

**Joint Hurricane Testbed**

**NA17OAR4590141**

**Improvements and extensions to an existing probabilistic TC  
genesis forecast tool using an ensemble of global models**

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1 July 2017 – 30 June 2019

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Annual Progress Report

## 1. Accomplishments

### *a. Maintained moe website to disseminate current guidance*

The web site to disseminate the guidance products (<http://moe.met.fsu.edu/modelgen>) continues to be maintained throughout the 2018 hurricane season. Guidance products are updated four times daily, with the arrival of each model cycle.

### *b. Guidance extended to the Central Pacific basin*

All real-time guidance products have been extended westward to 180° longitude to cover the Central Pacific Hurricane Center's area of responsibility. The Central Pacific basin products are shown on the same graphics/text products as the Eastern Pacific products. Given the relatively small sample size over the Central Pacific basin, the Eastern Pacific regression equations are used. Further research will determine whether two sets of regression equations are warranted, and where the basins should be split to ensure a sufficient sample in both domains.

### *c. Conducted genesis sensitivity criteria studies*

As outlined in the proposal, one weakness of the current version of the guidance is low probability of detection (POD) for TCs with baroclinic genesis pathways. Therefore, we tested the TC genesis verification statistics using several different threshold values of thickness and thickness anomaly (Figs. 1-2). As expected, reducing the threshold values does increase the POD of TCs that form poleward of 25°N. However, it is unclear if this benefit outweighs the vastly increased number of false alarms. We will soon run two parallel versions of the tool – one with the current genesis criteria, and one with the experimental genesis criteria. The reliability will be compared after the season ends.

### *d. Presented mid-year 1 results at the Interdepartmental Hurricane Conference (IHC)*

The mid-year 1 progress of the project was presented at the Interdepartmental Hurricane Conference. The PIs received constructive feedback from the POCs and HSU regarding further improvements to the guidance suite.

### *e. Presented mid-year 1 results at the 33<sup>rd</sup> AMS Conf. on Hurricanes and Tropical Meteorology*

The mid-year 1 progress of the project was presented at the 33<sup>rd</sup> AMS Conference on Hurricanes and Tropical Meteorology. The oral presentation focused on the genesis criteria sensitivity studies discussed in section *c*.

### *f. Converted to Python or c-shell all code for real-time guidance products*

Many of the early tasks for this project involve converting existing code to languages that are compatible with NHC's IT infrastructure. All of the code for the real-time products have been converted to Python or c-shell from GrADS or R. These new scripts are currently running on the FSU version of the guidance tool, with products available at <http://moe.met.fsu.edu/modelgentest>.

*g. Further updates to the consensus guidance*

At the request of the HSU, the consensus guidance graphic now includes the forecast location and categorical genesis probability of each individual model, in addition to the consensus location and probability (Fig. 3). Also, the consensus guidance is now generated at all four synoptic times, instead of the previous 00Z and 12Z issuances. The guidance is generated with the most recent available model run. For example, the consensus guidance from the 18Z suite of model output consists of the 18Z GFS, the 12Z UKM, and the 12Z CMC. Additional minor aesthetic changes were made to the graphical output as a result of feedback received during and after the IHC conference.

*h. Redesigned website running in test mode*

The website has been redesigned and simplified. It is currently running in a test mode at <http://moe.met.fsu.edu/modelgentest>. We anticipate that this redesigned site will become the operational site (<http://moe.met.fsu.edu/modelgen>) by 1 September 2018, and the points of contact will be notified when that switch occurs.

*i. Regression equations updated through 2017*

The regression equations have been updated and now use 2011-2017 as the developmental dataset.

*j. Additional issues addressed*

Since the regression equations for 48hr and 120hr do not explicitly interact with one another, it is possible on rare occasions that the 48hr probability is slightly higher than the 120hr probability. Since the 120hr probability must include the 48hr, this is an issue that should be resolved. Accordingly, in June the PIs contacted the NHC points of contact to solicit feedback on three proposed options to resolve this. The consensus of the response is that while this issue was not perceived as a serious one (given how rarely it occurs and that it typically occurs at high probabilities anyway), the preferred solution is to use the mean of both 48hr and 120hr probabilities (for both) as displayed on the webpage when the calculated 48hr probability is higher than the 120hr probability.

With approximately four years of NAVGEM model output now on archive at FSU, we are now in a position to calculate regression equations for genesis using that model. Before doing so, we reached out to contacts at NRL in an attempt to fill in any gaps in the local archive (the largest of which is 1-1.5 months in 2016). While responses were received, and the nature of those responses were helpful and supportive, followup attempts to retrieve the resulting missing data were not met with additional responses during this reporting period. Accordingly, we will move forward with producing regression equations for the NAVGEM with only the data we currently have. Note that these equations will not be as robust as those for the other models, as the developmental period will be the minimum possible length.

## **2. Products**

All of the guidance products are available at <http://moe.met.fsu.edu/modelgen>. All of the code for the real-time guidance is now in Python or c-shell. The updated consensus tracker has been implemented. Project updates were presented at the 33<sup>rd</sup> American Meteorological Society Conference on Hurricanes and Tropical Meteorology and the TCORF/IHC.

## **3. Participants and other collaborating organizations**

The PI and Co-PI are the primary participants on this project. They continue to collaborate with their NHC/JHT points-of-contact: Chris Landsea, Richard Pasch, and Matt Onderlinde. Other NHC personnel, including Mark DeMaria, Andy Penny, Mike Brennan, Eric Blake, and Robbie Berg have participated in planning meetings and/or provided feedback on the guidance.

There were no other organizations formally involved in the project during the reporting period, although as mentioned earlier, repeated attempts to retrieve missing NAVGEM data via NRL were not successful.

## **4. Impact**

Given how early it is in the project, it is difficult to quantify the impact of the ongoing work. However, we can report that we had extensive communication with several NHC forecasters regarding product availability and updates, suggesting that the products continue to be used at a high volume as previously. Web access logs at FSU reveal that the products are also being heavily used by the general public and forecasters outside of the NHC environment as well.

## **5. Changes/Problems**

The scripts that were converted to Python have not yet been transferred to NHC. We will continue to test the code rigorously during the 2018 hurricane season, fix any potential issues, and transfer it to NHC after the hurricane season.

The operational model output archive is ready to transfer to NHC. However, we are awaiting the necessary data storage capabilities at NHC. In addition, a final decision has not yet been made regarding the subset of the data they wish to store (whether through interpolation, variable subsetting, or geographic subsetting).

## **6. Special Reporting Requirements**

We assess the Readiness Level of the project at the beginning of the project period as a 5 and currently as a 6, given all code is now compatible with NHC's IT requirements.

## **7. Budgetary Information**

The project is on budget. No deviations from the proposed budget are anticipated.

## **8. Project Outcomes**

It is difficult to quantify the project outcomes at this time, given how early it is in the project cycle. However, the project is on schedule as of this time and, in fact, a few of the future deliverables have already been accomplished early.

Variations in thickness threshold have modest impact on mean results.

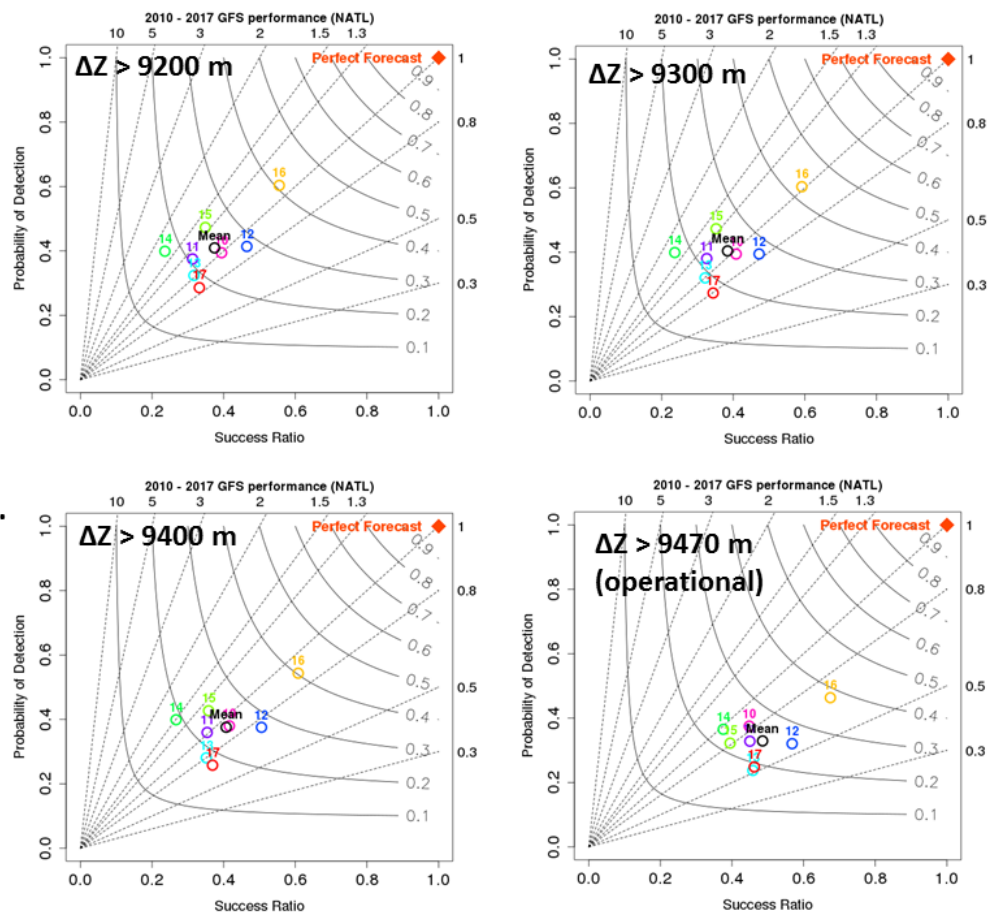


Fig. 1: TC genesis forecast verification statistics using different threshold values for the thickness criterion.

2010 – 2017 GFS TC  
genesis forecasts

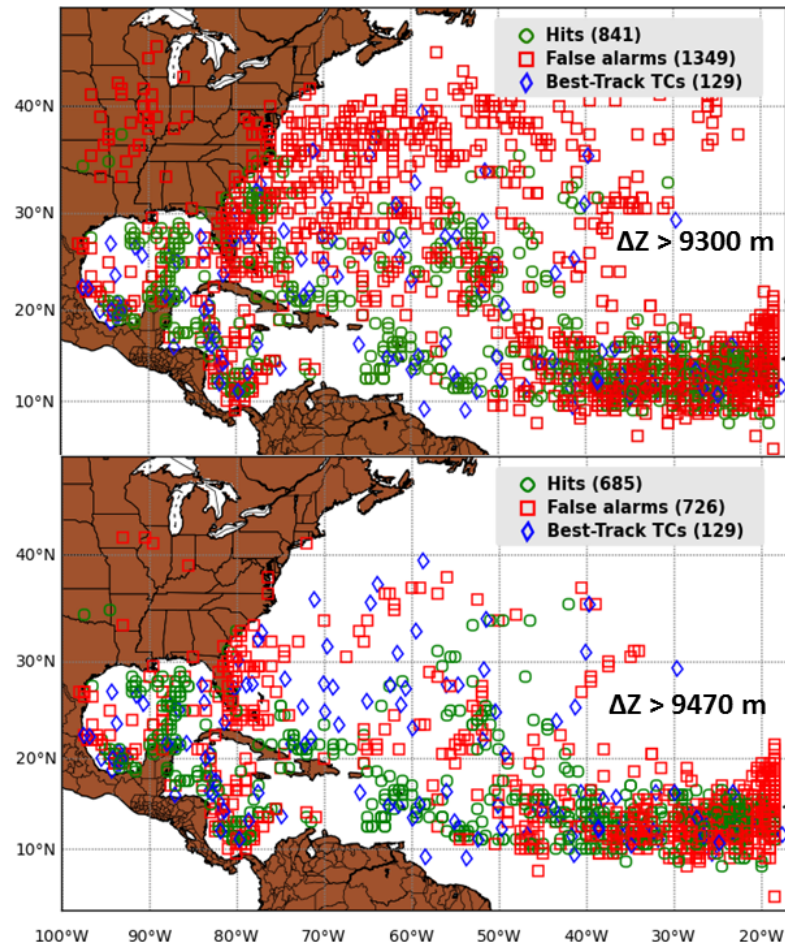


Fig. 2: The locations of forecast hits, false alarms, and verifying Best-Track TCs using a thickness threshold value of 9300 m (top) compared to the currently-operational 9470 m (bottom).

Experimental 0-120 h TC genesis probability  
CON model output initialized 2018-06-06 12Z

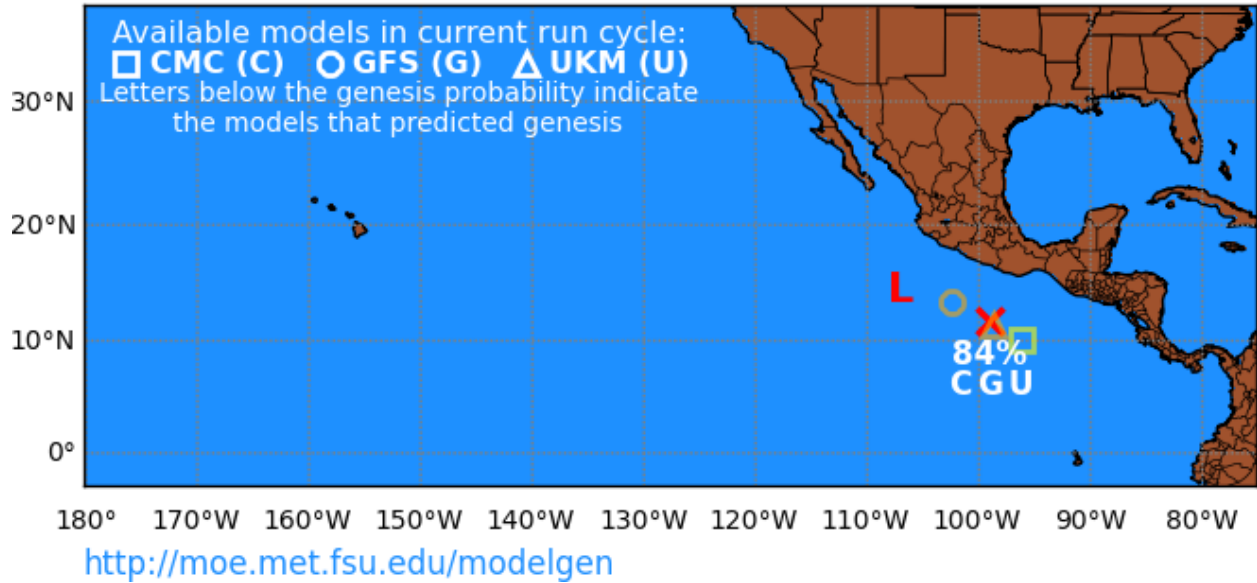


Fig. 3: The updated consensus guidance graphic showing the consensus forecast location and genesis probability as well as the forecast location and categorical genesis probability (color coded) from each individual model. The red “L” denotes a current TC that exists in the ATCF a-decks.