

The (d)evolution of ice phenomena in Poland due to the climate change

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The higher winter average temperature and snowless winters resulted in observed degradation in ice phenomena in Polish rivers. Here we analyse to what extent the visible with the naked eye lack of ice in rivers comply with the monitoring results.

The datasets for analysis base on the monitoring system of the Institute of the Meteorology and Water Management - IMGW (Official Polish Hydrological Service) and generally cover the period from 1951 to 2019. From the repository of the IMGW containing daily observation series for this research we selected 105 observation stations located at various rivers and creeks in Southern Poland. The measure points are evenly distributed and located at larger rivers which represent the whole spectrum of the hydrological regime in Poland.

The datasets of annual sums of days with ice phenomena were analysed in terms of their homogeneity by means of Pettitt's test, the Mann-Kendall trend test and slope Sen's test. Additionally, the variability in ice thickness was analysed. However, the amount of observation of the thickness hardly ever exceeds 30 years (including years with ice thickness equal to 0). Therefore, we proposed the simple linear regression analysis of the slope for the time series containing more than 10 years of observations.

Regardless the river size and regime and the location of the observation station, the Pettitt's test results suggest that the shift in time series was usually detected either just before or few years after the turn of the 21st century (1997-2006). This period coincides with observable increase of temperatures in Poland but also with the enormous rapid economic growth of the country which influenced the water management policy in the catchments. What is more, the Man-Kendal test results point that in the majority of the measurement sites the number of ice phenomena has been decreasing. Also, the Sen's test clearly shows that the general number of ice phenomena gradually but consequently declines over the recent years. Interesting is that, that the decline in number of ice phenomena is generally faster in the mountain catchments rather than in the lowland parts of rivers.