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Future climate-driven glacier energy balance change in the Canadian Rockies using the CMIP5

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A fundamental understanding of the climate and the Earth's system is necessary to interpret the short- and long-term impacts of climate change. The interaction between glaciers and climate is a sensitive relationship and and calculating variations in glacier energy is key to estimating future change. It is difficult, however, to accurately project future glacier change due to the complexity in the dynamics controlling glacier response to climate. The primary goal of this paper is to illustrate the future climate-driven glacier change on Haig Glacier, located in the Canadian Rockies. Therefore, the CM3 physical model of the GFDL center for the CMIP5 set of experiments was used to examine the future surface energy balance change. Daily meteorological variables from the historical and future projections under four radiative forcing pathways of RCP2.6, RCP4.5, RCP6.0 and RCP8.6 were used to conduct the full energy balance modeling for Haig Glacier. These scenarios range in complexity and reflect long-term trends (decades to centuries). Hence, changes in the different incoming and outgoing energy from the glacier surface were examined during different decades for different pathways. The data used for these calculations was limited to the summer melt season, May through September (MJJAS), in both the historical and future experiments, from 1975-2100. The results shows that, relative to the control baseline period (1975 to 2005), the glacier's mass balance will be in a moderately stable condition with only a slight increase in melt energy until about mid-century. This relatively stable period will be followed by a sudden acceleration in melt energy around 2050 which increases more than 100% of the baseline amount by the end of 21st century, depending on different pathways.