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Wave-resolved measurements of the beach evolution in the swash zone

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The swash zone remains a difficult zone to account for in beach evolution models. One reason is the relative lack of data on the bed-shape evolution in this zone, especially data resolved on the short time scales of the incident waves, and this even in the laboratory. To this end, an optical method has been developed by the IMFT in Toulouse which is non-intrusive and time-resolved. The principle is to reconstruct the bed-surface elevation by stereoscopic imaging by correlating identical points on the bed surface imaged from two different view points. The technique was implemented and validated in the swash zone of a beach in the large-scale wave-flume of the Universitat Politècnica de Catalunya. The initial profile of the beach, with a 1:15 slope, was made with ground silica of d50=260μm. The wave time-series given by the Jonswap spectrum was composed of 500 waves of mean period 4.47sec and repeated 39 times. Within the time series, a set of 5 bursts (spanning about 14 mean wave periods) was selected on the basis of typical wave-amplitude variations. Standard bed profiles measurements in the center of the flume were performed between each time series and showed a typical erosive condition in the area where the optical measurements were made.
Using this time-resolved technique, the data can be analyzed at different time scales: (i) within swash and backwash (sec.), (ii) wave-to-wave within a burst (min.), (iii) between bursts of a given time series (10 min.), (iv) between consecutive time series (hour), and (v) over the entire experimental duration (days). Preliminary results shows that the bed in the swash zone experiences a continuous erosion during the duration of the experiment, i.e. on time scales (iv). Moreover, the vertical evolution between two Time Series (time scale iv) may be of the order of 5mm, which is well below the precision of the mechanically measured bed profiles (about 1cm). In addition, it can be observed that within a Burst (time scale ii), significant bottom evolution may happen which proved to exhibit a strong spacio-temporal variability.