Geophysical Research Abstracts
Vol. 12, EGU2010-10625, 2010
EGU General Assembly 2010

3-D crustal velocity model for Lithuania and its application to local event studies

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PASSEQ 2006-2008 project (PASsive Seismic Experiment in TESZ) aimed at studying the lithosphere-asthenosphere system around the TransEuropean Suture Zone (TESZ)- the transition between old Proterozoic platform of north and east Europe and younger Phanerozoic platform in central and western Europe. The experiment was a seismic array research aiming to retrieve the structure of the crust and Earth's mantle down to the mantle transition zone, including mapping of upper mantle seismic velocity variations and discontinuities (Moho, lithosphere-asthenosphere boundary, mantle transition zone) using all available techniques. During the experiment 26 seismic stations (including four broadband stations) were installed in Lithuania. One of the main targets of PASSEQ deployment in Lithuania was identification and characterization of the local seismic activity. The PASSEQ stations in Lithuania were in operation since June, 2006 till January, 2008. During this period a number of local seismic events was recorded and preliminary event location was made using the LocSat algorithm and 1-D velocity model. This standard procedure is not enough precise for Lithuania, however, because the thickness of the crust varies significantly in the region (from 45 to 55 km). In order to improve event location, we separated the events into several groups and located each group separately using a VELEST algorithms and own 1-D velocity model for each group. We also compiled a 3-D seismic velocity of the crust down to a depth of 60 km. The model, consisting of four major layers (sediments, upper crust, middle crust, lower crust and uppermost mantle) was interpolated from 2-D velocity models along previous wide-angle reflection and refraction profiles into a regular grid. The quality of the approximation was analysed using comparison of travel times of P-waves recorded along previous controlled source profiles and synthetic travel times calculated using the 3-D velocity model. The model was converted into a density model using a special procedure, in which the density model is approximated by relationship between seismic velocity and density and the latter is found by inverting of the Bouguer anomaly. Comparison of the inversion results to the observed Bouguer anomaly showed that the upper part of the model needs to be corrected, in particular, in the regions not covered by the profiles. The epicentres of events relocated with the use of both VELEST algorithm and a 3-D velocity model are much less scattered and can be grouped into several clusters, some of which are confined to known areas of human activity. However, one group of events is spatially coincident with the region of two large earthquakes in Kaliningrad region in September, 2004, while another cluster shows good coincidence with known region of historical seismicity in Latvia.