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Solid Earth Discussions

Interactive comment on "ER3D: a structural and geophysical 3D model of central Emilia-Romagna (Northern Italy) for numerical simulation of earthquake ground motion" *by* Peter Klin et al.

Anonymous Referee #1

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General

The paper by Klin et al. presents a study on the construction of a large scale 3D geological model of the Po Plain, Emilia-Romagna region (referred to as ER3D), apt for use in physics-based numerical simulations of earthquake ground motion. Special efforts have been devoted by the authors to set up the 3D subsoil model, by collecting a comprehensive set of geological and geophysical data from available studies in the literature and by integrating them in a 3D digital platform. The 3D model has been, then, used to perform 3D seismic wave propagation analyses through the Fourier pseudo-spectral method (code: FPSM3D). To validate the 3D numerical model, results

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Discussion paper

of numerical simulations were compared with the recordings obtained at the available accelerometric stations during two earthquakes of small magnitude (Mw= 4-4.1). The paper is well written and it is capable of demonstrating the superiority of 3D numerical approaches to predict peculiar features of earthquake ground motion (amplitude values and duration) in complex geo-morphological conditions like the Po Plain. I have only a few minor remarks (see list below) to be addressed before the publication in the Journal.

Remarks (1) Introduction, pg. 2, line 9-10: deviations of ground motion observations from empirical predictions are typically obtained in the near source region of large earthquakes or in complex geologic conditions (e.g. deep basins), because the GMPEs are poorly calibrated and/or are not properly parameterized to account for those effects. Authors should specify better the reasons for the inconsistencies between GMPEs and recordings. (2) Introduction, pg. 2, line 29-30: with reference to Paolucci et al. (2015), the satisfactory agreement between simulated and recorded motions was not only due to the modelling of the extended seismic source but also to that of the most significant geologic discontinuities. The latter were demonstrated to be critical to explain the propagation of surface waves towards North and South. (3) Four references are missing: Guillen et al., 2004; Lajaunie et al., 1997; Chiles et al., 2004; Chiles et al., 2006. (4) Section 2.3: I suggest the authors to improve the description on how the elastodynamic properties of the soils were defined. Authors provide the basic relationships between Vp-Vs, Qs-Vs and Vp as a function of depth, but further details on how these functions were calibrated should be provided (which data? References?). Furthermore, in Table 1 values of Vs and Qs should be also provided besides Vp and its gradient, as they are fundamental (more than Vp) for any site response model. How does the Vs velocity model proposed by the authors compare with the ones available from geophysical surveys in the (e.g. Milana et al. 2014)?

Milana, G., Bordoni, P., Cara, F., Di Giulio, G., Hailemikael, S.&Rovelli, A., 2014. 1D velocity structure of the Po River plain (Northern Italy) assessed by combining strong

motion and ambient noise data, Bull. Earth. Eng., 12, 2195–2209

(5) Section 4.3: referring to Fig. 8, are the horizontal PGV values? Geometric mean or maximum of horizontal components of ground motion? What about vertical component? From Fig. 8, it is noted that at very short epicentral distances, typically less than 5 km, PGV from recordings are higher than the simulated ones, for both events. Furthermore, I encourage the authors to extend the comparison between recordings and synthetics by showing for selected stations a clearer comparison in terms of velocity waveforms and corresponding Fourier amplitude spectra (at least for some components of ground motion).

Editorial typos - Pg. 3, line 24: Boccalletti et al. 20111 - Eq. (3): specify that Vs is expressed in km/s - Pg. 7, line 10: Moczo et al. (2002) - Pg. 8, line 10: remove “t” at the end of the line - Table 2: add rows for Vs and Qs, as commented above, and change Vp to Vp(z=0).

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