Anticyclonic eddies in the central and coastal part of the Black Sea: statistics and parameters of salinity manifestations

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Introduction (1)
This work presents results of observation of the submesoscale eddies during different ship surveys data which were performed in the Black Sea for three intervals of years 1956-1969, 1970-1982 and 1983-1995. Anticyclonic anomalies of salinity with closed or nearly closed isolines, nuclei of which are located in central and frontal areas of the Black Sea are presented in the first part of the work. The second part of work contains observations of submesoscale coastal eddies of the Black Sea carried out in summer 2013 using ADCP.

Fig. 1 Climate (average annual) boundaries of the Black Sea (red line – central part; blue line - coastal area); red circle – Gelendzhik, region of study for coastal eddies observed in the second part of the work

Fig. 2 Area of the measurements conducted in 2013

Fig. 3 The scheme of types of anticyclonic mesoscale salinity anomalies (left) and scheme of anomalies distribution in different seasons (right)

Fig. 4 Synoptic situations with anticyclonic anomalies of salinity

Fig. 5 Synoptic situations without anticyclonic anomalies of salinity

The greatest values of parameters for anticyclonic anomalies in central area of the sea (type AE-C) are achieved in summer months (July-August), which are associated with increasing of anticyclonic weather conditions and the weakening of the background cyclonic vorticity of large-scale circulation in the Black Sea during spring and summer. For anticyclonic anomalies of type AE-F and AEM maximum of parameters occur in October and November respectively.

Fig. 6 Salinity field of AE-C on 100 m (left) and its vertical section (right) for survey in July 1976

Fig. 7 Salinity field of AE-C on 100 m (left) and its vertical section (right) for survey in October 1979

Fig. 8 Salinity field of AEM on 100 m (up) and its vertical section (under) for survey in October 1979

Fig. 9 ADCP “Rio Grande” 600kHz

Fig. 10 Research yacht “Vita”

Fig. 11 Current variability along 6-km sections from the Blue Bay

Fig. 12 Currents velocity variations (left) and velocity magnitude in the presence of eddy 27/05/13

Fig. 13 Currents velocity variations (left) and velocity magnitude in the absence of eddy 31/05/13

Fig. 14 Currents velocity variations (left) and velocity magnitude (right) in the eddy 7/06/13

Fig. 15 Satellite image from Modis – Aqua 26/05/2013. Image courtesy of Olga Lavrova, SRI RAS

Fig. 16 Satellite image from Terra Modis 29/05/13. Image courtesy of D. Solediev, MIH NASU

Anticyclonic eddies in the coastal area of the Black Sea (3)

Conclusions (4)
➢ The formation of anticyclonic eddies in the Black Sea is caused by instability and shifts of currents.
➢ The intensity of the Rim Current diminishes from spring to autumn.
➢ Maximum numbers of eddies in central part of the sea identified exactly at that period.
➢ As for the regional location anomalies in central part of the Black Sea, the main part of identified eddies located to the south, southeast and southwest of Crimea, as well as in the far west and south-east of the Black Sea.
➢ Observations with using ADCP provide valuable information of structure of currents during the passage of submesoscale eddies.

Tab.1 Morphometric parameters of eddies

Acknowledgments
This work is dedicated to memory of professor, Doctor of Science in Oceanology
V.S. Tuzhilkin

V.S. Tuzhilkin was a great scientist and teacher, expert in hydrology and water circulation of the Southern Seas of Russia, its variability, coastal research, formation and maintenance of oceanographic data bases. The author of over 150 publications, including 9 collective monographs. All students grateful to him for valuable advices, accessible explanations of material and his love of ocean science.