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Wave Sensing in the Upper-Great Lakes Observing System (Extended Abstract)

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1. Introduction

The Upper-Great Lakes Observing System (UGLOS) began deploying buoys on the Great Lakes in 2003 as part of the Integrated Ocean Observing System (IOOS) regional partner Great Lakes Observing System (GLOS). Oceanographic and meteorological data gathered by the buoys (Fig. 1) are transmitted every ten minutes back to receiving stations on land for further processing and visualization [1].

As the system gained popularity, new partners such as DTE Energy, the Great Lakes environmental Research Laboratory (GLERL) of NOAA, the National Data Buoy Center (NDBC), and the Alliance for Coastal Technologies (ACT) began requesting new data products in addition to more *in situ* platforms. Coastal researchers and data modelers noticed a distinct lack of wind and wave data from the near-shore region, especially in the Great Lakes [2]. One highly requested data product was the observation and estimation of near-shore surface wave information.

In 2008, GLOS funding allowed the Ocean Engineering Laboratory (OEL) to pursue buoy refurbishments and the design of a new buoy-mounted wave sensor. Many technologies exist to measure waves such as submerged pressure gauge fields, acoustic surface tracking, marine radars, laser altimetry, and inertial measurements. The OEL investigated each technology to assess the applicability for inclusion on the UGLOS monitoring buoys.

This paper discusses the design of the OEL IWS, ongoing research involving the observation of waves, a comparison of IWS output to the Great Lakes Coastal Forecasting System output, and a brief overview of future upgrades to the wave sensing program.

2. Inertial Wave Sensor Design

The OEL IWS (Fig. 1) is a +12V (+9 to +38V dc) powered inertial wave sensor that reports heading, significant wave height, dominant wave period, and mean wave direction via RS-232 communications. The IWS contains an integrated three-axis accelerometer (Analog Devices ADXL330) and a digital compass (Honeywell HMR3300) which also reports roll / pitch. These components provide 12bit measurements at a sample rate of 2Hz.

Due to the amount of data that is measured, it is impractical to store the entire wave record over the duration of deployment. Instead, each sample of approximately 8.5 minutes of data is temporarily recorded and post-processed to extract wave statistics from the record. Wave analysis is computed by a Digi International Rabbit RCM3600 core module using a custom discrete Fast Fourier Transform algorithm.

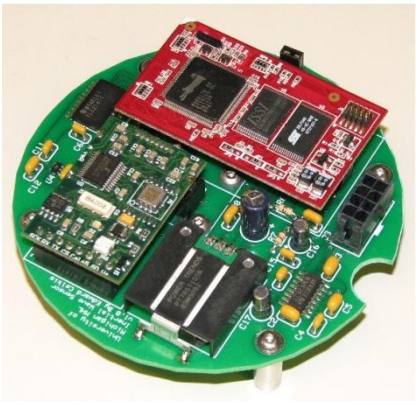

Figure 1. Upper-Great Lakes Observing System Environmental Monitoring Buoy.

3. Research

The University of Michigan's Ocean Engineering Laboratory is currently engaged in three research efforts motivated by the near-shore wave and meteorological data provided by the UGLOS buoys: automated detection and prediction of lake-breeze events, forecasting of harmful algal blooms, and better understanding nutrient and pollutant transport throughout the Great Lakes. These studies further demonstrate the need for high temporal resolution of nearshore observations.

4. Acknowledgment

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5. References

[1] H. C. Brown, H. L. Purcell, and G. A. Meadows, "The Upper-Great Lakes Observing System," in Proceedings of IEEE/MTS OCEANS 2010, 2010.

[2] L. Harris and V. R. Kotamarthi, "The characteristics of the chicago lake breeze and its effects on trace particle transport: Results from an episodic event simulation," Journal of Applied Meteorology, vol. 44, no. 11, pp. 1637–1654, 2005.