

Black Sea's wind wave parameters derived from numerical simulations driven by NCEP/NCAR and NCEP CFSR reanalyses

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This study is focused on typical features of spatiotemporal distribution of wind wave parameters on the Black Sea. These parameters were calculated during two experiments using the third-generation spectral wind wave model SWAN.

During the first run a 5x5 km rectangular grid covering the entire Black Sea was used. Forcing parameters – wind speed and direction – were derived from the NCEP/NCAR reanalysis for the period between 1948 and 2010.

During the second run high resolution wind fields from the NCEP-CFSR reanalysis were used as forcing for the period from 1979 till 2010. For the period from 2011 till 2015 the second version of this reanalysis was used. The computations were performed on an unstructured computational grid with cell size depending on the sea depth. The distance between grid points varies from 10–15 km in deep-water regions till 500 m in coastal areas.

Calculated values of significant wave heights (SWH) obtained during both runs were validated against instrumental measurements data. In the first case we used satellite altimetry data from the AVISO project. It turned out that calculated SWH values are typically lower than observed ones – the deviation between them was 0.3 m on the average, its maximum was of 1.67 m. Therefore, an empirical formula was applied to correct the modeling results obtained during the first experiment.

For the second experiment in situ measurements performed by a Datawell buoy installed 7 km off the city Gelendzhik were used for validation. The comparison of measured and modelled values of SWH shows a good agreement between these parameters in this case. No correction was applied to the results of the second experiment.

We applied the results of the NCEP/NCAR experiment to assess various features of the wave climate of the entire Black Sea. Thus, maximal SWH are observed in winter and autumn in two areas in the southwestern and northeastern parts of the sea; SWH values in these areas exceed 9 m. To define areas with most intense storm activity we calculated the presence duration of waves with SWH exceeding 2 and 4 m; in the first case the area with maximal duration is located in the central part of the sea, in the latter it trends to the southwestern part. The variability of total annual storm duration was assessed too. A period of increased storm activity is observed in approx. 1960–1975; the overall storminess trend for the study period is slightly negative.

High-resolution data obtained using the unstructured grid and the NCEP CFSR reanalysis were used for an in-depth study of wave parameters in coastal areas. Timeseries of wind waves parameters corresponding to 5 locations in the coastal waters of the Black Sea (Gelendzhik, Katziveli, the Karkinitzkaya Oil Platform, Sinop and Hopa) were analyzed. Maximal SWH values correspond to Sinop (6.36 m). Maximal SWH at all other study points are at least 0.5 m lower. The lowest SWH maxima correspond to Hopa (4.39 m).

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