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Alpine hydropower production and glacier retreat: the case of Switzerland

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Hydropower production (HP) in high mountainous areas relies on snow- and glacier melt influenced water resources and is thus highly sensitive to climate warming. Based on the case of Switzerland that produces over 50% of its electricity from hydropower, we quantify for the first time how glacier retreat and the associated glacier mass loss impacts hydropower production at country-scale. Our detailed analyses of observed HP and glacier mass loss show that since 1980, 3.0% to 4.0% (1.0 to 1.4 TWh yr-1) of the country-scale hydropower production was directly provided by net glacier mass loss. Using state-of-the art glacier mass balance simulations, we furthermore show that this share is likely to reduce substantially by 2040-2060, with an anticipated production reduction of about 1.0 TWh yr-1 by 2070-2090. Regional differences are however considerable, and HP from catchments with large, high elevation glaciers might start declining only after 2040 to 2060. A discussion of what these numbers mean for the ongoing energy turnaround in Switzerland completes this work.