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Fluctuations in regional groundwater volume as an on-line indicator for drought conditions

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Groundwater shortage during drought periods will become more important in future and of relevance even in water-rich regions. Switzerland as considered Europe's water tower disposes of large groundwater resources in the range of 150 km3, but some problems may arise under extreme conditions, such as in 2018 with dramatic precipitation deficit over more than 6 months.

Therefore, additional tools going beyond classical monitoring are needed to better characterize such situations and to improve the knowledge on the state and evolution of groundwater quantity on regional and national scales. An approach was developed accordingly for assessing dynamic groundwater volumes for Swiss unconsolidated porous aquifers, corresponding to areas of high water demand. Fluctuations in the regional groundwater volume are deduced from water level records in the framework of the national groundwater monitoring. Those are representative for typical groundwater settings and were linked to static groundwater estimates. Upscaling of normalized level amplitudes with respect to long-term mean values thereby allowed for the regionalization of the measurements. This provides complementary on-line information on the groundwater filling level, i.e. the ratio of volume variation and total volume, which in turn indicates sensitivity to drought.

The spatial pattern of the filling level is of particular interest in low-level situations, and identifies actual and potential areas at risk. The example of 2018 illustrates the decrease and recovery of groundwater volumes in the different regions of the country, many of which are provided with sufficient reserves despite very low groundwater levels reached. The groundwater volume indicator in this context gives useful advice for characterizing the impact of drought conditions for the different groundwater regimes. It represents a tool for administrations and water managers to define critical low-level values and to adapt regional groundwater planning. This also implies infrastructural measures, such as the interconnection of differing water resources, in order to ensure water supply today and related to expected climate change scenarios.