

**Joint Hurricane Testbed Semi-Annual Report for Year 1**  
September 1, 2006-February 28, 2007

Project: *Continued Development of Tropical Cyclone Wind Probability Products*

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Project dates: September 2005-August 2007

TPC Points of Contact: Rick Knabb, Michelle Mainelli, Chris Sisko and Jim Gross

## 1. Background

This project is continue the development of the Monte Carlo (MC) wind probability program and assist with the implementation of new products that are derived from the output. A verification system for the probabilities will also be developed. At the request of TPC, a new task involving the evaluation of the probabilities associated with hurricane watches and warnings from the 2004 and 2005 hurricane landfalls was added and presented at the last IHC. The timeline and deliverables for this project are listed below in the Appendix.

## 2. Accomplishments

### a. Verification code

The primary accomplishment during this time period was the development of FORTRAN code to verify the Monte Carlo wind probabilities and deterministic forecasts issued by TPC. The verification code creates statistics that answer specific questions about the MC forecasts. Table 1 shows those statistics and the questions they answer.

Table 1. Statistics associated with the verification of probabilistic forecasts and the questions they are designed to answer.

Statistic	Question answered
Brier Score	<i>What is the magnitude of the probability forecast errors?</i>
Brier Skill Score a. climatology reference b. deterministic forecast reference	<i>What is the relative skill of the probabilistic forecast over that of climatology and the deterministic forecast, in terms of predicting whether or not an event occurred?</i>
Reliability Diagrams	<i>How well do the predicted probabilities of an event correspond to their observed frequencies?</i>
Relative Operating Characteristics	<i>What is the ability of the forecast to</i>

	<i>discriminate between events and non-events?</i>
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Before one can calculate the statistics there were several steps that were necessary to create matching grids associated with the best track and the OFCL forecasts and the MC grids produced during the hurricane season. These include

- 1) Special code (FORTRAN 90 modules) was developed to read the A-decks, B-decks, and MC grids.
  - a. grib1 and grib2 readers were developed for the MC grids (see “Things that did not succeed”)
- 2) Since the deterministic forecast (i.e., OFCL) does not contain forecasts of the wind radii through 120-h, special procedures were developed to insert the forecasts of the five-day wind radii CLIPER model (DRCL) forecasts where TPC made a forecast of location and maximum winds, but not of wind radii. This capability is only needed if comparisons between the NHC deterministic forecast and the probabilities are desired.
- 3) Since the wind probabilities are valid for a specific time interval, best track and deterministic forecasts were interpolated to the same time period that the MC program uses to integrate individual realizations. This is a variable that can be changed as the MC code itself evolves.
- 4) Since the best track can exist when the determinist forecast does not exist (e.g., following extratropical transitions), special procedures were developed to clip (set values to missing) the best track at times when the OFCL forecasts were unavailable.
- 5) Since several storms can be active at the same time and on the same grid, each MC grid, deterministic forecasts and best tracks are matched in a time-relative manner.
- 6) Subroutines to calculate the Brier Score, Brier Skill Score, reliability diagrams, and the relative operating characteristics were created. These are called for each grid time and the statistics are accumulated during the time stepping.

The verification will consist of the comparison of the six MC grids (i.e., 34,50,64, cumulative and incremental) with similar grids populated by ones and zeros that were created from observed (i.e., best track) and deterministic (i.e., OFCL +DRCL) forecasts. The final results will consist of an accumulation of statistics shown in Table 1 at each 6-hourly time period.

b. Continued interaction with TPC

Mark DeMaria visited TPC on Feb. 22, 2007 and met with Michelle Manelli from TPC to discuss her plans to evaluate the utility of the MC probabilities to the problem of watches and warnings. She has agreed to undertake this evaluation. A special version of the MC

code that evaluates the probabilities at the watch/warning breakpoints will be provided to Michelle for that study.

### **3. Things not Completed/Pending Items:**

This project is nearly complete. The verification code is nearly finished and is undergoing a final debugging. Progress on this project and some preliminary verification results will be presented at the upcoming IHC. The verification code will be delivered to TPC as soon as it is complete. A final report will be provided at the end of the project.

### **4. Things that did not succeed.**

Grib2 reader for the verification code: We were unable to get the NCO grib2 libraries to open and decode more than one grib2 file at a time. It appears that the de-assignment of pointers and de-allocation of memory is not working properly within the libraries. Because of this issue we have suggested (to Chris Lauer) that grib1 format files be created until this issue is resolved. This part of the code is a separate module so it should be straightforward to swap the grib1 reader to grib2 once an adequate reading library is provided.

### **5. Plans for the remainder of Year 2**

The project will continue according to the schedule shown in the Appendix. The development of the verification program will continue and then run on the full 2006 season. Results will be reported at the Interdepartmental Hurricane Conference in March of 2007.

## **Appendix**

Year-two project timeline and deliverables:

- May/June 2006 – update the five-year error distributions (awaiting best tracks)
- November 2006 - Deliver verification code to TPC and provide training
- March 2007 - Present verification results at IHC
- April 2007 - Modify probability verification code as necessary
- March 2007 – Presentation of project summary at the IHC
- May 2007 – Coordination with TPC regarding the MC probability products
- Nov 2007 - Make any final modifications to MC code for product implementation