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Response of surface and groundwater on meteorological drought in Topla River catchment, Slovakia

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Continuously increasing number of drought studies published in scientific journals reflects the attention of the scientific community paid to drought. The fundamental works among many others were published by Yevjevich (1967), Zelenhasic and Salvai (1987), later by Tallaksen and van Lanen Eds. (2004).

The aim of the paper was to analyze the response of surface and groundwater to meteorological drought occurrence in the upper and middle part of the Topla River Basin, Slovakia. This catchment belongs to catchments with unfavourable hydrogeological conditions, being built of rocks with quite low permeability. The basin is located in the north-eastern part of Slovakia covering the area of 1050.05 km^2. The response was analyzed using precipitation data from the Bardejov station (long-term annual average of 662 mm in 1981 – 2012) and discharge data from two gauging stations - Bardejov and Hanusovce nad Toplou. Data on groundwater head from eight observation wells, located in the catchment, were also used, covering the same observation period.

Meteorological drought was estimated using characterisation of the year humidity and SPI index. Hydrological drought was evaluated using the threshold level method and method of sequent peak algorithm, both with the fixed and also variable thresholds. The centroid method of the cluster analysis with the squared Euclidean distance was used for clustering data according to occurrence of drought periods, lasting for 100 days and more. Results of the SPI index showed very good applicability for drought periods identification in the basin. The most pronounced dry periods occurred in 1982 – 1983, 1984, 1998 and 2012 being classified as moderately dry, and also in 1993 – 1994, 2003 – 2004 and 2007 evolving from moderately to severely dry years.

Short-term drought prevailed in discharges, only three periods of drought longer than 100 days occurred during the evaluated period in 1986 – 1987, 1997 and 2003 – 2004. Discharge drought in the upper gauging station in Bardejov lasts usually longer than in Hanusovce nad Toplou station being located downstream.

Higher number of short-term droughts was estimated for groundwater head in one monitoring well with the smallest depth of groundwater head below the surface. In this case, the influence of evapotranspiration could be the reason. More long-term droughts were estimated by TLM method for groundwater heads in other seven monitoring wells. Those droughts lasted for tens of weeks since summer until the spring of the next year. No regularity in temporal groundwater head drought propagation downstream the Topla River was discovered. However, results of the cluster analysis showed some common features of long-term drought periods (more than 100 days) occurrence for two groups of wells. Different hydrogeological conditions in two evaluated wells were also reflected in drought periods number and severity.

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