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The crustal structure beneath the Netherlands from ambient seismic noise

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A 3-D shear velocity model of the crust beneath the Netherlands is determined from fundamental mode Rayleigh and Love wave group measurements derived from ambient seismic noise recordings. The data are obtained from a temporary array of broad-band seismometers in and around the Netherlands (the NARS-Netherlands project, 2008-2012) complemented with data from existing networks in the Netherlands, Belgium and Germany. Rayleigh and Love wave group velocity maps were constructed for the period range of 10 to 30 s. Lateral variations in the group velocity maps primarily reflect variations in sedimentary thickness across the Netherlands. The 2-psi Rayleigh wave and 4-psi Love wave fast directions of the group velocity maps are in agreement with the NW-SE direction of maximum compressive stress as well as with the NW-SE dominant direction of faulting in the Netherlands. The frequency dependence suggests that the azimuthal anisotropy is caused by lattice preferred orientation (LPO) of lower crustal minerals.

A 3-D shear-velocity model is obtained by inversion of the group velocity maps using the Neighbourhood Algorithm. The results show a top layer that varies in thickness from 2 to 4 km with with a pattern that is similar to the base of the Rotliegend. A midcrustal discontinuity is found at a depth of about 13 km. The Moho appears to be relatively flat with an average depth of 33 km. Radial anisotropy is mainly positive (Vsh - Vsv > 0) for the lower crust. This can be an expression of LPO but also of horizontal layering or lamination. The top layer shows the largest variations in radial anisotropy with distinct areas of negative radial anisotropy that can be attributed to high-density near-vertical faulting in those regions.