Precipitation type redistribution toward convective rainfall increase over Northern Eurasia in 1965-2017

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Precipitation response to the global climate change is not fully investigated yet. It is expected that the frequency of extreme precipitation will increase in a warming climate [1]. In Northern Eurasia, the air temperature and humidity increase results in more frequent formation of convective unstable conditions [2]. It can be expected that warming may redistribute total precipitation toward convective component.

Here, we analyzed different genetic types of precipitation based on routine meteorological observations from 537 Russian stations for the 1966–2017 period [3]. We separated total precipitation into showery (convective), non-showery (stratiform or large-scale) and drizzle precipitation based on information on present and past weather and cloud morphological types (detected and coded during routine observations). We analyzed different characteristics (indices) for precipitation and estimated statistical significance with non-parametric methods.

We found that in Northern Eurasia, the redistribution of precipitation type takes place. In particular, showers become more frequent. In turn, non-showery precipitation becomes less common.

Positive and statistically significant trends are noted at most of the stations for different characteristics of showery precipitation: for seasonal sums (up to 5 mm year^{-1}) (Figs.1a,3), for intensity (not shown) (up to 1-2 mm day^{-1} decade^{-1}) for the 95th percentile (up to 5 mm year^{-1}) (Fig.1b), for the contribution of the 95th percentile into the seasonal sum (up to 7% decade^{-1}) (Fig.2a).

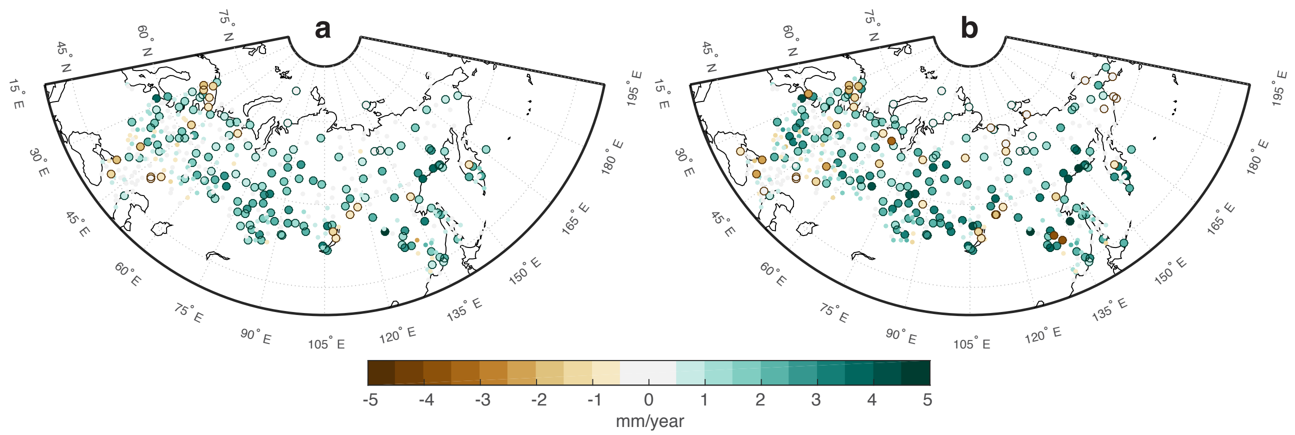

Figure 1. Theil-Sen trends (mm/year) for summer for (a) sum of showery precipitation, (b) the 95th percentile of showery precipitation. Circles stand for each meteorological station (only for stations that located below 500 m height and have less than 5 missed seasons). Large rimmed circles stand for statistically significant trends (at 0.05 significance level based on Mann-Kendall test).

Significant negative trends are noted for the same characteristics for non-showery precipitation (not shown). Opposite trends for showery and non-showery precipitation lead to redistribution between their contributions to the total precipitation (Fig.2b) (drizzle precipitation is negligible). For most of the stations, trends of contribution of convective precipitation are positive, for particular stations they exceed 20% $decade^{-1}$. As a result, in 1960–1980, non-showery precipitation dominated in Northern Eurasia, while showers have become the predominant type of precipitation in the beginning of the 21st century.

Obtained results can be used for validation of inter-annual variability of convective and large-scale precipitation in global climate models and reanalyses.

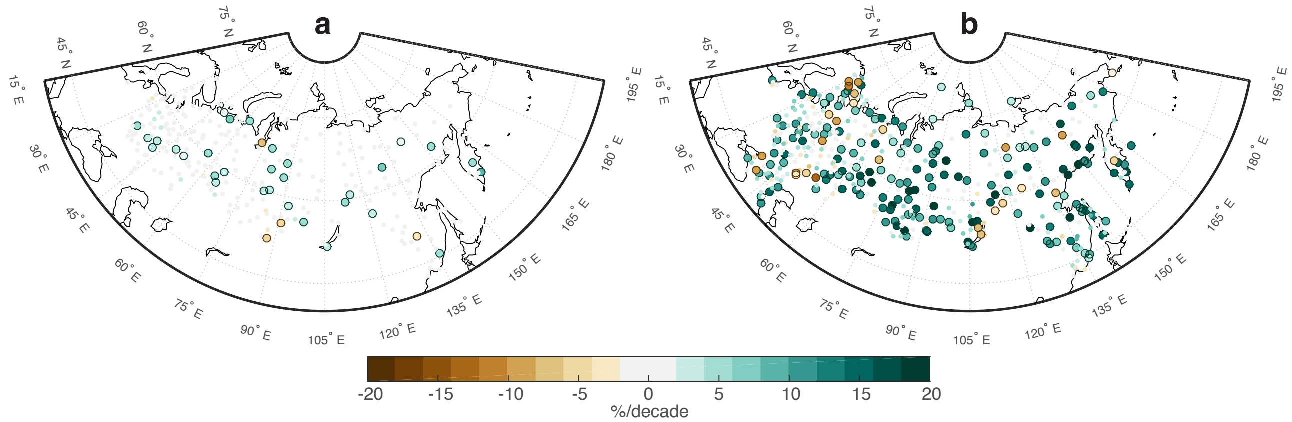

Figure 2. The same as Figure 1, but for (a) contribution of very wet days (95 percentile) to showery precipitation, (b) contribution of showery precipitation to total precipitation.

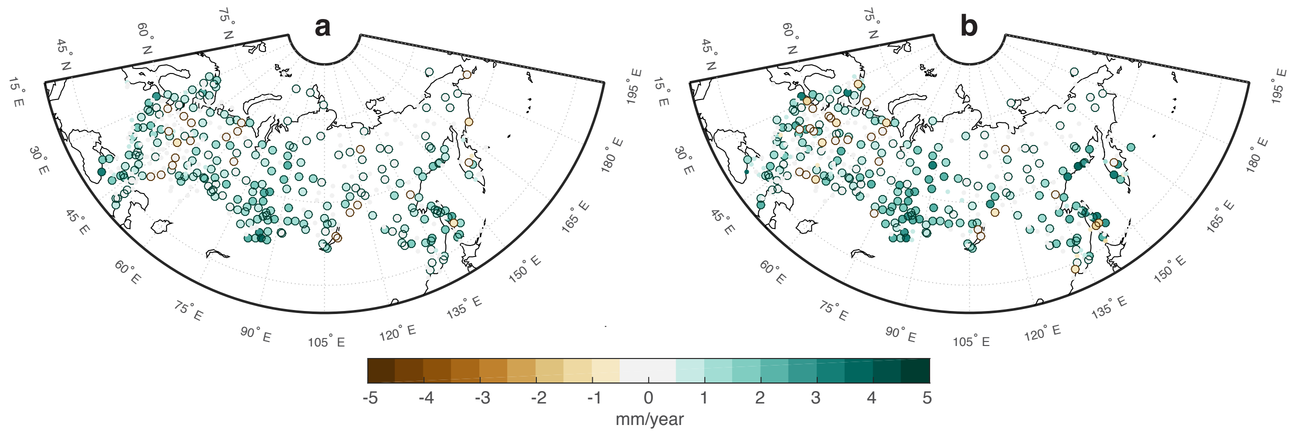

Figure 3. The same as Figure 1, but for sum of showery precipitation in (a) spring and (b) autumn.

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