Dependence of long-term persistence properties of precipitation on spatial and regional characteristics

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The long-term persistence (LTP), else known in hydrological science as the Hurst phenomenon, is a behaviour observed in geophysical processes in which wet years or dry years are clustered to respective long time periods. A common practice for evaluating the presence of the LTP is to model the geophysical time series with the Hurst-Kolmogorov process (HKp) and estimate its Hurst parameter H where high values of H indicate strong LTP.

We estimate H of the mean annual precipitation using instrumental data from approximately 1 500 stations which cover a big area of the earth's surface and span from 1916 to 2015. We regress the H estimates of all stations on their spatial and regional characteristics (i.e. their location, elevation and Köppen-Geiger climate class) using a random forest algorithm. Furthermore, we apply the Mann-Kendall test under the LTP assumption (MKt-LTP) to all time series to assess the significance of observed trends of the mean annual precipitation.

To summarize the results, the LTP seems to depend mostly on the location of the stations, while the predictive value of the fitted regression model is good. Thus when investigating for LTP properties we recommend that the local characteristics should be considered. Additionally, the application of the MKt-LTP suggests that no significant monotonic trend can characterize the global precipitation. Dominant positive significant trends are observed mostly in main climate type D (snow), while in the other climate types the percentage of stations with positive significant trends was approximately equal to that of negative significant trends. Furthermore, 50% of all stations do not exhibit significant trends at all.