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# HOW ARTIFICIAL SALT MARSH VEGETATION REDUCES THE THRESHOLD FOR SEDIMENT RESUSPENSION IN WAVE-CURRENT FLOWS

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## 1 INTRODUCTION

Suspended sediment transport and retention within salt marshes is a key factor in their resilience against erosion associated with threats such as sea level rise and coastal squeeze. Salt marshes are vegetated intertidal wetlands found in temperate climate zones. Their presence contributes to flood protection, coastal flora and fauna, and carbon sequestration (Temmerman et al., 2013). Vegetation-induced resuspension of fine sediment helps to transport fine particles deeper into salt marshes. The interaction between waves, currents, and vegetation may resuspend sediment sooner than it would without vegetation. It has been shown in conditions with only currents (Liu et al., 2021; Tinoco & Coco, 2014) or only waves (Tinoco & Coco, 2018) that the threshold for resuspension is lower within vegetated meadows than without vegetation. However, the threshold has not yet been studied for combined wave-current conditions, which often exist in the marsh environment. Identifying this threshold will enable us to predict when in a tidal cycle sediment resuspension occurs and can be used to improve sediment transport model. We use flume experiments to methodically identify the threshold of sediment resuspension in artificial salt marsh meadows of three different area densities under combined wave-current flows.

## 2 METHODOLOGY

We conducted the experiments in the Nepf Environmental Fluid Mechanics Lab at the Massachusetts Institute for Technology, USA. The flume (size: 24x0.38x1m) can generate waves and currents simultaneously. We placed three vegetation boards (size: 1x0.38 m; Figure 1) with emergent wooden dowels of 6.4 mm in diameter, representing the specie *Spartina Alterniflora*, at the bottom of the flume. The middle board was constructed with a recess that was filled with a 10 mm layer of artificial sediment (glass spheres, two grain sizes $d_{50}$ = 35 and 70 µm). We created boards in three densities: 250 stems/m$^2$ (sparse), 500 stems/m$^2$ (medium), and 1000 stems/m$^2$ (dense). We also ran conditions with a bare bed. For each experiment run, the current speed was set first, and then we incrementally increased the wave height until a sediment concentration above the noise level was recorded by one of two inserted optical backscatter sensors.

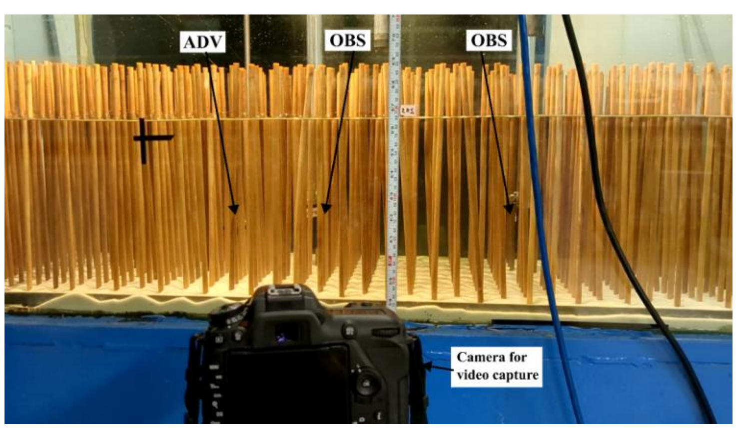


**Figure 1. Experiment setup with dense vegetation in 220 mm water depth with an acoustic doppler profiler (ADV) for velocity**

**measurements, two optical backscatter sensors (OBS) for suspended sediment concentrations, and a camera for video capture.**

## 3 CONCLUSIONS

Video analysis indicated that turbulent eddies in the wake of the stem drove resuspension for all vegetation densities. The threshold velocity for resuspension was lower for pure wave or current conditions than for combined wave-current conditions, based on preliminary results. The preliminary results also suggested that the differences between vegetation densities were small compared to the expected difference with the bare bed case. Finally, the temporal and spatial mean turbulent kinetic energy required for resuspension was higher for conditions with a strong unidirectional current component (relative to wave velocity component) than for conditions with a strong wave velocity component.

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