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Quantifying Wave Damping in Spartina alterniflora (Extended Abstract)

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Quantifying Wave Damping in *Spartina alterniflora*

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1. Introduction

Coastal or tidal marshes serve as the interface between dry land and ocean waters throughout the world, and the ecological importance of these natural features is widely established. More recently, there is a growing interest in describing and quantifying the impacts of vegetation on coastal hydrodynamics. Although a body of literature investigating vegetation in unidirectional flows is relatively comprehensive, there is a paucity of research in comparison for oscillatory-dominated flows [1].

A parametric study investigating the dissipation of wave energy by artificial *Spartina alterniflora* was performed in a large-scale flume. *Spartina* is the dominant emergent seagrass of Atlantic Ocean and Gulf of Mexico tidal marshes. The study focused on irregular wave trains, with varied significant wave heights (5.0-19.2 cm), peak periods (1.25-2.25 s), water levels (2 submerged, one emergent), and stem densities (200 and 400 stems/m^2). Bulk trends in wave attenuation and changes in spectral shape are discussed. Implementation of vegetation dissipation into the nearshore spectral wave model STWAVE is validated using the original solution [2]. Following validation, STWAVE is applied to the laboratory measurements to explore the behavior of the bulk drag coefficient.

2. Methods

The physical model experiments were completed in a wave flume measuring 64.1 m long, 1.5 m wide, and 1.5 m deep at the U.S. Army Engineer Research and Development Center. The vegetation field started 1.2 m after the transition from the 1/20 slope to a flat bottom and measured 9.8 m long. Free surface oscillations were measured by 13 capacitance wave gauges sampling at 25 Hz.

Polyolefin tubing was selected to serve as the artificial *Spartina* as it fulfilled three basic requirements: simulate basic morphology of a plant stem, reproduce the swaying motion of seagrass under wave action, and remain upright in shallow water to model emergent conditions. The tubing was cut into equal lengths of 41.5 cm and had a diameter of 6.4 mm, which is similar to values reported for real *Spartina* [3].

3. Results and Discussion

An increase in stem density and submergence ratio (ratio of stem length to water depth) resulted in a significant increase in wave attenuation for all wave

Figure 1. Artificial *Spartina alterniflora* bed.

conditions. Larger wave heights increased wave attenuation slightly, and no clear trend with respect to wave period was found. Although energy dissipation was observed at all frequencies of the wave spectra, higher-frequency components were dissipated more efficiently. The attenuation of higher frequencies is addressed by characterizing the spectral tail as an exponent function of frequency and exploring deviations from $f^{-4} – f^{-5}$. STWAVE was able to replicate the wave evolution trend of the experiments well, with a goodness of fit coefficient R^2 exceeding 0.90 for all comparisons. An empirical relationship between the bulk drag coefficient and the Reynolds number is reported.

4. Acknowledgment

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5. References

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