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Recent changes in total ice volume storage on Volcán Villarrica, Southern Chile, by means of airborne radar and lidar surveys

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Numerous active ice-capped volcanoes are found along the Southern Volcanic Zone (SVZ, 36-46°S) of Chile. Because they represent a potential natural hazard during eruptive events, when glaciers are susceptible to rapid melting, leading to laharic flows, knowledge upon the ice volume storage and their changes is therefore, very relevant in terms of risk assessment studies. We present the first intensive airborne surveys carried out at Volcán Villarrica (39ºS) in Southern Chile, one of the main active ice-capped volcanoes and lahar generator within historical times within the SVZ. We deployed a scanner laser system for detecting the glacier surface topography, and helicopter-borne ice penetrating radar, for measuring ice thicknesses, allowing altogether to determine the volume of snow and ice storage susceptible to be melted during eruptive events. The total estimated volume resulted in 1.17± 0.1 km3 of water equivalent (w.eq.) at the volcano in 2012, only 37% of the estimated volume of 1961. This reduction is mainly explained by the area shrinkage and ice thinning rates observed in the last 51 years. This total volume is the lower bound available for melting during eruptive events when lahars mudows can be generated, because in the winter, nearly 0.14 km3 w.eq. are potentially added to the volcano as temporal snow falls. The decreasing volume of water equivalent does not mean a lower risk associated to these flows because there has been a huge increase in populated areas and tourism industry in the surroundings of the volcano in recent years.