



Base flow drought index

Miriam Fendekova, Marian Fendek, and Milos Gregor

Comenius University, Department of Hydrogeology, Bratislava, Slovakia (fendekova@fns.uniba.sk)/+421-2-60296701

Groundwater drought indices could be derived for different groundwater parameters, e.g. base flow, groundwater table stage, spring discharge, or groundwater recharge values. The index describing the base flow drought developed at the Department of Hydrogeology was derived using the threshold level method.

Base flow drought index is proposed to be derived using stream flow discharges in a daily step. Derivation of the base flow value for each day is based on the local minimum method (Institute of Hydrology, 1980). The original method was reprogrammed by Gregor (2008) implementing suggestions of Tallaksen and van Lanen Ed. (2004). The program enables utilization of N-day non-overlapping consecutive periods for calculation of the minimum discharge values used for the base flow hydrograph course identification. N-day represents different length of the periods starting from 5 through 10, 15 and 20 up to 30 days. The utilization of different period's length was conditioned by the fact that the 5-day period used in the original BFI method of the Institute of Hydrology (1980) overestimated the base flow value in comparison with other methods (procedure of Kille and others) widely used for the base flow calculation in complicated hydrogeological conditions of the Slovak Republic.

After estimating the base flow (QB), flow duration curves of base flow values (base flow duration curves) for each entire hydrological year (from November 1st to October 31st of the next year) are constructed for at least 30-year long period. As the next, values of the master base flow duration curve are calculated as the values of arithmetic mean for percentiles of 0.1, 1, 5, 10, 20, 30, 50, 60, 70, 80, 90, 95, 99, and 99.9. QB90 QB80 and QB70 can be applied as threshold levels for base flow drought severity assessment. The classification scheme of groundwater drought occurrence is proposed as follows. Years are classified as years with extremely low base flow when the average yearly base flow value is less than 70 % of its long-term average, as very low base flow when QB lies in the interval of 70 – 79 % and as years with the low base flow (QB in the interval of 80 – 89 %). Years with the QB value within the interval of 90 – 110 % of the long-term average base flow value are classified as normal years. Severity of drought could also be classified as follows: base flow below the threshold level of QB70 characterizes extremely severe groundwater drought, baseflow ranging in the interval 70 – 79 % characterizes very severe drought with the threshold level of QB80 and base flow within the interval of 80 – 89 % characterizes severe drought occurrence. QB values above the threshold level of QB90 characterize no drought occurrence. Procedure of the baseflow drought index was applied in several catchments of Slovakia, and enabled to identify periods of base flow drought in late 40-ties, late 80-ties to early 90-ties of the last century and in the 2003-2005 period. More frequent base flow drought occurrence in the 21st century was documented.

Acknowledgment: the research was done with the financial support of the FP6 Watch project, contract No. 036946.

References:

Gregor, M. (2008) Vyvoj programov na analyzu casovych radov vydatnosti pramenov a prietokov vodnych tokov [Software development for time series analysis of spring yields and river discharges]. Podzemna voda, XIV 2/2008, Slovak Association of Hydrogeologists, Bratislava, 189-198. ISSN 1335-1052.

Institute of Hydrology (1980) Low Flow Studies Report, 3 volumes. Institute of Hydrology, Walligford, UK.

Tallaksen, L. M. & Lanen, H. A. J. van (2004) (Eds) Hydrological Drought – Processes and Estimation Methods for Streamflow and Groundwater. Developments in Water Sciences 48, Elsevier Science BV, The Netherlands.