ESC2016-172-1, 2016
35th General Assembly of the European Seismological Commission

Tomographic model of seismic body-wave anisotropy and velocity perturbations of the upper mantle beneath Fennoscandia - Application of a novel code AniTomo

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Seismological investigations of the continental mantle lithosphere, particularly its anisotropic structure, advance our understanding of plate tectonics and formation of continents. Orientation of the anisotropic fabrics reflect stress field during the lithosphere origin and its later deformations. We process teleseismic body waves recorded during passive seismic experiment LAPNET (2007-2009) deployed in the northern Fennoscandia to retrieve both anisotropic and isotropic velocity images of the upper mantle.

We have developed a novel code (AniTomo) that allows us to invert relative P-wave travel time residuals for coupled isotropic-anisotropic P-wave velocity models assuming weak hexagonal anisotropy with symmetry axis oriented generally in 3D. The code was successfully tested on synthetic data and here we present results of its first application to real data. The region of Fennoscandia is a right choice for the first calculation of anisotropic tomography with the new code as this Precambrian region is tectonicly stable and it has thick anisotropic mantle lithosphere (Plomerova and Babuska, Lithos, 2010) without significant thermal heterogeneities.

In the resulting anisotropic-tomography model of the upper mantle beneath the northern Fennoscandia, the strongest anisotropy and amplitudes of velocity perturbations concentrate in the mantle lithosphere. Different regions of laterally and vertically consistent orientation of anisotropy can be delimited in the model. In general, the identified anisotropic regions correspond to domains detected by joint interpretation of lateral variations of anisotropic parameters of P and SKS waves (Vecsey et al., Tectonophysics, 2007; Plomerova et al., Solid Earth, 2011). Simultaneous inversion for 3D distribution of velocity perturbations and anisotropy is the main benefit of new code AniTomo.