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Screening large streamflow datasets for human-induced changes in drought characteristics

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Streamflow droughts can have severe impacts on, e.g., river ecology, navigation or hydropower production. The characteristics of these streamflow droughts can be alleviated or aggravated by human influences such as reservoir operations or groundwater abstractions. The question is when, where and why these influences impact the timing and degree of change of drought characteristics. Using large datasets of observed streamflow records from the UK, US and Germany, this study aims to answer these questions in three steps: (1) Quantifying the dominant influences on streamflow drought characteristics for catchments with near-natural flow as a baseline, (2) identifying potentially influenced catchments with drought characteristics that deviate from this baseline, i.e. have drought characteristics that deviate from those expected under near-natural conditions, and (3) relating these deviations to available catchment or station information such as indicative descriptors of human influence provided by national agencies. For catchments with near-natural flow, the analyses show a strong relationship between catchment responsiveness and average streamflow drought duration as well as a strong correlation between meteorological and streamflow drought indices. Some of the catchments for which groundwater abstraction are indicated show prolonged drought durations. A diminished correlation between meteorological and streamflow drought indices was found for some of the potentially influenced catchments. It is likely that these weaker correlations are related to human influences such as reservoir operations or the augmentation of low flow. To conclude, the applied data screening approaches across large regions were successful in identifying catchments where human influences were likely to modify streamflow drought characteristics and propagation. These identified catchments could be the focal point for future, local scale, studies which aim to attribute the deviations from natural drought characteristics to human influences and, where needed, suggest changes in management to minimize the human impact.