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Impact of climate change on flood frequency in glaciated versus non-glaciatedsub-arctic catchments

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Climatic change is causing numerous alterations in arctic and sub-arctic landscapes including decreasing the depth and duration of snow cover, warming and thawing of permafrost, and increasing freshwater discharge into the Arctic Ocean. These changes impact the terrestrial freshwater cycle and particularly the timing and contribution of meltwater during the spring and summer months. Thus, changes in the timing and magnitude of hydrologic extremes are seen to provide an essential means by which climate change may be detected in these environments. This study compares annual and seasonal trends and the distribution of flood flows in relation to global climatic patterns in two sub-arctic Swedish catchments: the glaciated Tarfalajokken (21.5 km2) and the non-glaciated Abiskojokken catchment (566 km2). For both catchments, a generalized extreme value (GEV) distribution was fitted to the observed maximum annual floods. The results show that the glaciated Tarfalajokken catchment has a large, significant increasing trend in maximum annual flows, while the non-glaciated Abiskojokken catchment has a slight negative trend in maximum annual flows. During the past two decades, the maximum annual floods occurred more frequently in the late summer (end of July through August) in Tarfalajokken than Abiskojokken. In both catchments, variations in peak flows could be related to global atmospheric circulation patterns such as the North Atlantic Oscillation (NAO), the Scandinavian pattern (SCA), the Polar-Eurasia pattern (POL), the East Atlantic/West Russia pattern (EA/WR), and the Eastern Atlantic pattern (EA). In both catchments, the maximum annual flood events show a significant, negative trend in relation to the Eastern Atlantic pattern (EA), the East Atlantic/West Russia pattern, and the Polar-Eurasia pattern (POL). This indicates that the observed maximum annual streamflows are nonstationary and that the timing and magnitude of peaks are directly impacted by climate variability. Thus, this analysis not only assesses the current state of high-latitude environments but also provides a basis for evaluating the physical causes for the observed recent changes in the hydrological cycle (i.e. permafrost thaw or glacier melt) in connection with climatic patterns and trends allowing for increased accuracy in flood forecasting.