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Detecting climate change in Ukraine: trends, prediction and extreme events

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In this study the trends and variations in 25 extreme temperature and precipitation indices defined by ETCCDI, are examined using trend method, probability distribution analysis and spatial statistics for periods of 71 to 137 years for 16 stations evenly distributed in Ukraine. Data on the indices were obtained from www.ecad.eu.

Since 1981, temperature has increased by about 1°C in all stations in question relative to the period of 1945-1980. Analysis of the temperature indices indicates that during the 20th and the beginning of the 21th century there is significant warming which is particularly pronounced in annual mean and annual maximum temperatures. Occurrence of more summer days, warm days and tropical nights and warm spell duration reached the record highest level, and conversely occurrence of frost and ice days, cold days and cold spell duration fall to a record low for the last three decades in the most of study territory.

Since 1981, precipitation amount has grown by 30-50 mm relative to the period of 1945-1980 for the most of Ukrainian territory, except Uzhhorod and Uman where precipitation amount has remained the same. For Ukraine average, an increase in maximum daily and maximum 5 days precipitation amount, the maximum number of consecutive wet days, heavy and very heavy precipitation days, and a decrease in the maximum number of consecutive dry days are observed for the last three decades.

The analysis of the spatial distribution of trend of precipitation and temperature indices showed that there are large differences between regions of Ukraine, and coherence of spatial distribution of trends of various indices is low.

Spectral analysis and harmonic regression techniques were used to derive simulated and predicted (2019-2050) values of annual precipitation and annual mean temperature and four indices such as maximum value of daily maximum temperature, minimum value of daily minimum temperature, the highest 1-day precipitation amount and maximum number of consecutive dry days for some stations such as Kerch (the Crimean Peninsula), Kyiv (situated in north-central Ukraine along the Dnieper River), Lubny (Dnieper Lowland), Lviv and Shepetivka (Podillia Upland), Uzhhorod (Transcarpathia), Uman (Dnieper Upland).

Annual mean temperature and maximum value of daily maximum temperature were predicted to increase by 0.33°C per decade in the period of 2019-2050 with respect to 1981-2018, while minimum value of daily minimum temperature was predicted to grow slightly faster (by 0.43-0.63°C per decade).

Precipitation was predicted to increase for the stations in question by 20-66 mm up to 2050

relative to 1981-2018 and conversely maximum number of consecutive dry days will slightly decline except Lubny where increase in an aridity index was predicted. In the next three decades changes in maximum daily precipitation will be various: in Shepetivka and Kyiv such precipitation will be decreased and in other stations increasement in such precipitation will be up to 6 mm till 2050 with respect to 1981-2018.