Geophysical Research Abstracts
Vol. 19, EGU2017-8557, 2017
EGU General Assembly 2017

Tephra, trees, and trouble: forest dieback delays landslide response to pyroclastic eruption

Oliver Korup, Jan Seidemann, and Christian Mohr
Institute of Earth and Environmental Science, University of Potsdam, Potsdam, Germany (Oliver.Korup@geo.uni-potsdam.de)

Large explosive eruptions may substantially transform landscapes by burying topography under thick layers of tephra. The excess pyroclastic sediment that is gradually washed into rivers following such eruptions is responsible for some of the highest specific sediment yields ever documented. The handful of detailed quantitative studies of such catastrophic fluvial response has hardly looked at how hillslopes respond to tephra loads, however. We studied whether three recent eruptions in Chile's Southern Volcanic Zone (SVZ) noticeably changed hillslope erosion rates, and found a strikingly delayed increase in shallow landslide activity.
In the case of Chaitén volcano, which erupted in 2008, densely forested hillslopes nearby gained steadily in landslides abundance and area, and most rapidly some eight years after being covered by tephra. In 2016 alone, more than 75 per cent of the volume of all slope failures since the eruption (more than 2 million cubic metres) occurred in an area of 250 square kilometres around the volcano. Neighboring regions of comparable topography, forest cover, rainfall, and lithology have landslide rates at least ten times lower, so that we argue that successive loss of shear strength due to delayed tree-root decay and suppressed vegetation regrowth promotes slope failures near the volcano, especially where pristine rainforests were obliterated by tephra loads.
These shallow landslides scrape sediment, soils, and dead wood from hillslopes, and reinforce the supply to rivers with high sediment and organic carbon loads nearly a decade after the eruption. We estimate that 0.1-0.2 Mt C were mobilized by these slope failures, and thus more than 25 per cent of the total post-eruptive organic carbon flux bound for the nearby north Patagonian fjords. Given that explosive eruptions in the SVZ have a mean return period of ca. 275 years, we propose that protracted landslide response of densely forested hillslopes to explosive eruptions plays an important, though largely ignored, part in long-term sediment and organic carbon budgets. Our results also indicate that monitoring of post-eruptive sediment and biogeochemical fluxes should account for lagged landslide response of tephra-covered forested hillslopes to avoid substantial underestimates.