Geophysical Research Abstracts
Vol. 19, EGU2017-9856, 2017
EGU General Assembly 2017

Producing and Testing Anisotropic Seismic Models Without Node-by-Node Inversion

Maximiliano Bezada (1), Manuele Faccenda (2), Douglas Toomey (3), and Hwaju Lee (1)

(1) Department of Earth Sciences, University of Minnesota, Minneapolis, Minnesota, U.S.A., (2) Dipartimento di Geoscienze, Universita di Padova, Padova, Italy, (3) Department of Geological Sciences, University of Oregon, Eugene, Oregon, U.S.A.

While we know that the Earth's upper mantle is seismically anisotropic, and that in subduction zones the strength and complexity of the anisotropy field is considerable, isotropic teleseismic tomography remains a primary tool for imaging subduction and investigating subduction and peri-subduction processes. Various studies have pointed out that the unaccounted-for anisotropy may contaminate tomographic velocity images of the subsurface with artificial anomalies, which can hinder interpretation of the models in terms of physical processes. Anisotropic body-wave tomography is, of course, a potential solution to this problem but it is not universally applicable given that not all subduction zones produce sufficient seismicity at all depths of interest to constrain the much increased number of unknowns. We have implemented an alternative approach which relies on prescribing an estimate of the anisotropy field as an a priori constraint on the inversion. While the correct anisotropy field will never be exactly known, using synthetic data we show that even coarse approximations can yield useful results. We find that approximate anisotropy fields can produce improvements in data misfit and a reduction in the abundance and severity of artifacts. Importantly, we show that the same measures can be used to disqualify erroneous assumptions about the anisotropy field. An application of this approach to real data from the westernmost Mediterranean is yielding encouraging results. We propose that approximations to the anisotropy field can be derived from a combination of shear-wave splitting measurements and thermo-mechanical modeling. We also explore how, based on modeling results, the anisotropy field can be described in terms of a small number of parameters that may make inversion more feasible, including inversion using Bayesian approaches.