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Earthquake-induced static stress change in promoting volcanic eruptions

Fabio Luca Bonali, Alessandro Tibaldi, and Claudia Corazzato
University of Milan-Bicocca, Department of Earth and Environmental Sciences, Milan, Italy (f.bonali@campus.unimib.it)

The aim of this work is to study how earthquakes could favour new eruptions, focusing the attention on earthquake-induced static effects in two different case sites, where 9 seismic events with Mw $\geq$ 8 occurred in the last century: the Alaska-Aleutian and Chilean volcanic arcs. We followed a novel approach that resolves the earthquake-induced static stress change normal to the magma pathway of each volcano instead of considering the general crustal volume. We also considered other parameters that may contribute to control eruptions, such as magma composition and viscosity, magma chamber depth and local tectonic settings.
The dataset includes a total of 51 eruptions following the earthquakes; 33 represent first new eruptions occurred at each single volcano. Comparison of the eruption rate before and after each earthquake suggests that 26 out of the 33 first new eruptions have a positive relation with the studied earthquakes; 13 out of 26 represent awakening events, which are first new eruptions occurred at volcanoes with non-continuous eruptive activity that had no eruptions in the five years before the earthquake.
The sensitivity analysis performed for the 2010 Chile earthquake shows that the N-S- and NE-SW-striking magma pathways suffered a larger unclamping in comparison with those striking NW-SE and E-W. Magma pathway geometry contributes to control the magnitude of the static stress change induced by large earthquakes, with differences of up to 8 times among magma-feeding planes of different orientation at the same volcano. This range of diverse values is larger for the volcanoes closer to the epicentre. The possible error in the estimate of magma chamber depth has a minimum effect on the results since the sensitivity analysis shows that the range of stress changes with depth is about 1.5 orders of magnitude smaller than the range linked to variations in the magma pathway strike. Results suggest that unclamping effect promoted eruptions that occurred at non-continuously erupting volcanoes (Type B) in a range of 157-543 km, while awakening under unclamping occurred in a range of 157-353 km. Regarding the time-gap, unclamping promoted eruptions at Type B volcanoes and awakening in a time window of 2 days-3 years.