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Mass change of Northwest Spitsbergen glaciers for a range of 21st century climate trajectories

Ian Willis (1), Rhiannon Cogbill (1), Cameron Rye (1,2), and Neil Arnold (1)

(1) Scott Polar Research Institute, University of Cambridge, Cambridge, UK (iw102@cam.ac.uk), (2) Montpelier at Lloyd's, London, UK

The maritime setting of northwest Spitsbergen, Svalbard make its glaciers highly sensitive to enhanced global warming. Modelling the effects of this warming on glacier mass balance in the region is therefore important for quantifying their future contribution to sea level. Here, we develop a mass balance model using the positive degree approach, and calibrate it against data for two benchmark glaciers, Midre Lovénbreen and Kongsvegen. The model is used, together with volume-area scaling, to calculate the future mass balance of all glaciers across northwest Spitsbergen throughout the 21st century. Future socio-economic climatic trajectories were chosen from statistically downscaled outputs for RCP2.6, 4.5 and 8.5 of several CMIP5 GCMs to incorporate a complete envelope of possible futures. The regional volume loss was projected, on average, to be 31.3 $\pm$ 17.3% of the 2006 volume, contributing 1.11 $\pm$0.61 mm to SLR by 2100. The future mass balance is primarily dominated by temperature, particularly for the high-emission scenarios where temperature explains 87% of the variation in mass balance for 2006-2100. There are considerable spatial variations in the response of glaciated northwest Spitsbergen to climate, driven by local glaciological characteristics. This is evident from the significantly greater sensitivity of the small, low altitude Midre Lovénbreen to climatic change compared to the larger Kongsvegen, which extends to higher elevations. Our model predicts an envelope of future mass loss and sea level contribution that is somewhat lower than similar previous studies.