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Synoptic variability of currents on the Russian shelf of the Black Sea

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The study is focused on synoptic variability of the velocity of surface and bottom currents on the inner shelf near the city of Sochi in the Russian sector of the Black Sea. Hereinafter, the term "synoptic" refers to spatial scales of the order of 1 to 10 km, and temporal scales between 10 min and ∼50 hrs. The study region extending from the shore to the isobath 50 m is subject to significant influence of freshwater discharge from the Mzymta River, which is the largest river of the Russian Black Sea coast. The investigation is based on the data of in situ measurements conducted during 4 field campaigns (May 2009, May 2010, May 2011, and May 2012). During each of these surveys, surface and bottom velocity data were recorded at 4 mooring stations, accompanied by CTD profiling and meteorological data collection, as well as the measurements of river discharge rate.

The low frequency variability (defined here as that residing in periods over 6 hrs) was dominated by the inertial (17.6 hrs) and diurnal (24 hrs) cycles and had a similar spectral structure for the surface and the bottom layers. In contrast, the high frequency part of the variability exhibited different behaviors for the upper and the lower levels. At surface, it peaked at the periods from 4.5 to 4.9 hrs. These periods were also evident in the wind stress records, which points towards the conclusion that the high frequency variability in the surface layer was largely controlled by wind. However, the dominating periods for the bottom layer are generally shorter than those for the surface, they span between 2.8 and 4.9 hrs and exhibit no significant correlation with the wind variability – possibly, because of the "isolating" action of the stratification enhanced by continental discharges in the upper layer. We hypothesize that the oscillations of the bottom layer velocity are associated with short internal waves generated by the Mzymta plume. The phase relations between the velocity records obtained at different locations, as well as the vertical displacements of the isopycnal surfaces as inferred from CTD profiling seem to support this hypothesis.