Enclosed is the JHT Semi-annual Report for:

A PROPOSAL FOR TRANSITION OF RESEARCH TO OPERATIONS:

Upgrades to the Operational GFDL Hurricane Prediction System

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Major upgrades to the GFDL Hurricane Prediction System, made possible through JHT funding in FY03, were successfully implemented into the operational version of the GFDL model before the start of the 2003 hurricane season. The upgraded hurricane model performed very well, particularly for track, with skill relative to CLIPER exceeding 55% at all time levels beyond 36h in the Atlantic. In both the Atlantic and East Pacific basins, the GFDL model had the lowest track error of any other dynamical model guidance, beating even the official forecast through 48h in the Atlantic.

As outlined in the FY04 JHT proposal, further upgrades to the operational GFDL Hurricane Prediction System have continued to be made and tested, both in the model physics and vortex initialization. One of the serious problems with the new model that was observed during the past hurricane season, was that it often tended to under predict the intensity of weak systems, particularly depressions. In many cases the model incorrectly dissipated these storms when in reality the systems developed. Considerable effort was made during the first half of the JHT funded period, to try to remedy this problem by making several changes to the model physics. Incorporating some of the proposed JHT funded projects played a major role in helping to remedy this problem in the improved version of the model.

Also, although not part of the specific JHT WORK PLAN a major effort was made to improve the current axi-symetric model in the vortex initialization. The reason for this was that in interaction with TPC specialists and doing post-season analysis, it was found that the model also suffered from a serious spin-down and spin-up during the first 12 hours of the forecast. One of the likely reasons was inconsistent physics between the current axi-symmetric vortex spin up used in the initialization, and the three-dimensional prediction model. Beginning in September of 2003 an extensive effort was made to convert the current operational three dimensional hurricane model to a new axi-symmetric version. This would enable identical moist and boundary layer physics to be used in the two models. Testing of this new axi-symmetric model was begun in the early winter of 2003 and indicated that in some cases the spin-up/spin-down problem was dramatically reduced. Also, the initial intensity was often better matched to the observed initial condition. It is anticipated that this new model will become operational in 2004 assuming the extensive testing continues to be positive.

OUTLINE OF SPECIFIC PHYSICS IMPROVEMENTS

The parameters that define the extent of penetration of the downdrafts through the boundary layer in the SAS scheme was extensively evaluated for a variety of values. It was found that increasing this parameter to .5 gave a slightly more realistic moisture field in the tropical boundary layer, improved the pressure-wind relationship and helped in the intensification of weak systems.

Although the actual momentum mixing in the SAS scheme was not modified, a change has been tested, in which the effect of the momentum mixing was reduced in the eyewall region. It was found that this helped in a better intensification of the weak systems in most cases and greatly decreased the number of cases where the model incorrectly forecasted storm dissipation.

The effect of the evaporation of rain in large-scale condensation was put into the GFDL model in early summer of 2003. Parallel testing and reruns from the previous hurricane season indicated a positive improvement in intensity and track, particularly in the 4-5 day period. As a result, this change was implemented into the operational version of the GFDL model in late July, 2003. It performed well for the remainder of the hurricane season.

Although the testing of the Lin microphysics did not significantly progress, the above mentioned axi-symmetric model was coded with the capability to run with full Lin micro-physics. Once further testing of the microphysics is resumed, this important upgrade will enable the initial vortex to be spun-up with consistent micro-physics when used with the version of the forecast model with the Lin microphysics.

In conjunction with NCEP scientists, a modification was made in the large-scale condensation threshold used in the GFDL model. Testing has indicated that this change is also improving the development of weak systems.

All of the above-mentioned changes in the physics and vortex initialization have been successfully incorporated into a new upgraded version of the GFDL hurricane system. Testing has already extensively been made on a test bed of 71 cases from the 2003 Atlantic hurricane season. These cases include Hurricanes Isabal, Kate, Fabian and Tropical Storm Nicolis. Preliminary test indicate that the spinup/spindown problem has been significantly reduced in this new model, as has the tendency to dissipate weak systems. For example, in the early forecasts of Fabian, the operational GFDL model did not develop the storm and most cases dissipated the storm in the first 48h. At the same time the actual storm rapidly developed. In the new system Fabian consistently developed, although too slowly. However, by day 5 the new model eventually developed a formidable hurricane of Category 2 status.

Preliminary testing of this new model also indicated a small reduction in track error at 4 and 5 days of about 5% . There was also a reduction in the intensity error of about 10% in the first 2 days. Further testing of this upgraded system will continue with Hurricanes Isabel and Lili from the 2002 hurricane season. Depending on the final evaluation of these tests results, the decision will be made to implement these changes operationally in 2004.