DISPLACEMENT BASED COMPARISON OF ACCELEROMETER AND LOW-COST GNSS WAVE BUOYS

Jeff Hansen, University of Western Australia, jeff.hansen@uwa.edu.au
Michael Cuttler, University of Western Australia, michael.cuttler@uwa.edu.au
Ryan Lowe, University of Western Australia, ryan.lowe@uwa.edu.au
Ian Young, University of Melbourne, ian.young@unimelb.edu.au
Daniel Ierodiaconou, Deakin University, daniel.ierodiaconou@deakin.edu.au

INTRODUCTION

Wave observations are critical in both coastal and deep water and feed into applications including improving ocean forecasting, industry activities, and marine safety. Wave buoys are typically the most robust method to collect in situ wave observations, particularly when real-time data is required, however they have historically been expensive to purchase and operate. With the advent of low-cost and small-format Global Navigation Satellite System (GNSS) based wave buoys (e.g. Sofar Spotter), the ability to collect wave observations across a wider range of locations is feasible at a much lower cost. However, understanding the performance and behaviors of small-format GNSS buoys (e.g. spectral response and mooring effects), against more traditional accelerometer based platforms, is critical to inform their use across research and industry applications.

A number of previous studies have assessed the performance of the Sofar Spotter GNSS wave buoy (one of the most common low cost wave buoys) against a range of other instrumentation including other wave buoys, acoustic instrumentation and pressure sensors (Lancaster et al., 2021; Raghukumar et al., 2019). Here, we focus on comparing the Sofar Spotter to Datawell Waverider (Mark 3 and 4) buoys which are commonly deployed in operational networks globally. However, instead of comparing processed products (e.g. spectral statistics) produced by the buoy's onboard software, we begin our analysis with the buoy displacement time series directly to ensure consistency. We also assess the detailed spectral properties/moments, the GNSS buoy performance in different conditions (locations), and with different mooring configurations.

METHODS AND RESULTS

Sofar Spotter buoys are GNSS based buoys that are ~0.4 m in diameter and weigh ~5 kg. The internal GNSS calculates displacements at 2.5 Hz with these data stored internally on an SD card. Spotter buoys are compared against Datawell Waveriders at two locations in Western Australia (WA) with varying degrees of Southern Ocean swell exposure and different local wind climates (Figure 1A). In Torbay, WA two Spotter buoys were deployed adjacent to a 0.9 m Datawell Waverider Mark4 in 32 m depth. The Spotter buoys were deployed on either side (as close as to avoid entanglement) of the Waverider with different mooring configurations, one with single catenary and the other with a double catenary. The Waverider Mark4 buoy records displacements at 2.56 Hz based on a fluid filled accelerometer. Like the Spotter buoy the displacement data is stored on an onboard memory card which we used for all analysis. At Tantabiddi, in Australia's NW a single Spotter buoy was deployed adjacent to a 0.7 m Datawell Waverider Mark3 (operated by the WA Dept. of Transport) in 42 m depth. The Waverider Mark3 buoy records displacements at 1.28 Hz based on a fluid filled accelerometer.

Displacement data from both the Spotter and Datawell buoys was processed in 1-hr blocks consistently using both zero-up crossing and spectral approaches. In total, 6873 hours of concurrent data are available across 2020 and 2021. At both sites the estimates of the significant wave height (H_{m0}) agree (Figure 1B). However, at the Torbay site the Spotter shows some negative bias (0.09 m) particularly during larger wave conditions. At Torbay the different Spotter moorings did not modify the overall comparison statistics (Figure 1C different colors). Spectral response is similar across both buoys, with the Spotters showing slightly increased energy at the lowest frequencies.

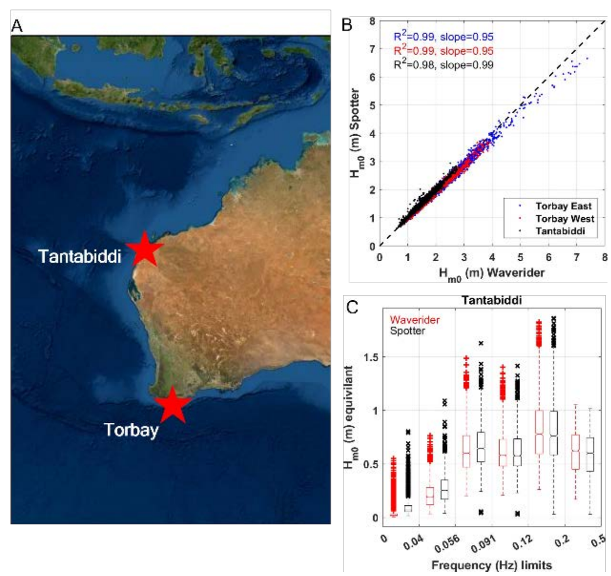

Figure 1. (A) Location map, (B) 1:1 plots of significant wave height (H_{m0}), and (C) box plot of equivalent wave height (Tantabiddi only)

REFERENCES

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