

WAVE ENERGY DISSIPATION FROM ADULT RED MANGROVES BASED ON MANGROVE FOREST DENSITY

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1. Problem Statement & Introduction

- Coastal ecosystems and inland waterways are at an increased risk due to the consequences of climate change and anthropogenic causes such as boat wake.
- Adult red mangroves (*Rhizophora mangle*) have demonstrated significant wave-breaking capabilities.
- This experiment aimed to look at adult red mangroves' wave energy dissipating properties and how this changes with mangrove density.



Figure 1: Mangroves breaking waves, mangroves in the tidal zone, and global mangrove coverage map

4. Results

- Over all trials, 1 model had a wave energy dissipation range of 0%-44.5%, 3 models 72.9%-98.6%, and 7 models 0-61.4%.

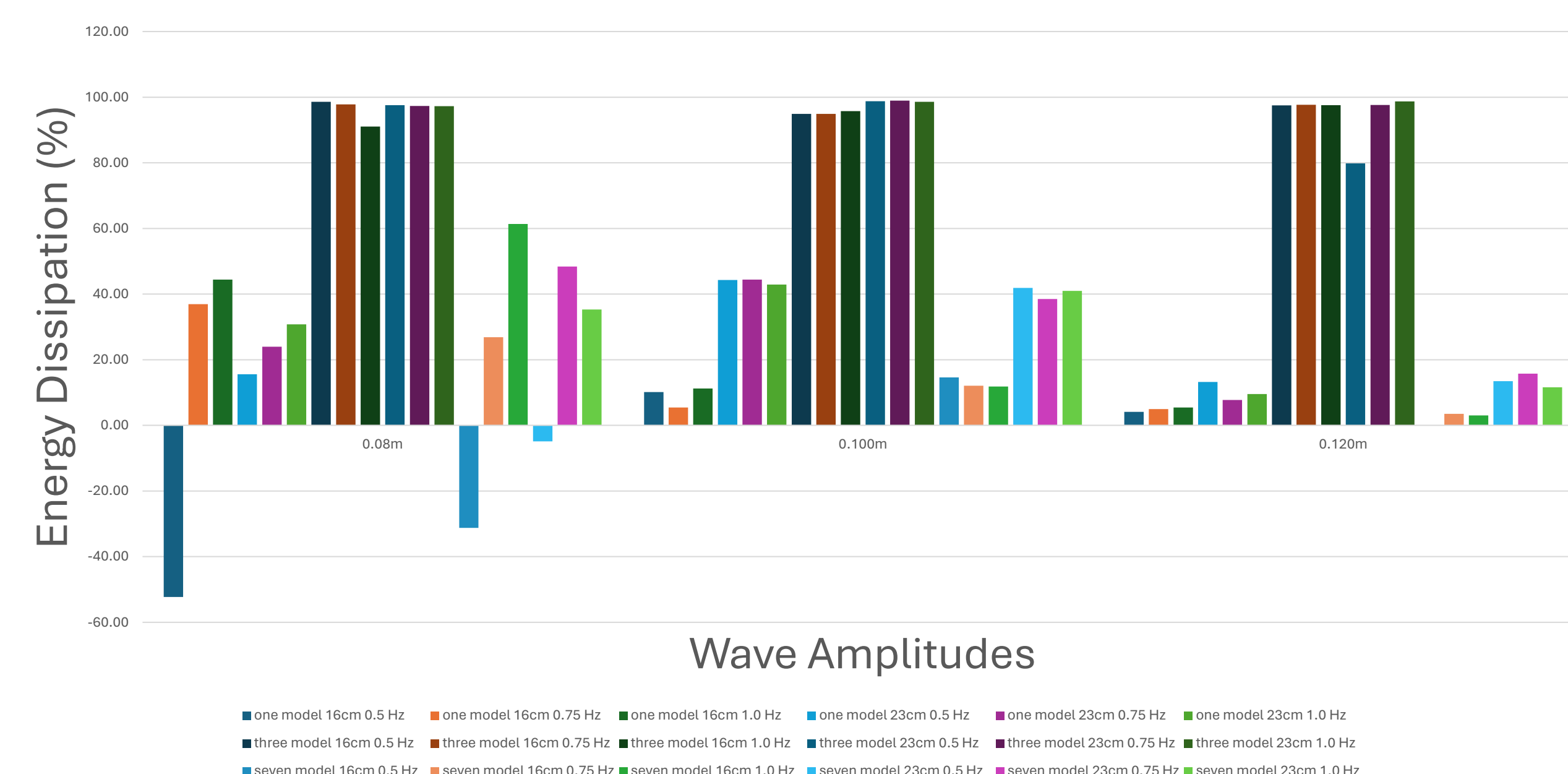


Figure 5: Energy dissipation per run dependent on number of models, frequency, water depth, and amplitude

2. Experimental Plan

Methods:

- Rigid mangrove models were created using PVC, steel wiring, and plastic tubing on a 1:5 scale using both South Florida mangrove data and field sampling.
- Wave parameters and water depth were scaled to fit the constraints of the Air-Sea Interaction (ASIST) wind-wave tank (15m l x 1m w x 1m h) while maintaining conditions found in a natural setting
- 4 mangrove densities were tested: 1-model, 3-models, 5-models, and 7-models
- Wave amplitudes of 0.08m, 0.10m, and 0.12m and wave frequencies of 1s, 1.33s, and 2s were used.



Figure 2: Experimental setup in ASIST

5. Conclusion & Future Study

- Adult red mangroves displayed wave energy dissipating potential, which increased with mangrove density.
- For 3 models, Wave Probe 2 and 5 were used rather than 3 and 5 so this could have affected the results.
- Future studies should include multiple sensor types as wave probes often returned faulty readings.
- Additional testing is needed but red mangroves represent a future, green protective measure for coastal regions and inland waterways.

3. Data Collection & Analysis

Sea surface elevation measurements were taken using Wave Probes, and these data were used to calculate

- Significant wave height (zero-up crossing)
- Wave energy
- Wave energy dissipation

*Data from the 5-model trial was not included due to sensor error
*Wave Probe 2 and 5 were used for 3-model trials due to turbulence generated from models that affected Wave Probe 3

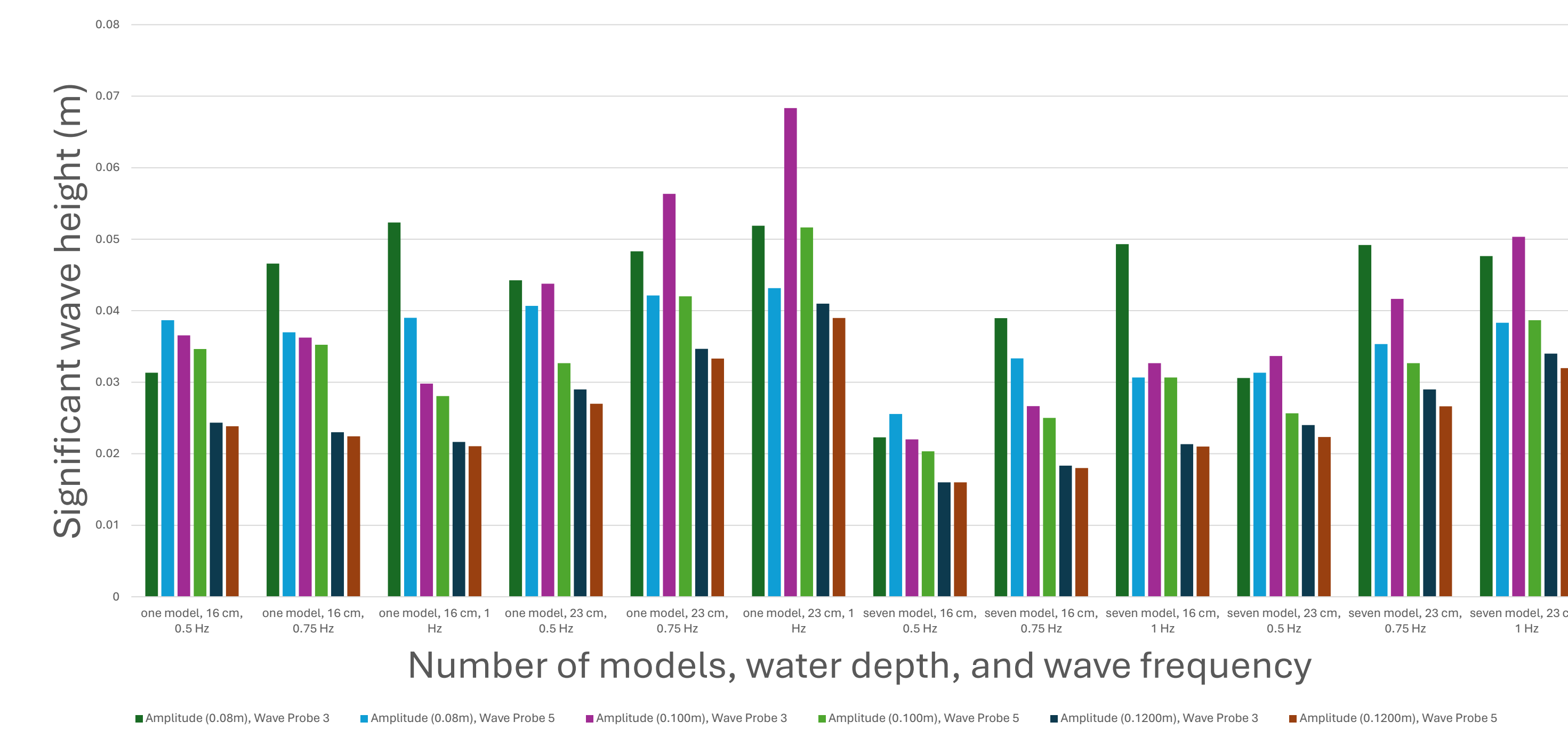


Figure 3: Significant wave height for the 1-model and 7-model trials at Wave Probes 3 and 5

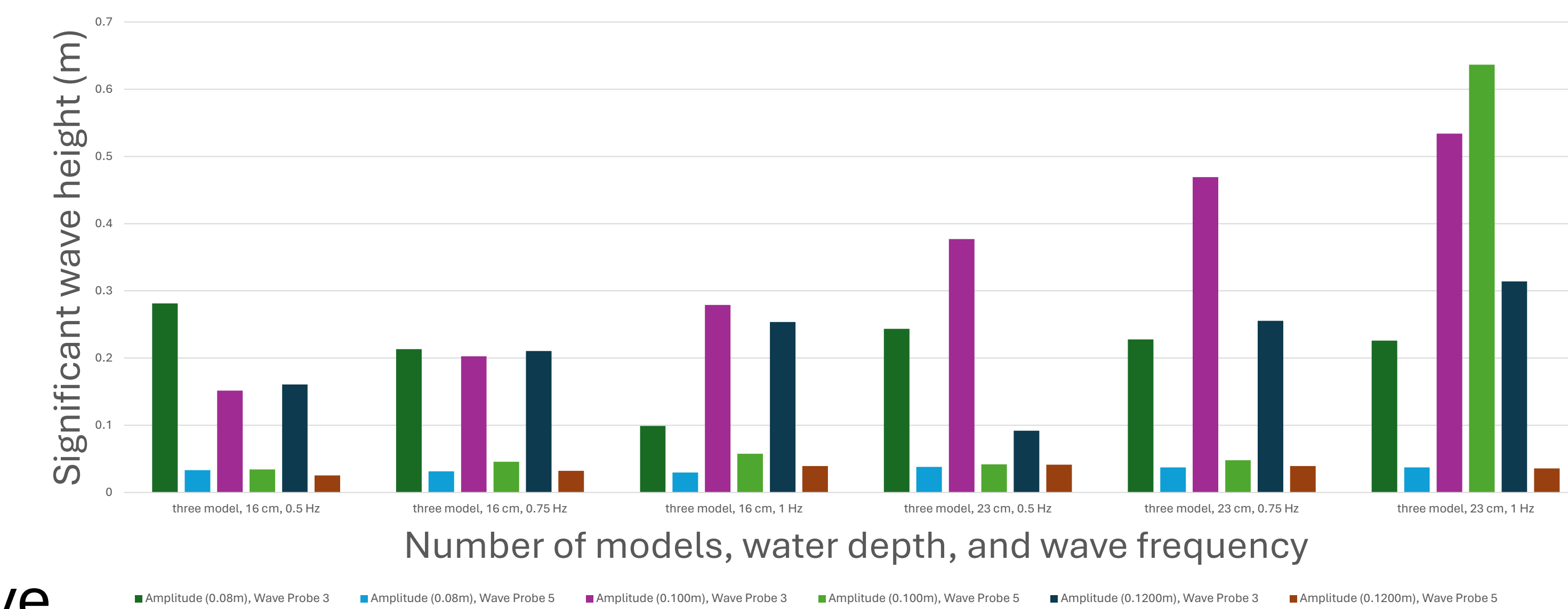


Figure 4: Significant wave height for the 3-model trials at Wave Probes 2 and 5

6. Acknowledgments

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