Proc. IEEE Conf., Ocean91, 3, Pages 1177-1180.

DYNAMICAL AND STATISTICAL PREDICTION OF MARINE GUIDANCE PRODUCTS*

by

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ABSTRACT

The Ocean Products Center (OPC) provides a variety of marine meteorological and oceanographic guidance products to the National Weather Service's (NWS) field forecast offices which have marine responsibilities. Some of the products are generated by applying additional dynamical and/or thermodynamical considerations to the output fields from the operational large scale numerical weather prediction (NWP) models of the National Meteorological Center (NMC). Some examples of such forecast fields are the ocean surface winds, global spectral ocean wave forecasts using a deep water model, and a regional shallow water spectral model for the Gulf of Mexico. Since the large scale NWP models are not capable of resolving coastal geometry adequately, a separate set of wind forecasts are produced at several coastal points that are considered critical by the NWS using a statistical approach based on the forecast fields of the nested grid model (NGM) This approach is also used to forecast wind fields over 12 regions on the Great Lakes. Wave forecasts on the Great Lakes are produced at 64 points using these regional winds in an empirical scheme. Statistical techniques are also use to produce guidance forecasts on fog and visibility over the high seas areas of the North Atlantic and North Pacific.

Introduction

NWS is responsible for providing forecasts and warnings to increase the safety of life and property, and for the of conduct marine operations in a safe and effective manner, in coastal, off shore, and high seas areas of the U.S. as well as over the Great Lakes. To support this responsibility of the NWS, NMC provides central guidance products from a suite of operational models and disseminates them to the field offices using various communication networks. This central guidance is then used by the field offices, with appropriate modifications to account for local conditions, to issue warnings and forecasts to the public. The public forecasts normally consist of wind, wave, and weather (small craft advisories, gale, storm, tropical cyclone, and hurricane storm surge warnings) information. Where and when appropriate, ice conditions are included in the forecasts of certain field offices. In addition, analyses of global and regional sea surface temperatures, frontal analyses of the Gulf Stream and Loop Current and the associated eddies are also provided to the public on a regular schedule. See [6] for a detailed description of the products produced by the OPC. A brief description is presented in this paper on the OPC models that provide forecasts of the ocean surface winds, coastal and Great Lakes winds, fog and visibility, and global and regional ocean waves.

Wind Forecasts

The marine wind forecast products consist of two distinctly different types. One is a global product that provides forecasts of winds at 10 m. above the ocean surface on a grid of 2.5 x 2.5 degrees latitude and longitude. This product is derived from the global operational Aviation (AVN) model through the use of a diagnostic boundary layer technique. The other is a local product that provides wind forecasts for selected locations along the coasts and the Great Lakes. This product is derived by applying statistical techniques to output fields from the operational NGM (see the special issue of Weather and Forecasting, Vol. 4, No. 3, 1989 for a collection of articles on NMC's numerical models).

The AVN model is a global spectral model with a horizontal wave number truncation of T-126. Its vertical coordinate is a sigma coordinate. The model has 18 unequal layers in the vertical between its top and bottom. The lowest sigma layer is 10 mb thick and, hence, the forecast winds are available at approximately 50 m above the sea level. To a good first approximation, this height can be considered to be in the constant flux layer and, therefore, a simple logarithmic profile fit is sufficient to obtain the winds at 10 m from the forecast level of 50 m. Stability of the atmospheric column above the ocean, as represented by the air-sea temperature difference, is taken into account in deriving the 10 m winds. The forecast fields are distributed to the field offices over the AFOS (an electronic communication system used by NWS for information exchange) in terms of wind barbs. The forecasts are also sent over the DIFAX, Honolulu FAX, Alaska FAX, and San Juan Fax systems with areal coverage appropriate to each region. Of all of these fax charts, only those on the DIFAX are available to the public through subscription. The fax charts combine both wind and wave information to save transmission time-one chart containing wind and wave height forecasts and another containing dominant wave period and direction. Fig.1 is an example of the DIFAX chart displaying wind forecasts using wind barbs (and also significant wave heights from the global deep water model to be discussed later) on a 2.5x2.5 degrees latitude/longitude grid. The OPC routinely performs a quantitative evalua-

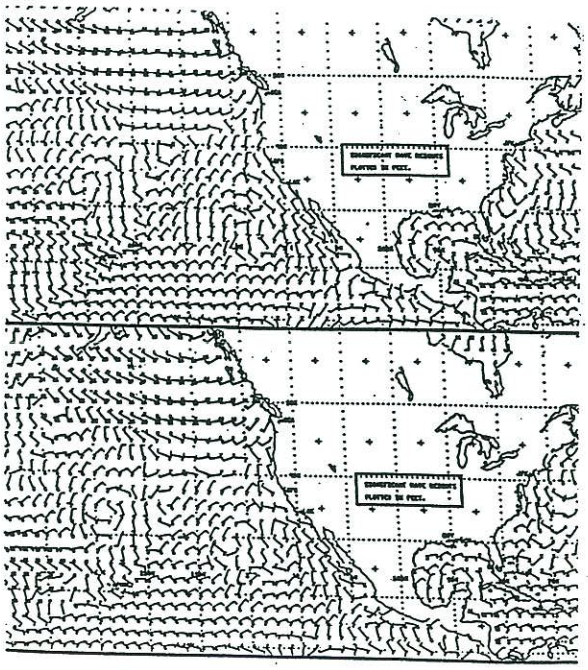

Figure 1. Sample DIFAX charts of gridded sigificant wave height (SWH) and winds barbs at two different time projections 12h apart.