A synthesis of the basal thermal state of the Greenland Ice Sheet

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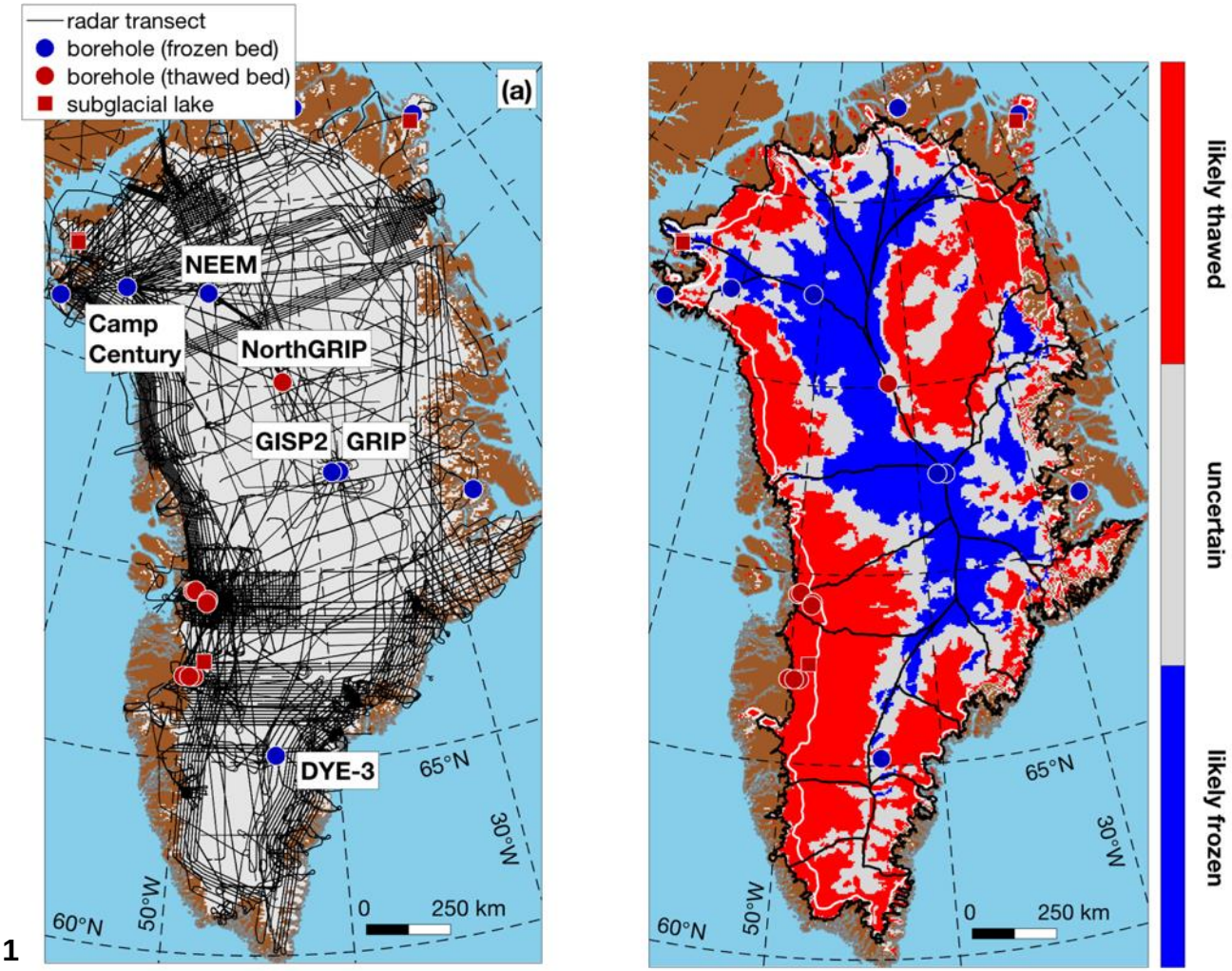

Figure 1

From a synthesis of models, airborne and satellite remote sensing, we found that 43% of the base of the Greenland Ice Sheet is likely thawed, 24% is likely frozen to the rock below, and the basal thermal state of the remainder is uncertain.

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References:

MacGregor, J.A., M.A. Fahnestock, G.A. Catania, A. Aschwanden, G.D. Clow, W.T. Colgan, S.P. Gogineni, M. Morlighem, S.M.J. Nowicki, J.D. Paden, S.F. Price and H. Seroussi, A synthesis of the basal thermal state of the Greenland Ice Sheet (2016), *Journal of Geophysical Research Earth Surface*, 121, doi:10.1002/2015JF003803

Data Sources:

- 8 SeaRISE ice-sheet thermomechanical models, including two NASA-supported models: ISSM (JPL) and PISM (UAF-GI)
- More than 400,000 km of PARCA and Operation IceBridge airborne radar-sounding surveys across Greenland
- 1995–2013 MEaSUREs InSAR surface velocity
- MODIS Mosaic of Greenland

Technical Description of Figures:

Figure 1*:*

- Left panel: Summary map of existing boreholes, known subglacial lakes and NASA airborne radar transects across Greenland.
- Right panel: Synthesis of the basal thermal state of the Greenland Ice Sheet, showing where the majority of the four methods agree on a particular basal thermal state, and where significant uncertainty remains.

Scientific significance, societal relevance, and relationships to future missions: Greenland's thick ice sheet insulates the bedrock below from the cold temperatures at the surface, so the bottom of the ice is often tens of degrees warmer than at the top, because the ice bottom is slowly warmed by heat coming from the Earth's depths. Knowing whether Greenland's ice lies on wet, slippery ground or is anchored to dry, frozen bedrock is essential for predicting how this ice will flow in the future. But scientists have very few direct observations of the thermal conditions beneath the ice sheet, obtained through fewer than two dozen boreholes that have reached the bottom. Our study synthesizes several independent methods to infer the Greenland Ice Sheet's basal thermal state –whether the bottom of the ice is melted or not– leading to the first map that identifies frozen and thawed areas across the whole ice sheet. This map will guide targets for future investigations of the Greenland Ice Sheet toward the most vulnerable and poorly understood regions, ultimately improving our understanding of its dynamics and contribution to future sea-level rise. It is of particular relevance to ongoing Operation IceBridge activities and future large-scale airborne missions over Greenland.