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Large aftershocks of the Maule 2010 mega earthquake in Central Chile

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The very large Mw 8.8 Maule earthquake of 27 February 2010 has been studied in great detail using seismic, geodetic tsunami and geologic data. This event was followed by a long series of aftershocks that have been relocated by several authors. One of the curious characteristics of this mega earthquake is that for the first few months it had very few large aftershocks and that many were not located on the main fault plane of the event. After three years, although there were many small aftershocks, only 22 larger than Mw 6 are listed in the CMT catalogue; the two largest aftershock having a magnitude of 7.1. According to Bath's rule at least one aftershock should have had a magnitude larger than 7.5. These larger aftershocks form a very tenuous network of events that do not cover entire fault surface as is the case of many other large earthquakes. A likely interpretation of our results is that the aftershock series will continue over a long period of time with large aftershocks in the future. The largest aftershocks of 2010 were a large outer rise event at 08 UT, two hours after the main shock of 27 February 2010 and located in the outer rise off the Arauco peninsula; and two large shallow crustal events of Mw 7.1 and 6.8 on 11 March 2010 near the city of Pichilemu. In the last couple of years the aftershock activity has continued and several larger aftershocks have occurred on the main fault of the Maule event. Here we study these aftershocks using relocation techniques and finite source modelling of the far field seismic radiation. Among the aftershocks that we study, three are particularly interesting: these are the events of Mw 7.1 on 2 January 2011 near the southern end of the 2010 rupture, that of Mw 6.8 on 11 February 2011 in the neighbourhood of the hypocenter of the Maule event and that of Mw 7.1 of 25 March 2012 in the northern patch of the main event. These aftershocks were located at different places of the 2010 rupture, on the plate interface close the bottom of the 2010 rupture zone. We compare this series of aftershocks with that of other large Chilean earthquakes of the last 40 years concluding that earthquakes of Mw < 8 tend to occur near the bottom of the plate interface. Ruptures extend towards the trench only for very large events that break the entire plate interface.