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SDM - A geodetic inversion code incorporating with layered crust structure and curved fault geometry

Rongjiang Wang (1), Faqi Diao (2), and Andreas Hoechner (1)

(1) GFZ German Research Centre for Geosciences, D-14473 Potsdam, Germany (wang@gfz-potsdam.de), (2) Institute of Geodesy and Geophysics, Chinese Academy of Sciences, Wuhan 430077, China

Currently, inversion of geodetic data for earthquake fault ruptures is most based on a uniform half-space earth model because of its closed-form Green's functions. However, the layered structure of the crust can significantly affect the inversion results. The other effect, which is often neglected, is related to the curved fault geometry. Especially, fault planes of most mega thrust earthquakes vary their dip angle with depth from a few to several tens of degrees. Also the strike directions of many large earthquakes are variable. For simplicity, such curved fault geometry is usually approximated to several connected rectangular segments, leading to an artificial loss of the slip resolution and data fit. In this presentation, we introduce a free FORTRAN code incorporating with the layered crust structure and curved fault geometry in a user-friendly way. The name SDM stands for Steepest Descent Method, an iterative algorithm used for the constrained least-squares optimization. The new code can be used for joint inversion of different datasets, which may include systematic offsets, as most geodetic data are obtained from relative measurements. These offsets are treated as unknowns to be determined simultaneously with the slip unknowns. In addition, a-priori and physical constraints are considered. The a-priori constraint includes the upper limit of the slip amplitude and the variation range of the slip direction (rake angle) defined by the user. The physical constraint is needed to obtain a smooth slip model, which is realized through a smoothing term to be minimized with the misfit to data. In difference to most previous inversion codes, the smoothing can be optionally applied to slip or stress-drop. The code works with an input file, a well-documented example of which is provided with the source code. Application examples are demonstrated.