Geophysical Research Abstracts
Vol. 18, EGU2016-9163, 2016
EGU General Assembly 2016

The numerical simulation features of the extreme surge occurred in the Sea of Azov on 2013/03/24

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As a result of the strong cyclone passed on 2013/03/24 over the southern part of European Russia and contributed to the formation of the strong southwest wind with speeds up to 22 m/s, the east-directed surge wave appeared in the Sea of Azov. The wind surge caused the sea surface height (SSH) rise in the eastern part of the Taganrog Bay. In the observation series for 1881-2013, due to the 3-meter difference between maximum and minimum SSH near Taganrog, the surge happened on 2013/03/24 takes the second position. With using numerical simulation, its reproduction was carried out to study the formation features and find out the requirements for the precision of simulating atmospheric and marine circulation in the Sea of Azov.

For this purpose, the three versions of Azov Sea circulation model were implemented on the basis of the ocean circulation model INMOM (Institute of Numerical Mathematics Ocean Model), their spatial resolutions are 4 km, 1 km and 250 m. For setting realistic atmospheric forcing over the Sea of Azov, three data types were used: ERA-Interim reanalysis (spatial resolution is 0.75°) and the simulation results of the two regional atmospheric circulation models: RegCM (Regional Climate Model, spatial resolution is 20 km) and WRF (Weather Research Forecast, spatial resolution is 10 km). The main factors of atmospheric forcing forming the extreme sea surges are wind and sea level pressure (SLP).

It was shown that only the simulation of the atmospheric forcing with high spatial resolution using the non-hydrostatic WRF model allows one to reproduce the extreme surge with an acceptable accuracy. At the same time, the quality of simulating non-extreme SSH oscillations does not depend on the type of used atmospheric forcing so much, as for extreme ones. It was also shown that increasing the spatial resolution of the INMOM improves the simulation of extreme surge temporal evolution, especially in coastal areas. However, its magnitude is affected by the INMOM spatial resolution not more than at 10%. This makes one conclude that the surge formation is mainly determined by the response of circulation in the entire Azov Sea basin to the atmospheric forcing.

It was found that the nonlinear terms in the momentum equations for sea circulation do not have much influence on the formation of extreme surges. It was also shown that the model based on the classic "shallow water equations" worse reproduces the extreme SSH deviation than the three-dimensional model of the same spatial resolution, despite the shallowness of the Azov Sea.

The research was supported by the Russian Foundation for Basic Research (grant № 16-35-00502).