Report Documentation Page

Form Approved
OMB No. 0704-0188

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1. REPORT DATE	2. REPORT TYPE	3. DATES COVERED
SEP 2000		**00-00-2000 to 00-00-2000**

4. TITLE AND SUBTITLE	5a. CONTRACT NUMBER
Mesoscale Wind Predictions for Wave Model Evaluation	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

14. ABSTRACT

15. SUBJECT TERMS

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT **unclassified**	b. ABSTRACT **unclassified**	c. THIS PAGE **unclassified**	**Same as Report (SAR)**	**3**	

Mesoscale Wind Predictions for Wave Model Evaluation

Richard M. Hodur
Naval Research Laboratory
Monterey CA 93943-5502
phone: (831) 656-4788 fax: (831) 656-4769 e-mail: hodur@nrlmry.navy.mil

Award #: N0001400WX20041
http://www.nrlmry.navy.mil/~coamps/index.html

LONG TERM GOALS

The long-term goal is to demonstrate the significance and importance of high-resolution (< 10 km) atmospheric wind and surface stress fields produced by an atmospheric mesoscale data assimilation system to the numerical prediction of ocean waves by an appropriate wave model.

OBJECTIVES

The main objectives of this project are to:

1. Build the infrastructure to generate the appropriate high-resolution atmospheric fields.

2. Perform long-term (> 1 year) atmospheric reanalyses and forecasts for specific littoral areas of interest to wave modeling.

APPROACH

Our approach is to use the Coupled Ocean/Atmosphere Mesoscale Prediction System (COAMPS) for our atmospheric reanalyses and forecasts. The atmospheric component of COAMPS has reached a level of maturity such that it is routinely used for numerous basic and applied research topics as well as for operational mesoscale forecasts. It has been applied for a wide range of scales, using resolutions varying from approximately 100 km to under 1 km and has been validated for, and is run operationally at the Fleet Numerical Meteorology and Oceanography Center (FNMOC). COAMPS contains the following components for atmospheric analysis and prediction: complex data quality control; a multivariate optimum interpolation analysis (MVOI) capability for winds and heights; model initialization; and a nonhydrostatic, multi-nested forecast model. COAMPS has been found to be particularly effective in simulating mesoscale phenomena in coastal areas and areas of steep terrain.

In this project, we will generate a set of 3-dimensional analyses and forecasts, including atmospheric forcing fields needed for wave models (e.g., surface stress, 10 m winds) using COAMPS with the highest horizontal resolution possible (generally, less than 10 km). The analyses will use all available atmospheric observations (e.g., radiosondes, satellites, aircraft, ship), and will be produced at 12 hour intervals, using the previous COAMPS 12 hour forecast as the first-guess field for the next analysis. In addition, we will use high-resolution coastline (500 m resolution) and terrain (100 m resolution) datasets for accurate depiction of the land-sea boundary and the surface elevation. In a related program, an ocean analysis has been developed to construct analyses of the sea surface temperature for

all COAMPS grids at the resolution of each of these grids. These analyses are important for the proper specification of the lower boundary condition of the COAMPS atmospheric model over water, and will also be generated every 12 hours, using all available ship, buoy, and MCSST data.

WORK COMPLETED

1. A reanalysis for the Mediterranean Sea is on-going using an 81/27 km doubly-nested grid structure. Reanalyses and 24 h forecasts have been completed from 1 October 1998 through 31 July 2000. Another reanalysis for the Mediterranean was started using 36/12 doubly-nested grid structure. Fields from this reanalysis have been completed only from 1 October 1998 through 31 January 1999.

2. A reanalysis for the eastern Pacific is on-going using an 81/27/9 km triply-nested grid structure. Reanalyses and 24 h forecasts have been completed from 1 October 1998 through 30 April 2000. Fields to drive ocean and wave models have been saved for every hour during this time period.

RESULTS

The atmospheric reanalyses indicate that increasing horizontal resolution allows for more accurate representation of coastal effects, such as coastal jets, gap flows, land-sea breezes, and terrain-induced circulations.

IMPACT/APPLICATIONS

The modeling capability will be used in support of the wave model evaluations supported by the Advanced Wave Prediction Program. The COAMPS reanalyses generated in this project provide first-of-their-kind fields. Never before have fields been generated with similar space and time resolutions for such an extended period of time. These fields will be used to drive ocean wave models and, in a separate but related effort, these fields will also be used as forcing in the Navy Coastal Ocean Model (NCOM).

TRANSITIONS

The results and data that we generate as part of this program will be used by others. The fields from our reanalyses over the eastern Pacific will be used by scientists at NRL SSC and at the Naval Postgraduate School within their joint National Oceanographic Partnership Program to study air-ocean coupling processes on the west coast of the United States.

RELATED PROJECTS

This project complements our work in developing and testing the ocean data assimilation component of COAMPS within PE 0602435N, project 3523, which also provides some support for the generation of our high-resolution atmospheric reanalyses and forecasts. COAMPS is also used in related 6.1 projects within PE 0601153N that include studies of fetch-limited and orographic flows, and in related 6.2 projects within PE 0602435N that focus on the development of the atmospheric components (QC, analysis, initialization, and forecast model) of COAMPS. 6.4 projects (within PE 0603207N) focus on the transition of COAMPS and TAMS/RT (Tactical Atmospheric Modeling System/Real-Time) to FNMOC.