Global investigation of Hurst-Kolmogorov behaviour in river runoff
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Abstract
Long-term persistence or Hurst-Kolmogorov behaviour (HK) is a well-identified property of river discharge. Here, we use a large dataset (GESIS international archive), which counts over 2500 records above 10 years, 450 of which are also above 100 years, to examine the dependence structure in annual time-scale. We estimate the Hurst coefficient $H$, for record lengths between 60 and 208 years, and investigate the sample size effect on the estimation. In subplots of 60–80, 80–100, 100–120 and above 120 years. We further extend our investigation by exploring the roles of catchment size, runoff mean value, elevation of gauge (above sea level), location (zonal, latitudinal, high-latitude) to $H$ determination. Finally, we determine if there are any links between $H$ in the streamflow and the regional precipitation.

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Methods
1. Data preparation
   - High quality original dataset.
   - Not demanding preparation of data.
   - Stable negative changes ($\lambda = 10\%$).
   - Strong decrease in the last 15 years (N. & S. America, Australia).
   - $H$ follows a normal distribution, with $\mu = 0.62$ and $\sigma = 0.13$.
   - Catchment size, latitude and elevation are weakly linked to $H$.
   - Record length is not.
   - $H$ increases with catchment size above 50 $10^5$ km$^2$ and elevation above 1000 m.
   - $H$ is higher in the tropical zone ($\theta_{\text{trop}}$) similarly to precipitation. However they are not correlated.

Conclusions
- Sample sizes are important and should be as long as possible, and need to be appropriately estimated.
- Our findings are general and conform to long-term and regional climate and hydrological long-term changes.
- Global spatial variability of $H$ coefficient, estimated from the 1981–2015 dataset ($\lambda = 0.13$), and from 1981–2015 at annual scale, from Markonis and Koutsoyiannis (2016).

References
Szolgayová, R. "Stochastic Hydrology of the Slovak Karst Catchment." PhD diss., Faculty of Civil Engineering, Slovak University of Technology, 2012.