



Impacts of anthropogenic activities on different hydrological drought characteristics

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The natural hazard drought can have severe impacts on a variety of sectors and at a variety of scales. Droughts, here defined as below average water availability, occur everywhere. However, the impact of a drought event is not only influenced by its severity but also by the vulnerability of an area to droughts. Research in catchments with natural flow conditions is crucial to gain process understanding about hydrological droughts. However, the locations of catchments with natural flow are often not representative for regions with a socioeconomic sector that is highly vulnerable to droughts. In these more vulnerable areas, human activities like groundwater extraction can intensify hydrological droughts. On the other hand, human activities can also mitigate or limit the magnitude of drought events. The aim of this study is to assess the impact of different anthropogenic influences on streamflow droughts by comparing hydrological drought characteristics between catchments with natural streamflow and with regulated or otherwise altered streamflow. The study is based on a large set of streamflow records from catchments in Germany, the UK and the USA with either known anthropogenic influences or natural streamflow conditions. Different drought characteristics (duration, deficit, frequency and timing of drought events) are computed for the selected stations. The drought characteristics in catchments influenced by various anthropogenic activities are stratified by the characteristics of anthropogenic influence, but also by similar physical and climatological properties. These stratified groups are then compared to drought characteristics in natural catchments with similar properties. Results show both negative and positive impacts of different human activities on droughts. For example, urbanized areas with low flow regulations show hydrological droughts with shorter durations and lower deficit volumes compared to nearby natural catchments, while records downstream of reservoirs show intensified drought characteristics. The differences between droughts in natural and regulated flow regimes, however, appear to be non-linear and variable with the severity of drought events. In conclusion, this study shows systematic impacts of human activities on different drought characteristics and furthermore reveals that management patterns have limits during severe droughts.