Search for repeating events at the plate interface in the seismic sequence of the 2014 $Mw8.1$ Iquique earthquake, Chile

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The 2014 $Mw8.1$ Iquique earthquake occurred along a segment of the northern Chile- southern Peru seismic gap which had not ruptured for more than 100 years. A specific feature of this event is the observation of prominent foreshock clusters with successively increasing seismic moment releases starting several months before the main shock (e.g., Schurr et al., 2014). The entire seismic sequence, including also the aftershock seismicity, was monitored exceptionally well by the Integrated Plate Boundary Observatory Chile (IPOC).

Here, we present results from a systematic, long-term search for repeating seismic events along the plate interface in the source region of the 1 April 2014 ($Mw8.1$) Iquique main shock. Repeating earthquakes are widely assumed to indicate recurrent ruptures on the same fault patch and to accommodate aseismic slip in the creeping portions around the seismic patch. According to this concept, the analysis of repeating events and of their temporal behaviour provides a tool to estimate the amount of creep.

We use the IPOC and two additional local seismic networks and select recorded waveforms of several hundreds of located earthquakes within the foreshock and aftershock series as template events. Waveforms are windowed around the P and S phases and bandpass-filtered for different frequency bands. Window starts are defined by manually revised P onset times. We then run a newly implemented correlation detector on the resampled, continuous seismic data to find highly similar waveforms for each template event. Repeating earthquakes are finally identified by a combination of estimated source dimensions, high waveform similarity and precise relative relocations of the events within each multiplet group.

The analysis of the spatial and temporal patterns of the detected repeating earthquake sequences allows to test the proposed idea of progressive unlocking of the plate boundary before the Iquique main shock.