



The Chiloé Mw 7.6 earthquake of 25 December 2016 in Southern Chile: Rupture of an asperity of the Mw 9.5 1960 Valdivia earthquake

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On 25 December 2016, a Mw 7.6 earthquake broke a portion of the Southern Chilean subduction zone south of Chiloé Island, located in the central part of the Mw 9.5 1960 Valdivia earthquake. This region is characterized by repeated earthquakes in 1960 and historical times with very sparse interseismic activity due to the subduction of a young (~ 15 Ma), and therefore hot, oceanic plate. We estimate the co-seismic slip distribution based on a kinematic finite fault source model, and through joint inversion of teleseismic body waves and strong motion data. The coseismic slip model yields a total seismic moment of 3.94×10^{20} Nm that occurred over ~ 30 s, with the rupture propagating mainly downdip, reaching a peak-slip of ~ 4.2 m. Regional moment tensor inversion of stronger aftershocks reveals thrust type faulting at depths of the plate interface. The fore- and aftershock seismicity is mostly related to the subduction interface with sparse seismicity in the overriding crust. The 2016 Chiloé event broke a region with increased locking and most likely broke an asperity of the 1960 earthquake. The updip limit of the main event, aftershocks, foreshocks and interseismic activity are spatially similar, located ~ 15 km offshore and parallel to Chiloé Islands west coast. The coseismic slip model of the 2016 Chiloé earthquake suggests a peak slip of 4.2 m that locally exceeds the 3.38 m slip deficit that has accumulated since 1960. Therefore, the 2016 Chiloé earthquake possibly released strain that has built up prior to the 1960 Valdivia earthquake. We discuss the second rupture of this asperity in the context of earthquake recurrence models and the earthquake cycle in an partitioning setting.