# Enclosed is the Mid-Year JHT Report for:

## A PROPOSAL FOR TRANSITION OF RESEARCH TO OPERATIONS: Transition of GFDL Hurricane Prediction System to HWRF

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Major upgrades to the GFDL Hurricane Prediction System that were developed and tested during the past year through JHT funding were made operational in time for the 2006 hurricane season. These physics changes were made in close collaboration with scientists at NCEP (National Centers for Environmental Prediction) and URI (University of Rhode Island) and during the past 6 months have been fully transitioned into the Hurricane WRF (HWRF) model that will become operational in 2007 to run in parallel with the GFDL model.

As was anticipated the new upgrades have significantly improved the GFDL model's skill in intensity prediction both in the Atlantic (*Figure 1*) and Eastern Pacific (*Figure 2*). In these figures, all forecasts through October 26$^{th}$ are included, with comparisons made with the official and statistical models (SHIPS and DECAY SHIPS), using both the current GFDI interpolation technique and a new interpolation technique (GHMI), which reduces the correction to the original model intensity, beyond day 1. In both basins, using both techniques, the GFDL model exhibited superior performance compared to the statistical models in most forecast time periods, beating even the official forecast in the Atlantic and in the longer forecast time periods in the Eastern Pacific. Indeed, in the Atlantic the GFDL model was the only intensity prediction model that showed any skill relative to SHIFOR, which occurred during the early time periods.

Once the new GFDL forecast system became fully operational in June 2006, the emphasis at GFDL shifted to assist in the transition of the GFDL physics to the new HWRF model under development at NCEP. The strategy adopted by NCEP is to implement HWRF with the same physics packages that were used in the final version of the GFDL model. As was outlined in the modified work plan presented in the JHT year-one final report, it was decided that the best approach to guarantee that these packages were the same was to evaluate the HWRF physics code directly in the GFDL model. This involved a certain amount of a re-coding effort. The GFDL group, funded by this JHT proposal, focused on the moist physics, including both the cumulus parameterization and the Ferrier bulk microphysics. Comparison of the heating rates and heating tendencies helped to pinpoint differences in the two codes. These changes have been rectified and the moist physics packages in the two models are now nearly identical.

During the past 2 months the HWRF group at NCEP has continued to make major progress in the HWRF model development. The 3DVAR initialization package was made available and is currently being tested and tuned along with the physics in the HWRF model. A set of storms from the 2005 (Katrina, Rita, Wilma, Philippe) and 2006 hurricane season (Ernesto and Helene) was selected to serve as a suite of test cases, and forecasts have been run with the new HWRF model with the results compared to forecasts made with the 2006 GFDL model.

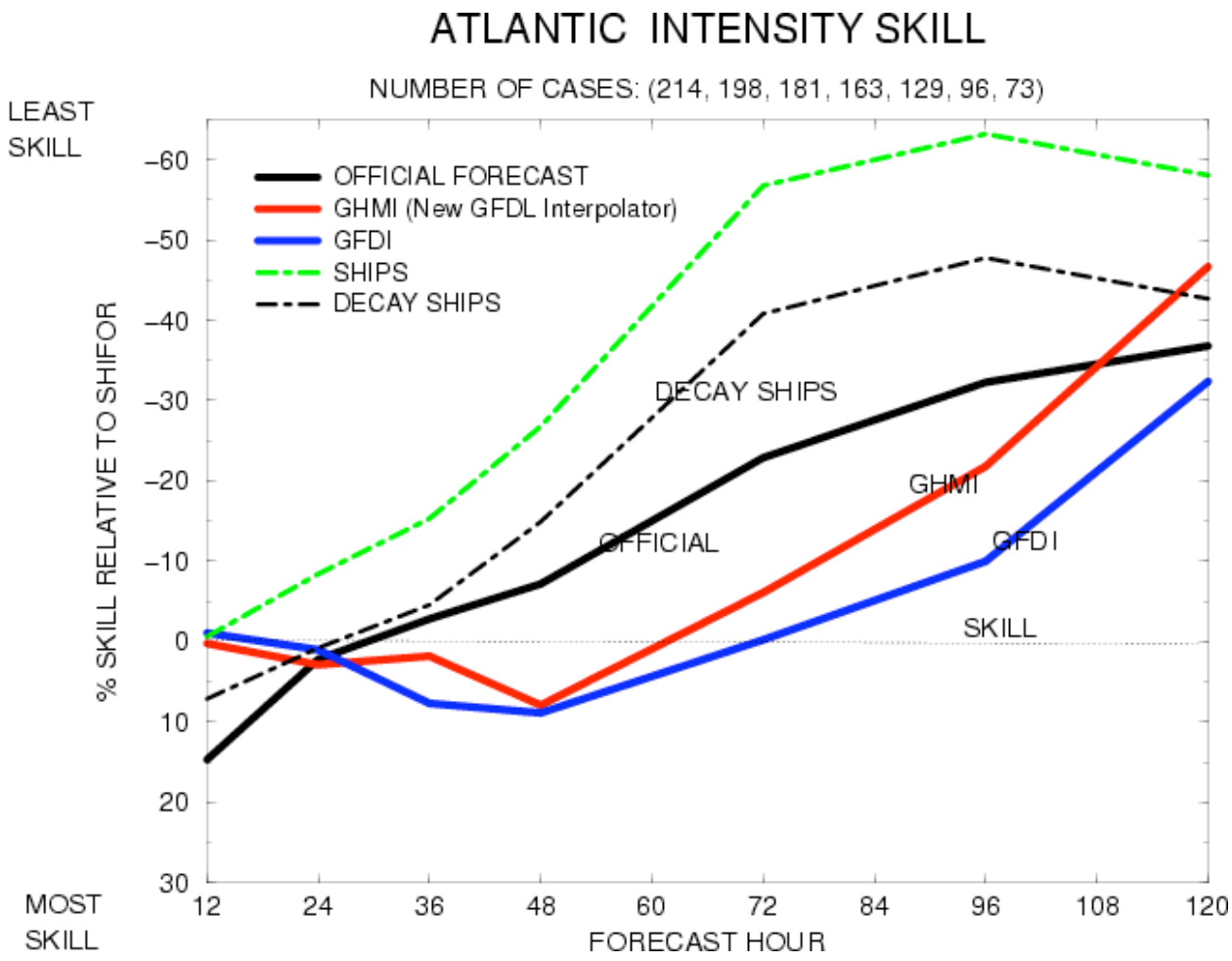


*Figure 1 Average forecast intensity error normalized relative to SHIFOR for the 2006 Atlantic hurricane season, for the GFDL model with the GFDI interpolator (blue line), the new model interpolator (GHMI, red line) compared with the SHIPS (green dot-dashed line), the Decay SHIPS (black dot-dashed line) and the Official forecast (black solid line).*

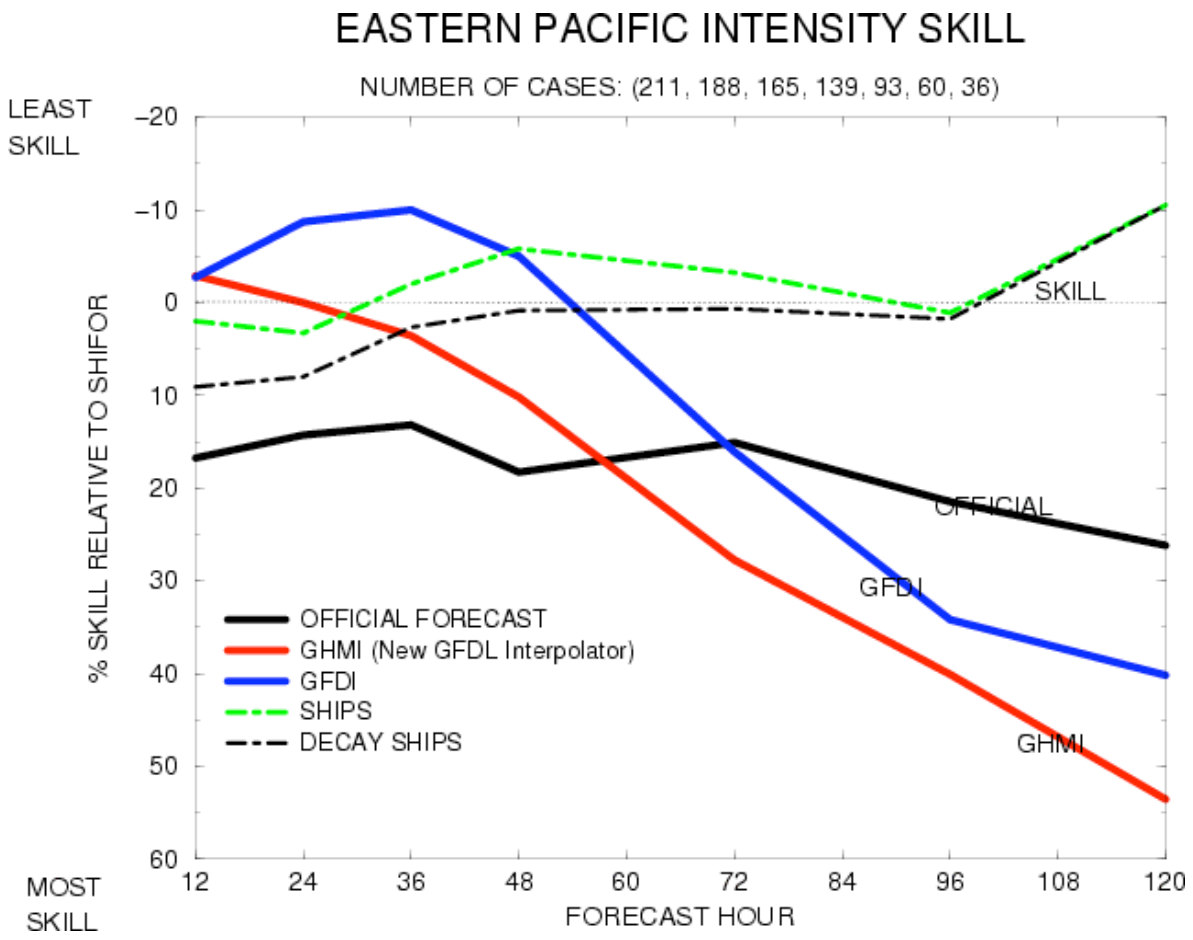


*Figure 2 Average forecast intensity error normalized relative to SHIFOR for the 2006 Eastern Pacific hurricane season, for the GFDL model with the GFDI interpolator (blue line), the new model interpolator (GHMI, red line), compared with the SHIPS (green dot-dashed line), the Decay SHIPS (black dot-dashed line) and the Official forecast (black solid line).*

The GFDL group has been actively involved in assisting in the evaluation of the HWRF performance both for track and intensity. It is also assisting NCEP scientists in the tuning of various parameters particularly in the moist physics packages. This is an ongoing effort. So far this has resulted in continued improved performance of the HWRF forecast system which is now exhibiting track skill that is comparable with the current GFDL forecast system (*Figure 3*) for the small set of cases tested. Although this is a very preliminary result, it is encouraging that the new HWRF model is beginning to demonstrate a similar high amount of skill as the GFDL model.

As already pointed out in the modified work plan, once the 2007 version of the HWRF model is ready, extensive testing of the 2006 version of the GFDL model will commence on additional storms during pervious hurricane seasons. These runs are essential to determine if the new HWRF model can perform comparable to the GFDL model in both the Atlantic and East Pacific basins for track and intensity on a broad suite of cases.

Finally, consultation with Navy personnel at FLEET has continued. Since the GFDN model performance has shown significant degradation over the past two years, evaluation of the

two systems were made which uncovered a bug in the model initialization in the GFDN system. This coding error was fixed and it is anticipated that this will lead to a more reliable model performance. The high-resolution version of the GFDN code so far as not been implemented at FLEET although current plans are to begin to test it with some of the physics upgrades that were made operational at NCEP in 2006. The GFDL group continues to assist in this effort.

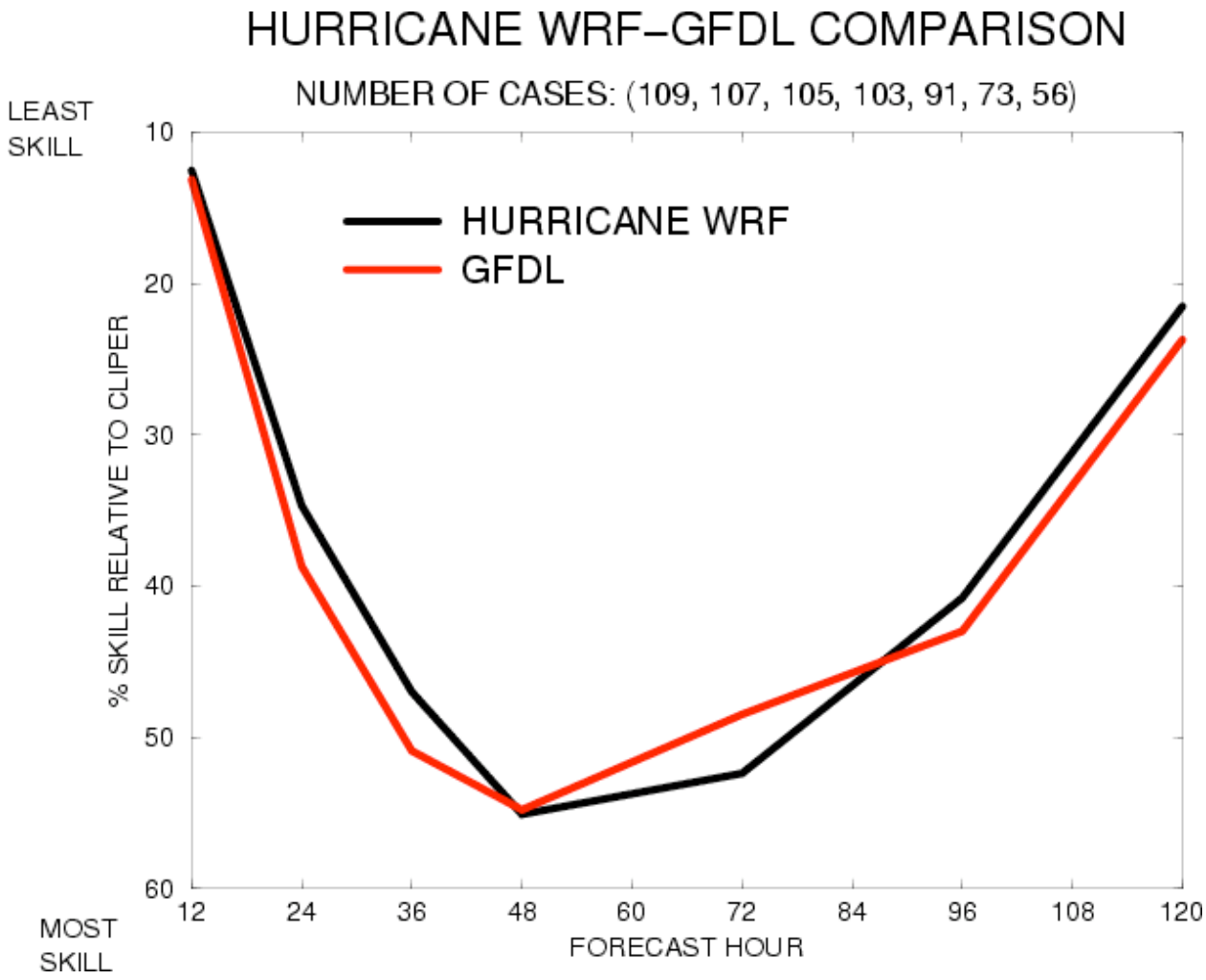


*Figure 3. Average forecast track error normalized relative to CLIPER (Climatology-Persistence) for selected track forecasts for Hurricanes Katrina, Rita, Philippe, Wilma, Ernesto and Helene, using the 2006 operational GFDL model (red line) and the Hurricane WRF model under development at NCEP.*