Flume experiments of sediment resuspension in wetland vegetation under wave-current conditions

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1. Introduction

Understanding suspended sediment transport over salt marshes is key to understanding their resilience to adverse conditions (e.g. sea level rise). Salt marshes are vegetated coastal wetlands in the intertidal zone, which contribute to coastal protection. Their vegetation modifies flow patterns, dampens wave action, and triggers turbulent eddies in its wake. The turbulence resuspends fine particles, which are then transported over the marsh.

Our interest lies in identifying the threshold for sediment resuspension under wave-current conditions using laboratory experiments, i.e. finding the minimum current and wave velocities under which resuspension occurs. The threshold has previously been studied in conditions with only currents (Liu et al., 2021 and others) or waves (Tinoco & Coco, 2018), but not yet in combination. Identifying this threshold helps to understand when sediment resuspension occurs over a tidal cycle and can be applied to improve sediment transport models.

2. Methodology

We conducted flume experiments in the Nepf Environmental Fluid Mechanics Lab at MIT. We constructed three vegetation boards, each 1 m long, from emergent wooden dowels with a diameter of 6.4 mm. One board included a tray which was filled with artificial non-cohesive sediment (glass spheres, d_{50} = 70 µm). We positioned two OBS sensors and one ADV inside the canopy to measure the suspended sediment concentration and flow velocities, respectively. For each test condition, we set the current velocity and incrementally increased the wave height until resuspension was observed.

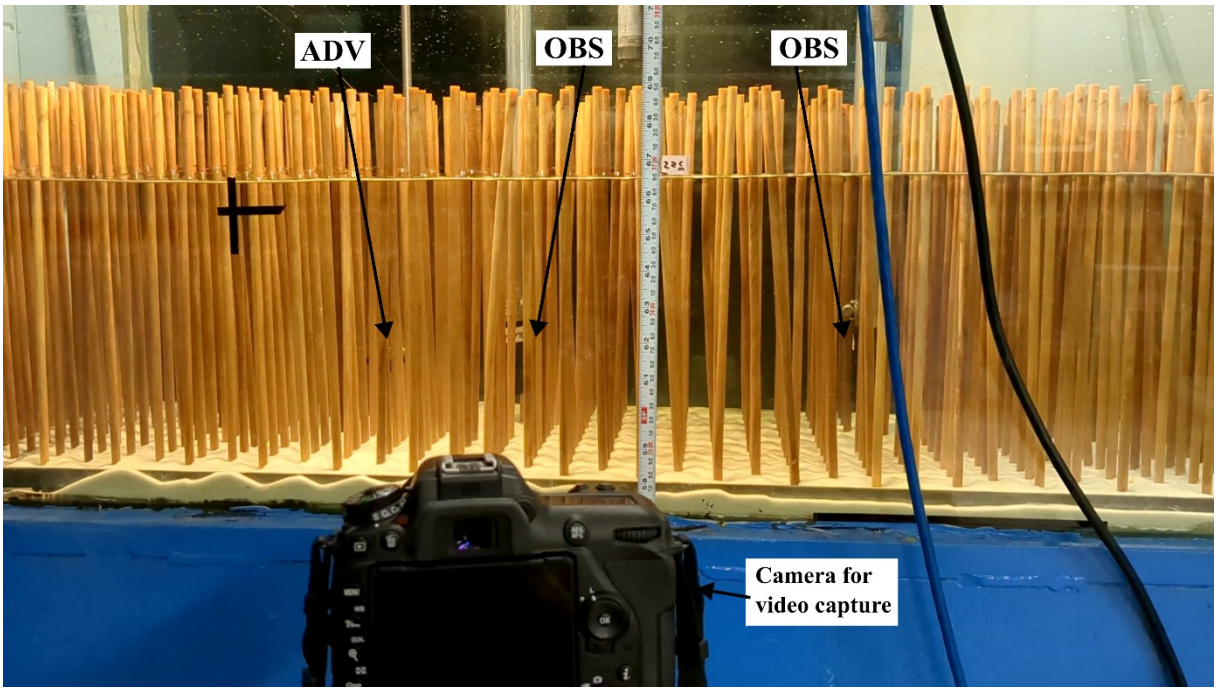

Figure 1: Experiment setup

3. Results

Our preliminary results indicate that turbulent eddies in the wake of the stem drive resuspension in wave, current and combined wave-current conditions in dense vegetation meadows. The first analysis of the results suggests that the turbulent intensity required to generate resuspension increases when the current velocity increases relative to the wave velocity. We will elaborate further on our results during the conference.

References

Liu et al. (2021). Impact of Stem Size on Turbulence and Sediment Resuspension Under Unidirectional Flow. WRR, 57(3), e2020WR028620.
Tinoco & Coco (2018). Turbulence as the Main Driver of Resuspension in Oscillatory Flow Through Vegetation. JGR: Earth Surf., 123(5), 891–904.