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The case of the 1964 M 6.0 Athens intermediate-depth earthquake: Modelling its anomalous macroseismic pattern with stochastic finite-fault simulations

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We model the macroseismic damage distribution of the 1964 (17 June, M6.0, h∼155km) Athens intermediate-depth earthquake, which exhibits a spatially anomalous macroseismic pattern, since its most significant impact was observed at a very large epicentral distance (>200km), along the western Hellenic arc. Macroseismic data for this event were collected from published macroseismic databases and compared with the spatial distribution of seismic motions obtained from stochastic simulation, after conversion to macroseismic intensity (Modified Mercalli scale, IMM). For this conversion, we used an updated correlation between macroseismic intensities and peak measures of seismic motions (PGA and PGV) proposed for intermediate-depth earthquakes in the southern Aegean Sea region (Kkallas et al., 2018). For the stochastic simulation approach, the anelastic attenuation GMPE model of Skarlatoudis et al. (2013) was implemented into the EXSIM code (Boore, 2009), in order to constrain the different attenuation properties of the back-arc and fore-arc Aegean Sea area. Model parameters of the simulations, such as stress parameters, fault dimensions, and attenuation parameters (e.g. back-arc/along anelastic attenuation) were adopted from previous work performed in the area, while site-effects were approximated using generic transfer functions proposed for the Aegean Sea area, on the basis of VS30 values from topographic slope proxies. Since observed intensities were much larger than the modeled ones, we performed simulations for a large event magnitude range (6.0 to 7.1). The results suggest that a M=6.8 event, with an epicenter near Athens, gives the optimal results (smaller model RMS and bias values), with the modeled macroseismic field being in very good agreement with the observed anomalous damage pattern (largest intensities at distances >200km from the epicenter). The results verify observations that intermediate-depth events (h>60km) in the Aegean subduction have a prominent effect mainly in the outer Hellenic arc, in excellent agreement with the available historical information. This work has been partly supported by the HELPOS (MIS 5002697) project.