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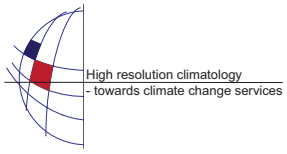

Cyclonic variability in the Mediterranean-Black Sea region associated with global processes in the ocean-atmosphere system

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The aim of the paper is to analyze interannual and decadal variability of cyclonic activity in the Mediterranean and Black Sea regions associated with the North Atlantic Oscillation (NAO), El-Nino – Southern Oscillation (ENSO) and Pacific Decadal Oscillation (PDO). Using daily NCEP/NCAR reanalysis data sets on the 1000 hPa geopotential height in 1948 – 2006, the main parameters of cyclones such as frequency, area, depth and intensity were calculated for the Western and Eastern Mediterranean and Black Sea region, the data sets of parameters of cyclones were created. Quality control of the detection of cyclones on the basis of reanalysis data was done. Comparison of number of cyclonic centers selected from NCEP/NCAR reanalysis and the same values obtained from cinematic maps of the Ukrainian Hydrometeorological service demonstrates quite good agreement of the analyzed series; correlation coefficient between them reaches 0.91.

Interannual variability of the parameters of cyclones associated with NAO index and SOI (Southern Oscillation index) was analyzed. Correctness of the choice of these global signals is corroborated by the results of spectrum analysis of the parameters of cyclones. Particularly, it was shown that typical scales of cyclonic variability in the Mediterranean and Black Sea regions are $\sim$2, 4.3 – 4.8 and 7 – 8 years which confirm that this variability is characterized by the same time scales as NAO (2 – 8 years) and SO (3 – 7 years). Correlation analysis of the monthly cyclonic parameters with NAO and SO indices was performed. Correlation coefficients of the winter-spring cyclonic parameters with NAO index reach -0.6; while the lagged (4 – 6 months) correlation coefficients with SOI reach 0.49. In particular, correlation analysis of the connection between parameters of cyclones and SOI has shown that ENSO variability in September causes up to 20% of anomalous weather conditions in all studied regions in winter (correlation coefficient r = 0.43); ENSO in November-December is responsible for about 24% of climate/weather anomalies in spring (r = 0.49); ENSO in May-July determines approximately 12% of autumn weather anomalies (r = 0.34). Thus, we can conclude that the joint NAO and ENSO influence is responsible for more than 50% of cyclonic variability in winter and spring in the Mediterranean-Black Sea region.

Decadal variability of cyclonic activity was studied with the focus on PDO influence since its phase change reflects the shift in global climatic system. Using composite analyses, quasi-decadal differences of values of the main parameters (frequency, area, depth and intensity) of the Mediterranean-Black Sea cyclones associated with the alteration of PDO phases were calculated for each month. It was shown that during the negative PDO phase frequency of winter cyclones is about twice greater, the area and depth (intensity) are about 500 thnd sq. km and $\sim$5 hPa greater, respectively, than in the positive phase. Hence, climatic shift in the variability of parameters of cyclones associated with PDO phase change in the middle of 1970s was detected.

Strong manifestations of the global climatic signals were also shown in different hydrometeorological fields in the studied regions which confirm the results obtained for the variability of cyclonic activity.