

Ice volume estimates from ground-penetrating radar surveys, western Nordenskiöld Land glaciers, Svalbard

A. Martín-Español¹, E.V. Vasilenko², F.J. Navarro¹, J. Otero¹, J.J. Lapazarán¹, I. Lavrentiev³, Y.Y. Macheret³, F. Machío⁴, A.F. Glazovsky³

1. Technical University of Madrid, Dept. of Applied Mathematics, ETSI Telecomunicación Av. Complutense, 30, 28040 Madrid, Spain, E-mail: alba.mespanol@upm.es
2. Institute of Industrial Research Akademprigor, Academy of Sciences of Uzbekistan Akademgorodok, St. F. Hujaev 28, 100123 Tashkent, Uzbekistan
3. Institute of Geography, Russian Academy of Sciences 29 Staromonetny Per., 109017 Moscow, Russia
4. Escuela Superior de Ingeniería y Arquitectura, Universidad Pontificia de Salamanca en Madrid/Fundación Pablo VI, Paseo Juan XXIII, 3, 28040 Madrid, Spain

ABSTRACT

As part of ongoing work within the SvalGlac project aimed to obtain a reliable estimate of the total ice volume of Svalbard glaciers and their potential contribution to sea level rise, in this contribution we present volume calculations, with detailed error estimates, for ten glaciers on western Nordenskiöld Land, central Spitsbergen, Svalbard. The volume estimates are based upon a dense net of GPR-retrieved ice thickness data collected over several field campaigns spanning the period 1999-2012, all of them except one within 2010-2012. The total area and volume of the ensemble are $113.38 \pm 0.09 \text{ km}^2$ and $10.439 \pm 0.185 \text{ km}^3$, respectively, while the individual areas, volumes and average ice thickness lie within $2.5\text{-}49.1 \text{ km}^2$, $0.08\text{-}5.48 \text{ km}^3$ and $29\text{-}108 \text{ m}$, respectively. The maximum recorded ice thickness, $265 \pm 15 \text{ m}$, corresponds to Fridtjovbreen, which has also the largest average thickness ($108 \pm 1 \text{ m}$). Available empirical formulae for Svalbard glaciers overestimate the total volume of these glaciers by 24% with respect to our calculation. On the basis of the pattern of scattering in the radargrams, we also analyse the hydrothermal structure of these glaciers. Nine out of ten are polythermal, while only one is entirely cold.