



Assessment of low flow indices and water deficit for the Romanian rivers

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Water resources management has become a challenging issue in the southern Europe (including Romania), an area under a recurrent water stress. Here we aim to determine specific values ("threshold" values) based on different methods in order to assess the low flows and water deficit in Romania. For an accurate and efficient analysis of low flows, it is necessary to approach several indicators. The low flow indices are presented and calculated for the daily discharge series at 57 hydrometric stations in Romania over the period 1970 - 2015. Among the presented indices are the base flow index, the standardized streamflow index (SSFI), the multiannual average discharge, the 80th, 90th, and 95th percentiles from the duration curve of the daily average discharges, the mean annual 7-day minimum discharge (MAM7), the water deficit (characterized by duration, volume, intensity, minimum discharge and time of occurrence), seasonality index, and the seasonality rate. Considering that in Romania the low flows occurs throughout the whole hydrological year, as a result of the climatic conditions, the seasonal variations were also taken into account for the estimation and analysis of the low flows. Therefore, the estimation of the low flows indices was performed for two periods: cold season (October 1 - March 31) and warm season (April 1 – September 30), within the hydrological year (between October 1 and September 30). For the analysis we used the lfstad applications package developed in R program. Also, a correlation analysis was performed to highlight the relation between the calculated indices. Regarding the water deficit identified during the low flows period, an assessment of its characteristics was performed based on the use of the threshold level method, and of a moving average filter of 7 days. The threshold level can either represent a demand, e.g. water supply or ecological minimum discharge, or it can represent normal low flow conditions. Thus, two thresholds were chosen: seasonal Q80 and Q90. Our results emphasize that there is an overall tendency towards a decreasing trend in the mean annual streamflow, especially over the eastern and southern part of the country. For the countries situated at high altitudes the occurrence date of the lowest discharge is always during the winter season, while for the station situated at lower altitudes the occurrence date of the lowest discharge is always throughout the summer season. By analysing the standardized streamflow index we show that the north-west part of the country is affected mostly by short-term drought, the north-eastern part of the country is mostly affected by medium-range drought, while in the southern part of the country we have a high frequency of occurrence for the long-term drought.