedure resulted in a factor of 11 speed up of the code in the test cases with moderate sized grids, with no change to the output. The operational code already included a much simpler screening algorithm, so the new optimization resulted in a factor of 6 speed up when applied to the IBM code. Because these results were so encouraging, we worked with Chris Lauer to install the new optimized code on the IBM before the start of the 2007 season, and it has run with no problems. In the proposal we anticipated a speed of about 50%, but ended up with a 600% improvement. This part of the project is complete.

Topic 3: M. DeMaria visited TPC in August of 2007 and met with C. Lauer and A. Krautkramer to discuss the wind probability table product. A copy of the operational code was obtained, and the format of the input tables was described. The code is written in such a way that the major effort will be to provide code to update the tables. Minor modifications will also be needed to extend the product to include the 96 and 120 hour forecasts (the current version only extends to 72 hours). Preliminary work has been begun to write Fortran 90 modules to read the ATCF A and B decks that are needed to update the probability table.

3. Things not Completed/Pending Items:

We are a little behind on some of the tasks due to the late arrival of funds at CIRA.

4. Things that did not succeed.

So far, no serious problems have been encountered.

5. Plans for the remainder of Year 1

The project will continue according to the schedule listed in the Appendix with the final report completed in April of 2007.

Appendix

Year-1 Project timeline and Deliverables:

Apr 2007 - Project begins
Apr 2007 - Begin Optimization of MC code
Jul 2007 - Compare optimized code with real-time runs, implement on IBM in coordination with TPC
Aug 2007 - Finalize creation of GPCE database for the Atlantic
Sep 2007 - Adjust probability generation code for wind probability table
Oct 2007 - Complete GPCE database for other basins
October 16, 2007 - Mid-year report due
Jan 2008 - Complete first version of MC code with track-dependent probabilities
Jan 2008 - Select case studies from 2007 season and run parallel MC code
Feb 2008 - Complete verification of case studies and compare with operational MC model
Mar 2008 - Report results at the IHC
April 16, 2008 - Year one progress report/renewal proposal due