

Ice volume of Monte Tronador glaciers

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Keywords: Ice volume, surface velocity, volume-area scaling

Monte Tronador (41.15° S; 71.88° W) is an extinct stratovolcano in the North Patagonian Andes which hosts twelve glaciers, four of them in Argentina and are the focus of a glaciological monitoring by IANIGLA, which includes: ice thickness estimation, ice surface velocity, mass balance measurement, and glacier fluctuation analysis. Here we present a comparison of different methods to calculate the ice thickness distribution and ice volume of glaciers. Four different methods to calculate ice thickness distribution and glacier ice volume are applied to Monte Tronador glaciers. Three of the methods applied to calculate the ice thickness distribution are based on; (1) perfect plastic approximation; (2) ice surface velocity; and (3) mass continuity equation, finally the fourth one is the well-known scaling volume-area method. The last one is first applied with published coefficient to make an independent comparison with the others three methods and the tuned to get the best fit with the total ice volume estimations. Ground Penetration Radar (GPR) surveys were also conducted to measure the ice thickness in Alerce, Castaño Overa and Manso glaciers in order to obtain ground truth data to evaluate the performance of the different ice thickness estimations. In general terms, we found a good agreement between the ice thickness measurement by GPR and the various methods used to calculate the ice thickness distribution (RMSE between 10 to 30 m). Main differences between methods are associated with zones of compressional and extensional ice flux, where, for example, the perfect plastic approximation fails. Our results show that the three different methods used to retrieve ice thickness distribution are useful approaches, and they could be used to tune the volume-area scaling method to obtain a good approximation of the ice volume of other glaciers with similar morphology and climatic setting.