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The Collaborative Seismic Earth Model Project

Andreas Fichtner, Dirk-Philip van Herwaarden, and Michael Afanasiev
ETH Zurich, Department of Earth Sciences, Zurich, Switzerland (andreas.fichtner@erdw.ethz.ch)

We present the first generation of the Collaborative Seismic Earth Model (CSEM). This effort is intended to address grand challenges in tomography that currently inhibit imaging the Earth's interior across the seismically accessible scales: [1] For decades to come, computational resources will remain insufficient for the exploitation of the full observable seismic bandwidth. [2] With the man power of individual research groups, only small fractions of available waveform data can be incorporated into seismic tomographies. [3] The limited incorporation of prior knowledge on 3D structure leads to slow progress and inefficient use of resources.

The CSEM is a multi-scale model of global 3D Earth structure that evolves continuously through successive regional refinements. Taking the current state of the CSEM as initial model, these refinements are contributed by external collaborators, and used to advance the CSEM to the next state. This mode of operation allows the CSEM to [1] harness the distributed man and computing power of the community, [2] to make consistent use of prior knowledge, and [3] to combine different tomographic techniques, needed to cover the seismic data bandwidth. Furthermore, the CSEM has the potential to serve as a unified and accessible representation of tomographic Earth models.

Generation 1 comprises around 15 regional tomographic refinements, computed with full-waveform inversion. These include continental-scale mantle models of North America, Australasia, Europe and the South Atlantic, as well as detailed regional models of the crust beneath the Iberian Peninsula and western Turkey. A global-scale full-waveform inversion ensures that regional refinements are consistent with whole-Earth structure. This first generation will serve as the basis for further automation and methodological improvements concerning validation and uncertainty quantification.