Determining last interglacial ice sheet configuration using glacial isostatic adjustment modelling

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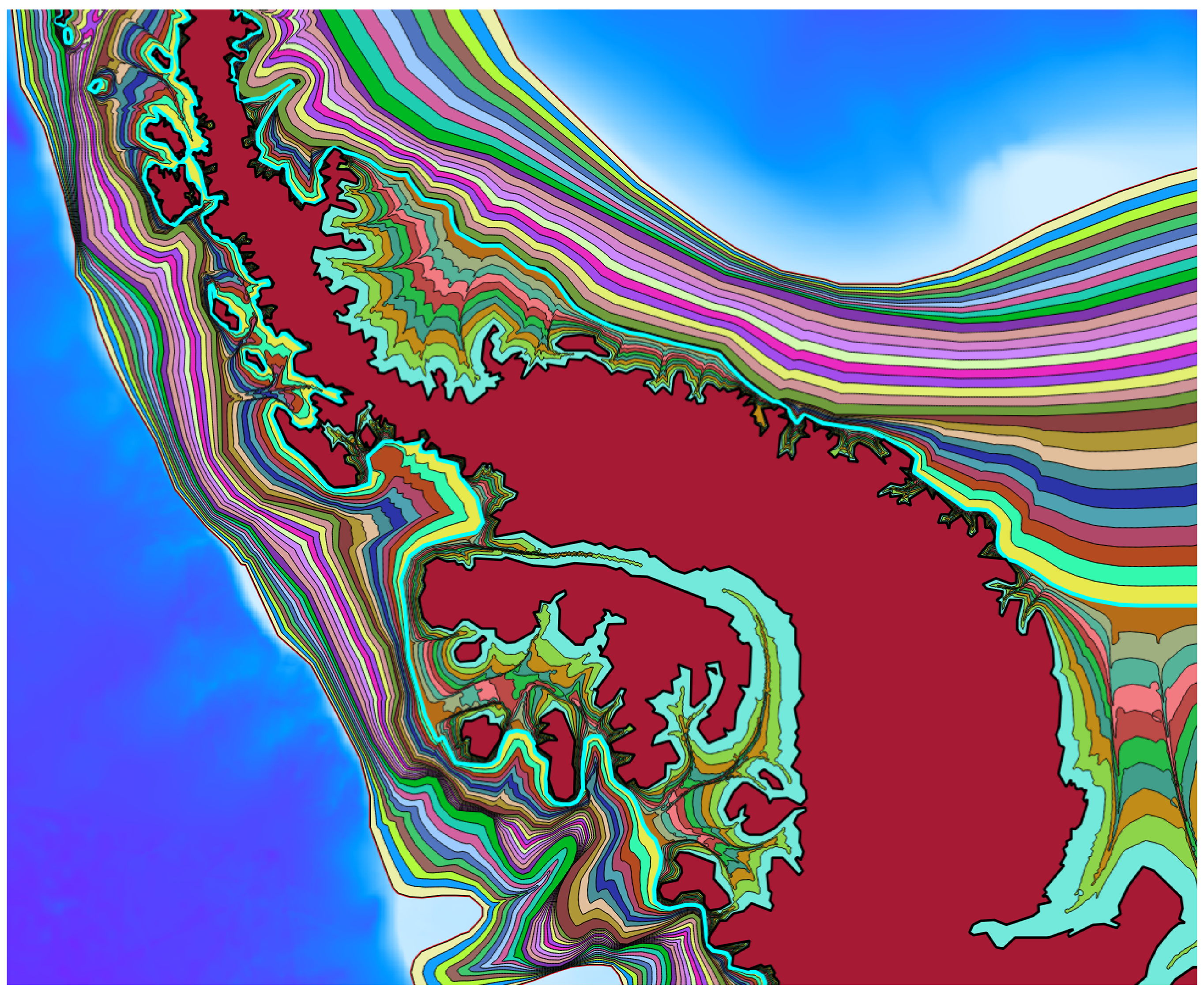
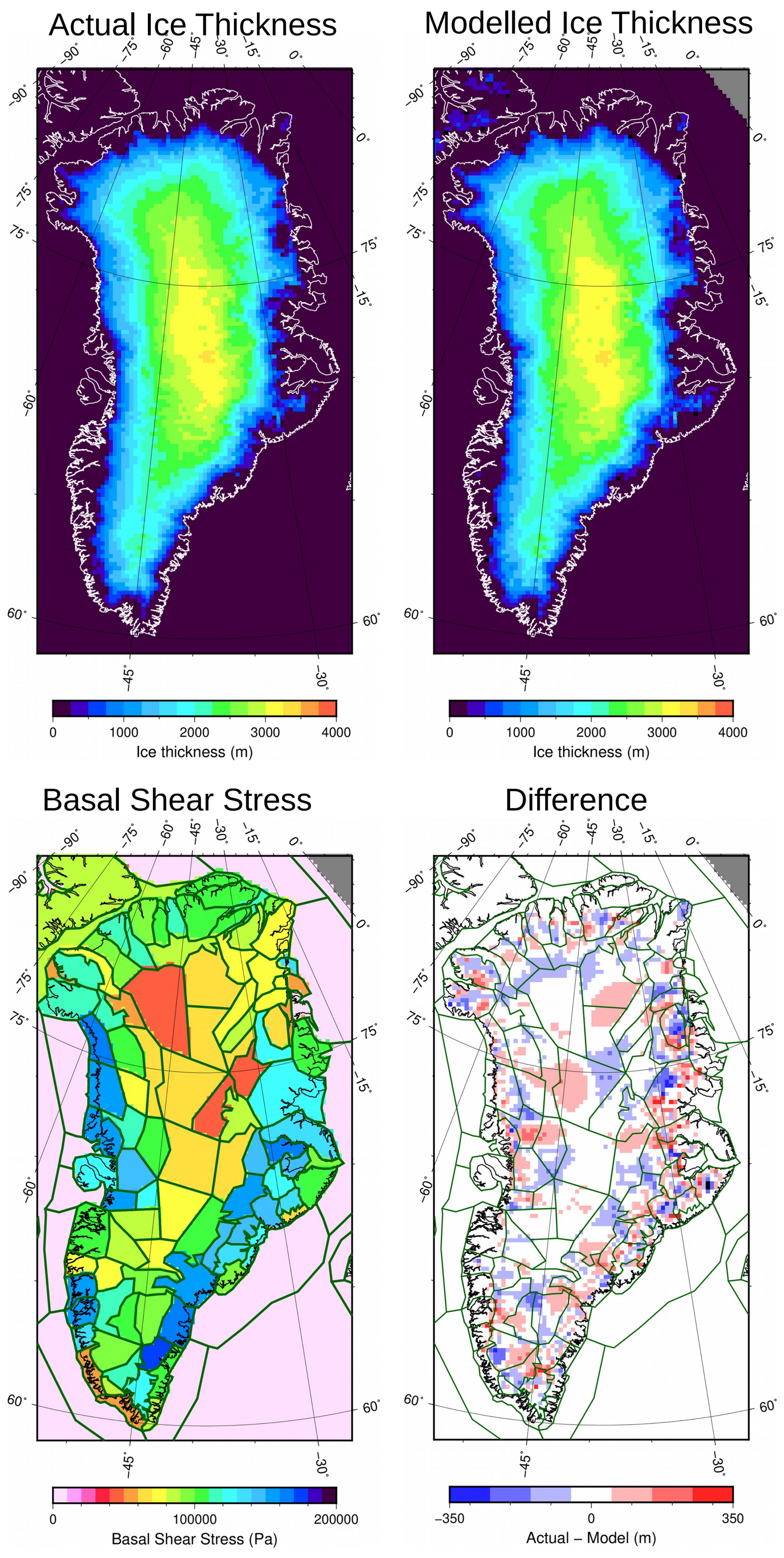
Ice sheet reconstructions based on geological and geophysical information

- Ice sheets can be reconstructed from using geomorphological data such as ice flow lineations, chronological data such as radiocarbon dates that indicate ice margin location through time, and geophysical data such as relative sea level data that indicates the volume and distribution of ice through time
- The ice sheet reconstruction should have at least a minimal amount of glaciological realism. This can be achieved using our model, ICESHEET (Gowan et al 2016b), which uses perfectly plastic rheology.
- Reconstructions have increasing uncertainty further in the past. For instance, there is ambiguity in the amount of ice lost in Antarctica and Greenland during the last Interglacial, so multiple scenarios should be tested
- Margin reconstructions for the past 200,000 years and collection of sea level data are in process (see poster "A global dataset of last interglacial sea-level elevations and geochronology" by D.D. Ryan et al.)



Antarctic margin reconstructions at 500 year intervals between 20,000 yr BP and present, based on interpolation between the 5000 year intervals by the RAISED Consortium (2014). Deep red area represents present day grounded ice from the BEDMAP2 dataset (Fretwell et al., 2012). We have developed tools that allow for the reconstruction of ice sheets based on geological data, including making the smooth transition between margin reconstruction time steps.

Greenland Ice Sheet



To test the utility of ICESHEET (and derive estimates of basal shear stress), it is instructive to show the results versus the contemporary Greenland Ice Sheet. The shear stress domains were adjusted to minimize the misfit of the modelled ice thickness and actual ice thickness. Even with the coarse resolution of the shear stress domains, the modelled ice thickness is generally within 150 m of the true thickness. The largest differences happen at the borders between the shear stress domains. Using coarser shear stress domains is advantages for paleo-reconstruction to reduce the amount of adjustable parameters.

Methodlogy to make ice sheet reconstructions using ICESHEET

- Inputs for ICESHEET include the margin at discrete time periods, and a temporal variable basal shear stress model which controls the ice surface profile.
- Can include iterations of GIA to account for changes in basal topography from loading and sea level change. We use SELEN (Spada et al., 2012) to compute this.
- At present, we have setups for North American, Eurasian and Antarctic ice sheets from 30,000 yr BP to present.

North American Ice sheets at 20000 yr BP

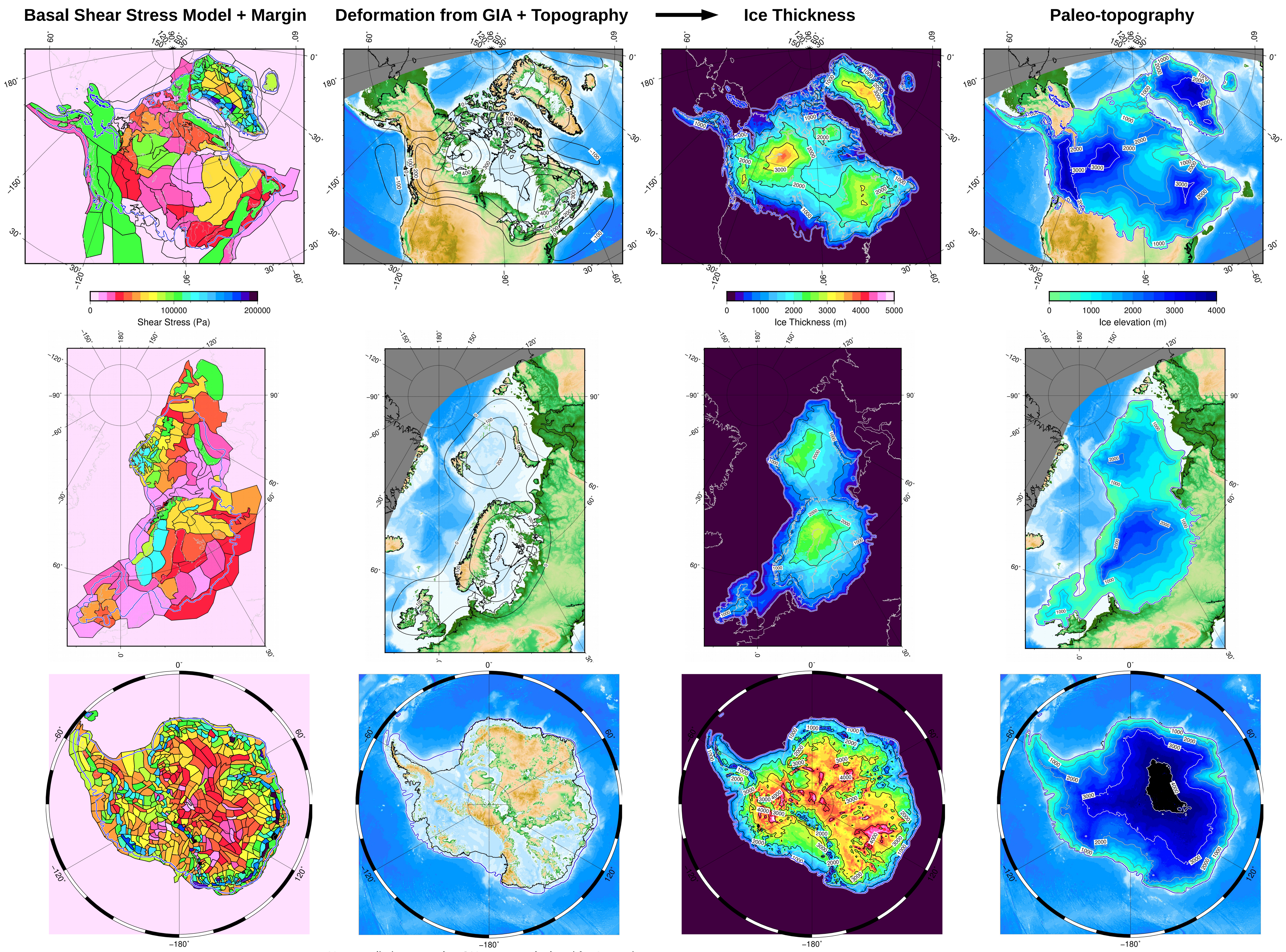
(blue line is the margin reconstruction from Dyke, 2004 and Gowan et al. 2016a)

Eurasian Ice sheets at 20000 yr BP

(blue line is the margin reconstruction from Hughes et al. 2016)

Antarctica Ice sheets at 20000 yr BP

(blue line is the margin reconstruction from RAISED consortium, 2014)



Note: preliminary results, GIA not yet calculated for Antarctica

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