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LAKE ERIE WAVE HEIGHT FORECASTS
GENERATED BY EMPIRICAL AND DYNAMICAL METHODS -
COMPARISON AND VERIFICATION*

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1. INTRODUCTION

Accurate wave forecasts are very important to shippers, coastal industries, commercial fisheries, coastal residents, and recreational boaters and bathers. Lake activities are often interrupted by the destructive action of severe storms and waves. For example, in a storm on November 9, 1913, ten ships were sunk and 20 others were driven ashore with the loss of more than 250 lives. Lakes Huron and Superior were hardest hit. More recently, April 1979, the 315 ft ship LABRADO, with a crew of 20, foundered on Lake Erie in 20 ft seas and 45 kt winds. Fortunately all hands aboard LABRADO were rescued by helicopter.

To aid marine forecasters in preparing wave forecasts, automated wave height forecast guidance for the Great Lakes has been generated at the National Weather Service's (NWS) National Meteorological Center since January 1975. These forecasts are made with an empirical wave forecast method developed by NWS's Techniques Development Laboratory (TDL). Wind input to the method is from NWS automated wind forecasts. Recently NOAA's Great Lakes Environmental Research Laboratory (GLERL) and Canada's National Water Research Institute have developed a dynamical wave prediction model for the Great Lakes. This model, which may also be driven with NWS automated wind forecasts, is available to NWS Forecast Offices.

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An opportunity to compare and verify wave height forecasts generated by the two forecast methods presented itself when two sets of Lake Erie wave data were collected in September and October 1981. The first set of measurements is from a NOAA buoy, reporting real-time wave data via satellite, that is moored in the western part of Lake Erie (Fig. 1). The second set consists of nearly continuous measurements of wave height at a GLERL tower located 6 km off the southern shore of the Lake. See Fig. 1.

Before we present the results of our comparison and verification, we will briefly discuss wave generation and automated wind forecasts for the lake. This will be followed by a description of the two wave forecast methods and a comparison and evaluation of 24-h significant wave height (average height of the one-third highest waves of a given wave group) forecasts generated by these methods. The evaluation will include a look at measured data, plots of measured and forecast wave heights, and objective verification statistics. Conclusions and future plans based on this evaluation will also be presented.

2. WAVE GENERATION

Wave height and period are a function of fetch (distance over water that wind has essentially constant direction and speed), wind speed, and duration (length of time the wind has blown over the fetch). Waves are generated not only in the direction of the wind, but at various angles to the wind. The effect of a narrow fetch width, such as found on Lake Erie, is to enhance the contribution of wave growth by wave components from the maximum fetch direction, which may be different from the wind direction (Donelan, 1980).

Shallow water will also affect the height of the individual wave form. At a depth of about one-half the deepwater wave length, waves start to "feel" the bottom, and their height, length, and velocity begin to change. The height of the shoaling wave first decreases slightly and then increases until reaching the breaking point. As waves enter shallow water, they also undergo height