GLOBAL NON-LINEAR EARTHQUAKE LOCATION: APPLICATION TO THE ISC ROUTINE LOCATION PROCEDURE

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Traditional earthquake location based on Geiger's method generally consists of linearized inversion of individual arrival time picks using layered seismic velocity models to determine single hypocenter locations, or, at best, using these arrival times in a joint hypocenter inversion to find overall station corrections. Uncertainty information is often limited to estimates based on RMS minimization with ad-hoc weighting of arrival time errors. For many years, Geiger's method has been chosen for applications on regional or global scales due to its efficiency in calculating earthquake locations. However, recent advances in computing power and developments of new, non-linear location algorithms have pushed earthquake location beyond traditional hypocenter location. In this study, we present the application of the non-linear earthquake location algorithm NonLinLoc (Lomax, 2005) to the global test data set provided by the ISC. Using a very efficient global sampling algorithm called Oct-Tree, NonLinLoc computes the posteriori probability density function (PDF) for the hypocenter location problem. In addition to the standard L2 norm, NonLinLoc can use the Equal Differential Time (EDT) likelihood function to compute the PDF. The EDT likelihood function produces very robust results in the presence of outliers due to mispicks or phase misidentifications. For computation efficiency, travel times are calculated beforehand for all stations to all points in the model and stored on hard disk for later access. Any kind of velocity model can be used given an accurate algorithm to compute travel times in spherical coordinates. In our study, we will use the TauP method to compute travel times in standard 1D velocity models such as ak135. We are also working on computing travel times in ellipsoidal, 3D velocity models using the fast-marching method (FMM). The non-linear solution includes complete estimates on location uncertainties due to the network configuration, and uncertainties in the arrival time picks and travel time calculations; the location uncertainties can be represented by confidence contours or density scatter clouds. Available ground-truth information for the test events will allow us to calibrate the picking and travel time uncertainties to better represent the true errors. We will further test various options to improve earthquake locations such as station corrections computed by iterative relocation and station correction surfaces.

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2. Seismology, Earthquake Location
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4. E
5. PC
6. No
7. N/A
8. None