Solid Earth Discussions

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Comment on se-2021-6

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Community comment on "Very early identification of a bimodal frictional behavior during the post-seismic phase of the 2015 M_w 8.3 Illapel, Chile, earthquake" by Cedric Twardzik et al., Solid Earth Discuss., https://doi.org/10.5194/se-2021-6-CC2, 2021

Twardzik and co-authors investigate the first 12 h of post-seismic deformation following the 2015 M8.3 Illapel Chile earthquake. For the geodetic data, they use GNSS positions of 15 stations hourly displacements are inverted for hourly afterslip on the plate interface. For the seismicity, they and earthquake catalogs based on template matching based on previous studies. Then the seismicity is compared with the aftershocks. The northern patch is essentially aseismic slip, while in the southern patch, slip is essentially seismic slip related to aftershocks. Furthermore, the authors show that the ratio of seismic to aseismic slip might change over time at some locations.

The manuscript is well written and well-illustrated. I have only a few points related to the ratio of seismic to aseismic slip. Since for subduction zones, there are just limited observations on the relation of aftershocks to afterslip (in particular for the very first hours after the co-seismic), the topic is sound and relevant, and the paper contributed new and interesting aspects on this topic. The comments and suggestions below should all be feasible to be incorporated.

In the manuscript, you sometimes refer to “south/north of the rupture area,” but it seems that the two patches you classify as south and north of the rupture are still located in the co-seismic region (e.g., between 30-32°S). I suggest clarifying the two patches exact position and how they are related to the co-seismic slip.

In particular, previous authors observed a widening of the aftershock zone of the Illapel earthquake (e.g., Lange et al., 2016, GJI, doi: 10.1093/gji/ggw218). It would be interesting to state if this is observed with the catalog based on template matching and how this relates to the inverted afterslip. I assume that the possible expansion outside the co-seismic region is too small to be robustly inverted by the hourly evolving afterslip model. I suggest adding some words to this.

In particular, the authors find that the partitioning in seismic and aseismic slip changes in time (As mentioned in Line 207). I could not feasible see this in Figure 7 and S7.1, and suggest to simply plot the displacement versus the number of events for the patches to show the relationship between both processes. For example, Lange et al. (2014, GJI, doi: 10.1093/gji/ggu292) mapped for the late postseismic (e.g. >1d) of the Maule 2010 earthquake the partitioning of seismic to aseismic slip, which was relatively stable in time.

There is a similar observation for strike-slip faulting for early observation of afterslip and

aftershocks, and their relation (Savage, 2007, GRL, doi: 10.1029/2010GL042872) shows that aftershock seismicity rate is not proportional to the stress relaxation rate for the San-Andreas fault.

Formal issues:

I suggest adding a caption to Fig. S7.1 and S7.2.

Figure S7, S7.1, and S7.2 (right panels) might need additional labeling for the number of aftershocks. Currently, only the slip is labeled.

Table 1 and 2 do not contribute and might belong to the supplementary.

I suggest showing Figure S7.1 (temporal development southern patch) in the primary material since parts of the findings are difficult to understand without this figure.

Line 9: …. and thus could contribute to a more data-drivenforecasts of long-term aftershocks.

I cannot necessarily follow the argument in Line 9. Since the partitioning of seismic slip in some places changes in time prediction might be very difficult if this process remains enigmatic. Does the suggested forecast suggested here use Omori-laws and constant b-values, such as modelled by (Jonsdottir et al., 2006, Tectonophysics 424, https://doi.org/10.1016/j.tecto.2006.03.036.)?