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Investigation of in-field devices for underwater surveying of reef structures

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Introduction

The aim of this study is to investigate how accurate and precise in-field devices at measuring underwater structures and features. These methods will be tested on a structure with well a known structure, where it has been directly (physically) measured or fabricated with known specifications, such as an Artificial Reef. This poster presents the results of the first data collection with a multibeam echo-sounder system over two pre-fabricated Artificial Reefs structures located 11 km south of the west end of Rottnest Island, Western Australia. As the structure and dimensions are well understood through engineering diagrams, they provide a valuable test site for underwater survey methods. Future work will include mapping the structures with other techniques, such as photogrammetry and laser, as well as repeating surveys to examine precision.

Methods

A multibeam survey was carried out on 27th September 2018 using the Western Australia Department of Transport's (DoT) hydrographic vessel the Alec Hansen lll. Data were collected over the artificial reef structures with DoT's R2Sonic 2024 multibeam echo-sounder and Applanix POS MV for position and attitude data. Acquisition was carried out in QPS QINSy. Post-processing of the POS MV data was carried out using Applanix POS Pac MMS. Processing of the bathymetry was carried out in QPS QIMERA. Engineering diagrams were drawn in Autodesk AutoCAD, and the point cloud was created in the Autodesk ReCap. Comparison between the multibeam measurements and the engineering diagram was carried out in CloudCompare including calculating the Root-Mean-Square (RMS) difference between the multibeam measurements and diagram.

Results

A 1m grid of the multibeam bathymetry surface can be seen in a 2D view in Figure 1 and a 3D view in Figure 2. A 3D view of the multibeam point cloud over the engineering diagram can be seen in Figure 3.

Results

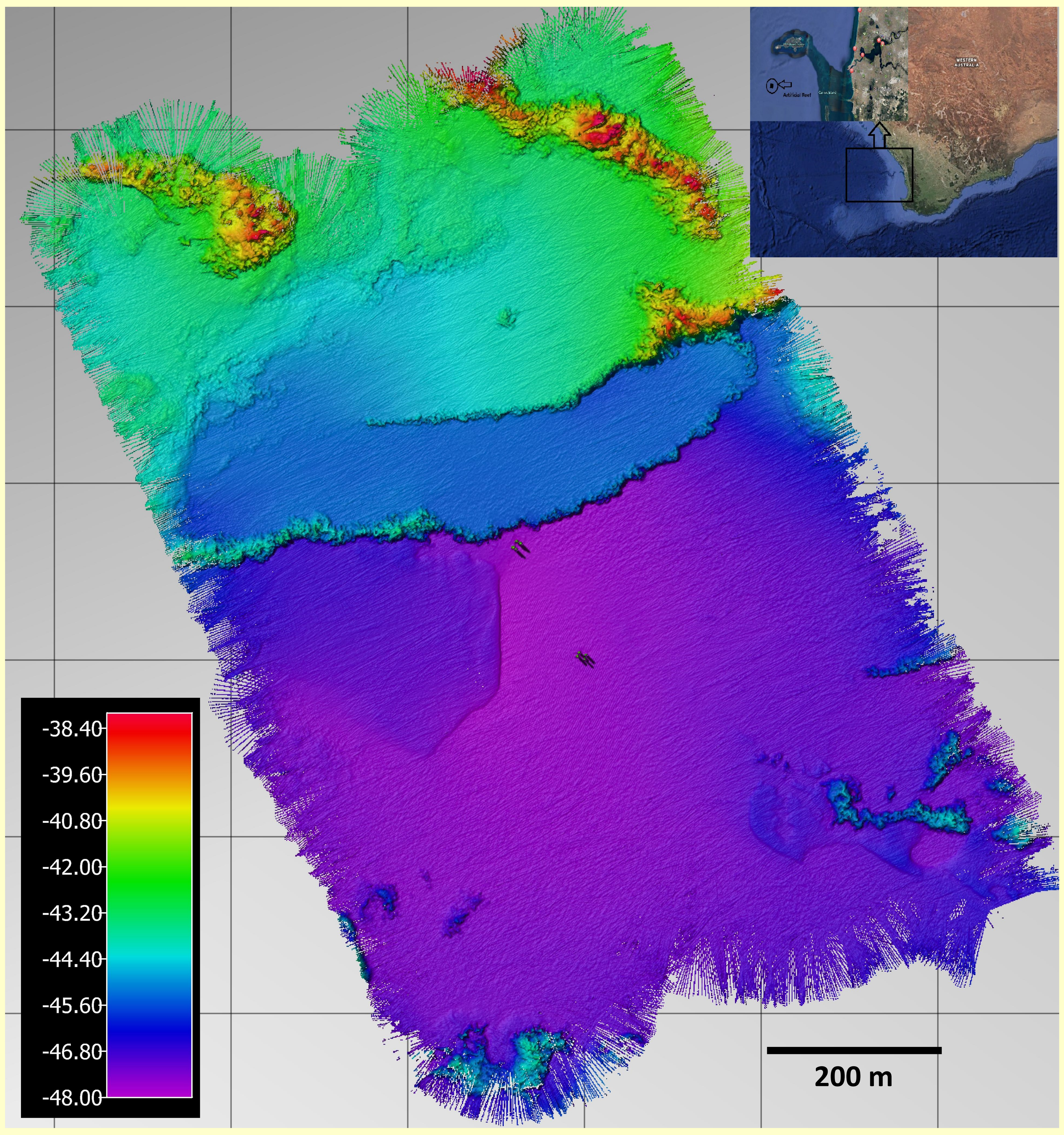

Figure 1: 2D View of the bathymetry of the Artificial Reefs and surrounding area.

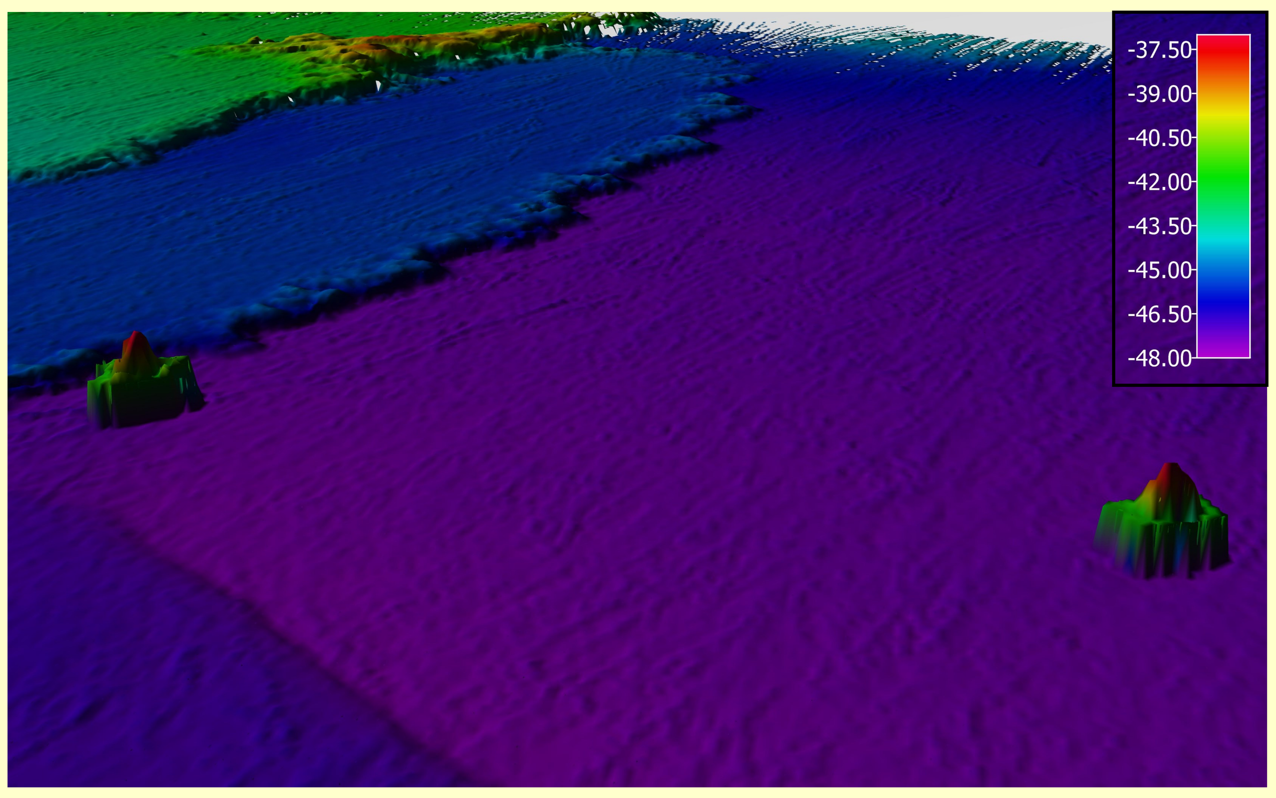

Figure 2: 3D View of the of the Artificial Reefs.

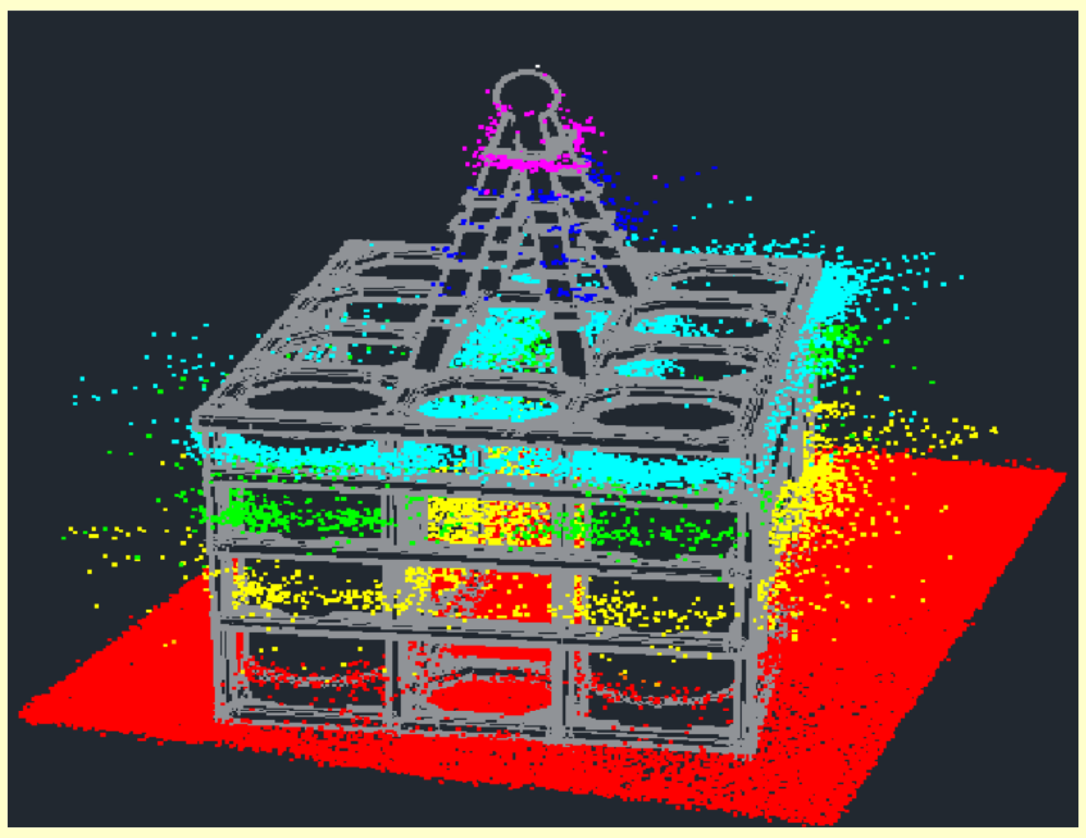

Figure 3: 3D View of the of the multibeam-measured point cloud over the engineering diagram of the Artificial Reef.

Analysis

Using the reef structures, the dynamic offsets of the multibeam system were further improved by the addition of –0.957° in the pitch alignment (Figure 4). The unsigned distances between the multibeam point cloud and the engineering diagram are shown as a 3D view (Figure 5) and signed values as a histogram (Figure 6). The RMS between the multibeam measurements and the engineering diagram was 1.167 m. The mean signed distribution distance was 0.846 m, and standard deviation was 0.939 m. However, the seafloor has contributed to the high distances see in Figures 5 and 6. Future work will aim to remove these points from the analysis.

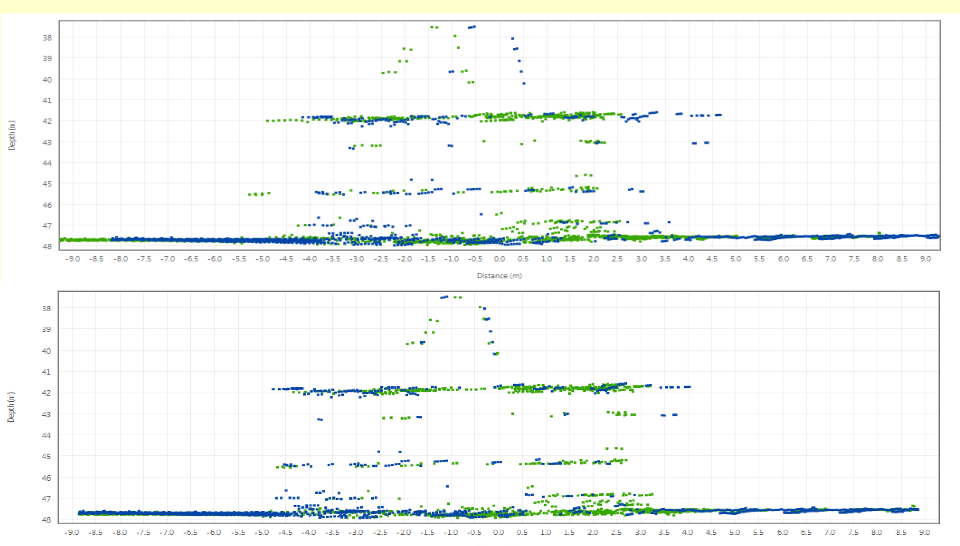

Figure 4: Point clouds over part of the Artificial reef: before (top) and after (bottom) adjusting the pitch offset.

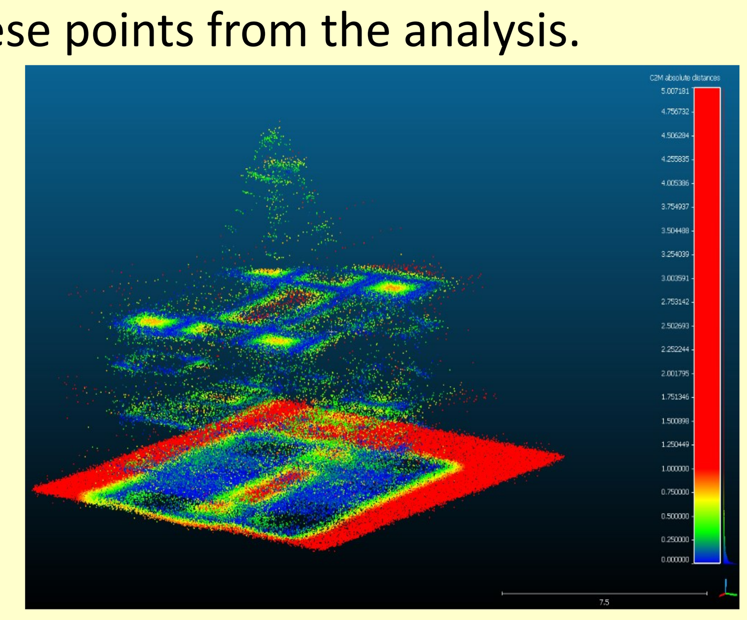

Figure 5: Unsigned distance between the multibeam point cloud and the diagram.

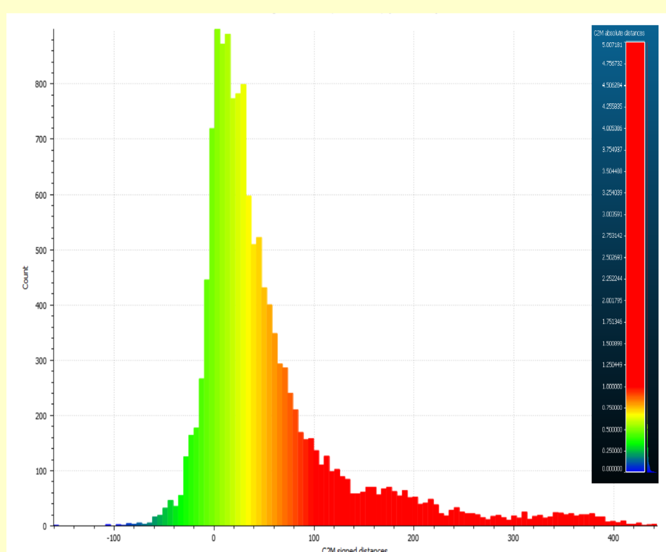

Figure 6: Histogram of the signed distances between the multibeam point cloud and diagram.

Acknowledgements

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