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Hydrological response to changing climate conditions: Spatial streamflow variability in the boreal region

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It has long been recognized that streamflow-generating processes are not only dependent on climatic conditions, but also affected by physical catchment properties such as topography, geology, soils and land cover. We hypothesize that these landscape characteristics do not only lead to highly variable hydrologic behavior of rather similar catchments under the same ***stationary*** climate conditions (*Karlsen et al., 2014*), but that they also play a fundamental role for the sensitivity of a catchment to a ***changing*** climate (*Teutschbein et al., 2015*). A multi-model ensemble based on 15 regional climate models was combined with a multi-catchment approach to explore the hydrologic sensitivity of 14 partially nested and rather similar catchments in Northern Sweden to changing climate conditions and the importance of small-scale spatial variability. Current (1981-2010) and future (2061-2090) streamflow was simulated with the HBV model. As expected, projected increases in temperature and precipitation resulted in increased total available streamflow, with lower spring and summer flows, but substantially higher winter streamflow. Furthermore, significant changes in flow durations with lower chances of both high and low flows can be expected in boreal Sweden in the future. This overall trend in projected streamflow pattern changes was comparable among the analyzed catchments while the magnitude of change differed considerably. This suggests that catchments belonging to the same region can show distinctly different degrees of hydrological responses to the same external climate change signal. We reason that differences in spatially distributed physical catchment properties at smaller scales are not only of great importance for current streamflow behavior, but also play a major role as first-order control for the sensitivity of catchments to changing climate conditions.

References

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