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Analysis of storm waves on the Black Sea

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Waves in the Black Sea caused by gale-force wind are the main object of this study. The third-generation SWAN spectral wave model is used for wave simulation. NCEP/NCAR reanalysis fields for the period between 1948 and 2012 with a frequency of 6 hours are the forcing input in these calculations. Such physical processes as quadruplet interactions, whitecapping, triads, bottom friction, depth-induced breaking and diffraction are considered in the model. A 5x5 km horizontal grid is used. The output of the model contains data about significant wave heights, wave propagation direction, wave length and period and wave energy transfer. The frequency of the output data is 3 hours. Modeling is performed out continuously for every year. Calculations are carried out on the supercomputer “Lomonosov” in the Moscow State University.

Waves higher than 2 m are defined as storm waves. If waves higher than 2 m are found during one or several adjacent output steps, these steps are identified as a storm event. More than 1500 of such events were registered during 64 years of analysis. Following parameters of storm events are estimated: annual and monthly average quantity and duration, area and storm path length. Regions with most intense storms are identified – these are the western and north-eastern parts of the Black Sea.

Synoptic atmospheric situations (wind and pressure fields) during storms are analyzed. Two predominant types of such situations are identified. The first is a fast movement of a Mediterranean cyclone or its trough toward the Black Sea and, at the same time, a large and stable anticyclone over Eastern Europe. The second – an abrupt quasi-meridional intrusion of a cyclone or a trough from the north.

Extreme wave parameters of different probability are estimated using the logarithmically normal distribution. Thus, the maximal wave height possible once in 100 years is more than 14 m.

Study results are compared with similar researches and observation data.

NCEP Reanalysis data provided by the NOAA/OAR/ESRL PSD, Boulder, Colorado, USA, from their Web site: http://www.esrl.noaa.gov/psd/. For more information on this reanalysis refer to Kalnay et al., The NCEP/NCAR 40-year reanalysis project, Bull. Amer. Meteor. Soc., 77, 437-470, 1996.

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