Assessing the Predictability of Tropical Cyclone Intensity using HWRF

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1 Scientific Accomplishments

During the past three months, the scientific focus of this project has been to prepare for the two real-time demonstration systems that are carried out as part of the HFIP Ensemble Products Tiger Team. Similar to the past two years, the probability of various intensity change categories will be computed from the HWRF and HMON ensemble prediction systems (primarily in the Atlantic basin; one storm per cycle). Furthermore, the HWRF analog group will also contribute forecasts toward this effort. The COAMPS-TC group has limited funding for this activity; therefore, it is unlikely that they will consistently provide output for this effort.

As in past years, we will employ quantile matching to bias-correct the HWRF and HMON intensity change forecasts in each 24 h window. As a consequence, it is necessary to recompute the comparison of HWRF and HMON intensity change CDF against the corresponding best track information. Figure 1 shows the HWRF and HMON intensity change CDFs for two different time periods (0-24 h, 12-36 h). Most of the difference between the best track and model CDFs is associated with the highest intensity change values; therefore, the figures are zoomed into these regions. For both time periods, the 95th percentile HWRF intensity change is 30 knots 24 h$^{-1}$, while the 95th percentile from best track is closer to 38 knots 24 h$^{-1}$; therefore, it appears that the model is under-estimating the biggest intensity changes. By contrast, the HMON system exhibits different behavior for these two time periods. For the 0-24 h period, the 95th percentile HMON intensity change is 35 knots, which is clearly closer to the best track value than HWRF. Between 12-36 h, the 95th percentile change decreases to 30 knots, which is different than HWRF, which has a more consistent 95th percentile value during each time window. The difference in 0-24 h and 12-36 h intensity change CDF suggests that the higher 0-24 h intensity changes in HMON could be due to the spurious spin-up of TCs in this model during the first 24 h. Beyond that time, the largest intensity changes become less frequent.

During the upcoming season, ensemble-based RI probabilities will be displayed on the HFIP webpage (http://www.hfip.org/data_ri). Currently the e-deck files are being transmitted to DTC, who is producing the RI plots. In addition, we are producing stacked bar charts of the probability of all intensity change categories at all points of the forecast (http://www.atmos.albany.edu/facstaff/torn/HWRF_ens). Furthermore, we would like to generate multi-model ensemble probabilities. During the previous quarter, we found that the inclusion of COAMPS-TC ensemble information was a valuable component of the multi-model ensemble; however, given that the COAMPS-TC ensemble information is unlikely to be available for many Atlantic basin TCs, the multi-model ensemble probabilities will have limited availability.

The second main ensemble-based product that will be available during the upcoming year is ensemble-based sensitivity of TC track and intensity information based on the ECMWF and HWRF ensemble prediction systems. For TCs of interest, PI Torn provided an assessment of this
Figure 1: Cumulative distribution function of the (a) 0-24 h and (b) 12-36 h changes in maximum wind speed for the HWRF model using cases from 2015-2017 (red). The black line is the corresponding-time best-track intensity changes. (c) and (d) as in (a) and (b), but for the HMON model.

information to NHC forecasters, which they used as a source of guidance for directing observation assets. To date, we have set up the scripting to gather ECMWF and HWRF fields and compute the forecast sensitivity. The output is displayed at http://www.atmos.albany.edu/facstaff/torn/SHOUT-ECMWF/SHOUT_target.php for ECMWF-based sensitivity and http://www.atmos.albany.edu/facstaff/torn/SHOUT/SHOUT_target.php for HWRF-based sensitivity.

Finally, our paper on the track sensitivity for three cases of large track variability (Debby, Joaquin, Lionrock) was accepted for publication in *Monthly Weather Review*. The early online version of this paper can be downloaded from: https://journals.ametsoc.org/doi/pdf/10.1175/MWR-D-18-0153.1

2 Issues Delaying Progress

The project was completed on 31 July 2018.
3 Interactions with NOAA Scientists

PI Torn co-chairs the HFIP Ensemble Products Tiger Team with Dr. Mark DeMaria. As part of that work, PI Torn has validated the probability of various intensity changes and communicated the results to the HWRF and HMON ensemble development team (NOAA Scientists Zhan Zhang, Weiguo Wang).

4 Progress Against Milestones

All milestones are completed.

5 Changes to the Execution of the Original Proposal

N/A

6 Outcomes That Could Be Transitioned to Operations

PI Torn is currently leading the HFIP Ensemble Products Tiger Team effort. The goal of this team is to develop ensemble-based products that could be used by NHC forecasters during the upcoming season. The first such product is a probability of rapid intensification that will be computed from various statistical and dynamical ensemble prediction systems, which was available to NHC forecasters during the 2016-2018 seasons. Given that several modeling systems provided skillful RI (and non-RI) intensity change guidance and the software infrastructure is present to provide this information to NHC, this will be repeated again during the 2018 season. In addition, the TC track sensitivity guidance discussed in the previous report will be transitioned into an operational product using a Joint Hurricane Testbed proposal that will be submitted during the next grant competition.

7 Budget Issues

N/A