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Mass losses from Svalbard land-terminating glaciers by the end of the 21st century under an RCP 8.5 scenario

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The high Arctic archipelagos are among the most strongly glacierized landscapes on earth apart from the Greenland and Antarctic ice sheets. Svalbard, one of these archipelagos, holds about 36,000 km^2 of glaciers and ice caps and is the region that has shown the least negative mass balance of all the high Arctic regions. However, future projections suggest that the archipelago will experience an unprecedented -for the Arctic- glacier recession over the 21st century.

We here present a high-resolution modelling study of the future ice-mass evolution of 29 individual land-terminating glaciers on the Svalbard archipelago under an RCP 8.5 climate forcing, a rather pessimistic scenario that unfortunately seems to be becoming realistic. Our model calculates glacier mass balance and area/volume changes using a temperature-index approach in combination with a surface elevation change parameterization. The initial glacier topographies and volumes have been assessed from extensive ground-penetrating radar measurements carried out in recent years. The calculations are performed for the 21st century and are forced by statistically downscaled output of ten different global circulation models representing the RCP scenario 8.5. By a topography-based extrapolation of the simulation results to the entire archipelago we show that a complete loss of most of Svalbard's land-terminating glaciers and even a deglaciation of certain subregions of the archipelago might occur by the end of the 21st century. 98% of the land-terminating glaciers will have retreated to less than one tenth of their initial extent by 2100, resulting in a loss of 7392$\pm$2481 km^2 of ice coverage.