Geophysical Research Abstracts
Vol. 16, EGU2014-390, 2014
EGU General Assembly 2014
© Author(s) 2013. CC Attribution 3.0 License.

Currents' spatial structure in the Western, Central and South-Eastern Baltic on the base of numerical model and ADCP data analysis

Mariya Golenko and Nikolay Golenko

Atlantic Branch of the P.P. Shirshov Institute of Oceanology, Russian Academy of Sciences, Kaliningrad, Russian Federation (nikolay.golenko@atlantic.ocean.ru)

Numerical modeling of the currents' spatial structure in some regions of the Baltic Sea is performed on the base of POM (Princeton Ocean Model). The calculations were performed under the westerly (most frequent in the Baltic) and north-easterly wind forcings. In the regions adjacent to the Kaliningrad Region's, Polish and Lithuanian coasts these winds generate oppositely directed geostrophic, drift and others types of currents. On the whole these processes can be considered as downwelling and upwelling. Apart from the regions mentioned above the Slupsk Furrow region, which determines the mass and momentum exchange between the Western and Central Baltic, is also considered.

During the analysis of currents not only the whole model velocity but also components directed along and across the barotropic geostrophic current velocity are considered. The along geostrophic component for one's turn is separated into the geostrophic current itself and an ageostrophic part. The across geostrophic component is totally ageostrophic. The velocity components directed along and across the geostrophic current approximately describe the velocity components directed along the coast (along isobathes) and from the coast towards the open sea. The suggested approach allowed to present the currents' spatial structures typical for different wind forcings as two maps with the components directed along and across the barotropic geostrophic current velocity.

On these maps the areas of the intensive alongshore currents are clearly depicted (for ex. near the base of the Hel Spit, in the region of the Slupsk Sill). The combined analysis of the vectors of the whole and geostrophic velocities allows to reveal the areas where the geostrophic component is significantly strengthened or weakened by the ageostrophic component. Under the westerly wind such currents' features are clearly observed near the end of the Hel Spit and at the southern boarder of the Slupsk Sill, under the north-easterly wind - near the base of the Hel Spit, at the southern boarder of the Slupsk Furrow, near the Curonian Spit (where the relief is bent).

On the maps presenting the spatial distributions of the across shore velocities the areas where the mass and momentum transport from the shore to the open sea in the surface layer and vice versa takes place are discriminated. There are also revealed the areas where sharp changes of different velocity components under the wind changes are expected as well as the areas where such changes are expected to be minimal.

The model is validated using the field surveys of current velocities by ADCP in the area adjacent to the Kaliningrad region. The comparison of current velocities has shown a close correspondence. In rather wide area the directions and amplitudes of the model and ADCP surface velocities are close, that is additionally confirmed by the comparison of the local vorticity distributions. On the vertical transects of the ADCP current velocity directed across the shoreline the geostrophic jet is clearly pronounced. Its horizontal and vertical scales are in close correspondence with ones of the model jet.

At that the more detail calculations which are allowed during the modeling have shown that the geostrophic currents amount to 40-60% (in average) of the whole velocity; two components of the ageostrophic velocity directed along and across the geostrophic velocity are highly variable (from 10 to 60% of the whole velocity). The ageostrophic component directed along the geostrophic current generally strengthens it (up to 20-40% in average and up to 60-70% near the end of the Hel Spit). But in some regions, for example, in the Slupsk Furrow the ageostrophic component slows down the geostrophic current (to 30-40%).

In some narrow local areas immediately adjacent to the coast currents directed oppositely to the general quasi geostrophic jet were registered on both field and model data. Before the comparison with the field data these

local jets revealed on the model data were considered as improbable. As a result, the comparative analysis of the field and model data led to more detail understanding of dynamic processes in some coastal parts of the Baltic Sea.