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On Repeating Earthquakes in the Northern Chilean Subduction Zone

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At the northern Chilean subduction zone, where the IPOC network has been monitoring seismicity since 2007, we have identified multiple families of repeating earthquakes. High data quality and long observation time allow analyzing these sequences in detail.

Often repeaters are searched to be used as creep proxies and their spatio-temporal cumulative displacement is compared with the tectonic plate convergence rate or GPS based slip rate estimates for smaller fault patches. Repeaters can be classified into periodic, pseudo-periodic or aperiodic types. Put into relation with large earthquakes such as the 2014 M_w 8.1 Iquique earthquake, repeaters may be described as continuous or burst type families. A precondition for such an analysis is that events are collocated and show highly similar mechanism. This is usually ensured via high cross correlation values between waveforms or by catalog location, or both. Errors in grouping would heavily bias the analysis for individual groups.

Therefore, we not only use cross correlation values, but we analyze the intra-family relations in detail. Events are relocated relative to each other based on phase based cross correlation refined s-p travel time differences. Rupture sizes are estimated and intra-family rupture histories are resolved. Having confirmed the characteristics of true repeating earthquake families in this way, we make the classifications and compute the slip rates mentioned above.

This study shows that the concept of repeating earthquakes holds beautifully in the case of the northern Chilean subduction zone. Repeater families repeatedly rupture the same patches, and they are observed to respond different to the 2014 Iquique with a strong dependence on their location. Particularly, the time around the Iquique megathrust event shows very interesting patterns in several families. We observe clear precursor patterns, burst reactions and unresponsive families simultaneously.