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Mapping the spatiotemporal development of groundwater drought from data: the 2018-2019 drought in the Netherlands

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The 2018-2019 drought in northwestern Europe caused severe damage to a wide range of sectors, and has made clear that even in temperate-climate countries adaptations are needed to cope with increasing future drought frequencies. A crucial component of drought strategies is to monitor the status of groundwater resources. However, providing up-to-date assessments of regional groundwater drought development remains challenging due to the limited quality of available data. We set up a time series modelling-based method for data preparation to map the spatiotemporal development of the 2018-2019 groundwater drought in the southeastern Netherlands, based on a large amount of monitoring data. The data preparation method was evaluated for its usefulness and reliability for groundwater drought studies and prediction. The analysis showed that the 2018-2019 meteorological drought caused extreme groundwater drought throughout the southeastern Netherlands, breaking 30-year records almost everywhere. Drought onset and duration were strongly variable in space. Groundwater drought development appeared to be governed dominantly by the spatial distribution of rainfall and the geological-topographic setting. The time series modelling-based data preparation method was found a useful tool for the given situation to enable a detailed, consistent record of groundwater drought development. The time series simulations were generally found to be reliable; however, the use of time series simulations rather than direct measurement series may bias drought estimations especially at a local scale, and underestimate spatial variability. Finally, time series modelling was also found a promising tool for regional-scale drought nowcasting and prediction. Further development of time-series based validation and simulation methods, combined with accessible and consistent monitoring data, will be valuable to enable better groundwater drought monitoring in the future.