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Investigating simultaneous postseismic processes following the Maule Mw 8.8 earthquake of Chile, 2010

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The commonly agreed understanding of the postseismic period is that a short period of afterslip (lasting months to a couple of years depending on the magnitude of the mainshock) is concurrent with a viscoelastic relaxation of stress in the oceanic and continental mantles. When afterslip dies out the dominant processes become the viscoelastic relaxation and the re-locking of the ruptured plate interface. However, questions remain as to the relative contributions of the contributing processes to the surface signal and their evolution with time. The Maule 2010 Mw 8.8 postseismic cGPS time series are unique in allowing us to investigate postseismic kinematics of the plate interface because of their proximity to the rupture area. Additionally the network extends far enough away from the rupture to capture a wide extent of the longer wavelength viscoelastic relaxation signal. Coupled with the excellent aftershock catalogue from IMAD deployment we can investigate the postseismic subduction zone processes with unprecedented resolution. With these data we investigate the contribution of three simultaneous postseismic processes (viscoelastic relaxation, plate interface afterslip, and plate interface relocking) by means of a parameter search to reproduce the first four years of postseismic surface deformation. We present a suite of best fitting parameter combinations, deducing the most likely models according to geophysical constraints and considering the limitations of the methodology. In particular, we discuss the best fitting mantle viscosities, the time functions of plate interface kinematics, and the azimuth of relative afterslip plate motion in comparison to focal mechanisms from aftershocks. Finally we interpret our results within the frameworks of both short-term seismo-tectonic behaviour of the seismic cycle and the long-term roll-back at this margin over multiple seismic cycles.