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Temporal variability of winter temperature extremes in Poland

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The observed increase in air temperature in the northern hemisphere in recent decades is indisputable and is supported by extensive research.

The aim of the study is to estimate the trend in winter minimum air temperature extremes in Poland during the period 1951–2015 by demonstrating the changes in the magnitude of temperature anomalies, temperature "shortage", as well as the area influenced by extreme temperature occurrence. For the purpose of this paper, the probability approach to distinguish temperature anomalies has been used. A minimum temperature extreme was defined as a value lower than the seasonal (December–February) 5th percentile value calculated from daily data for the reference period of 1961–1990. Minimum air temperature (Tn) values were obtained from 98 stations of the National Meteorological Service network, relatively regularly distributed across Poland. To express temperature "shortage", as well as the area influenced by extreme temperature occurrence daily maps of minimum air temperature were created to calculate the total area affected by temperature extremes. To combine the effect of spatial extent and temperature anomaly, an Extremity Index was introduced. Extremity index, expressed by monthly and seasonal totals of EI, was calculated for each month and season separately, taking into account only the days with extreme temperature over at least 10% of the area.

To estimate the changes in extremeness the 5th percentiles with time, percentiles were calculated for consecutive overlapping 30-year periods The results confirmed an increase in winter minimum air temperature, evidenced also in the decrease of winter extremeness. Nevertheless the episodes of severe cold days occurred. The use of an extremity index with detailed analysis of the parameters composing the index provides an important additional information about the spatial extent of extreme events. The index was also used to rank Polish winters in terms of their thermal conditions, and confirmed the regional importance of atmospheric circulation.