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Svalbard glacier changes

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The Svalbard archipelago has about 36 000 km2 glaciers. Annual mass balance studies have been conducted at some selected glaciers since 1967. However, these are only fairly small glaciers at the north-west and south-west coast and cover less than 0.5 % of all glacier area.
Different approaches have been used to assess the overall glacier mass balance; 1) Direct surface mass balance measurements 2) Shallow ice cores and 3) Geodetic mass balance estimated from DEMs and elevation changes by satellite data, airborne laser profiles and ground-based surveys.
Svalbard mass balance estimates from $\sim$40 years of in situ measurements have been hampered by a lack of ablation measurements outside of western Spitsbergen. Hagen et al. (2003) estimated the surface mass balance to be -0.5 Gt y^{-1} for the period 1967 – 1997 when regional mass balance curves were estimated from the available accumulation data from direct measurements and an array of shallow ice cores. In addition they estimated the total ice loss from calving to be -4 ± 1 Gt y^{-1}. More recently the calving has been estimated to -6.8 ± 1.7 Gt y^{-1} (Blaszczyk et al., 2009). Thus the overall average thinning should be -0.13 to – 0.21 ± 0.05 m w.e. y^{-1}. The calving in Svalbard glaciers stands for 20-30 % of the mass loss. There are large inter-annual variations in the net surface mass balance driven mainly by summer temperature (summer ablation) variations.
Geodetic mass balances have been estimated for different periods. For the last 40 years Nuth et al. (2010) estimated a negative overall balance of ca. – 9 ± 0.5 Gt y-1 loss rate from 1965–1990 DEMs and 2003–2008 ICESat elevation data. They used different DEMs derived from available aerial photos during 1965-1990, thus different periods for different regions. They excluded the Austfonna ice cap, so when this is added the overall balance should be ca. 11.5 ±1 Gt/y or -0.32 ± 0.03 m w.e. y^{-1}. For the recent past five years period 2003–2008 geodetic mass balance obtained by ICESat satellite data (excluding calving front retreat or advance) is found to be -4.3 ± 1.4 Gt y^{-1}, corresponding to an area-averaged overall thinning of -0.12 ± 0.04 m w.e. y^{-1} (Moholdt et al. 2010). The less negative mass balance over the period 2003-2008 is also seen in the mass balance monitored glaciers in North-west Spitsbergen.
The ICESat laser altimetry data during 2003-2008 show that most glacier regions in Svalbard have experienced low-elevation thinning and high-elevation balance or thickening.
There are in general strong gradients in the mass balance over Svalbard with more negative mass balances in the west and south than in the north and east where the surface mass balance is closer to zero. This is nicely shown in the ICESat elevation change data (2003-2008) showing close to balance in north-east and large thinning along the west coast. However, the frequent surge-type dynamics of Svalbard glaciers must be considered in geometry change studies.