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Dynamics of a River Plume on the Northeastern Shelf of the Black Sea: A Case Study

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It is well known that buoyant plumes play an important role in the regime of the coastal waters, particularly in enclosed and inland seas. In this paper, we report preliminary results of a field investigation of a river plume in the Black Sea. Mzymta River is the largest tributary of the Sea within its Russian coast. Although its mean runoff is moderate (49 m3/s), it can grow by an order of magnitude during high discharge periods. A field experiment focused on the plume and the adjacent shelf area was conducted during the flood on May 20-27, 2009. The study area was repeatedly sampled once a day from R/V Ashamba. The observations included top-to-bottom CTD profiling at 12 stations, as well as continuous CTD and fluorescence measurements at the surface along the ship track using a pump-through system. In addition, 3 mooring stations were deployed in the plume area, each one equipped with 2 current meters in the surface and the bottom layers. Meteorological data were continuously recorded at 2 portable stations, one located near the river mouth and the other one near the southern extremity of the plume, about 8 km south of the estuary.

The collected data showed that the plume was strongly non-stationary, and its daily pattern, spatial extent, and the salinity drop in it depended critically on the wind forcing and ambient coastal circulation. It was observed that the downwelling-favoring conditions resulted in more extensive spreading of the plume, and, hence, more efficient flushing of the estuarine area. This conclusion was later supported by numerical modeling (see the poster by [Zhurbas et al] at this session). The variability of the river runoff rates governed the plume to a lesser extent.

In addition, the data obtained by the current meters pointed towards significant internal wave activity around and beneath the plume. We note that, as an enclosed basin, the Black Sea is non-tidal, so there should be some mechanisms generating the internal waves other than the interaction between tide and bathymetry. We hypothesize that the disturbances caused by the non-stationary river plume can possibly play this role. The characteristic period of the observed short waves was 10-15 minutes, superimposed on a near-inertial oscillations with the period between 11 and 13 hours. The latter is some 25% shorter than the inertial period for this region.