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Kinematic and dynamic inversions of the 2000 Tottori earthquake based on elliptical subfault approximations

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We study the kinematic and dynamic rupture propagation of the 2000 Tottori (Japan) earthquake. Although many kinematic models of the Tottori earthquake fit the observed data well, not all of them are consistent with simple earthquake source dynamics. Can earthquake dynamics distinguish among these models? In order to explore this question we developed a simple kinematic and dynamic rupture inversion scheme using slip distributions controlled by a very small number of ellipsoidal patches. Since each patch is characterized by 6 geometric parameters, the number of parameters in the non-linear dynamic inversion is sufficiently so that dynamic inversion is realistic. Unlike classic kinematic method where slip distribution is inverted on the total fault area, this technique only inverts small regions of the fault plane. We apply this method to a set of 33 strong motion recordings located within 40 km of the epicentre. The data are processed using a band pass center Butterworth filter from 0.1 to 0.5 Hertz. The fit between observed data and synthetics is measured with an L^2 norm.

We start from a non-linear kinematic inversion where we assume a constant rupture speed on a vertical 30x25 km fault zone. We invert for the slip distribution on the fault with slip parameters ranging from 0 to 4m and a fixed hypocentral depth of 18.5 km. The inversion converges very nicely to a slip distribution concentrated along a curved zone following the surface. Synthetics fit the observed records very well. The final fault model gives a maximum slip amplitude of 2.6 m at a depth of 8.5 km. The total moment of $1.56*10^{19}$ N.m is in agreement with a magnitude 6.6 event. We then approximate the slip distribution by a few ellipsoidal patches on which we specify stress drop, static and dynamic friction as well as a slip weakening friction law. Adjusting stress drop we obtain an excellent fit to the observed records that we are currently improving by dynamic inversion of the observed records.