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Retreating Canadian glaciers and their implications for regional climate and hydrology in future climate

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Glaciers are frozen fresh water reservoirs that respond to changes in temperature and snow accumulation at the surface. Outside Greenland and Antarctica, Canada has the greatest concentration of glacier coverage. In western Canada, concern is growing about the impact that changes in glaciers, particularly reducing glacier melt in summer, may have on water resources. Canada's Arctic Glaciers, with an area of approximately 146,000 km^2, are among the largest of the Arctic glaciers, and their possible contribution to sea level rise is not negligible. Regional Climate Models (RCM) are an important tool to assess the projected changes to climate, particularly due to its high resolution compared with GCMs. Recently, a dynamic glacier scheme, based on volume-area relationship, has been introduced in CRCM5. Both offline (i.e., glacier scheme and land surface scheme) and online (CRCM5 with the new glacier scheme) simulations were performed for the 2000–2100 period over a domain covering the glaciers of western and Arctic Canada. The offline simulations were driven by outputs from a CRCM5 transient climate change simulation, driven by CanESM2 at the lateral boundaries, for RCPs 4.5 and 8.5. This driving data shows an increase in winter precipitation for the Arctic region and a decrease over the west Canadian glaciers. Despite the increase in winter precipitation for the Arctic glacier regions, the offline simulations suggest significant decreases in glacier fraction for the region, suggesting that the gain of mass from the increase in precipitation over the Arctic Glaciers won't offset the glacier mass loss due to the temperature increase. Results also suggest significant decreases in glacier fraction and volume for the west Canadian glaciers. The results of the offline simulation will be confirmed with the coupled simulation, and the impact of retreating glaciers on the regional climate and hydrology will be presented based on the coupled simulation.