Geophysical Research Abstracts
Vol. 17, EGU2015-6387-1, 2015
EGU General Assembly 2015


# The Performance of the Standardized Precipitation Index as a Groundwater Drought Indicator

Rohini Kumar (1), Jude Musuuza (1,2), Adriaan Teuling (3), Luis Samaniego (1), Anne Van Loon (3,4), Jurriaan Ten Broek (3), Roland Barthel (5), Juliane Mai (1), Sabine Attinger (1,6)

(1) Helmholtz Centre for Environmental Research-UFZ, Computational Environmental Systems, Leipzig, Germany (rohini.kumar@ufz.de), (2) Water and Environmental Management Research Centre, Queen's School of Engineering, University of Bristol, Bristol, UK, (3) Hydrology and Quantitative Water Management Group, Wageningen University, The Netherlands, (4) School of Geography, University of Birmingham, UK, (5) Department of Earth Sciences, University of Gothenburg, Sweden, (6) Institute of Geosciences, University of Jena, Germany

Droughts are recurrent extensive climatic phenomena characterized by below-average water availability. Drought is often associated with large socioeconomic losses and damage to ecosystems. Many of these direct drought effects are related to storage conditions in surface water, reservoirs, and groundwater. Due to a lack of global groundwater and surface water observations, most studies on drought have so far relied on drought indices based on precipitation only. Among them, the Standardized Precipitation Index (SPI) is commonly used drought index. It is often assumed that by computing SPI over longer timescales (e.g., 3, 6, 12 or more months), it captures the effect of accumulating precipitation deficits typical for hydrological (and groundwater) droughts.It remains to be tested whether the SPI is suitable for groundwater drought monitoring at regional to local scales relevant for water management.

In this data-based exploratory study we analyzed the suitability of the SPI to characterize groundwater droughts at more than 2000 groundwater wells located in Germany and the Netherlands with at least 10 years of available records. The monthly groundwater heads available since the year 1950 for the German wells and 1988 for the Dutch wells was converted to a percentile-based groundwater index (SGI) similar to the SPI. A cross-correlation analysis was performed separately at each well to understand the spatio-temporal relationship between SGI and SPI at different accumulations and lags.

The accumulation periods (of the SPI) to achieve maximum correlation (with SGI) exhibited high spatial variability with values ranging between 1 and 48 months, while the lag times showed a smaller variability with the majority of wells having values around zero. This leads to the conclusion that a priori selection of the accumulation period would result in inadequate characterization of groundwater droughts as there exists no single representative value that is applicable over the entire domain. For instance, using the SPI with a uniform accumulation period of 1, 3, 6, and 12 months significantly reduced the correlation from a spatially average maximum value of 0.67 to 0.23, 0.46, 0.53, and 0.51, respectively. Further, a low probability of detection (20-60%) and a high false alarm ratio (40-80%) at the majority of wells demonstrated the low reliability of groundwater drought predictions using the SPI. The findings of this study highlight the inability of the SPI to adequately characterize groundwater drought events, and calls for a different observation-based indicator like the SGI.