

In this presentation, we discuss developments to complement the post-desktop data acquisition world within the synthetic realm. Our focus shall lie in ideas and applications that circumvent the numerical and time-consuming burden of dealing with such wave solvers altogether. To this end, we present "instaseis" and "syngine", which deliver accurate broadband synthetic seismograms for 1D Earth models quasi-instantaneously.

Instaseis (www.instaseis.net) extracts waveforms from pre-computed Green's function databases. These databases are computed with our wave-propagation backbone AxiSEM (www.axisem.info) which delivers 3D wavefields for 1D, 2D, or 3D structures in a complexity-adaptive fashion. This "once-and-for-all solution" relies on reciprocity and requires only two AxiSEM simulations to construct the databases, while allowing for arbitrary parameter changes (e.g. source, processing, structure) with negligible computational cost and storage requirements. The code is integrated with ObsPy (www.obspy.org) and contains a graphical user interface (see Figure). Instaseis runs behind syngine, the DMC's web-service for on-demand synthetics that complements the time series data IRIS has traditionally distributed (<http://ds.iris.edu/ds/products/syngine>). Synthetics are accessible for user-specified source-receiver combinations and a variety of models (PREM, IASP91, AK135f) with anisotropy and attenuation. Instaseis and syngine can be used for source inversion or brute-force modeling, analyzing the imprint of different planetary models, temporal changes in instrument responses, ambient-noise simulations, finite-fault modeling, waveform tomography, uncertainty estimations, as well as teaching. AxiSEM is currently being generalized to local and regional wave propagation such that locally adapted databases (e.g. Europe, North America) will be feasible at higher frequencies. More generally, these approaches open doors to new means of processing, analyzing and understanding seismograms on multiple levels. In the context of this session, we will specifically touch upon some of the following ideas:

- 1) Teaching/education: The interactive nature of these tools animates textbook examples of the sensitivity of seismograms upon parameter variations (source parameters, filters, models), and thus allows students and researchers to interrogate the connection between data and modeling in a quantitative, and tangible manner.
- 2) The ease of parameter manipulation facilitates usage of these modeling tools at school and laymen levels.
- 3) Eliminating the burden of dealing with intricate numerical solvers and access to existent remote databases allows an ever-larger user-base to address research questions independent of their computational cost.
- 4) Statistical approaches in the context of evaluating full seismograms.
- 5) Large earthquakes & tsunamis: Instantaneous estimation of realistic amplitudes for statistical distributions of Earth and source models could be automated, possibly regionally.
- 6) Early-warning: Statistical calculations of amplitude distributions given source uncertainties.

In summary, we hope to relieve practitioners from the complexity of intricate numerical solvers as much as possible, moving alongside acquisition and processing developments towards "in-situ" applications in that access to realistic synthetics is now feasible for teaching and research on mobile devices. Apart from obvious applications, we hope to facilitate a shift in the prevailing mode of inferring from data and synthetics.

