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Global characterization of subduction interface earthquakes from the SCARDEC catalog of source time functions

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Source Time Functions (STFs) describe how the seismic moment is released with time. In addition to moment magnitude M_w, they carry information on more detailed rupture properties, such as earthquake's impulsivity and radiated energy. Earthquake's impulsivity is the moment scaled STF peak, which is, under self-similarity assumption, proportional to the product of stress drop and the cube of rupture velocity ($\Delta\sigma V_r^3$). In this study, we systematically analyze a set of 1433 STFs extracted from the SCARDEC method (Vallée and Douet, 2016), containing the $M_w \geq 5.6$, shallow earthquakes ($z \leq 70$ km) with dip-slip mechanism that occurred between 1992 and 2014. At the global scale, we observe scale-invariance of stress drop and moment-scaled radiated energy with magnitude. In a second step, the source parameters distribution is investigated in light of the tectonic context. In agreement with other approaches, we confirm that subduction interface earthquakes have lower impulsivity and lower radiated scaled energy relative to all other earthquakes (e.g. crustal earthquakes). Using Apparent STFs from SCARDEC, we observed recently on $\simeq 100$ earthquakes that the impulsivity does not vary with rupture velocity, but strongly varies with stress drop (Chounet et al, 2017) . Hence, low impulsivity of subduction interface earthquakes is more likely the result of low stress drop rather than low rupture velocity. This observation may be the consequence of the hydrated subducted materials leading to lower friction at the interface. It can also reflect the fact that subduction plate boundaries host a very large number of earthquakes, making the fault zone mature. The low stress drop and radiated scaled energy in these zones may explain why damages observed after crustal earthquakes tend to be larger than the ones due to subduction earthquakes of the same magnitude. Finally, a focus on subduction interface earthquakes (approximately 800 earthquakes) is done by considering 18 regional segments of subduction zones. We find that these segments do not have the same signature in terms of macroscopic rupture properties, which means that large scale plate convergence properties influence rupture behavior. In a given segment, local heterogeneities of stress drop or radiated scaled energy can be associated with local features of the subduction zone. In particular, we find that low coupled zones generate earthquakes with low stress drop and radiated scaled energy. This last feature, also observed at a larger scale, suggests a positive correlation between coupling and stress drop.