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Ice thickness radar surveys of Nevados de Sollipulli and Volcán Villarica

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Several glaciers in Central and southern Chile are located on top of active volcanoes. Few of them have information about the water equivalent volume and about their possible changes in relation to atmospheric variability or them connection to the volcanic activity. Nevados de Sollipulli and Villarrica volcanoes, located in the Chilean Lake District, are volcanoes where several radar surveys were conducted in 2012 using helicopter-borne ground penetrating radar capable to measure temperate ice and tephra-covered glaciers. The survey allowed data collection along pre-designed track of near 20 km in length at Nevados de Sollipulli and 145 km in length over the Villarica glaciers. A maximum ice thickness of 579 m was detected in the Sollipulli main caldera. In Glaciar Pichillancahue (Villarica volcano) the maximum thickness was 191 m. Most of the resulting radargrams showed bedrock returns indicating a flat bottom topography at Sollipulli caldera and a more rough subglacial topography under Pichillancahue Glacier. These measurements were compared to ice thickness radar data collected on the ground in 1996 and 2011 at Sollipulli, and in 2005 at Villarrica. The resulting data have been compiled and interpolated in order to determine the volume of water equivalent for both glaciers, resulting in a volume of 2.66 km3 for Sollipulli and 1.17 km3 for Villarica respectively. For lahar modeling purposes these volumes must be divided among basins from where the potentially melted ice can flow along different lahar flow paths. For this mapping task, high resolution/accuracy Digital Elevation Models are needed, especially focused on the glacier surfaces where the ice divides are complex or not easily derived from the analysis of aerial photographs or satellite images. This is the reason why LiDAR and Radar airborne surveys are recommended to be used in tandem or separated by few days apart.