Impact of climate change on mean and high streamflow characteristics in Icelandic watersheds: A case study. Philippe Crochet, – desember 2021.

Ágrip skýrsluhöfundar:

This study presents an analysis of the hydrological response of three Icelandic river catchments to projected climate change in the 21st century. The catchments are located in the southeast (Geithellnaá), northeast (Selá) and northwest (Vatnsdalsá) of the country and vary in size from 190 to 700 km2. The current hydrological regimes of these catchments are strongly influenced by snowmelt seasonality. Daily streamflow series were simulated over the period 1981-2100 with the HYPE hydrological model forced with an ensemble of bias-corrected climate projections under two emission scenarios. The hydrological response of these catchments to projected climate change was analysed within moving 30-year periods and compared to the situation in the reference period (1981-2010).

A significant warming is projected throughout the projection horizon, more or less pronounced depending on the season and catchment location (0.3°C/decade on average for the lower emission scenario and 0.47°C/decade on average for the higher emission scenario). The variability of precipitation projections is mainly characterised by decadal to multi-decadal oscillations. The most noticeable long-term changes concerning mean precipitation are observed in the Vatnsdalsá catchment, where an increase is projected in summer under both emission scenarios, and in the Selá catchment, where an increase is projected in summer and autumn under the higher emission scenario.

In all three catchments, the projected warming is found to gradually lead to shorter snow seasons combined with less snow storage and an increasing fraction of precipitation will fall as rain rather than snow. These changes will, in turn, lead to changes in the seasonality of streamflow, by attenuating the contrast between low winter flows and high spring/summer flows, as observed in the present climate. A gradual streamflow increase is projected in autumn/winter in all catchments; Spring streamflow is projected to decrease in the Vatnsdalsá and Selá catchments but first increase and later decrease in the Geithellnaá catchment; Summer streamflow is projected to decrease in the Selá and Geithellnaá catchments but remain essentially unchanged in the Vatnsdalsá catchment. The changes are more pronounced under the higher emission scenario because it leads to a larger warming and therefore to a larger snowpack reduction than the lower emission scenario.

Projected climate change will also have an impact on the flood regimes of these catchments. As the projected warming will lead to less snow storage and shorter snow seasons, considerable changes are expected to occur in the Vatnsdalsá and Selá catchments, where annual maximum floods are mostly generated by spring snowmelt in the present climate. In these two catchments, these events will increasingly occur in winter in Vatnsdalsá and autumn/winter in Selá, instead of spring and their magnitude is expected to decrease. Toward the end of the 21st century, annual maximum floods will no longer occur primarily in spring but will have a similar or even higher probability of occurring in winter in Vatnsdalsá and autumn/winter in Selá. These changes reflect the decreasing influence of spring snowmelt and the increasing influence of rainfall or the combination of rainfall and

snowmelt in autumn/winter driven by the projected warming. The Geithellnaá catchment will remain under the main influence of rainfall-generated annual maximum floods in autumn and their magnitude will possibly increase slightly. Results related to changes in the seasonal frequency of annual maximum floods appear to be relatively consistent and robust while those related to the changes in magnitude are associated with large uncertainties.