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Groundwater in times of droughts

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Droughts are characterized as sustained and regionally extensive occurrences of below-average natural water availability. They affect all components of the water cycle: from deficits in soil moisture (agricultural droughts) through reduced groundwater recharge and groundwater levels to low streamflows or dried-up rivers (hydrological droughts).

Groundwater discharge is a significant component of streamflow, with groundwater contributing as much as 90 percent of annual streamflow volume in some parts of the U.S., Canada and Europe (Beck et al., 2013). And groundwater systems strongly control the hydrological drought characteristics all over the world (van Lanen et al., 2013). Making use of large scale hydrological models van Lanen demonstrated that groundwater systems substantially affect the duration, particularly of the more extreme drought events. The responsiveness of the groundwater system is as important as climate for hydrological drought development.

This urges for an improvement of subsurface modules in conceptual hydrological models to be more useful for water resources assessments.

In this talk, we will discuss different subsurface modeling approaches ranging from spatially distributed groundwater models to simpler reservoir-type modeling approaches and the implications the chosen model has on modelled groundwater droughts and base flow characteristics. In particular, we discuss a standardized groundwater drought index (SGI) to characterize the groundwater deficit and the groundwater head anomalies. Based on SGI, we investigate different statistics (severity, area and duration) of individual drought events for the different model approaches. These results will be related to locally measured groundwater data.