Geophysical Research Abstracts
Vol. 17, EGU2015-11969, 2015
EGU General Assembly 2015

Instaseis: Instant Global Broadband Synthetic Seismograms Based on a Waveform Database

Martin van Driel (1), Simon Stähler (2,3), Lion Krischer (2), Alex Hutko (4), Kasra Hosseini (2), and Tarje Nissen-Meyer (5)

(1) Dept. of Earth Sciences, ETH Zürich, Zuerich, Switzerland, (2) Dept. of Earth Sciences, Ludwig-Maximilians-Universität München, München, Germany, (3) Leibniz-Institute for Baltic Sea Research, Warnemünde (IOW), Germany, (4) IRIS Data Services, Seattle, United States, (5) Dept. of Earth Sciences, University of Oxford, Oxford, UK

Spherical models for planetary bodies represent a common characterization of bulk global material properties, often satisfying up to 90% of recorded data. Our new methodology combines accurate seismic wave propagation with symmetry properties of radiation patterns, reciprocity, and high-order interpolation to deliver a comprehensive waveform database from which arbitrary source-receiver configurations and high-frequency record sections for a given model can be extracted within seconds. The database thus acts as a once-and-for-all solution to wave propagation in spherically symmetric models. This not only frees users from re-running wave propagation codes, but opens doors to new applications in which vast numbers of parameter alterations are desired such as modifications in source properties (moment tensor, source-time function, location), filtering, or background models, e.g. in a framework for probabilistic uncertainty assessment.

Using reciprocity, two simulations with the global wave-propagation solver, AxiSEM (Nissen-Meyer et al. 2014, www.axisem.info), suffice to generate a complete database of Green's functions: one as a "source" for the vertical, and one for both horizontal components. Storage of the propagating spatio-temporal displacement field at all distances (0-180 degrees) and depths (0-700km for earthquakes) on the actual basis of the spectral-element mesh ensures the same accuracy as for the numerical wave propagation solution upon posteriori interpolation. The ease of computation (10K CPU hours) and tolerable storage requirements (a few TB for 1Hz waveforms) implies that multiple such databases may be computed for several models at high resolution (1Hz for global-Earth synthetics), e.g. continental versus oceanic crust, anisotropic versus isotropic, or various lower-mantle models. Further applications include the efficient generation of reference synthetics for global tomography, wavefields for hybrid 1D-3D methods, and responses to finite-fault sources. Instaseis offers a user friendly interface written in Python and directly integrates with ObsPy, it includes a GUI and can run as Client/Server via HTTP, such that the databases can be accessed and shared via internet without the necessity to download large volumes of data. A first example of such a database is being developed and stored at the IRIS DMC (Seattle), to deliver on-demand customizable synthetics.