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ABSTRACT

Accelerating mass loss of central Spitsbergen glaciers

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Glaciers cover nearly 60% of Svalbard, but despite decades of research on local glaciers many regions remain relatively seldom studied. One of them is poorly glacier-covered Dickson Land (DL) in the arid interior of Spitsbergen. The vast majority of DL glaciers have not been studied before, so not much is known about their present-day state and mass balance. With use of digital elevation models and old topographic maps, modern geometric characteristics, together with length, area and volume changes could be assessed for the whole population of DL ice masses. Geometry data was available for the Little Ice Age maximum (LIA), 1960s, 1990 and 2009/11.

In the most recent 2009/11 inventory 152 ice masses have been catalogued in DL, all terminating on the land. 87 ice masses (57%) are very small (<0.5 km2) and only 9 glaciers (6%) are larger than 5 km2. Their estimated modern volume of glaciers is roughly 12 km3. Since the termination of the LIA glaciers of DL have been continuously losing their area. The smallest ice masses (LIA area <1 km2 lost on average 60% of their area, while the largest ice masses (>5 km2) lost 35%. The rate of area loss has been continuously increasing between the study years and the same applies to front retreat rates, measured for 62 largest glaciers of the region.

Thinning rates for the two last periods have been measured only within a sample of 8 glaciers. The results show that thickness loss rates accelerated by 58% after 1990 and that they are particularly well visible in the highest zones of the study glaciers, likely being a positive feedback related to decreased albedo of former accumulation zones. Thinning rates for the last study period have been measured almost for the whole region. The results have shown that median glacier elevation is a strong control on their geodetic mass balance, in contrast to aspect and incoming shortwave radiation.

Acceleration in area, length and volume loss rates is in line with the ongoing atmospheric warming over Svalbard. Direct mass balance measurements and field observations on DL glaciers confirm high ablation and no firn accumulation over the last decades. The presented results may be applied as a mass balance estimate for other poorly glacier-covered arid regions of the archipelago to improve regional estimates of sea-level rise contribution of Svalbard.