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The contribution of inertial oscillations in water dynamics in terms of the 2013/03/24 storm situation in the northeastern part of the Black and Azov Seas

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The results of sea dynamics numerical simulation for the northeastern part of the Black Sea and Azov (BAS) are manifested for period of strong storm occured on 22 - 28 March 2013. The INMOM (Institute Numerical Mathematics Ocean Model) was used, implemented for the whole BAS domain with a spatial resolution about 4 km. This INMOM version is the main component of the system for operational diagnosis and prognosis of hydrometeorological characteristics in the BAS implemented in the State Oceanography Institute (SOI). This system also includes Weather Research and Forecasting (WRF) model for computation of atmospheric forcing and Russian wind wave model (RWWM) for computation of the wind wave characteristics. During the storm, the extensive cyclone appeared with the center located northward to the Sea of Azov. Its southern periphery, covering almost the whole BS, formed airflow, which lead to the domination of the southeast wind in the eastern part of the BS with speed more than 20 m/s over the open sea. At the same time, the strong wind intensification occurred on the night of 2013/03/23. It lead to the excitement of inertial oscillations in the wind influence zone with sea velocities up to 100-120 cm/s. The simulations of the wind wave height, performed for this period using RWWM, revealed strong wind wave intensification with heights over 6 m. This was the main factor that led to the destruction of coast-protecting structures in the area Imeretinsky coast. At the same time, the sea level was not greater than 20 cm, which is nevertheless also led to the destruction of coast-protecting structures. The oscillation period of sea velocity in the active layer corresponds to the Coriolis frequency. The field of velocity inertial oscillation covered the whole open eastern part of the BS. Following the physical nature of inertial oscillations, a few hours after the storm beginning, the sea velocity field in the 0-30m layer stopped corresponding to the storm wind, and changed its direction and magnitude by forming vortex formations along the coast and throughout the eastern part of the sea. It was shown that the excitation of inertial oscillations is caused by the rapid change of wind speed. The analytical relation is proposed for the amplitude of the inertial motion velocity and rapid change of wind speed, which is confirmed by numerical simulations. At the same time, the intensive oscillating inertial currents virtually did not affect the density and sea level gradients. This means that the high sea velocity are not presented on the satellite sea surface height maps, widely used, for instance, to estimate the surface velocity field in the seas and oceans.