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Monitoring shallow water environment - MEDUSA data acquisition system

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We show a sub-set of data acquired by MEDUSA, the Multiparametric Elastic-beacon Devices and Underwater Sensors Acquisition system, a marine research infrastructure for monitoring shallow water environment, with a focus on the low-rate ground subsidence and uplift processes (bradyseism) occurring in the last tree-years in the volcanic caldera of the Campi Flegrei (Gulf of Pozzuoli-Naples, Italy).
MEDUSA infrastructure consists of four instrumented geodetic buoys with cabled seafloor multi-parameter modules and 152+ channels with sampling rate in the range from 60 seconds to 200 Hz. The conspicuous dataset available from the MEDUSA is visualised by means of a dedicated data-portal allowing downloading in various formats.
We show the augmented possibility offered by these innovative multi-parametric observatories, designed mainly to monitor the local seismicity and the seafloor movements in shallow-waters of a volcanic area.
Seismic recordings of local and regional earthquakes obtained by the hydrophones, show high quality signal highlighting a improved signal to noise ratio than the co-located seismometer.
The long time-series of the geodetic GPS data acquired on the MEDUSA buoys processed with a standard software (RTK-lib), show an accurate and stable agreement of the vertical seafloor displacement measured with the land GPS stations.
The GPS measurements of MEDUSA have been also used to confirm that data recorded by the bottom pressure recorders (BPRs), located in the same site on board the seafloor modules, provide an independent measure of the seafloor vertical uplift in shallow water. Finally, the data recorded by BPRs are compared with the tide-gauge reference station located outside the deformation area, used as reference baseline to correct the data.
The use of GPS, BPR and tide gauge data provided by MEDUSA, have allowed assessing for the first time the seafloor deformation field in the Gulf of Pozzuoli: we estimated a seafloor vertical displacement of about 10 ± 1 cm over a period of twenty months embracing 2016 to 2018.
A network of permanent GPS buoys represents a powerful tool to measure the seafloor vertical deformation field in shallow water. In fact, the performance of this system is comparable to on-land high-precision GPS networks, marking a significant achievement and advance in seafloor geodesy and extending volcano monitoring capabilities to shallow offshore areas (up to 100 meters depth).