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Spatio-Temporal Trends and Patterns of Historical Streamflow Drought in Sweden

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Streamflow droughts play a fundamental role in the management of rivers and influence the balance between in-stream uses such as aquatic life and recreation, and out-of-stream uses such as reservoir regulation. Consequently, streamflow drought knowledge is important for many aspects of water resources management including hydropower planning, determining allowable water transfers and withdrawals or decisions regarding environmental flows. It is thus essential to better understand, simulate and predict streamflow droughts to secure the needs of the environment, society and economy now and in the future. Although Sweden has historically been a region abound with water, it is not exempt of streamflow droughts. Especially the 1976 Northwest European drought and the 2003 European heatwave will long be remembered for their devastating effects in Europe including Scandinavia. The slowly developing drought in 1976 led to streamflow reductions of roughly 19% in Northern Sweden and 57% in Southern Sweden. In 2003, drought conditions developed rather quickly due to a heatwave accompanied by a lack of summer rainfall, which caused streamflow to decrease on average by 24% (10% in the north, 31% in the south). In both cases, however, there was large spatial variability in hydro-climatic patterns across the country, which highlights the complex interplay of meteorological and topographic features and the resulting hydrological impacts at the catchment scale. Given the large observed temperature increase in Northern Europe over the last century, accompanied by changes in precipitation patterns and dramatic increases in human activities, we hypothesize that streamflow droughts in Sweden have become more common and that not all regions are affected by streamflow droughts to the same extend. To assess these hypotheses, we examined the spatial and temporal development of streamflow droughts in 89 Swedish catchments over the last 56 years. Streamflow droughts were identified and characterized with help of the standardized streamflow index (SSI) and the threshold method. Temporal trends were analyzed using the non-parametric Mann-Kendall test and the Sen's slope estimate.