



## **Resolution and Covariance of the LLNL-G3D-JPS Global Seismic Tomography Model: Applications to Travel Time Uncertainty and Tomographic Filtering of Geodynamic Models**

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Resolution and covariance of global seismic tomography models are most often unknown quantities. However, there are many potential applications of these matrices in the broad solid Earth research community as well as more focused scientific groups including the nuclear explosion monitoring research community. In this study, we construct both the resolution and covariance matrices for the recent LLNL-G3D-JPS global joint model of P- and S-wave velocity (Simmons et al. 2015). The global model consists of >1 million free parameters, creating matrices with >1 trillion elements. Given the scale of the problem and computational limitations, we employed a custom method to calculate impulse responses at every node in the Earth model and produced sparse, yet representative resolution and covariance matrices that can be practically employed for several real applications. We apply the matrices to real problems as example use cases. Utilizing the covariance matrix, we computed travel time uncertainties for thousands of P-waves emanating from (or to) specified points around the globe and constructed maps of the travel time error to illustrate the variability of path-specific travel time uncertainty. Utilizing the resolution matrix as a tomographic filter, we converted geodynamically derived renditions of Earth structure to images that may be visible through the often-distorted lens of seismic tomography. This work performed under the auspices of the U.S. Department of Energy by Lawrence Livermore National Laboratory under Contract DE-AC52-07NA27344.