7D.5 BETA TEST AND DEVELOPMENT OF A PROTOTYPE DYNAMICAL MODEL TRACK PREDICTION EVALUATION SYSTEM MODEL FOR THE ATLANTIC

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1. MOTIVATION

The U. S. Weather Research Program Hurricane Landfall has sponsored the Joint Hurricane Testbed program to facilitate a transition of research toward operations at the Tropical Prediction Center/National Hurricane Center (NHC). This paper describes the first-year effort during the 2001 hurricane season for producing a dynamical model expert system module for evaluating tropical cyclone track predictions in the Atlantic. This project is to adapt for use in the Atlantic a similar expert system for the western North Pacific that has been used successfully at the Joint Typhoon Warning Center, Hawaii.

2. METHODOLOGY

2.1 *Beta Test*

The five dynamical model tracks and predicted fields utilized in the Atlantic system were: NCEP Aviation (AVNO) and Geophysical Fluid Dynamics Lab (GFDL) models, U. S. Navy Operational Global Atmospheric Prediction System (NOGAPS) and Navy version of the GFDL model (called GFDN), and the UK Met Office (UKMO) global model. After conversion by the Computer Science Corporation (Dan Martinez and Jim Peak), a beta test was carried out at the Naval Postgraduate School (NPS). Simulated real-time model evaluations were made for 00 UTC and 12 UTC track forecasts from mid-August to early October. Model fields received at NPS were processed and transferred to NHC where the Navy liaison (LCDR Laura Salvador) independently exercised the prototype expert system.

2.2 *Model Traits Knowledge Base*

While the beta test examined the basic display features of the expert system, proper usage of the system requires an understanding of how models perform in certain scenarios. A model traits knowledge base based upon the entire 2001 season was built by examining the tracks and associated model fields when the 72-h consensus spread exceeded 225 n mi. Experience in the western North Pacific has shown that rejecting model tracks when the ensemble spread was less than 225 n mi often lead to degraded forecasts because small spread scenarios usually are accurate. Error mechanisms were assigned to a particular model if it degraded the non-selective consensus (NCON) of all available models and if the rejection of that model resulted in an improved selective consensus (SCON).

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3. RESULTS

3.1 *Beta Test*

Examples of expert system applications by both analysts will be presented, especially for difficult cases in which the 72-h consensus spread was large.

3.2 *Model Traits Knowledge Base*

The primary goal of the project is to improve the 72-h forecast by comparing model field guidance. The number of cases in which three or more models made verifiable 72-h forecasts was 162. A subset of 80 cases had ensemble spreads greater than 225 n mi for which a more accurate SCON could possibly be created.

An example of a large ensemble spread (273 n mi) case is shown in Fig. 1 for developing Michelle. All model-predicted tracks are toward the northwest, but the GFDL model predicted a faster motion, while the NOGAPS and GFDN models forecast a more westward turn toward the Yucatan Peninsula.

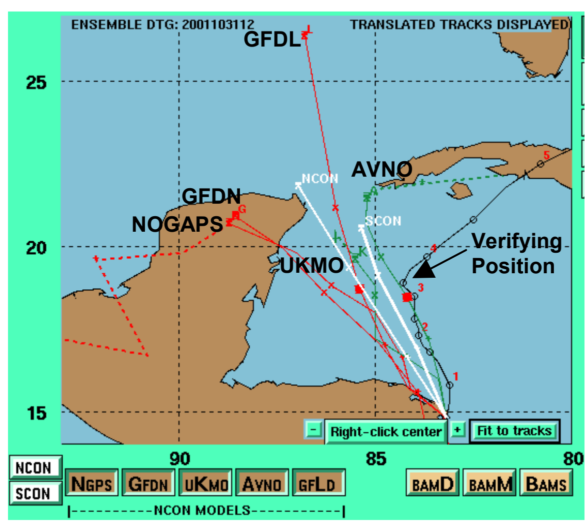

Fig. 1: Best track and forecast tracks available at 12 UTC 31 October 2001 as Michelle developed.

The most common model error mechanism in the western North Pacific was Excessive-Direct Cyclone Interaction (E-DCI) in which the model overdoes the interaction of the tropical cyclone with an adjacent cyclonic circulation, which results in a decreasing separation distance and possibly even a merger. All five models' tracks in Fig. 1 may have been corrupted by E-DCI, but to varying degrees.

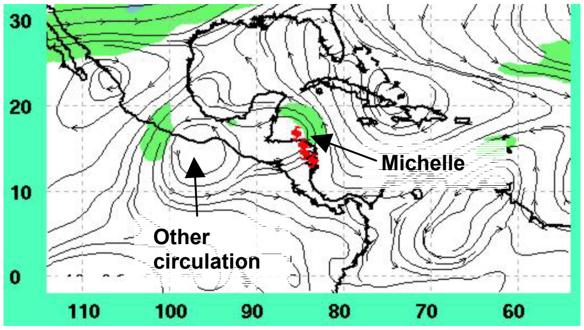

Fig. 2: NOGAPS 500-mb streamline and isotach forecast valid for 00 UTC 2 November 2001. Michelle's circulation is depicted as part of and under the influence of a cyclonic circulation to the west, which leads to a westward deflection in the NOGAPS track in Fig. 1.

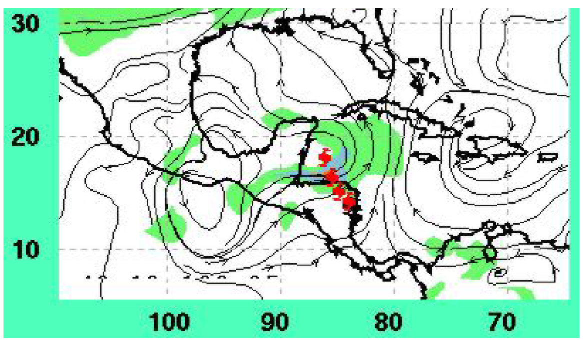

Fig. 3: As in Fig. 2, except for GFDL. An excessive interaction with the western circulation also leads to a poleward and westward deflection in the GFDL track. A subsequent midlatitude cyclone interaction leads to a rapid northward acceleration in the GFDL track in Fig. 1.

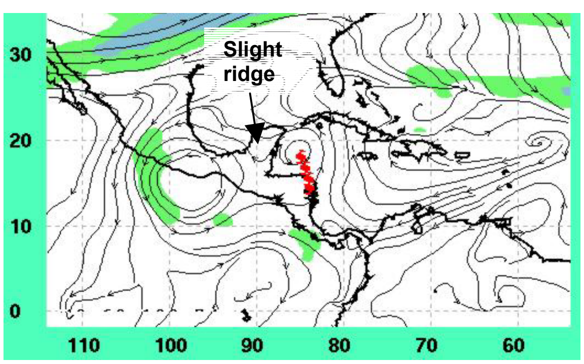

Fig. 4: As in Fig. 2, except for AVNO. By contrast, a slight ridge between Michelle and the western cyclone leads to less interaction and less westward deflection in the AVNO track in Fig. 1.

Two pieces of evidence would give a forecaster confidence that E-DCI could be degrading the models. First, satellite imagery (Fig. 5) indicates no evidence of a strong circulation to the west, which is a hint that the models have over-predicted that circulation. Second, the model traits knowledge base from the western North Pacific shows that when models mishandle direct cyclone interactions, they overwhelmingly err on the side of excessive interaction rather than Insufficient-Direct Cyclone Interaction (I-DCI). During the 1997-98 seasons, three models were degraded by E-DCI quite often (NOGAPS-50; GFDN-38; UKMO-25) but were never degraded by I-DCI.

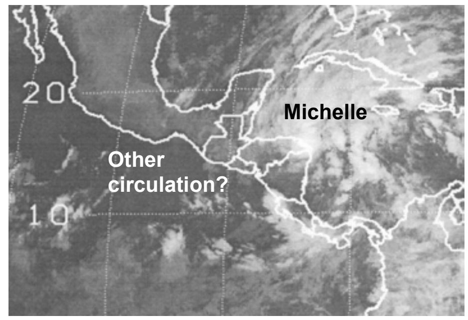

Fig. 5: GOES-8 IR imagery at 1215 UTC 31 October 2002.

A forecaster who recognizes E-DCI would be able to reject the most affected models (GFDL, NOGAPS, and the similar GFDN) and produce an improved SCON forecast based only on AVNO and UKMO (Fig. 1). If the forecaster believes that all models are possibly affected by E-DCI, the official forecast track could be shaded to the east side of SCON, which in this case would be a further improvement. In retrospect, all models were degraded by E-DCI, but the AVNO and UKMO models were the least affected. The verifying AVNO analysis in Fig. 6 indicates that Michelle and the western circulation have remained distinct, and Michelle has not been pulled as far poleward and westward as all the models had indicated.

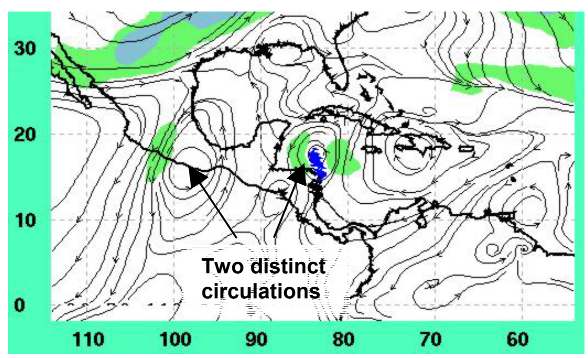

Fig. 6: AVNO analysis at 00 UTC 02 November 2002.

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