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# Utilisation of meteorological and hydrological drought monitoring as base for operational low flow forecasting

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A drought is a persistent, repetitive and regional phenomenon of below average natural water availability. The spatial and temporal drought characteristics are varying widely from region to region. From a hydrological point of view, this water scarcity is perceived in form of low flows, which may cause ecological and economic damages. Forecasts of hydrological droughts are essential for an effective low flow management. These forecasts can be subdivided into two groups. One is based on assumptions or observations of meteorological droughts. Here the lag time between the meteorological and hydrological droughts and the relationships between severities of both drought categories are most relevant. For the other type of forecasts, which is highly important during an ongoing hydrological drought, the duration, severity and recovery of respective drought are most important. Both types of forecasts require specific tools. For the first type of forecasts, it has to be considered, that a hydrological drought does not develop immediately. The time span between meteorological and hydrological drought, the lag, quantifies, how much time a catchment needs to respond with low flows on dry weather conditions. It is shown that, if the lag time of a catchment is known, which is affected by several conditions (initial wetness, season, catchment characteristics) a probability of the occurrence of a low flow period can be calculated under different scenarios of future precipitation deficits. To predict this occurrence, catchment characteristics, historical precipitation deficits and corresponding low flow periods are used.
The impact of ongoing hydrological droughts depends in a multivariate way on the relationships between their duration and severity. Different impacts can be expected if a period of low flows is long but less severe or much more severe but short. These conditions have to be evaluated differently according to the characteristics of the respective rivers and the expected damages. To classify both characteristics jointly, a new low flow index is proposed. By updating this index on a daily base and in comparison with observed low flow conditions of the past, using the nearest neighbour method (types specific), the current state of a low flow situation can be specified. It is essential that anthropogenic impacts are considered here, which may alter these low flow conditions. These forecasts depend strongly on the capacity of watersheds to recover from hydrological droughts.
In summary it is shown how the information of both, meteorological and hydrological drought conditions, can improve the assessment of low flow situations and their operational use. The advantages of the proposed new procedures are shown in a German case study.