Geophysical Research Abstracts
Vol. 21, EGU2019-5858, 2019
EGU General Assembly 2019

Climate change, local artefacts, or random patterns? Hydro(geo)logical trends revisited.

Gunnar Lischeid (1), Ralf Dannowski (1), Tobias Hohenbrink (2), Knut Kaiser (3), Christian Lehr (1), Gunnar Nützmann (4), Jörg Steidl (1), and Peter Stüve (3)

(1) Leibniz Centre for Agricultural Landscape Research, Müncheberg, Germany (lischeid@zalf.de), (2) Institute of Ecology, Ecohydrology and Landscape Evaluation, Technical University of Berlin, Berlin, Germany, (3) GFZ German Research Centre for Geosciences, Helmholtz Centre Potsdam, Potsdam, Germany, (4) Department of Ecohydrology, Leibniz-Institute of Freshwater Ecology and Inland Fisheries, Berlin, Germany

Trend analysis is widely used to check for effects of climate or direct anthropogenic change on hydrological systems. Often inconsistent patterns are found. These are often either ascribed to local, usually anthropogenic effects or are regarded to result from natural spatial heterogeneities of meteorological drivers, evapotranspiration, or of subsurface structures. In this study a set of 40 time series of lake water level and groundwater head observations in North Germany was studied that exhibited contradictory trends during a 28 year period. Joint analysis of these data was justified by close hydraulic contact between groundwater and surface water bodies.
Principal component analysis was used for factoring out local effects from the time series. But that did hardly affect the results of the trend analysis. In contrast, spatial heterogeneity of long-term dynamics at different sites in the first place could be ascribed to different degrees of damping of the hydrological input signal. Positive long-term linear trends were found exclusively for time series exhibiting a minor degree of damping, whereas negative trends were restricted to time series with pronounced damping.
It has been postulated that inconsistent trends could result from low-pass filtering of meteorological input variables. In fact power spectrum analysis confirmed the pivotal role of low-pass filtering of the groundwater recharge signal. Low-pass filtering of a 107 year time series of the climatic water balance as a proxy for groundwater recharge in that region in fact reproduced the observed negative trends of groundwater head data as part of a low-frequency oscillation. The more high-frequency oscillations were attenuated during seepage flux in the vadose zone, the more minor long-term oscillations in the input signal became visible, resulting in apparent monotonic trends. These results are in line with theoretical considerations and numerical experiments. Consequently, outermost caution is advised when trend analysis is applied to hydro(geo)logical time series in a naïve way.