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Sediment resuspension and bedform generation induced by internal solitary waves

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In the Strait of Messina (Italy) strong internal solitary waves (ISWs) are generated by the interaction of tidal currents with underwater ridges and the shallow sill located within the straits. ISWs propagate northward and in the Gioia Basin (Calabrian coast of the Tyrrhenian Sea, Italy) interact with a sloping bottom. Previous studies suggest that the sand wave field present in that location could be produced by the action of the bottom boundary current induced by ISWs transition.
In this work, we investigate the role of solitary waves in sediment resuspension and bedforms generation, by linking experimental studies with physical models and real-field observations.
We observed, experimentally, that the repeated stroke action induced at the bottom by successive solitary waves can produce bedforms even in absence of unidirectional currents. In particular, we generated successive surface solitary waves (SSWs), interacting with a mobile bottom initially flat. Our goal is to reproduce the same stroke action at the bottom as the one induced by ISWs, although with an opposite flow direction. We investigate the action of 7 different SSWs, each characterized by defined amplitude, wavelength, and celerity. For each case, we generate 400 successive SSWs and we used high-resolution acoustic velocimeter to measure the 3D water velocity induced 5 mm from the bottom by each wave. For all the experiments sediment resuspension and the related bedform triggering process occurs locally; the sand wave field develops downstream, increasing its length during migration. It is composed by equal to each other asymmetric dunes-like bedforms. We observe an inverse relation between the bed load transport and the mean acceleration induced at the bottom by the SSW passage. Surprisingly, the more SSWs action at the bottom is characterized by an unsteady stroke, the less is the bed load transport.
Regarding the real field, we collected hydrographic data during two oceanographic cruises (RITMARE 2016 and MSFD 2017) in the Gioia Basin, where the ISWs interact with a relevant topographic structure of the seabed (the Gioia Canyon). We show evidence of sediment resuspension associated with ISWs packets transition and we start to explore the role of ISWs in reshaping the seafloor.