Data providing us with ~400 processors.

A key feature of SALSA3D is that path-specific model uncertainty of travel time predictions are calculated using the 3D model covariance matrix computed during tomography, which results in more realistic uncertainty ellipses that directly reflect tomographic data coverage.

Recent improvements in the model include the generation of an elastic velocity model to complement the P velocity model and development of capability to compute travel times for core phases and reflections of the core-mantle boundary.

For use in routine operations, travel time predictions and prediction uncertainties, are precomputed and stored in station specific 3D lookup tables, which allows fast, reliable retrieval of information saved by locations. The lookup capabilities are based on the open-source GeoTools software package available at http://www.geotools.cnri.

Our models, derived from the newest versions of the OT model of travel time pick sets measured by Los Alamos National Laboratory. The model is represented using the triangular tessellation system described by Bard et al. (2006), which incorporates variable resolution both in the geographic and radial dimensions. For the starting model, we use a simplified 3D model derived from the Chat-2D model, salting a 10 meter. Sufficient depth is used to resolve velocity differences similar to the ray paths changes between transitions.

We obtain model improvements by using progressive grid refinement,orthogonal to the ray trace to reduce the data amount required for such a refinement. We utilize the diagonal of the model resolution matrix to control grid refinement success, resulting in more consistent and continuous changes of resolution. Moreover, the model is refined both according to the ray trace and the underlying tomographic data independently in both ray trace coverage and the velocity gradients required by the tomographic data. This ensures a better balance between the model refinement and the tomographic data.

We compare the travel time prediction and location capabilities of the SALSA3D model to standard 2D and 3D models via location tests on a global event set with 97% of success.

Validation

All validation events were selected from the USL ULC. These events have having ground truth of less than 10 km. These events were chosen so that they were used for validation of the RTT and have many phases from which to choose from for generating random realizations of available data sets.

Repeatability Tests and Standard for Location Validation

The maximum number of total phases was never more than 20. A target total number of phases as well as a target number of S phases was chosen. A total of 21 phases were selected from these to choose for validation. For each of the events and target number of phases, 30 random realizations were chosen, if possible.

Since we are dealing a global 1D model, we cannot use 3D regions to determine any location tolerance, which is why we have to determine RMSE results. The RMSE results are the same for both methods of relocating.

The minimum RMSE differences show that location is stable and the 2D model gives lower results.

Validation Events (P)

All validation events were selected from the USL ULC. These events have ground truth of less than 10 km. These events were chosen so that they were used for validation of the RTT and have many phases from which to choose from for generating random realizations of available data sets.

Validation Events (S)

All validation events were selected from the USL ULC. These events have ground truth of less than 10 km. These events were chosen so that they were used for validation of the RTT and have many phases from which to choose from for generating random realizations of available data sets.

Adaptive Grid Refinement and Tomography

The two tessellations in the mantle are refined, in both the geographical and radial dimensions, during the process of the tomographic inversion.

Since the radius of the ray trace is to be refined, the ray trace for the 3D model is computed using 1D tomographic data. We refined the ray trace model to the 1D model.

Adaptive Grid Refinement (P)

The two tessellations in the mantle are refined, in both the geographical and radial dimensions, during the process of the tomographic inversion.

The two tessellations in the mantle are refined, in both the geographical and radial dimensions, during the process of the tomographic inversion.

Three Tessellations (Starting from an Initial 1D)

A 3D model was created from an initial 1D model.

Adaptive Grid Refinement (P)

A 3D model was created from an initial 1D model.

The two tessellations in the mantle are refined, in both the geographical and radial dimensions, during the process of the tomographic inversion.

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Adaptive Grid Refinement (S)

A 3D model was created from an initial 1D model.

Three Tessellations (Starting from an Initial 1D)

A 3D model was created from an initial 1D model.

Adaptive Grid Refinement (S)

A 3D model was created from an initial 1D model.

Validation

All events were relocated fixed depth or at the depth equal to the depth of the 1D model.

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