An extreme meteorological and hydrological drought occurred in Northern Europe in 2018, with widespread impacts including vast amounts of forests destroyed by wildfires, major crop losses, hydropower shortage, freshwater ecosystem stress, and water usage restrictions. Drought impacts are commonly felt on the ground and many are related to freshwater rather than solely to the atmosphere. A better understanding of the hydrological aspect of drought propagation is therefore vital in order to mitigate drought impacts. This study aims at assessing the drought propagation in 2018 in the (continental) Nordic countries at a monthly resolution, with a special emphasis on the streamflow and groundwater aspect. We used the E-OBS gridded observational datasets for temperature and precipitation, as well as high quality near-natural streamflow and groundwater data from the Nordic countries provided by national agencies. The extremeness for each variable was assessed by ranking each month of 2018 relative to that month in a 60-year record of data (30-year for groundwater due to data limitations). Whereas record-breaking high temperatures and precipitation deficits emerged over the Nordic region in May (Bakke et al., in prep.), streamflow stations did not experience extreme conditions before June in Norway, Sweden and Finland. This delay reflects the effect of various catchment properties and in particular the contribution of catchment water storages (mainly snowmelt) that dampens and delays streamflow response to meteorological conditions. The extent of record low streamflow maximized in July. In mid-August, high precipitation replenished the rivers in western and northern parts of the Nordic region. In the southeastern region, however, extremely low streamflow persisted throughout 2018 despite the return to more normal temperature and precipitation conditions after July. Catchments in western Denmark did not experience extremely low streamflow conditions during the summer of 2018, likely due to large groundwater reservoirs feeding the rivers. The response in groundwater levels was also delayed, with unusually low levels emerging in June and expanding in July. However, there was no clear spatial pattern of extremely low groundwater levels, even wells located very close together showed different results, reflecting the various hydrogeological properties and depths of the wells. Nevertheless, extremeness in groundwater are seen in about half of the wells throughout 2018. The response delay (estimated by the precipitation moving average window best correlated with the groundwater time series), depth and soil type help explain part of the variability in the results amongst the wells. In addition to assessing the uniqueness of the 2018 northern European drought, this study emphasises the added complexity of drought propagation, and the need of incorporating more variables than weather alone to
understand hydrological drought development.
