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Remobilized tephra in lacustrine deltas as a potential factor in landslide susceptibility evaluation: two deltas from northern patagonia affected by the 2011 Cordón Caulle eruption

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Pireco and Totoral (PT) deltas are located at the northwestern coast of Nahuel Huapi lake (Northern Patagonia) at 40km SE from the Cordón Caulle (CC) 2011 eruption vent and 10km NW from the coastal city of Villa La Angostura. A 50-15-cm tephra layer (predominantly lapilli and coarse ash) was deposited over the PT watershed during the CC 2011 eruption. No attention has yet been paid to the potential impacts of the accumulation and remobilization of these tephra deposits over the watershed and its further sedimentation on the lacustrine deltas, where a significant deltaic plain progradation was observed soon after the tephra deposition. Slope instability at the lake floor is a concern for coastal populations due to previous tsunamigenic processes recorded in the lake (as the 1960 subaqueous landslide-induced tsunami that affected Bariloche city). This study involved (1) a GIS-based volume estimation of the CC 2011 tephra deposited and remobilized (2012) over the PT watershed, (2) an analysis of sedimentation rates at the deltas during the eruption, and (3) a study of the delta fronts morphology and evolution from 2011 to 2014. A tephra volume of ~57 x 106m3 was deposited over the watershed in 2011. By the beginning of 2012, the watershed had suffered a net loss of ~3.3 x 106m3 of tephra, which was mainly remobilized towards the deltas by surface runoff and fluvial transport. Intense sedimentation was recorded at the deltas from the beginning of the eruption (0.96cm/year in 2011-2012 at a distal delta environment). Consequently, the lake shoreline was displaced several tenths of meters offshore. Subaqueous mass-movements were identified at the steep delta fronts (14°-21°). One of them (composed mainly by tephra and organic material) occurred on February-May 2012, suggesting an increase of slope instability due to high sedimentation rates of low-density (0.47g/cm3) and poorly-compacted pyroclastic materials.