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Measurements of near-bottom stress and turbidity in the Gulf of Trieste during the passage of vessels

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The Gulf of Trieste (GT) is a semi-enclosed 20 x 20 km gulf in the northernmost part of the Adriatic Sea with depths that reach 24 m at the most. Sediments in the southern (Slovenian) side of GT inside the shallow Bay of Koper, where measurements of near-bottom stress took place, are composed primarily of clayey silt (2–63 um). The observation of currents and turbidity took place inside the Bay of Koper at a location inside the shipping route, where the bottom depth is around 19 m. The goal of measurements was to study the bottom erosion due to changes to flow fields by ship movements (and due to propeller wakes).
High-frequency measurements of currents and turbulence near the sea bottom were conducted with two Vector instruments (Nortek AS) with pressure sensors in the interval 123-31 July 2013, mounted at heights 0.2 m and 1.3 m above the sea bottom. Turbidity was measured with the same frequency with Seapoint IR (880 nm) turbidimeters placed at the same heights. In addition, turbidity was measured also with the 'old' Minitracka II instrument of Chelsea Instruments that functioned at 470 nm. 10 s averages of 1 s measurements were recorded. When the voltage output of this instrument surpassed the chosen threshold value (e.g. 2 V out of 5 V range) the triggering signal was sent to start measurements of the size distribution of suspended sediments and their falling speeds with the laser in-situ scattering and transmissometery (LISST-STX). In the interval 7-19 November 2013 currents over the whole water column with vertical resolution of 0.5 m have been also surveyed with the 1 MHz ADCP instrument (Nortek AS) with a sampling frequency of 1/s, where 10 s averages were recorded.
It appears that pure ship's dislocation of a mass of fluid, which may easily surpass 10^5 tons, is important in the erosion of the bottom. We have confirmed this by velocity and stress peaks near the sea-floor in the Bay of Koper that were frequently accompanied by peaks of turbidity during vessels' passages. Ten-second-average ADCP current-meter measurements showed a synchronous and sharp jump of velocities over a large part of the water column during vessels passage, the vertical extension of disturbance depends on the vessels' characteristics and its speed. At the time of velocity peak a sharp pressure drop (of $\sim$ 0.1–0.2 dbar) was recorded at the bottom of the bay due to the 'squat' effect. Twenty events ship passages were studied between 23 and 31 July 2013. The velocity magnitude peak above the 'ambient currents' for about 0.5 m/s within only 60 s is symmetric with respect to the peak's position. This deviates from the supposed time asymmetry in the propeller's jet. The effect of the latter seems to be less important at the place of measurements.