Geophysical Research Abstracts, Vol. 7, 06258, 2005
SRef-ID: 1607-7962/gra/EGU05-A-06258

Construction and testing of a 3D seismic velocity model in the greater Barents Sea region

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We constructed a 3D seismic P velocity model for the extended Barents Sea region including Svalbard (Spitsbergen), Novaya Zemlya, the Kara Sea, and the Kola-Karelia regions. The crustal model is based on a large number of existing 1D and 2D velocity profiles, constrained by geological observations, and the nominal resolution is 50 km. Each grid node is filled with a five-layer crustal model (plus water and ice), and the continuous upper mantle velocity structure is taken from published regional models. Seismic S velocities and the density structure shall be included in the near future. The final model also aims to improve seismic monitoring and verification in this region, including improved event locations and event size estimation, and a better understanding of regional seismic wave phases.

Validation of our velocity model includes forward modeling of observed travel times and relocation of seismic events. For this purpose we compiled a set of reference events with known or well-located epicenters, referred to as *Ground Truth* (GT) events. The GT events comprise quarry blasts and announced chemical explosions located mainly in Scandinavia and the Kola Peninsula, nuclear explosions in northwestern Russia and on Novaya Zemlya, and natural earthquakes. With these events we obtain good P_n and S_n ray coverage in the main target region. Phase arrival times of multiple events at some sites provides estimates on timing errors at some stations.

Here we present our model in terms of regional contour maps and seismic velocity transects. North-south trending transects in the western Barents Sea show Moho depths between 10 and 45 km, with average values around 35 km. Thicknesses of sedimentary layers vary considerably and reach locally more than 10 km. Strongest variations are observed in the west between northern Norway and Svalbard, whereas transects further east exhibit a more simple, layered crustal structure. As the crustal velocity structure in the source or receiver region strongly influences phase arrival times, the detailed 3D model is therefore also important for the monitoring of events at regional distances, where corresponding ray paths run mainly in the upper mantle. Furthermore, there are evidences for significant velocity variations in the mantle of our study region. We show comparisons of observed travel times and GT data along selected transects and initial time correction surfaces calculated from our model.