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Source-modelling of the 2003 Bam earthquake using multiple data sets

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The December 26, 2003 earthquake ($M_w 6.5$) destroyed almost 85% of the buildings in the city of Bam leaving 75'000 of Bam's inhabitants homeless and more than 26'000 people lost their lives. Although a mapped geological structure exists south-east of the city of Bam, no major earthquakes have been reliably documented in this area. Moreover, there is considerable controversy to what extent this mapped fault has been activated during the Bam earthquake. In this study we determine the source-rupture process of the 2003 Bam event using multiple data sets. We start with a point source estimation using teleseismic P and SH waves and apply a grid search to estimate the strike, dip, and rake, and their uncertainties, of the fault; we then apply a non-linear, finite-source inversion to image the slip distribution on the fault plane. We set up the fault geometry with a a single approximately north-south striking fault segment in contrast to other studies who introduced a secondary thrust fault. First inversion results reveal a right lateral 20km long strike-slip fault with a maximum slip of 3 to 4m in the uppermost 5km of the rupture plane. Additionally, we cross-validate our teleseismic source model with slip-estimates based on InSAR data and rupture modelling of near source strong-motions. Finally, we reconcile our inversion results with source dynamics to address whether or not the rupture-front may have travelled with super-shear rupture speed - an aspect that is particularly important for understanding earthquake physics, but also for future seismic hazard studies.