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Front Cover: Figure depicts streamlines of most frequent September, 1980 wind directions, south-central California. Used by permission, from "South Central Coast Cooperative Aerometric Monitoring Program (SCCCAMP)" by Walter F. Dabberdt and William Viezee. Published in BAMS, Vol. 68, No. 9, Sept. 1987.

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EVALUATION OF WAVE FORECASTS FOR THE GULF OF MEXICO*

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1. INTRODUCTION

Presently, there are three operational wave models routinely forecasting wave conditions in the Gulf of Mexico. One of them is the Fleet Numerical Oceanography Center's GSOWM which provides 72-hour wave forecasts at 12 hour intervals and at a resolution 2.5 degree grids (Zambresky, 1987). The other two models are the NOAA Ocean Wave (NOW) and the Techniques Development Laboratory (TDL) models. The NOW model (Chin,1985) is a discrete spectral wave model whose mesh size is 2.5 degree in latitude and longitude extending from 70S to 75N. The model computes 72-hour forecasts at 3 hour intervals. Boundary layer wind fields to drive the model are computed from the 1000 mb wind fields of the NMC global atmospheric spectral model. Corrections are made for height above the sea surface and stability using the air-sea temperature difference. The TDL model is a singular wave model based on regression equations for calculating the significant wave height and period (Pore and Richardson, 1973). It provides 48-hour forecasts at 12 hour intervals. The grid size of the model is approximately 250 km. The input winds are obtained from the NMC Limited-Area Fine-Mesh (LFM) wind model.

Questions concerning the adequacy of using these model outputs as a guidance for realistic forecasts of wave conditions in the Gulf have been raised by concerned marine forecasters. The relative levels of forecasting performance of these models have not been systematically verified against observed data. The problem becomes quite acute when the forecast results of these models for an identical location and time are significantly different. The major shortcoming of the TDL model stems from its pure empiricism; there is no physics involved in the formulation of prediction equations. It is difficult to improve this type of model. The NOW model and the GSOWM, on the other hand, are built upon a theoretical base even though they do not include all known wave dynamics. They are, however, designed to predict the general wave patterns of the global-scale ocean. The output of these models cannot be accurate enough to describe small-scale, regional wave phenomena. Furthermore, all three models only predict waves in deep water. Waves near the coastal areas, where most human activities are concentrated, cannot be predicted by either of these models. The effects of bottom conditions on wave growth, transformation and dissipation are excluded from their model formulations.

As part of the continuing effort to improve and extend NMC wave forecasting capability over the coastal areas of the United States, a new regional spectral ocean wave model applicable for both deep and shallow waters of the Gulf of Mexico, NROWM1, has been placed in an experimental operational evaluation mode. The purpose of this article is to present the result of comparisons between measured deep water wave data and concurrent wave forecasts provided by the aforementioned four models. An evaluation of the performance of the new model in shallow water areas will be presented in a separate paper.

2. THE REGIONAL OCEAN WAVE MODEL

The NOW and TDL models as well as GSOWM have been briefly described above. Detailed information concerning the NROWM1 will appear in a separate paper. However, for completeness, some information relevant to the present article are described below.

The NROWM1, is an adaptation of the model developed by Duffy and Atlas (1984) to the Gulf of Mexico. The essential governing equations and computational procedures follow the model described by Golding (1983). The model solves the energy balance equation of the form

$$[[[[\partial E/\partial t = -\nabla.(VE)] - \partial[(V.\nabla\theta)E]/\partial\theta] + I + D] + N]$$

where E is the spectral density of the wave field, V the group velocity and θ is the wave direction, and where I represents energy input from winds, D ener-

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