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New constraining datasets for Eurasian ice sheet modelling: chronology, fjords and bedrock

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The increasing resolution of ice sheet models demands more detailed data for constraining and for comparison of results. Important data for this include ice sheet chronology, bed conditions and topography. We address this by compiling published data into three new constraining data sets.
The Eurasian ice sheet chronology is reconstructed in our database-GIS solution (called DATED; Gyllencreutz et al., 2007). In DATED, we are building a database with all available dates, and a GIS with all geomorphologic features, that are relevant for the ice configuration through the Last Glacial Maximum and the following deglaciation, based on results from the literature. Reconstructions of the ice sheet configuration are presented as thousand-year time slices of the advance and decay of the Eurasian ice sheet between 25 and 10 thousand calendar years ago, based on chronologic, geomorphologic and stratigraphic data from the literature. To facilitate handling of error estimates in ice sheet modeling using our reconstructions, we made three reconstructions for every time slice: a maximum, a minimum and a "probable" ice sheet configuration, based on the limitations of the data at hand. The estimated uncertainty for the reconstructions was calculated in the GIS, and amounts to about 1 million km2 (about 1/5 of the maximum area) for most of the record before the Younger Dryas, indicating significant gaps in the knowledge of the Eurasian ice sheet configuration.
In order to facilitate modeling of fast ice flow and ice streams, we compiled information about exposed bedrock from digital Quaternary maps in scale 1:1 million by the geological surveys in Norway, Sweden, Finland, UK and Ireland, together with published drift thickness estimates. The bed conditions data set was generalized to a grid resolution of 0.25 x 0.25 degrees.
The Norwegian fjords are important for topographic steering; especially for fast glacier flow and draw-down from more central parts of the ice sheet. However, most fjords are less than a few kilometers wide and therefore are not captured even by high-resolution models. Therefore, we assembled information about the major Norwegian fjords, to a dataset containing fjord width, average depth, post-glacial sediment thickness, threshold elevation and drainage direction, also generalized to a 0.25 x 0.25 degrees grid resolution.
The implementation of these new constraining datasets and the associated impact thereof is demonstrated by an ensemble of glacial cycle simulations using a three-dimensional thermo-mechanically coupled glacial systems model.

References:
Gyllencreutz, R., Mangerud, J., Svendsen, J.-I. & Lohne, Ø. 2007. DATED – A GIS-based Reconstruction and dating Database of the Eurasian Deglaciation. Applied Quaternary research in the central part of glaciated terrain. Geological Survey of Finland, Special Paper 46, 113–120.