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Climate extremes dynamics study in the Arctic region

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The dynamics of climate extremes in the polar region was assessed using indices developed by a group of experts in climate extremes research. [1] These indices can act as predictors of significant climate change.

A total of 27 indices of climate extremes were calculated. The calculation was based on daily values of surface air temperature and precipitation according to ERA5 reanalysis data with a grid step of 0.25°×0.25° from 1979 to 2014. The interannual variation was obtained with a test at the 5% significance level. The difference between the index values averaged over two fifteen-year periods was calculated.

The obtained index values can be conditionally divided into 4 categories [2]:

1 – absolute indices, measured in absolute values, including: maximum of maximum daily temperatures; minimum of maximum daily temperatures; maximum of minimum daily temperatures; minimum of minimum daily temperatures; average annual temperature range; maximum amount of one-day precipitation; maximum amount of precipitation over 5-day periods; annual precipitation; precipitation intensity index.

2 – threshold indices that count the number of days exceeding a fixed threshold, among them the following are distinguished: number of days with frost (frost days); number of hot days, number of days with persistent frost (ice days); number of tropical nights; length of the growing season; annual number of days with precipitation; annual number of days with precipitation greater than or equal to 10 mm; annual number of days with precipitation greater than or equal to 20 mm.

3 – percentile-based threshold indices indicating the exceedance rates below or above a certain percentile derived from the base period (percentage of days with minimum daily temperature below the 10th percentile; percentage of days with maximum daily temperature below the 10th percentile; percentage of days with minimum daily temperature above the 90th percentile; percentage of days with maximum daily temperature above the 90th percentile; annual precipitation when daily precipitation exceeds the 95th percentile; annual precipitation when daily precipitation exceeds the 99th percentile)

4 – duration indices representing the duration of certain periods based on an absolute or percentile threshold (maximum duration of dry period; number of days with observed cold waves; maximum duration of dry days; number of days with observed heat waves).

The results of the work can be used to develop adaptation strategies in key economic sectors such as agriculture, energy and health, where extreme temperatures and precipitation have a significant impact on the resilience of systems.

1. Peterson T.C. Climate Change Indices // WMO Bulletin. 2005. Vol. 54. № 2. P. 83–86.
2. Kim Y.-H. et al. Evaluation of the CMIP6 multi-model ensemble for climate extreme indices // Weather and Climate Extremes. 2020. Vol. 29. P. 100269. DOI: 10.1016/j.wace.2020.100269.

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