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A comprehensive earth model across the scales: regional updates and global validation

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We present the current state of the 'Comprehensive Earth Model' (CEM), a solver-independent multi-scale model of the global distribution of density and visco-elastic parameters. The overall goal of this project is to produce a model that represents the Earth on all seismically accessible scales; which contains high resolution sub-models where data and computational concerns allow, and which presents a low wavenumber Earth in regions yet to be probed in detail. To accomplish this, we have designed the model to be independent of any particular forward solver. This allows the usage of a wide variety of forward and inverse techniques, each of which may contribute updates within their respective regimes of validity.

Over the past year, several regional updates have been incorporated within the CEM. These include updates from full waveform tomography of Japan and the Western Mediterranean, along with an update from a new traveltime tomography of Europe. Additionally, we report on a global-scale full waveform update to the model. This update serves to adjust the long-wavelength background of the CEM, and to set an initial global waveform misfit, against which the misfit of future sub-region updates will be judged. With this global update applied, we discuss the initial results from a full waveform tomography aimed at resolving the deep structure beneath the African continent.

When investigating structures that may span the entire mantle, an effort must be made to ensure that the datasets and misfits used to image these structures are sensitive to the desired set of parameters. For example, a dataset comprised of only sS phases may be completely insensitive to lower mantle structure. With the goal of improving the imaging of mantle plumes, we discuss a hybrid misfit based on body and surface wave time-frequency measurements, combined with a misfit based on normal mode measurements. While this particular misfit measure is not new, its incorporation into an adjoint spectral element based tomography is expected to reveal physically accurate 3D normal mode, body, and surface wave sensitivity kernels, which may prove especially valuable in linking upper and lower mantle structure.