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The Italian Project S2 – Task 4:Near-fault earthquake ground motion simulation in the Sulmona alluvial basin

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Recently the Italian Department of Civil Protection (DPC), in cooperation with Istituto Nazionale di Geofisica e Vulcanologia (INGV) has promoted the 'S2' research project (http://nuovoprogettoesse2.stru.polimi.it/) aimed at the design, testing and application of an open-source code for seismic hazard assessment (SHA). The tool envisaged will likely differ in several important respects from an existing international initiative (Open SHA, Field et al., 2003). In particular, while "the OpenSHA collaboration model envisions scientists developing their own attenuation relationships and earthquake rupture forecasts, which they will deploy and maintain in their own systems", the main purpose of S2 project is to provide a flexible computational tool for SHA, primarily suited for the needs of DPC, which not necessarily are scientific needs. Within S2, a crucial issue is to make alternative approaches available to quantify the ground motion, with emphasis on the near field region. The SHA architecture envisaged will allow for the use of ground motion descriptions other than those yielded by empirical attenuation equations, for instance user generated motions provided by deterministic source and wave propagation simulations. In this contribution, after a brief presentation of Project S2, we intend to illustrate some preliminary 3D scenario simulations performed in the alluvial basin of Sulmona (Central Italy), as an example of the type of descriptions that can be handled in the future SHA architecture. In detail, we selected some seismogenic sources (from the DISS database), believed to be responsible for a number of destructive historical earthquakes, and derive from them a family of simplified geometrical and mechanical source models spanning across a reasonable range of parameters, so that the extent of the main uncertainties can be covered. Then, purely deterministic (for frequencies < 2Hz) and hybrid deterministic- stochastic source and propagation simulations are carried out for different fault rupture scenarios (but including important features such as the dominant near-surface geology), and the results in terms of representative ground motion parameters appropriately enveloped. The fully 3D problem is solved using the Spectral Element (SE) method, extensively published by Faccioli and his co-workers, and Quarteroni and co- workers, starting from 1996, and the computational code GeoELSE (Stupazzini et al., 2009; http://GeoELSE.stru.polimi.it/). Finally, numerical results are compared with available data and attenuation relationships of peak values of ground motion in the near-fault regions elsewhere. Based on the results of this work, the unfavorable interaction between fault rupture, radiation mechanism and complex geological conditions may give rise to large values of peak ground velocity (exceeding 1 m/s) even in low-to-moderate seismicity areas, and therefore increase considerably the level of seismic risk, especially in highly populated and industrially active regions, such as the Central Italy.

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