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Estimates of stress changes from the 2010 Maule, Chile earthquake: the influence on crustal faults and volcanos

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The south-central Chile margin is an active plate boundary where the accumulated stress in the subduction interface is released frequently by megathrust earthquakes (Mw>8.5). The Maule earthquake of February 27 2010 affected about 500 km of the plate boundary producing spectacular tectonic deformation and a devastating tsunami. A compilation of pre-, co-, and post-earthquake geologic and geodetic data offers the opportunity of gain insight into the processes that control strain accumulation and stress changes associated to megathrust events.

The fore-arc deformation is primarily controlled by the stresses that are transferred through the locked parts of the plate interface and the release of stresses during megathrust events. During a great interplate faulting event, upper plate faults, rooted in the plate interface, can play a key role in controlling fluid pressurization. Hence, the hydraulic behavior of splay faults may induce variations of shear strength and may promote dynamic slip weakening along a crustal fault. Furthermore, the co-seismic stress transfer from megathrust earthquakes can severely affect nearby volcanos promoting eruptions and local deformation. InSAR and time-series of continuous GPS in the aftermath of the Maule earthquake show evidences of activation of the NW-striking Lanalhue fault system as well as pressure increase at the Antuco volcano.

We build a 3D geomechanical-numerical model that consists of 1.8 million finite elements and incorporates realistic geometries adapted from geophysical data sets as well as the major crustal faults in the region. An updated co-seismic slip model is obtained based on a joint inversion of InSAR and GPS data. The model is used to compute stress changes in the upper plate in order to investigate how the Maule earthquake may have affected the crustal faults and volcanoes in the region.