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An upper mantle S-wave velocity model for Northern Europe from Love and Rayleigh group velocities

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A model of upper mantle S-wave velocity beneath northwestern Europe is presented, based on a tomography of regional surface wave observations. Data from international and regional data archives (including temporary deployments) were used to measure group velocities for both Love and Rayleigh surface waves in the period range 10 to 150s which are then inverted for 2-D group velocity accounting for Fresnel zone sensitivity. Our new set of group velocity maps differs significantly from global reference maps, enhancing many details and amplitudes of group velocity variations in the study region.

We then apply a linear inversion scheme to invert for 1-D profiles of shear wave velocity and anisotropy which are subsequently assembled to a 3-D model. By choosing conservative regularization parameters in the 2-D inversion we ensure the smoothness of the group velocity maps and the resulting 3-D shear wave speed model. To account for the different tectonic regimes in the study region, we compare inversions with 3 different reference models (pure 1-D, 3-D crust / 1-D mantle and pure 3-D) to investigate the sensitivity of the 1-D inversions to inaccuracies in crustal models. We find that all three models are consistent at depths below 90 km and the resulting models deviate only slightly from each other, mostly in amplitudes.

We image an intriguing low-velocity anomaly extending from the Iceland plume domain across the north Atlantic beneath southern Scandinavia between 70-150 km depth. Beneath southern Norway, the negative perturbations reach a maximum of up to 13% w.r.t. ak135 and a shallowing of the anomaly is indicated. This observation will be discussed in the context of the sustained uplift of southern Scandinavia in

Neogene times, the mechanisms of which are still enigmatic. Furthermore, our upper mantle model reveals good alignment to ancient plate boundaries and first-order crustal fronts around the triple junction of the Baltica-Avalonia-Laurentia collision in the early Paleozoic and shows some interesting patterns in anisotropy that may be related to the postglacial rebound of Fennoscandia.