**7A.1** 2001 COAMPS™ TROPICAL CYCLONE VERIFICATION IN THE NORTHWEST PACIFIC

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## 1. INTRODUCTION

Mesoscale models have become increasingly important as an objective aid to guide forecasters in providing more accurate and timely tropical cyclone (TC) forecasts. Similar to global scale models, mesoscale modeling systems are now equipped to assimilate observations from both satellite and conventional measurements, and to incorporate TC bogus messages. One of the major benefits of applying mesoscale models to TC forecasts is the better depiction of storm structure through higher spatial resolution and the ability to define nested grids within a model domain. Additional benefits in recent years have included increased temporal resolution, more appropriate physical parameterizations, and moving nests.

In 2001, 33 significant tropical cyclones received warnings in the Western North Pacific. Of these, 4 were tropical depressions, 9 were of tropical storm strength, 17 were typhoons, and 3 were of super typhoon strength. This paper summarizes the track error performance of the Navy's Coupled Ocean Atmosphere Mesoscale Prediction System (COAMPS™) for 2001 and how it compares to other prognostic mesoscale, global, and climate models.

## 2. METHODOLOGY

Homogeneous statistics for tropical cyclone tracks in the Northwest Pacific Ocean were calculated using the Automated Tropical Cyclone Forecast (ATCF) software package (Sampson and Schrader 2000). Storms were selected that met a minimum 35 knot initialization and verification wind speed intensity criteria. Another criterion for computing the homogeneous statistics was that all storms were located within the COAMPS™ Western Pacific (WPAC) domain (i.e., 5°-45°N, 100°-165°E). The forecast models (objective aids) used to compute the end-of-year homogeneous statistics include the Navy Operational Global Atmospheric Prediction System (NOGAPS), COAMPS™, the Geophysical Fluid Dynamics Laboratory - Navy Model (GFDN) (Rennick 1999), the Climate and Persistance model (CLIP), and the Joint Typhoon Warning Center (JTWC) track forecasts. All track error figures are computed against the JTWC best track estimate.

COAMPS™[1] is a 30 level nonhydrostatic compressible mesoscale model being run at a nominal grid spacing of 27 km by Fleet Numerical Meteorology and Oceanography Center (FNMOC). The COAMPS™ WPAC forecast is run out to 72 hours. COAMPS™ incorporates a Multivariate Optimal Interpolation Analysis of winds and heights (Hodur 1997), while boundary conditions are provided by NOGAPS at roughly 81 km spatial resolution. COAMPS™ is run operationally twice a day, with additional runs at 0600 and 1800 UTC which provide first-guess fields for the initialization of the 0000 and 1200 UTC analyses.

## 3. RESULTS

The aforementioned criteria for generating the homogeneous statistics reduced the 33-storm sample to 26. Imposing the intensity and location criteria reduced the number of cases at each forecast hour by approximately 10-15% of the original sample.

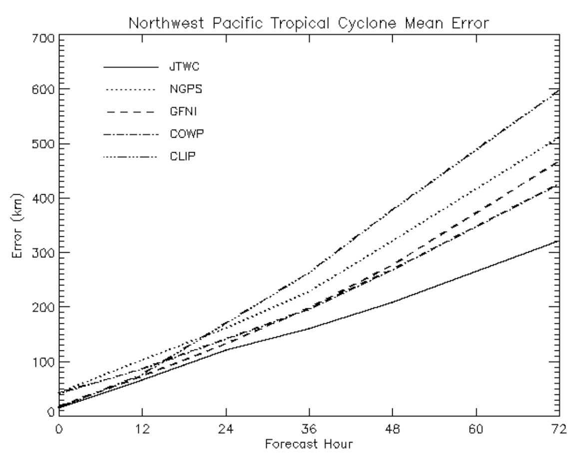


Figure 1: Tropical cyclone storm track errors (km) for NOGAPS, CLIP, COAMPS™, GFDN-intermediate (GFNI), and JTWC for the Northwest Pacific basin during 2001.

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[1] COAMPS™ is a trademark of NRL.

An intercomparison of model track error performance as a function of time illustrates the overall improvement of track errors with the higher resolution models such as GFDN and COAMPS™ (Fig. 1). Track errors associated with CLIP are smaller than the physical models for the first 24 hours, then degrade rapidly with increasing time. COAMPS™ and GFDN track errors cross at 36 hours where COAMPS™ errors become smaller on average.

The sensitivity of the annual track error statistics to extreme cases was tested by removing the 3 "best" and "worst" storms from the sample. The "best" and "worst" storms were determined by weighting the average error given the number of cases for each forecast hour. Track errors were relatively insensitive to removing the "best" 3 storms (0-2% change) while removing the 3 "worst" storms reduced the mean annual track errors by 8-12%.

The storm-relative position errors at the 72-hour forecast indicate that, on average, COAMPS™ TC forecasts are behind and to the left of the best estimate positions (Fig. 2). At smaller forecast times, the cross- and along-track errors are also negative (i.e., behind and to the left of the best estimate positions).

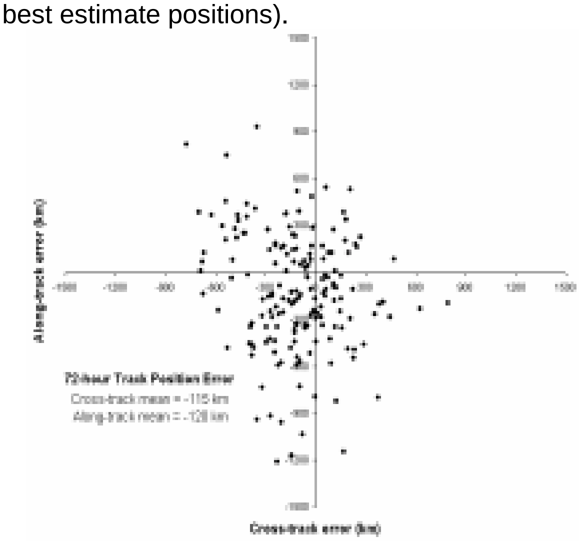

Figure 2: COAMPS™ 2001 72-hour storm-relative position error (km) in the Northwest Pacific.

All objective aids used in this study seemed to have difficulty with the track of TC 25W (Haiyan). Of particular interest is the forecast of 15 October 0000 UTC, for which all physical models' track errors were in excess of 200 and 500 km for the 48 and 72 hour forecast, respectively (Fig. 3). In addition, NOGAPS and COAMPS™ forecast track solutions seem to have diverged after 24 hours. NOGAPS tended to diminish a trailing surface front and underestimate the strength of an upper level ridge at 15-20°N. Unlike NOGAPS, COAMPS™ did strengthen the upper level ridging to the south of Haiyan, and thus produced stronger southerly steering currents in the 24-48 hour forecast period.

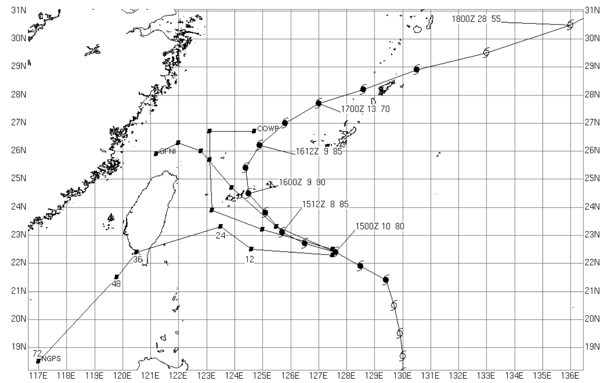

Figure 3: Tropical cyclone Haiyan (25W) forecast track from 15 October 2001 at 00 UTC. JTWC best track increments are at every 6 hours whereby objective aid increments are at 12, 24, 36, 48, and 72 hours as indicated for the NOGAPS forecast track.

## 4. CONCLUSIONS

Tropical cyclone forecast track errors from five objective aids were compared in the Northwest Pacific region for the 2001 season. COAMPS™ and NOGAPS track errors start out nearly equal, while GFDN, CLIP, and JTWC have the smallest errors initially. After 36 hours, JTWC produces the smallest track error followed by COAMPS™, GFDN, NOGAPS, and CLIP. Preliminary results from GFDN with a 1/2° outer nest and an expanded 1/6° inner nest indicate an improvement in track performance after 24 hours. COAMPS™ displayed a tendency to be, on average, behind and to the left of the best-estimate cyclone track at all forecast times.

## 5. REFERENCES


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