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a Consistent Travel-Time Framework to Compare Three-Dimensional Seismic Velocity Models for Location Accuracy

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Location algorithms have relied on one-dimensional (1-D) velocity models for fast, seismic event locations. The fast computational speed of these models made them the preferred type of velocity model for operational needs. Three-dimensional (3-D) seismic velocity models are becoming readily available and usually provide more accurate event locations over 1-D models. The computational requirements of 3-D models tend to make their operational use prohibitive. Comparing location accuracy for 3-D seismic velocity models tends to be problematic as each model is determined using different ray-tracing algorithms. Attempting to use a different algorithm than used to develop a model usually results in poor travel-time prediction. We have previously demonstrated and validated the ability to quickly create 3-D travel-time correction surfaces using an open-source framework (PCalc+GeoTess, www.sandia.gov/salsa3d, www.sandia.gov/geotess) that stores spatially-varying data, including 3-D travel-time data. This framework overcomes the ray-tracing algorithm hurdle because the lookup tables can be generated using the preferred ray-tracing algorithm. We have created first-P 3-D travel-time correction surfaces for several publicly available 3-D models (e.g., RSTT, SALSA3D, G3D, DETOX-P2, etc.). We demonstrate using these correction surfaces to compare models fairly and consistently for seismic location accuracy via a set of validation events and International Monitoring System stations.

Promotional text

Allowing for direct comparison and/or use of 3-D velocity models pertains to Goal 1 for identifying opportunities/methods for improving nuclear test monitoring. Goal 4 is also relevant for supporting civil and scientific applications, as well as capacity building.

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Oral preference format

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