Effects on SICOPOLIS Greenland ice sheet simulations of a hot spot and large basal river, two proposed geographic features hidden at the base of the ice.

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What mysterious geographical features lie hidden at the base of the Greenland ice cap? We present results from simulations used to investigate how the ice sheet could be influenced by two proposed features.

The first is a possible geothermal hot spot associated with an ancient volcanic area in north-east Greenland. The lubricating water from basal melting due to this hot spot is thought to be responsible for the formation of the North-East Greenland Ice Stream (NEGIS), by far the largest ice stream in Greenland and a major bugbear for ice sheet modelers. We present SImulation COde for POLythermal Ice Sheets (SICOPOLIS, Greve 1997) model results that test the effect of the introduction of a hot spot on ice sheet flow. Results show that an area of basal meltwater near the source of NEGIS spreads to the coast following the path of the ice stream even when there is no hot spot introduced. It is also clear that lubrication from this water increases the movement of ice towards the coast. Nonetheless basal water amounts do increase with hotter hot spots and this does further increase the sliding of ice. Questions therefore remain over the existence of this hot spot and also on the role of the deformation of, and frictional heating from, basal till.

The second feature is revealed by the widely used BedMachine basal topographic dataset (Morlighem et al. 2017) that shows a broken valley extending from Petermann Fjord far into the center of Greenland (Figure 1). The valley appears to be blocked by topographic rises at many points along its route (Figure 2). It will be demonstrated that these blockages are entirely artificial consequences of data interpolation (Figure 2) and that all available data indicate that the valley is not blocked. In addition, the base of the valley appears to be roughly level from Petermann Fjord to central Greenland which is suggestive of a recent or currently active, erosive and depositional process. Therefore we are opening up this valley to create an uninterrupted potential water pathway to Petermann Fjord to establish if water flows along its length. We will present the effect of this valley on the ice-sheet hydrology and dynamics. If confirmed with further radar bed observations, this would be a great world river the runs under ice for its entire length, a distance that could be up to 1600 km.

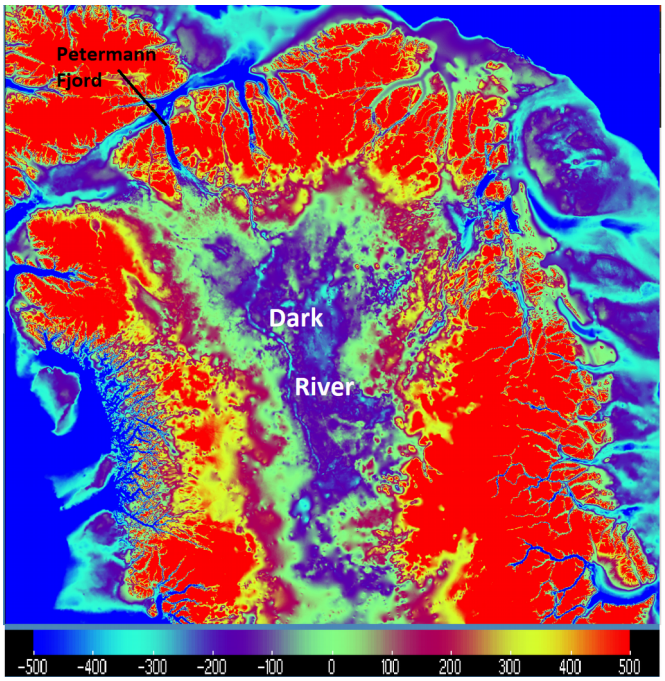

Figure 1: BedMachine bed topography for north Greenland focused on elevations between -500 to 500 metres.

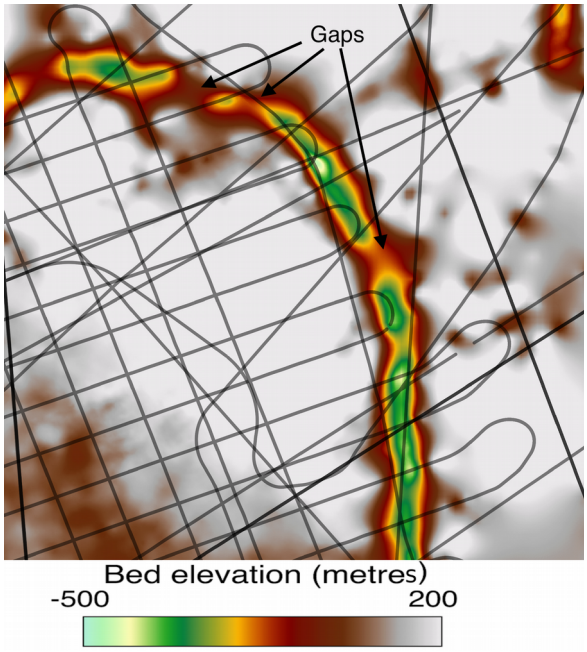

Figure 2: BedMachine bed topography (-500 to 200 metres) for the northern canyon showing the locations of the data scan lines used in the interpolation.

References

Greve, R., 1997: Application of a polythermal three-dimensional ice sheet model to the Greenland ice sheet: Response to steady-state and transient climate scenarios. J. Climate 10 (5), 901-918.

Morlighem, M., and 31 others, 2017: BedMachine v3: Complete bed topography and ocean bathymetry mapping of Greenland from multibeam echo sounding combined with mass conservation. Geophys. Res. Lett., 44 (21), 11051–11061.