Submitted Abstract

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Title	Variation In The Streamflow Response To Climate Change Between Glacierized Headwater Mountain Basins In The Canadian Rockies And The Austrian Alps.
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Abstract

Mountain glaciers worldwide are retreating, with varied consequences for downstream water supply. With a warming climate and shifting precipitation phase, timing and volume, the hydrological processes occurring in headwater mountain catchments are changing. These changes were investigated in the well-studied Peyto Glacier Research Basin, Canadian Rockies, and the Rofental Basin, Austrian Alps, using a semi-distributed glacio-hydrological model in the Cold Region Hydrological Modelling platform (CRHM) which includes process representation for energy-balance snow and ice melt, ice melt under debris, blowing snow sublimation and redistribution, avalanches, and subsurface water storage and flow. The CRHM models were forced with bias-corrected, high-resolution, dynamically downscaled atmospheric modelling outputs, available at 4km resolution from the WRF model for Peyto, and at 2km resolution from the COSMO for the Rofental. Current climate conditions (the early 2000s) and pseudo-global-warming conditions, which represent simulated weather perturbed by an end-of-century RCP 8.5 scenario, were compared for both basins. The CRHM models were evaluated in each basin with available field data from glacier mass balance, snow accumulation and streamflow observations. Both basins are composed of similar mountain landforms and are predicted to be almost glacier-free by 2100. They have contrasting areas, current glacier cover, and elevation ranges. Under current conditions, the Peyto and Rofental basins both have basin-averaged annual air temperature near -3.8°C; this warms by 5°C in both PGW simulations. The precipitation regime in both basins is currently dominated by snowfall, but Peyto basin receives 15% more precipitation and has a larger proportion of precipitation falling as snow than Rofental. Under PGW, precipitation in Peyto Basin increases by 16%, largely as greater summer rainfall. In contrast, precipitation in Rofental Basin decreases due to a substantial decline in snowfall and increase in rainfall. These contrasting shifts in precipitation, combined with a differences basin area, elevation range and initial glacier cover, cause differing streamflow responses to climate change. Peyto Glacier Research Basin end-of-century streamflow decreases by 7%, with a strong decrease in late summer flow and a 30% decrease in peak flow, whose timing advances by one month. In contrast, Rofental Basin streamflow decreases by 33%, primarily in mid to late summer but sustains relatively unchanged spring streamflow. By comparing two well-studied headwater glacierized basins in differing mountain ranges, this study provides insights into the role of basin topography and precipitation change in causing a shift in streamflow response to climate change.