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Understanding lithospheric stresses in Arctic: constraints and models

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This pilot project aims to model stress patterns and analyze factors controlling lithospheric stresses in Arctic. The project aims to understand the modern stresses in Arctic as well as to define the ways to test recent hypotheses about Cenozoic evolution of the region. The regions around Lomonosov Ridge and Barents Sea are of particular interest driven by recent acquisition of high-resolution potential field and seismic data. Naturally, the major contributor to the lithospheric stress distribution is the gravitational potential energy (GPE). The study tries to incorporate available geological and geophysical data to build reliable GPE. In particular, we use the recently developed integrated gravity inversion for crustal thickness which incorporates up-to-date compilations of gravity anomalies, bathymetry, and sedimentary thickness. The modelled lithosphere thermal structure assumes a pure shear extension and the ocean age model constrained by global plate kinematics for the last ca. 120 Ma. The results of this approach are juxtaposed with estimates of the density variation inferred from the upper mantle S-wave velocity models based on previous surface wave tomography studies. Although new data and interpretations of the Arctic lithosphere structure become available now, there are areas of low accuracy or even lack of data. To compensate for this, we compare two approaches to constrain GPE: (1) one that directly integrates density of modelled lithosphere and (2) one that uses geoid anomalies which are filtered to account for density variations down to the base of the lithosphere only. The two versions of GPE compared to each other and the stresses calculated numerically are compared with observations. That allows us to optimize GPE and understand density structure, stress pattern, and factors controlling the stresses in Arctic.