

Experiments with Tropical Cyclone Wave and Intensity Forecasts

Charles R. Sampson
Naval Research Laboratory
Monterey CA 93943-5502
phone: (831) 656-4714 fax: (831) 656-4769 e-mail: sampson@nrlmry.navy.mil

Award Number: N0001407WX21197
http://www.nrlmry.navy.mil/atcf_web/wavewatch

LONG-TERM GOALS

The goal of this project is to improve guidance for the prediction of waves and intensity associated with tropical cyclones.

OBJECTIVES

The objectives of this project are to develop, test and evaluate new strategies to predict (a) tropical cyclone generated waves and (b) tropical cyclone intensity as measured by one-minute mean maximum sustained wind speed.

APPROACH

(1) Develop a strategy to forecast waves that are consistent with tropical cyclone warnings/advisories from the Joint Typhoon Warning Center and the National Hurricane Center. Evaluate results against available buoys or other observations. The wave forecast algorithm must be designed to operate within the constraints of the Fleet Numerical Meteorology and Oceanography Center infrastructure and must be efficient in that the products can be made available to users within six hours of the warning/advisory dissemination. (2) Attempt to improve intensity forecasts from the Statistical Typhoon Intensity Prediction System (STIPS) and other forecast models. Implement and experiment with new formulations of STIPS. Publish results.

WORK COMPLETED

1. Wave forecast algorithm

In FY07, we designed and implemented a version of Wavewatch III that uses tropical cyclone warnings/advisories as input. Much of the emphasis was designing the infrastructure for an algorithm that could produce forecasts for all tropical cyclones in the Northern Hemisphere.

2. Intensity forecast algorithm.

In FY07, we experimented with intensity consensus combinations for the Atlantic, eastern and western North Pacific basins. These experiments were documented in a Note to Weather and Forecasting.

Report Documentation Page

Form Approved
OMB No. 0704-0188

Public reporting burden for the collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to a penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.

1. REPORT DATE 30 SEP 2007		2. REPORT TYPE Annual		3. DATES COVERED 00-00-2007 to 00-00-2007	
4. TITLE AND SUBTITLE Experiments With Tropical Cyclone Wave And Intensity Forecasts				5a. CONTRACT NUMBER	
				5b. GRANT NUMBER	
				5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S)				5d. PROJECT NUMBER	
				5e. TASK NUMBER	
				5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Naval Research Laboratory, Monterey, CA, 93943				8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)				10. SPONSOR/MONITOR'S ACRONYM(S)	
				11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
12. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release; distribution unlimited					
13. SUPPLEMENTARY NOTES code 1 only					
14. ABSTRACT The goal of this project is to improve guidance for the prediction of waves and intensity associated with tropical cyclones.					
15. SUBJECT TERMS					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT Same as Report (SAR)	18. NUMBER OF PAGES 5	19a. NAME OF RESPONSIBLE PERSON
a. REPORT unclassified	b. ABSTRACT unclassified	c. THIS PAGE unclassified			

RESULTS

1. Wave forecast algorithm

So far, the results from testing have been anecdotal. Figure 1 shows a JTWC forecast (track and 34 kt wind radii), the concurrent NOGAPS forecast, and the verifying best track for MAN-YI (WP042007). The JTWC and NOGAPS forecasts from 12 UTC on July 12, 2007 both show MAN-YI moving north into Kyushu. In this particular case, the JTWC and NOGAPS forecast tracks are similar with the NOGAPS forecast hitting Kyushu about six hours early and the JTWC forecast hitting about six hours late. The JTWC intensity forecasts (not shown) are 5-25 kt too high in the 36 hours before MAN-YI runs ashore while the NOGAPS forecast are 38-79 kt too low. The JTWC 34 kt wind radii (Fig. 1a) are generally smaller than the verifying wind radii (Fig. 1c) by 0-100 nm, and the NOGAPS 34 kt wind radii (Fig. 1b) are generally larger than the verifying 34 kt wind radii, especially in the SE quadrant where the errors approach 400 nm.

The 36-h Wavewatch III forecast using the JTWC warning as input is shown in Fig. 1d. This was just as the JTWC forecast was moving MAN-YI into Kyushu. Significant wave heights were forecast to approach 60 feet just offshore of Kyushu. Since the JTWC forecast intensity was 5-25 kt higher than observed, we suspect that the forecast significant wave heights are also high. We also suspect that using 10-minute mean winds as input to Wavewatch III may be more appropriate than using 1-minute mean winds. In future work, we intend to use buoys and altimeter passes to verify the results and test the system more rigorously.

2. Intensity forecast algorithm.

In this work, we found that forming a consensus (average) of the most skillful model forecasts produces forecasts with mean forecast errors that are generally lower than the individual model errors. Figure 3 shows skill relative to a statistical forecast aid for the individual aids and consensus aids for the Atlantic, eastern North Pacific and western North Pacific basins. The skill of the consensus aids (INT2 and INT3) is generally higher than individual model skill, and some of the differences are highly significant (using a one-tailed t-test that accounts for 30 hours of serial correlation). These consensus aids are now undergoing operational evaluation at the forecast centers for use as baselines to verify other more complex ensemble techniques and as forecast aids for use in real-time forecasting.

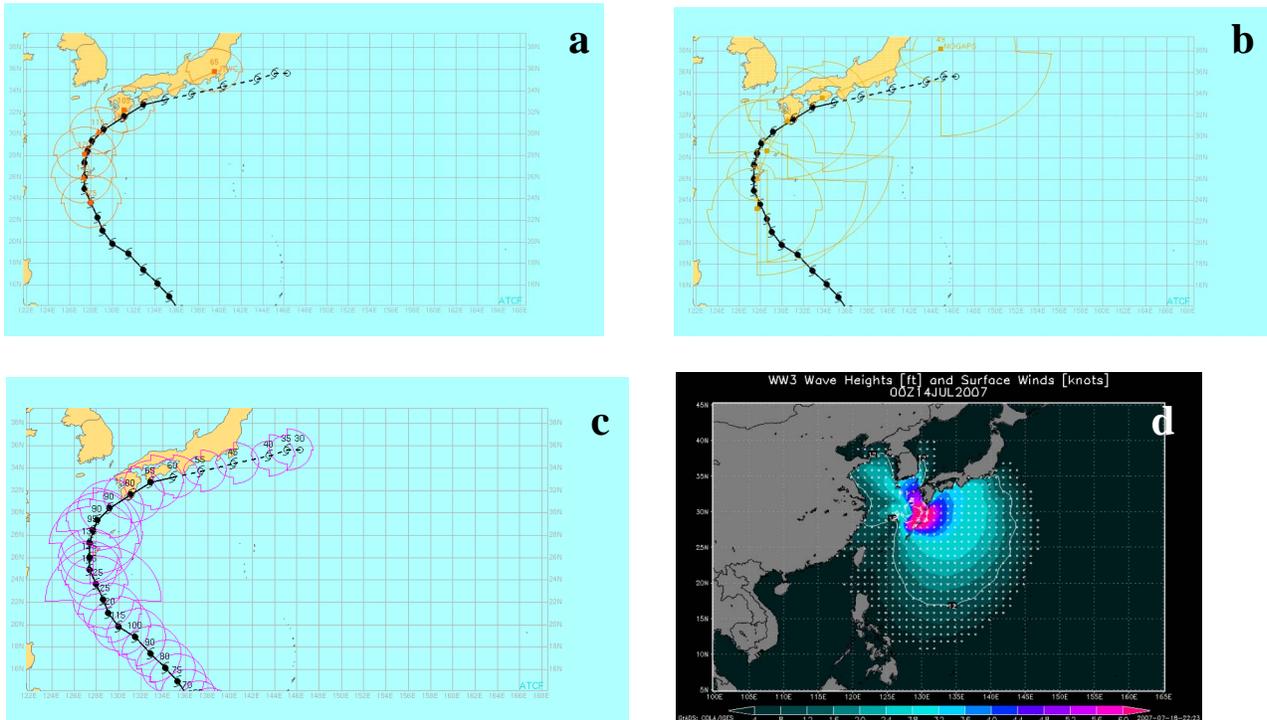


Figure 1. Track and 34 kt wind radii for a) the JTWC forecast b) the NOGAPS forecast, c) the verifying tropical cyclone analysis and d) resultant 36-h Wavewatch III forecast using JTWC forecast as input. Forecasts are for MAN-YI (WP052007) 12 UTC July 12, 2007.

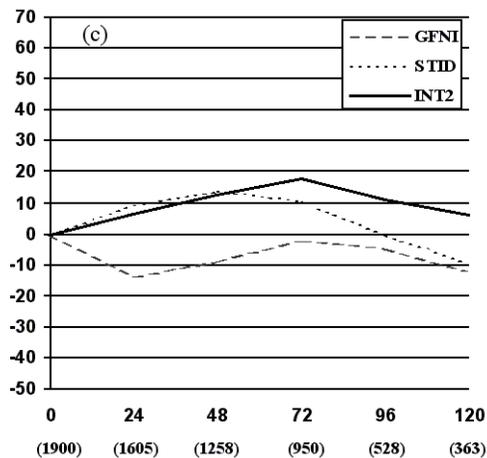
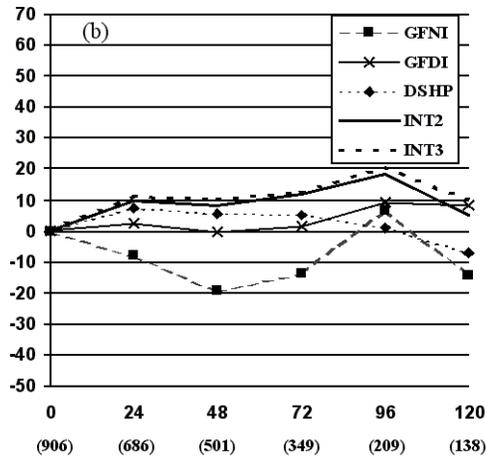
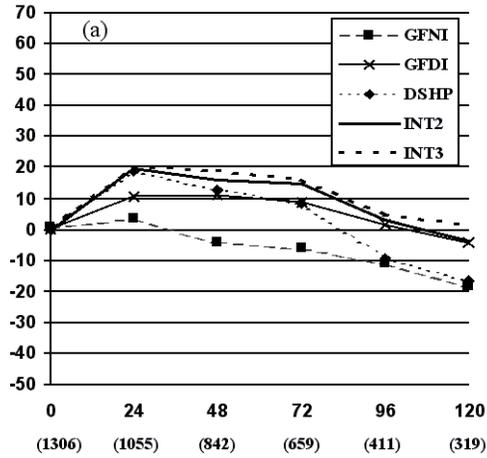


Figure 2. Intensity forecast skill (%) of consensus and consensus members relative to a statistical model in (a) the Atlantic, (b) the eastern North Pacific, and (c) the western North Pacific for the 2003-2006 seasons. INT2 and INT3 are the consensus aids while GFDI, GFNI, DSHP and STID are individual forecast aids.

IMPACT/APPLICATIONS

The Wavewatch III work is intended to be a forecast aid for ship routing and shore sites with assets affected by high seas. The output is consistent with the operational tropical cyclone forecast, which can be much different than that of an individual NWP model. The concept has received interest and encouragement from Naval personnel at NMFC Pearl Harbor, NMFC Norfolk, COMSUBGRUSEVEN Japan, TPC Miami and NOAA/NWS WFO Honolulu.

The intensity consensus aids produce deterministic forecasts that are intended for use at the Joint Typhoon Warning Center and the National Hurricane Center. Intended uses are for operational guidance and as baselines to evaluate the skill (in terms of mean forecast error) of other more complex ensemble techniques. The aids developed in this work are currently undergoing operational evaluation.

TRANSITIONS

The Wavewatch III work transitions to 6.4 ATCF and then to Fleet Numerical Meteorology and Oceanography Center.

The intensity consensus transitions to 6.4 ATCF then to the Joint Typhoon Warning Center and the National Hurricane Center.

RELATED PROJECTS

None.

REFERENCES

None

PUBLICATIONS

Sampson, C. R., J. L. Franklin, J. A. Knaff and M. DeMaria, 2007: Experiments with a Simple Tropical Cyclone Intensity Consensus. Wea. And Forecasting, In Press.