Coarse sediment tracing experiment at the Promenade des Anglais (Nice, France)

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Coarse sediment nourishments are increasingly used as a form of coastal protection at sites where the natural shore is affected by erosion processes. Based on the extent of the erosion effects, they can be just an integration to the backshore or rather an artificial reconstruction of a beach that has been completely eroded. In both cases, the comprehension of the physical processes affecting coarse sediments would be crucial to define the transport patterns, which are not completely understood yet. In this sense, short-term tracing experiments have already proved to be a reliable method to gain a significant amount of data about sediment transport in brief timespans. The aim of this work is quantifying the transport rate of coarse tracers 4, 24 and 48 hours after the injection during a time interval characterized by very low to no wave activity. Pebbles of about 7 cm in mean diameter were sampled on the coarse-clastic beach of the Promenade des Anglais in Nice (France), which needs yearly nourishments because of a reported huge sediment loss to the offshore. Since 1969, around 600 000 m³ have been brought in order to maintain the coastline. Once the pebbles fall downslope, no natural process is able to move them back landward due to the steepness of the shoreface. Passive RFID cylinder glass tags have been inserted into the tracers, which have been measured with a caliper and weighed. A 110 m long portion of the public beach has been selected as the site of the experiment because it is confined within two consecutive boulder groynes, which reduce longshore sediment exchange with the adjacent sectors. The pebbles have been injected along 21 transects, two at the berm crest, two in the swash zone and two at the step crest. The tracers have been inserted in the surface of the beach to avoid immediate displacement due to the uprush and backwash flows. The surrounding size of the sediments was on average slightly finer than the tracers. Visual observations right after the injection allowed us to report a strong downslope movement of the swash zone pebbles. The first detection campaign after 4 hours reached just about 60% of recovery rate, which is surprisingly low compared to previous such experiments at different locations. Topographic surveys made contextually revealed the destruction of the fair-weather berm during the rising tide, which led to the burial of a large number of tracers. During the night, low-energy waves managed to wipe out the thin layer of gravel, unearthing back several marked pebbles that had not been detected before: the recovery rate was beyond 90% after 24 hours. This dataset confirms the high transport rate of coarse sediments in very short timespans and under very low energy
such condition is responsible of moving downslope the tracers with little chance of getting them back up unless the wave motion increases significantly. Such high mobility might also imply a high wear of coarse sediments, which in turn can contribute to volume loss of the beach.