EXPERIMENTAL AND NUMERICAL MODELING OF THE EFFECT OF SEAGRASS (P. oceanica) ON FLOW AND PARTICLE TRAPPING

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Retention of particles in seagrass canopies is usually contributed to the indirect attenuating effects canopies have on flow, turbulence and wave action, promoting sedimentation and reducing resuspension within seagrass meadows. Yet, recent evidence suggests that seagrasses are able to affect particle flux directly, through loss of momentum and increased path length derived from collisions with leaves and binding of particles. We evaluated the role of Posidonia oceanica on flow and associated particle trapping using a combination of flume experiments and numerical modeling. Our results confirm the existence of two dynamically different environments, the below-canopy habitat, with low shear stress and reduced turbulence and the canopy-water interface region, characterized by highs shear stress and turbulence intensity where vertical transport of momentum is enhanced.
Experimental particle loss rate in the vegetated treatment after particle circulating in a 41 m long racetrack flume was one order of magnitude larger relative to particles transported across the empty flume with a flat sand surface in the test-section. The probability that a particle is lost from the flow upon a collision with a seagrass leaf is estimated as 2-3%. The numerical model fitted the experimental data well and demonstrated leaf density and flow velocity effects on particle loss rates. The numerical model estimates that 30% of the particle momentum is lost upon each collision with a leaf. Based on these results we hypothesise that physical filtration by plant structures plays a role in particle removal in aquatic systems.