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## The Gulf of Alaska Regional Wave Model

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FIRST BULLETIN ON THIS SUBJECT



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This bulletin, written by Yung Y. Chao of the Marine Prediction Branch, Development Division, National Meteorological Center (NMC), describes the structure and performance of a new operational regional ocean wave forecast model for the Gulf of Alaska.

The model runs twice daily by using wind data derived from aviation runs of the NMC global atmospheric model. Model outputs for the projection hours 0, 12, 24, 36 and 48 are transmitted to the NWS Forecast Office in Anchorage in Gridded Binary (GRIB) format on NMC Storage Grid 214 (polar stereographic, 47.625 km grid size). Transmitted data include the significant wave height of wind-sea and swell combined, the period and direction associated with the peak energy component of the directional spectrum, the significant wave height, the mean period and mean direction of swell, and the mean period of wind sea. The model performance has been evaluated by means of statistical error analyses by using National Data Buoy Center (NDBC) buoy wave measurements as the standard of reference. Indications are that the model can provide good quality guidance forecasts.



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# THE GULF OF ALASKA REGIONAL WAVE MODEL[1]

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## 1. INTRODUCTION

Accurate forecasts of wave conditions over the open oceans in general, and the coastal areas in particular, are required for the safety and efficiency of recreational and commercial activities at sea.

Currently, the National Weather Service (NWS) has one spectral wave model routinely forecasting wave conditions on the global oceans, including the Gulf of Alaska. It is the National OOceanic and Atmospheric Administration Wave Model (NOAA/WAM) (Chen 1995). This model provides 72-h forecasts, and the spectrum is described by 25x12 discrete frequency-direction spectral components at each of about 7,000 grid points. The grid mesh is 2.5 by 2.5 degrees in latitude and longitude, extending from 67.5°S to 77.5°N. The NOAA/WAM is a third-generation wave model[3].

Questions concerning the adequacy of using this model's output as guidance for realistic forecasts of wave conditions in the Gulf have been raised by concerned marine forecasters. Since it is designed to predict general wave patterns of the global-scale ocean, the output of this model cannot be accurate enough to describe small-scale, regional wave phenomena. Furthermore, this model only predicts waves in deep water. Waves near the coastal areas, where most human activities are concentrated, cannot be predicted by this model. The effects of bottom conditions on wave growth, transformation, and dissipation are excluded from its model formulations.

As a part of NMC's continuing effort to improve and extend wave forecasting capability over the coastal areas of the United States, a second generation[4], regional spectral ocean wave model applicable for both deep and shallow waters of the Gulf of Alaska was implemented April 19, 1994.

## 2. MODEL CHARACTERISTICS

The Gulf of Alaska regional wave model (GAK) solves a spectral energy balance equation involving wave growth by winds, refraction by bottom bathymetry, energy loss due to whitecapping and bottom friction, and parameterized wave-wave energy transfer. The structure of the wave model is essentially the same as the one that is currently operational for the Gulf of Mexico (Chao 1991). However, unlike the Gulf of Mexico which can be considered as an enclosed basin, the Gulf of Alaska is open to the Pacific Ocean. In this model, the effect of waves incoming from the Pacific is treated as the input boundary condition obtained from the NOAA/WAM.

A grid mesh of 30 by 30 n mi has been established for the Gulf region extending from 53°N to 61°N and 132°W to 155°W. A total of 30x18=540 grid points is required to cover the area. The grid points in the outer portion of the Gulf are overlaid on the global model grid points of 2.5 by 2.5 degree resolution in latitude and longitude. Wave spectra forecasts by the NOAA/WAM in this boundary zone at 3-h intervals

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[1]For a detailed description of the model structure and forecast performance, see Chao (1993).

[2]OPC Contribution No. 84

[3]A third generation wave model uses the most updated wave dynamics in wave generation, wave dissipation, and nonlinear energy transfer with no limitation on wave growth.

[4]A second generation wave model uses dynamics in wave generation, but the nonlinear energy transfer mechanism is over-simplified, and the wave growth is artificially limited by the Joint North Sea Wave Project (JONSWAP) spectrum (SWAMP Group 1985).