Geophysical Research Abstracts, Vol. 9, 04320, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-04320

A method for seismogenic fault detection from hypocenter trends in critical network conditions

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We compared the performances of linear and non-linear hypocenter location methods working in 3D velocity structures, a not-fully explored subject of main interest in the regions where the location problem is ill-conditioned. Comparisons are made between the linear location method known as SIMUL (Evans et al., 1994) and the non-linear probabilistic algorithm named BAYLOC (Presti et al., 2004). We found that in nearly critical network conditions the SIMUL and BAYLOC algorithms furnish hypocenter coordinates of comparable accuracy leading to similar hypocenter spatial trends, while the location error estimates from SIMUL are, in general, less accurate than BAYLOC's. These findings are further supported by the results of relocations of synthetic events performed in the same network-model conditions of the real sequences. We conclude that the approximations of the linearization process determine lower accuracy of linear location error estimates but no apparent incremental bias in the hypocentral coordinates (compared to non-linear methods) when location is performed in nearly critical network. Therefore, we extend to location in 3D velocity structures a conclusion drawn by previous investigators for 1D location (Lomax et al., 1998; Lomax et al., 2000; Lippitsch et al., 2005). Because location error estimates may be crucial to establish whether the hypocenter trend of a sequence does really mark the seismogenic structure or simply reflects ill-conditioning of the location process, we based on the BAYLOC location probability concept our approach to hypocenter trend evaluation for seismogenic fault detection. This procedure, named ISO-TEST, works through isotropic generation of synthetic hypocenters inside the sequence volume (simulations) and comparison by misfit variables of the location probability function of the sequence with the probability functions from simulations.

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