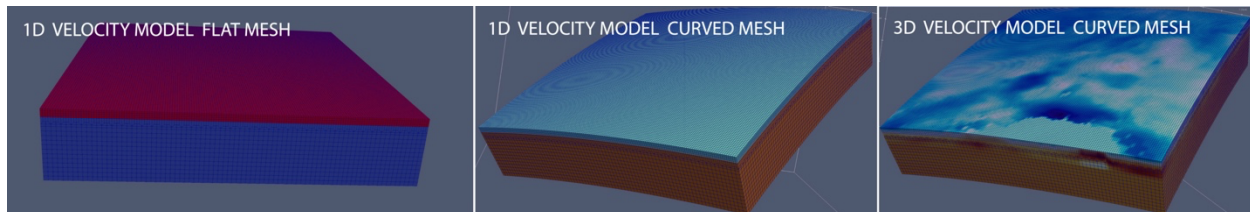


Effects of 3D velocity structure and Earth curvature on moment tensors from regional waveform modeling – preliminary results for a case study in Iran

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At regional distances, 1D velocity models have been widely and successfully used for moment tensor estimations of M_w 3.5 and larger seismic events, especially when only double-couple sources are considered. However, resolving non-double-couple (NDC) parts of the full moment tensor for complex or unconventional seismic sources is problematic and the use of 1D models may limit their resolution. Several studies indicate that NDC parts become smaller when realistic 3D models are used for Green's Function (GF) calculations (e.g., Hejrani et al., 2017; Wang and Zhan, 2020) suggesting that NDC parts, in some cases, may reflect unaccounted model rather than source complexities. At larger regional distances of ~ 500 km and more, Earth curvature, which is usually not considered in GF calculations, may also affect results. Here, we conduct a modeling exercise to gain understanding of the effects of velocity models and Earth curvature on the moment tensor using GFs calculated for models with increasing level of complexity: 1. 1D model for flat Earth; 2. 3D model for flat Earth; 3. 1D model considering Earth curvature; and 4. 3D model with curvature. We used Specfem-3D (Komatitsch et al., 2009) and the Cube2sph package (Liu et al., 2021), which enables Specfem-3D to account for Earth curvature, to calculate the GFs. We used the Moment Tensor Uncertainty Quantification (MTUQ) package (Modrak, et al., 2018) to perform moment tensor estimations. For our tests, we used source-receiver geometries for earthquakes in Iran and model observed and simulated regional broadband seismic data at several different passbands. Our primary goals are to obtain insights into moment tensor uncertainties and the potential for systematic errors caused by oversimplified Earth models at regional distances. For practical purposes, we are also interested in understanding model complexity requirements for reliable moment tensor estimation while keeping computational costs low.



Meshes for waveform calculations. From top to bottom: Flat Earth 1D velocity model (simplest mesh), curved 1D model and curved 3D model (most complex considered) (not shown: Flat Earth 3D model).