Enhanced basal lubrication and the contribution of the Greenland ice sheet to future sea-level rise

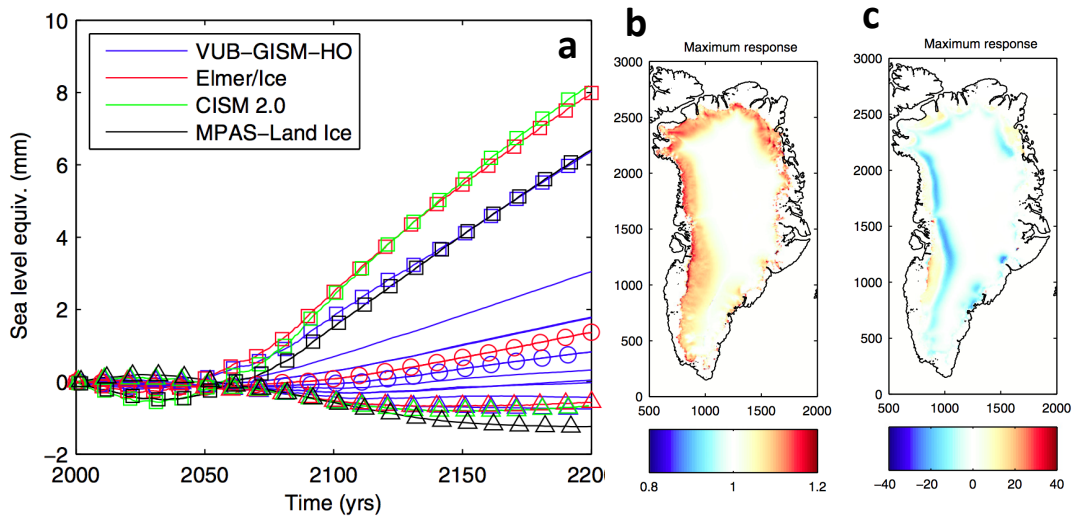
Objective

Estimate future sea-level rise from the Greenland ice sheet from meltwater-induced changes in basal sliding

Approach

- Use observations to derive empirical models for increased glacier speed (through increased sliding) as a function of increased meltwater input to the glacier bed
- Implement these empirical models in next-generation ice sheet models
- Force ice sheet models with climate model output from 2000 to 2200, including estimates for increased meltwater generation resulting from increased warming

Additional sea-level rise from meltwater-sliding feedback, relative to the base-case with no feedback (a). Fractional ice speedup (b) and cumulative thickness change (c) at 2200, relative to base-case with no feedback.



Impact

At 2200, sea-level rise from meltwater induced sliding in Greenland is small; ≤ 8 mm on top of the ~170 mm from increased melting alone (≤ 5%). At 2100, the effect is even smaller.

Shannon, S.R., A.J. Payne, I.D. Bartholomew, M.R. van den Broeke, T.L. Edwards, X. Fettweis, O. Gagliardini, F. Gillet-Chaulet, H. Goelzer, **M.J. Hoffman**, P. Huybrechts, D.W.F. Mair, P.W. Nienow, **M. Perego**, **S.F. Price**, C.J.P. Paul Smeets, A.J. Sole, R.S.W. van de Wal, and T. Zwinger. 2013. Enhanced basal lubrication and the contribution of the Greenland ice sheet to future sea-level rise. *PNAS*, doi:10.1073/pnas.1212647110.