SOUTHERN CALIFORNIA EARTHQUAKE CENTER

Home | About SCEC | Research | Resources | Education & Outreach

Home > 2005 Annual Meeting > Abstracts

Search Go

SCEC 2005 Annual Meeting: Abstracts

Your search produced the following results:

Abstract Title: On the Random Nature of Earthquake Processes: A Case Study the 2004 Parkfield Earthquake

Author(s): Lavallée, Daniel (UC Santa Barbara), Susana Custodio (UC Santa Barbara), Pengcheng Liu (UC Santa Barbara), and Ralph J. Archuleta (UC Santa Barbara)

Abstract: In a series of papers (Lavallée and Archuleta, 2003; 2005 and Lavallée et al., 2005), we have laid the basis for a theory that provides a coherent and unified picture of earthquake variability from its recording in the ground motions to its inference in source models. Based on the superposition of seismic waves and the Central Limit Theorem, this theory stipulates that the random properties of the ground motions and the source for a single earthquake should be both distributed according to a Levy law. Our investigation of the random properties of the source model and peak ground acceleration (PGA) of the 1999 Chi Chi earthquake confirms this theory (see: http://www.scec.org/core/public/showNugget.php?entry=2118). As predicted by the theory, we found that the tails of the probability density functions (PDF) characterizing the slip and the PGA are governed by a parameter, the Levy index, with almost the same values close to 1. The PDF tail controls the frequency at which extreme large events can occur. These events are the large stress drops—or asperities—distributed over the fault surface and the large PGA observed in the ground motion. Our results suggest that the frequency of these events is coupled: the PDF of the PGA is a direct consequence of the PDF of the asperities. The 2004 Parkfield earthquake is the best-recorded earthquake in history for the density of near-source data. It provides an ideal candidate for evaluating and validating the theory discussed above. For this purpose, we used several source models computed for the Parkfield earthquake by Custodio et al. 2005. All the source models used in this study are based on a method to invert kinematic source parameters developed by Liu and Archuleta (2004). The compiled source models differ by the number and the location of the stations used in the inversion. For each source, we compile the parameters of the stochastic model and compare to the random properties of the PGA. We found that that the tails of the probability density functions (PDF) characterizing the PGA are governed by a parameter, the Levy index with a value close to 1. For several source models, the computed Levy index is in good agreement with this value. Our results suggest that all source models are not equivalent in term of their random properties. The values of the stochastic parameters depend on the location a number of stations used in the inversion. Thus, this study provides the basis to compare, validate and optimize computed source models by comparing the random properties of the source to the random properties of the ground motions.
Custodio, S., P. Liu, P., and R. J. Archuleta. Seism. Res. Lett., 76, 211, 2005. Lavallée, D., and R. J. Archuleta,.Geophys. Res. Lett., 32, L08311, doi:10.1029/2004GL022202, 2005. Lavallée, D. and R. J. Archuleta. Geophys. Res. Lett., 30 (5), 1245, doi:10.1029/2002GL015839, 2003. Lavallée, D., P. Liu, R. J. Archuleta. Geophys. J. Int., in revision, 2005. Liu, P-C and R. J. Archuleta. J. Geophys. Res. 109, B02318, doi:10.1029/2003JB002625, 2004.

Back