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Modelling of glacial isostatic adjustment in the Barents Sea region: Earth rheology inferred from various ice load scenarios for the last glacial cycle

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The Barents Sea, bordered by Norway to the south, Svalbard to the north and Novaya Zemlya to the east, was covered by ice during the last glacial cycle. The extent and thickness of the marine-based ice sheet as well as timing of glaciation / deglaciation are, however, difficult to constrain, partly due to the few terrestrial areas available. There are various models for the ice load history in this region, but large discrepancies remain between them depending on the dataset used as constraint (e.g. sea-level data, temperature record or geomorphology data). Our aim here is to compare and find the best ice load scenario for this region over the last glacial cycle and solve for the Earth structure in the area.

To achieve this, we model the present-day crustal deformation and sea-level variations during the last deglaciation by solving the sea-level equation. We use a wide range of Earth models, where we vary the lithosphere thickness and the upper and lower mantle viscosities, as well as four ice load scenarios. The first three ice load scenarios come from published studies, and include the ICE-5G model as well as models from M. Siegert and J.-O. Näslund, while the last one is currently being developed at the University of Tromsø, Norway. We compare the modelled sea-level predictions to relative sea-level curves at key locations around the Barents Sea using chi square, which enables us to infer the best Earth structure and ice history. We also compare the predicted surface deformation from our best model with GPS observations from stations located around the Barents Sea. The GPS provides a constraint on the present-day evolution of deformation in the area and is complementary to the relative sea-level data, which constrain the long-term deformation.

First results show that the published ice load scenarios are not accurate enough to reproduce the sea level curves around the Barents Sea, regardless of the Earth model tried. However, the last model, currently being developed, provides a much better fit to the relative sea level data.