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Sea-level rise contribution from changes in glacier geometry and extent in Svalbard using digital photogrammetry

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Small mountain glaciers constitute only about 3% of the glacierized area on Earth but of all the world's ice masses are currently contributing most to eustatic sea level rise. Estimates of their contribution are uncertain due largely to a paucity of long-term mass balance observations. Of more than 160,000 glaciers worldwide only about 40 have mass balance records longer than 20 years. We use archived historical stereo photography to create a time-series of digital elevation models (DEMs) controlled by high resolution contemporary lidar data to calculate the actual volume change of glaciers. The large number of ground control points that can be extracted from the lidar means the quality of the resultant DEMs can approach those collected using ground-based control. In the SLICES project we have used this method to produce high-quality, high-resolution topographic data for glaciers in Svalbard since the 1950s. These data, which give a direct measure of volume change over the epoch between photographs, provide the first long-term mass balance record for Svalbard of this quality, spatial resolution and areal distribution. Glaciers in the West of the archipelago have experienced acceleration in thinning over the entire period, which is consistent with long-term mass balance records. We are now in a position to extend these results to the much less studied East side of the archipelago, and hence are able to make an improved estimate of the sea level contribution from Svalbard.