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Earthquake depth estimations in the Po Plain (North Italy) using teleseismic data: influence on stress drop.

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On May 2012, the central part of the Padano-Emiliana Plain (North Italy), has been shocked by a dramatic sequence of earthquakes, with higest Mw 6.0. These events were very shallow (˜ 5-10 km) with low stress drops and large ground-motions amplitude have been observed in the fault area. On the opposite, on the last 25th and 27th January other two deeper moderate earthquakes (either with Mw 4.9) occurred in the same area (south of Parma). These two events made very few damages and no victims, but have been felt also far from the source, which could be explained by their important focal depths (33 and 65 km respectively). Hence, a study of depth influence on seismic properties is of great interest. However, Po plain is a very complex area, the largest alluvial basin of northern Italy, characterized by anomalous propagation dues to the variable thickness of quaternary alluvium and with complex Moho discontinuities (Appenines Moho, Alpine Moho and Ligurian Moho): depth estimation can be sometimes challenging. Recent seismicity studies proposed that a deeper subducting slab of Adriatic lithosphere could occur as well in this area and the question about the depth estimation resolution remains open.

Based on teleseismic dataset, we have used coherent depth phases detected on CTBTO arrays (comprehensive-test-ban treaty-organization), using cepstral methods as well as focal mechanism estimations from genetic algorithm inversions to constrain the depths of all recent events above magnitude 3.8 in this area. The use of the teleseismic records gives the opportunity to reduce uncertainties due to complex crustal propagations during regional depth estimations. Moreover, pmP reflexions, observable on some teleseismic records, prove that, at least one event, (January 27, 2012) occurred below the Moho discontinuity, strengthening the hypothesis of the active slab.

Then, we have focused on characterizing the link between depth and stress drop, as it is a crucial parameter for ground motion prediction models. Hence, In addition of our new improved depth catalog, good stress drops evaluations are needed. These stress drops have been extracted from source spectra (magnitudes and corner frequencies, assuming Brune 's model), using the regional North Italy dataset collected in the last years by the strong-motion network (RAIS, INGV). We have used an iterative Gauss-Newton method developed by Drouet et al. (2011), which aims to separate source, sites effects and propagation contributions in the acceleration spectra. Inverted attenuation parameters are similar to those estimated by Castro et al. (2013) and sites effects have been checked to be coherent with the H/V profiles from the RAIS web site (http://rais.mi.ingv.it/), which strongly validate the isolated source spectra, thus, the associated stress drops. Finally, depth and stress drop are shown to be strongly correlated as depth events show high stress drop. Hence, in the global aim to predict ground motions, it seems that depth should be taken account in a more systematic way; especially as new seismic equipments (for instance CTBTO arrays) afford now better resolution for this crucial parameter.

キーワード: depth, stress drop, teleseismic, Po Plain, parametric inversion, corner frequency
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