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Modern Workflow Full Waveform Inversion Applied to North America and the Northern Atlantic

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We present the current state of a new seismic tomography model obtained using full waveform inversion of the crustal and upper mantle structure beneath North America and the Northern Atlantic, including the westernmost part of Europe. Parts of the eastern portion of the initial model consists of previous models by Fichtner et al. (2013) and Rickers et al. (2013). The final results of this study will contribute to the 'Comprehensive Earth Model' being developed by the Computational Seismology group at ETH Zurich.

Significant challenges include the size of the domain, the uneven event and station coverage, and the strong east-west alignment of seismic ray paths across the North Atlantic. We use as much data as feasible, resulting in several thousand recordings per event depending on the receivers deployed at the earthquakes' origin times.

To manage such projects in a reproducible and collaborative manner, we, as tomographers, should abandon ad-hoc scripts and one-time programs, and adopt sustainable and reusable solutions. Therefore we developed the **LA**rge-scale **S**eismic **I**nversion **F**ramework (LASIF - `http://lasif.net`), an open-source toolbox for managing seismic data in the context of non-linear iterative inversions that greatly reduces the time to research.

Information on the applied processing, modelling, iterative model updating, what happened during each iteration, and so on are systematically archived. This results in a provenance record of the final model which in the end significantly enhances the reproducibility of iterative inversions. Additionally, tools for automated data download across different data centers, window selection, misfit measurements, parallel data processing, and input file generation for various forward solvers are provided.