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Focal Mechanism determination of local M<4 earthquakes in mainland Portugal

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We determine the focal mechanisms of local small (ML<3.9) earthquakes that occurred between 2013 and 2014 in mainland Portugal. These low magnitude events were recorded by several stations that provide first-motion polarity solutions. However, only few stations are located near the epicenter and record a waveform with a signal-to-noise ratio (SNR) high enough to allow full waveform modelling. To overcome this limitation, we used a new approach called cyclic scanning of the polarity solutions (CSPS) (Fojtíková and Zahradnik, 2014), which performs a joint inversion of full waveform and first motion polarities to retrieve the focal mechanism.

This methodology has the advantage of yielding reliable focal mechanism solutions, even when high SNR waveforms are available from only a few near field stations (or in the limiting case, only with one single station). To apply the CSPS method one needs to: i) run the the FOCal MEChanism (FOCMEC) code (Snoke, 2003) to obtain a suite of the DC solutions corresponding to the first motion polarities, and then ii) perform the waveform modelling in order to decrease the uncertainty. The ISOLated Asperities (ISOLA) software (Sokos and Zahradník, 2008, 2013) is used in this second step.

We applied this method to weak events recorded by a network of 30 broadband seismic stations that transmit data in real-time to Instituto Português do Mar e da Atmosfera (IPMA), the institution responsible for seismic monitoring in Portugal.

We interpret the obtained fault plane solutions in light of active faults and regional tectonics, and in comparison with focal mechanisms previously inferred for events in the region. The focal mechanisms obtained for small earthquakes allow us to significantly expand the database of available focal mechanisms in mainland Portugal, contributing to the understanding of active deformation in the region.