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Laboratory experiments on the influence of particles size and density on the plastic debris motion in the nearshore

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The accumulation of plastic debris in the marine environment is attracting increasing awareness due to their abundance and potential environmental impact. Coastal and riverine inputs are widely recognized whereas oceanic gyres are seen as accumulation areas. However, we have a limited knowledge of the fate of plastic particles in the nearshore. In coastal regions, plastic debris are affected by the wave action leading to sinking, fragmentation and degradation of plastic debris before beaching or transportation to open oceans, but these processes remain poorly understood.

Aiming to improve the description of the plastic debris motion in the nearshore, controlled laboratory experiments have been performed in a medium scale wave flume at Universitat Politecnica de Catalunya (CIEM-UPC). The plastic particles motion is measured in real time using two synchronized video cameras of 5.1Mp shooting at 75 frames per second. The particles trajectories are obtained after image processing using an open source Particle Tracking Velocimetry software (OpenPTV). Different wave conditions are generated varying the wave steepness. Plastic particles are manufactured in-house with high control of the particles size and relative density with respect to water. The tested sizes range from 2 to 10 mm (in the range of micro and mesoplastics) while the tested relative densities range from 0.9 to 1.2 covering the typical relative density range of observed plastic debris.

Trajectories of plastic particles will be presented as a function of wave conditions and plastic characteristics. Observed trajectories show important differences in the plastic fate depending on whether the plastic is transported by the wave action close to the water surface or close to the bottom. Experimental conditions and measurements will be presented and the wave-induced plastic transport processes will be discussed with implications on abundance and distribution of plastic debris.