pySeismicFMM: Python based travel time calculation in regular 2D and 3D grids in Cartesian and geographic coordinates using Fast Marching Method

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Seismic wave travel time calculation is the most common numerical operation in seismology. The most efficient is travel time calculation in 1D velocity model – for given source, receiver depths and angular distance time is calculated within fraction of a second. Unfortunately, in most cases 1D is not enough to encounter differentiating local and regional structures. Whenever possible travel time through 3D velocity model has to be calculated. It can be achieved using ray calculation or time propagation in space. While single ray path calculation is quick it is complicated to find the ray path that connects source with the receiver. Time propagation in space using Fast Marching Method seems more efficient in most cases, especially when there are multiple receivers. In this presentation a Python module pySeismicFMM is presented – simple and very efficient tool for calculating travel time from sources to receivers. Calculation requires regular 2D or 3D velocity grid either in Cartesian or geographic coordinates. On desktop class computer calculation speed is 200k grid cells per second. Calculation has to be performed once for every source location and provides travel time to all receivers. pySeismicFMM is free and open source. Development of this tool is a part of authors PhD thesis. National Science Centre Poland provided financial support for this work via NCN grant DEC-2011/02/A/ST10/00284.