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Synthetic tests to explore the resolution of slip models obtained from the inversion of teleseismic waveforms: Complex and segmented rupture of the 14 August 2003, Mw6.2 Lefkada (Ionian Islands) earthquake

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The 14 August 2003 (Mw 6.2) Lefkada earthquake ruptured the Lefkada Segment of the Cephalonia transform fault zone (CTFZ), a major structure along the Ionian Islands of Greece. We invert 30 $P$and 9 Swaves recorded by the Global Seismographic Network to recover the slip distribution on the fault. Teleseismic (Benetatos *et al.*, 2005) and regional (Zahradnik *et al.*, 2005) waveform modeling has revealed the multiple-event (mainly double) character of the mainshock. Our slip model indicates that the earthquake did occur as two distinct subevents, separated in space by approximately 40 km and in time by 14 sec. The two subevents ruptured the Lefkada segment of CTFZ. Rupture initiated in the north and propagated to the south with an average speed of 2.4 km/sec. The moment was released in three distinct patches. The first patch of moment release, located beneath the western coast of Lefkada Island, is confined in a small area ($\sim$ 25x10 km^2), extends in depth from 10 to 25 km, and here the maximum slip of $\sim$34cm is observed. The second patch of moment release is located offshore further to the south, but close to the northern coast of Cephalonia Island, and is confined in an even smaller area ($\sim$15x10 km^2). The third patch, for which the uncertainty is the highest, occurred at the intersection of the two fault segments, which is actually the intersection of the Lefkada and Cephalonia segments of the CTFZ. To obtain a satisfactory fit to the regional and teleseismic body waves the contribution from subevents

on both segments has to be considered.

To estimate the uncertainties and the bias imposed on the resolved slip patches due to the filtering and the dimensions of the fault-plane gridding, we did a series of inversions with coarser subfault dimensions and filtering at different frequency bands. We examined different dimensions of the sub-faults (1×1, 2×2, 5×5, 10×10, km) in which the fault plane has been divided and also different frequency ranges (0.01-0.05, 0.01-0.1, 0.01-0.2, Hz) for the original dataset in order to identify our resolution capabilities. Additionally we varied the λ parameter that is an empirical value controlling the smoothness of the inversion results in our search, for an optimal value that balances between roughness of the slip model and acceptable fit of the synthetic waveforms. Further tests involved omitting groups of stations from different azimuthal quadrants in order to identify the quality of the results using reduced data sets. The resolution of the model has been further investigated with synthetic tests that have been performed using variations of the classic checkerboard test again using various frequency ranges. It has been shown that frequencies down to 0.15 Hz in combination with 1×1 km sub-fault grid can provide acceptable results both in spatial characteristics of the slip and in absolute values. The uncertainty of our inversion results has been quantified by performing the inversion procedure 500 times in which we randomly omitted the 20% of the total number of stations at each run. Then from all the resulting models the mean value and standard deviation has been projected on the fault plane.