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Estimating Rupture Directivity of Aftershocks of the 2014 $Mw8.1$ Iquique Earthquake, Northern Chile

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The 2014 $Mw8.1$ Iquique earthquake was accompanied by numerous fore- and aftershocks of magnitudes up to $M \sim 7.6$. While the rupture processes of the main event and its largest aftershock were already analysed in great detail, this study focusses on the rupture processes of about 230 smaller aftershocks that occurred during the first two days after the main event. Since the events are of magnitudes $4.0 \leq M \leq 6.5$ it is not trivial which method is most suitable. Thus we apply and compare here three different approaches attempting to extract a possible rupture directivity for each single event.

The seismic broadband recordings of the Integrated Plate Boundary Observatory Chile (IPOC) provide an excellent database for our analysis. Their high sampling rate (100 Hz) and a well distributed station selection that cover an aperture of about 180 $^\circ$ are a great advantage for a thorough directivity analysis.

First, we apply a P wave polarization analysis (PPA) where we reconstruct the direction of the incoming wavefield by covariance analysis of the first particle motions. Combined with a sliding time window the results from different stations are capable of identifying first the hypocentre of the events and also a migration of the rupture front, if the event is of unilateral character. A second approach is the back projection imaging (BPI) technique, which illuminates the rupture path by back-projecting the recorded seismic energy to its source. A propagating rupture front would be reconstructed from the migration of the zone of high constructive amplitude stacks. In a third step we apply the empirical Green's function (EGF) method, where events of high waveform similarity, hence co-located and of similar mechanisms, are selected in order to use the smaller event as the Green's function of the larger event. This approach results in an estimated source time function, which is compared station wise and whose azimuthal variations are analysed for complexities and directivity.