Ground-penetrating radar surveys and ice volume estimates of Wedel Jarlsberg Land glaciers, Svalbard

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ABSTRACT

We present volume calculations, with detailed error estimates, for eight glaciers on Wedel Jarlsberg Land, southern Spitsbergen, Svalbard, and compare them to those obtained from area-volume scaling relationships. The volume estimates are based upon a dense net of GPR-retrieved ice thickness data collected over several field campaigns spanning the period 2004-2011. The total area and volume of the ensemble are 502.9±18.6 km^2 and 80.72±2.85 km^3, respectively. Excluding Ariebreen (a tiny glacier, < 0.4 km^2 in area), the individual areas, volumes and average ice thickness lie within 4.7-141.0 km^2, 0.30-25.85 km^3 and 64-183 m, respectively, with a maximum recorded ice thickness of 619±13 m in Austre Torellbreen. To estimate the ice volume of small non-echo-sounded tributary glaciers, we used a function providing the best fit to the ice thickness along the centre line of a collection of such tributaries where echo-soundings were available, and assuming parabolic cross-sections. We did some tests on the effect on the measured ice volumes of the distinct radio-wave velocity (RWV) of firn as compared to ice, and cold versus temperate ice, concluding that the changes in volume implied by such corrections were within the error bounds of our volume estimate using a constant RWV for the entire glacier inferred from common mid-point measurements on the upper ablation area.