SUB-MESOSCALE WATER DYNAMICS AT THE NARROW BLACK SEA SHELF: PHYSICAL MECHANISMS.

Viacheslav Kremenetskiy [1]* and Andrei Zatsepin [1]
[1] P.P. Shirshov Institute of Oceanology, Moscow, Russia - sk@ocean.ru

Abstract
Using traditional and modern observational methods, the investigations of short-term variability of hydrophysical structure and water dynamics in the Black Sea over the shelf and upper part of continental slope near Gelendzhik were carried out during 3 years (2006-2008). The methods include: a) an analysis of satellite images (sea surface temperature and color); b) sea-going transects at shelf-deep sea area with frequent CTD-profiling; c) quasi-instantaneous surveys (snapshots) with measurements of velocity field by means of towed ADCP. The activities were fulfilled predominantly in autumn season under the conditions of well-developed mesoscale water circulation in north-eastern part of Black Sea and non-stationary wind forcing.
Keywords: Black Sea, Continental Shelf, Coastal Processes, Continental Slope

Sub-mesoscale (1-10 km) and short-term (1-100 hours) variability of the hydrophysical structure and fluid dynamics at the narrow Black Sea shelf depends on a number of factors: wind forcing, fresh water runoff, fluid dynamics over the continental slope and deep part of the sea, coast relief and bottom topography. The influence of the mentioned factors on the shelf fluid dynamics and cross-shelf exchange processes (that are responsible for shelf water renewal and self-purification from natural and anthropogenic pollution) is not well studied. In this paper we present the results of an investigation on the Black Sea shelf fluid dynamics and its short-term and sub-mesoscale variability under the influence of water dynamics over the continental slope and deep sea as well as coast relief and bottom topography.

The study was fulfilled in Gelendzhik area at autumn seasons of 2006-2009. Following data, methods and equipment were used:

1) NOAA, MODIS-AQUA and MODIS-TERRA satellite information (sea surface temperature, chlorophyll "a", water leaving radiance);
2) cross-shelf CTD sections;
3) towed ADCP surveys with sub-mesoscale resolution;
4) bottom mounted ADCP measurements at selected stations.

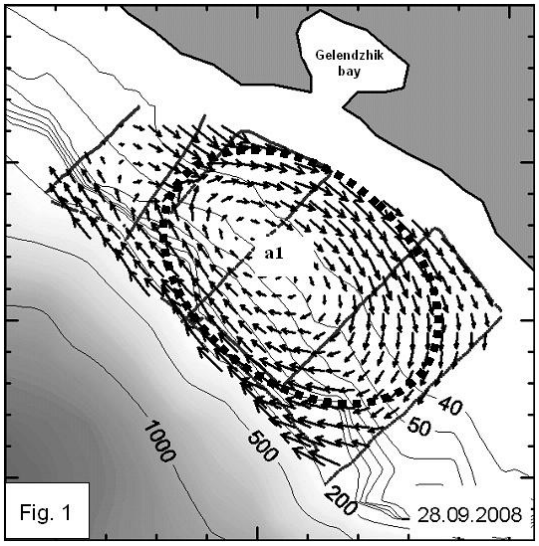

Fig. 1. Anticyclonic sub-mesoscale eddy over the Black Sea shelf, revealed during a towed ADCP survey.

A well-pronounced short-term and sub-mesoscale variability of the fluid dynamics over the shelf and upper continental slope was revealed. Particularly the dynamical variability was characterized by an inconstancy of the alongshore and cross-shore velocity components accompanied by intensive cross-shelf water exchange. The general origin of the observed variability was related to the formation and along-shore transfer of sub-mesoscale eddies with diameter about 5-10 km (Fig. 1).

These eddies were ageostrophic and their life-time normally did not exceed a few days. The main energy source of sub-mesoscale eddy formation was the external circulation – currents over the continental slope. Two basic physical mechanisms of sub-mesoscale eddy formation were revealed. The first was the shear instability of the along-shore current. The second was observed only in case of strong external circulation (when along-shore current velocity over the shelf edge exceeded 40-50 cm/s) and consisted in periodic eddy formation in the concave forms of the coast relief, their detachment from the shore and inclusion to the along-shore current. Some eddies grow up rapidly and transform to mesoscale (geostrophic balanced) eddies, that play an important role in cross-shelf water exchange and influence on the ecosystem of Black Sea coastal zone [1].

This study was supported by the EC IP SESAME, RFBR grants 08-05-00183, 08-05-0063, 09-05-90175, 09-05-13527, 09-05-574.

References

1 - Arashkevich E., Timonin A.G., Zatsepin A.G., Kremenetskiy V.V. and Drits A.V., 2005. Effect of the Rim current regime on the zooplankton distribution in the "shelf – slope – deep sea" system in the Black Sea. *Oceanology*, 45 (Suppl. 1): 149-160.