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Trends in liquid, solid and mixed precipitation indices in Poland on the background of current climate change

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Precipitation is crucial element of the Earth system, responsible for many environmental processes and is decisive for a life. Changes from solid to liquid precipitation over time influence potential of snowmelt flooding. Lack of adequate spring melt would yield shortage and interruption of stream flows and lead to hydrological droughts in late spring and summer. Changes in the occurrence and amount of solid precipitation, which is vital for snow cover development, indirectly modify radiation balance (increased albedo) and impact large-scale climate dynamics. Phase (solid, liquid, mixed) which precipitation occurs in may alter due to current climate change.

This study will discuss trends in solid, liquid and mix precipitation characteristics and its relation to air temperature on annual seasonal and monthly scale in Poland. We aimed at answering the question how is the effect of current warming on the frequency and amount of solid, liquid and mixed precipitation? and Is there spatial variability in temporal changes in precipitation phases in Poland?

We used the sub-daily synoptic data (every 3h a day from 00UTC) on weather phenomena and air temperature covering the period 1960–2018. Every day was classified as day with solid, mixed or liquid precipitation based on notation of current weather (ww) and past weather (WW). Phase based precipitation indices included: probability and totals of solid, mixed and liquid precipitation and contribution of solid and liquid precipitation into overall total and frequency.

Our previous study in the high latitudes of Europe showed that precipitation phases were sensitive to warming, however, to a various degree depending on phase, mean climate, month and local conditions. Preliminary results from southern Poland indicated significant relation between precipitation phase and both, precipitation frequency and totals, the relation is stronger for the latest one. The 1 oC increase in summer air temperature caused a decrease of –4 days and –33mm in liquid precipitation frequency and totals while in winter changes were contrasting and of a magnitude of +2 days and +5 mm per 1oC. In winter air temperature-induced changes in solid precipitation reached –2.4 days and –5 mm per 1oC. Statistically significant changes involved increasing trends in summer liquid precipitation and decreasing trends in solid precipitation in December (fastest warming). Warming also caused a shortening of the period with snowfall.

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