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The ice-free topography of Svalbard

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We present an ice-free topography of the Svalbard archipelago based on a two-step mass-conserving approach for mapping glacier thickness. For the thickness reconstruction, 70000 individual measurements were assimilated, belonging to survey profiles with a total length of ∼7600 km. The approach is further informed by surface mass balance from a regional climate model, a recent digital elevation model, surface elevation changes and surface ice velocities. The latter three fields are inferred from satellite remote sensing.

For entire Svalbard, we reconstruct a total ice volume of 6573 km3. Aggregation of the values of an associated error-estimate map provides upper and lower ice-volume bounds of 5274 - 8555 km3. These bounds are almost exhausted by the last two estimates from volume-area scaling, which forwarded 5350 and 9089 km3 (Grinsted et al., 2013; Radić et al., 2014). A more recent global approach (Huss and Farinotti, 2012) was able to present the first distributed thickness field for Svalbard with a total volume of 8123 km3. A major reason for the somewhat elevated estimate is that frontal thickness values of marine terminating glaciers are significantly higher. The mean calving-front thickness lies more than 70 m higher than in our reconstruction having important consequences for ice-discharge estimates.