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Sediment size effects on ripple formation in a large scale wave flume

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The RIPCOM (RIPples on COMPLEX) experiments are part of the experimental program developed in the COMPLEX (Cross disciplinary Observations of Morphodynamics and Protective structures, Linked to Ecology and eXtreme events) Joint Research Activity within the EU Hydralab+ project. The main objective of the experiments was to study ripple growth and dynamics in a large wave flume under waves above fine unimodal and mixed sands. The experiments presented were conducted in the CIEM large scale wave flume of Barcelona, having dimensions of 100 m in length, 3 m in width and 4.5 m in depth.

The experimental plan was divided into three steps:
1. Finding the optimum wave conditions that ensured appropriate scaled ripples (based on measured velocities and previous literature studies) in the study area. Test the targeted waves with unimodal fine sediment (d50=0.250 mm) and measure the ripples obtained under these tested conditions. From the measurements, the waves to be used on the next two steps are selected in order to produce the "best" ripples within the experimental constrains.
2. The upper 13 cm of the fine sediment were removed and replaced by a coarser sediment (d50=0.545 mm). The previously selected waves were run while measuring wave height, velocity, suspended sediment concentration and collecting bathymetric information.
3. The fine and coarser sediments previously employed were mixed homogeneously along the study area. The selected wave conditions were repeated while hydro-morphodynamic information were collected under the new mixed sediment conditions.

The waves tested were selected in order to produce ripples in accordance with different formulation (Nielsen 1981, Mogridge et al. 1994, or Faraci and Foti 2001), but also trying to control the reflection coefficient within the wave flume. Finally wave periods of 5, 7 and 9 seconds with wave heights of 0.25 and 0.3 m were chosen for the three different sediment size distributions.

The water surface elevation was measured by means of Resistive Wave Gauges (RWG), Acoustic Wave Gauges (AWG) and Pore Pressure Transducers (PPT). Acoustic Doppler Velocimeters (ADV) and Optical Bacskatter Sensors (OBS) were used to collect information of velocity and suspended sediment concentration. In this presentation the main results will tackle ripple growth and development which were obtained using an Acoustic Ripple Profiler (ARP) and four Echosounders mounted on the flume mechanical profiler.

The ripples were formed faster than on previous experiments (Pedocchi and Garcia, 2009), since within the first two hours of waves the ripples were already developed. The measured ripples ranged between small 3D ripples which had a ripple height of 0.05 m and ripple length of 0.5 m, up to 2D ripples with a ripple height of 0.13 m and a ripple length of 0.9 m. The presentation will end with some conclusions and ideas for continuing research on this topic.