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SURFACE WAVE DATA RECORDED IN LAKE MICHIGAN DURING 1973 AND 1975-77

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This report presents surface wave data recorded by Waverider Buoys deployed in Lake Michigan during 1973, 1975, 1976, and 1977.

1. INTRODUCTION

This report presents surface wave data recorded by Waverider Buoys deployed in Lake Michigan during 1973, 1975, 1976, and 1977. Latitude, longitude, and depth of the buoy locations are listed below. The data were continuously recorded on analog magnetic tapes and processed through a computer digitization and analysis system that includes manual editing, calibration, time correlation, analysis, and data summary generation. Prior to August 1976 the analog signals from the Waverider Buoys were recorded at receiving stations located and monitored in the field. Since August 1976 the buoy signals at the lake receiving stations have been transmitted via radio and telephone links and recorded on laboratory instruments at the Great Lakes Environmental Research Laboratory.

2. MEASUREMENT AND RECORDING OF WAVES

2.1 Waverider Buoys

The Waverider Buoy, manufactured by Datawell, Holland, is of spherical shape 1 m in diameter and about 100 kg in weight. It contains two main components: an accelerometer and a transmitter. The accelerometer, mounted on a pendulous system, measures the vertical component of acceleration as the buoy moves with the waves. Two electronic integrators in cascade then transform the output into a voltage that represents the vertical displacement of the buoy. This voltage controls the frequency of an audio oscillator, which in turn modulates a crystal controlled transmitter that transmits the signal by telemetry to a shore receiver. The Waverider is moored tc a chain sinker with a mooring line consisting of a rubber stretch cord, steel cable, and polypropylene rope. Total length of the mooring line approximated twice the depth of water.

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Table 1. Waverider Buoy Locations

Time period	Latitude	Longitude	Depth, m
Muskegon, Mich.			
1973 (June 30-Nov. 27)	43.15" N	86.43" W	50
1975 (July 23-Dec. 4)	43.17' N	86.43' W	45
1976-1* (Sept. 22-Nov. 22)	43.17" N	86.47" W	75
1976-2 (Aug. 16-Nov. 19)	43.17" N	86.57" W	105
1977-1 (July 8-Nov. 27)	43.20" N	86.45" W	75
1977-2 (July 9-Oct. 2)	43.20" N	86.58" W	105
Milwaukee, Wis.			
1976-3 (Sept. 22-Oct. 12)	43.17' N	87.52' W	70
1977-3 (June 13-July 14)	43.20' N	87.77" W	75
1977-4 (June 16-Nov. 29)	43.20" N	87.64" W	90

*The first of three gages monitored during this year.

2.2 Recording

Prior to 1977 the wave data were recorded on a tape recorder that used standard 0.635 cm (0.25 in), one-track magnetic tape at a recording speed of 0.02 cm/s (0.5 in/min). During 1977 the recording speed was 0.04 cm/s (1.0 in/min). These slow speeds make it possible to store 10-20 days of continuously recorded analog wave data on a single tape. Further description of this recording system as well as the time and height calibrations is given in Liu and Robbins (1974).

3. DATA PROCESSING

The recorded wave data were processed through a computer digitization and analysis system developed during 1972, the International Field Year for the Great Lakes, for use with a Xerox Sigma III computer and subsequently revised for GLERL's Hewlett Packard 9603A. The analog wave data tapes were digitized at an equivalent real time rate of three samples per second through an analog-to-digital converter configured as a peripheral device to the computer. The processed wave data were stored in record blocks, each equivalent to 5 min of actual recording, on digital magnetic tapes with units calibrated to meters and proper time headers inserted in each block. Wave statistics presented in this report were calculated based on 10 min of digital data during each hour.

Wave heights and periods were determined by consecutive zero-upcrossings of the average water surface. Liu and Robbins (1974) give a detailed discussion of this data processing system.

4. PRESENTATION AND DISCUSSION OF DATA

The data presented in this report were generated in the form of daily summaries of hourly wave statistics. These statistics consist of standard deviations, significant and average wave heights, and their corresponding wave periods. It also includes the corresponding analog tape tab number, record-block number index, and data type, together with a plot of the significant wave height and period for easy reference. In addition to providing basic and systematic wave information, these data summaries can also be used as an index to the digital tapes for further analysis and study.

Among the variables presented in the summaries, the significant wave height and average wave period are of particular interest. Since these two variables have been calculated with the zero-upcrossing method, they correlate quite closely with the corresponding significant wave height and average wave period derived from spectrum analysis as shown by Liu and Robbins (1974). Thus the data from this report can be understood and interpreted in terms of conventional spectrum analysis.

Applications and uses of these data, including detailed analyses of storm episodes, the study of spectral growth and decay of waves, the correlation of waves with available meteorological data, and the application of these data to wave predictions, are presently being developed at GLERL. Others interested in the use of the available digitized wave data should contact the authors at GLERL.

5. REFERENCE

Liu, P. C., and R. J. Rcbbins (1974): Wave data analysis at GLERL. In: *Proceedings, International Symposium on Ocean Wave Measurement and Analysis*, New York, American Society of Civil Engineers, 64-73.

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