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Glacial isostatic adjustment of Northern and Middle Europe and the radial viscosity structure of the Earth's mantle

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During the last glacial maximum (LGM), large ice sheets have covered the Scandinavian Peninsula, the Barents Sea, and the Northern British Isles. Subsequent to the LGM, the ice sheets disappeared and the solid Earth readjusts towards a new isostatic equilibrium. The glacial isostatic adjustment (GIA) process is documented in numerous observations, e.g. paleo-shorelines covering the last deglaciation phase, and ongoing crustal deformations monitored by GPS stations, e.g. the BIFROST project. In this study, we use paleo-shoreline data from Scandinavia, the Barents Sea, and Middle Europe as well as radial crustal velocities from the BIFROST campaign to infer the radial viscosity structure of the Earth's mantle underneath Northern and Middle Europe. A global inverse procedure based on the Neighbourhood Algorithm allows us to explore the hypothesis of a low-viscosity zone in the upper mantle, which has been proposed in the literature. Our results indicate a low-viscosity zone underneath the British Isles and the Barents Sea, with viscosities between $(1 - 4) \times 10^{19}$ Pa s in a depth interval of 130-200 km. No such low-viscosity zone is found underneath Scandinavia. The thickness of the rheological lithosphere increases from 60-70 km underneath the British Isles and the Barents Sea towards values exceeding 120 km underneath Scandinavia.