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SCARDEC: a new technique for the rapid determination of seismic moment magnitude, focal mechanism and source time functions for large earthquakes using body-wave deconvolution

Martin Vallée (1), Jean Charléty (2), Ana MG Ferreira (3,4), Bertrand Delouis (5), and Julien Vergoz (6)

(1) Geoazur, IRD, University of Nice, France (vallee@geoazur.unice.fr), (2) Geoazur, CNRS, University of Nice, France (charlety@geoazur.unice.fr), (3) University of East Anglia, UK (a.ferreira@uea.ac.uk), (4) ICIST, Instituto Superior Tecnico, Lisboa, Portugal, (5) Geoazur, University of Nice, France (delouis@geoazur.unice.fr), (6) Laboratoire de Détection Géophysique, CEA, Bruyères le Chatel, France (Julien.VERGOZ@CEA.FR)

In the numerous cases where earthquakes occur in remote or little instrumented areas, the first geophysical information comes from teleseismic body waves. Standard body-wave methods give accurate magnitudes for earthquakes up to Mw=7-7.5. For larger earthquakes, the analysis is more complex, because of the non-validity of the point-source approximation and of the interaction between direct and surface-reflected phases. The latter effect acts as a strong high-pass filter, which complicates the magnitude determination. We here propose an automated deconvolutive approach, which does not impose any simplicity in the rupture process, thus being well adapted to large earthquakes. We first determine the source duration based on the length of the high frequency (1-3Hz) signal content. The deconvolution of synthetic double-couple point source signals - depending on the four earthquake parameters strike, dip, rake and depth - from the windowed real data body-wave signals (including P, PcP, PP, SH and ScS waves) gives the apparent source time function. We use the Neighborhood Algorithm to search the optimal combination of these four parameters able to respect the physical features of any source time function: causality, positivity and stability of the seismic moment at all stations. Once this combination is retrieved, the integration of the source time functions gives directly the moment magnitude. We apply this new approach, referred as the SCARDEC method, to most of the major subduction earthquakes in the period 1990-2009. Magnitude differences between the Global CMT and the SCARDEC method may reach 0.2, but values are found consistent if we take into account that the Global CMT solutions for large, shallow earthquakes suffer from a known trade-off between dip and seismic moment. More detailed results for the set of subduction earthquakes, as well as further validations of the SCARDEC method will be presented in two other abstracts.