

Review after Author revisions of: **Kuiper**, Weikusat, de Bresser, Jansen, Pennock and Drury
“Using a composite flow law to model deformation in the NEEM deep ice core, Greenland:
Part 1 the role of grain size and grain size distribution on the deformation of Holocene and
glacial ice”

The paper is much improved. A superb contribution. It is now easier to follow and I think will
have a greater impact. I have a few suggestions and comments to improve things further.

The Mistake in G&K

The opening two paragraphs of section 3 (flow law parameters) are much better- but they
still skirt around the issue that this is an unfortunate mistake and a reader has to work really
hard to work this out. I think this can be corrected by some minor changes:

- Line 10: Add a new sentence after “..experimental data”: “This analysis
highlighted an error in one part of the published flow law. The error was
confirmed by others (Goldsby pers comm; Prior Pers comm) and is
explained and corrected in the next two paragraphs”. Then start a new
paragraph with “A comparison....”
- Line 21,22: Remove most of these two lines and start the paragraph with “We
modified the flow law....”

Minor things

- Page 1. Line 15: comma after slip. Hyphen between rate and limited (and if you do
hyphenate- do for whole manuscript).
- Page 1. Line 16: comma after slip. Hyphen between rate and limited.
- Page 2. Line 5: Remove GBM from the list- it is not a deformation mechanism. After the
citations on line 7 you could add “... and associated with recrystallisation
mechanisms, including GBM.”
- Page 3. Line 11: Replace “only one defm mech, that is” with “just”.
- Page 3. Line 13: Key reference for $n=4$ at Tertiary creep would be (Durham et al., 1983).
- Page 3. Line 22: The new bit in red does not make that much sense. I think the alternative
you are trying to suggest is a flow law that reflects directly the behavior
at steady state or in Tertiary creep. Evidence that this has a different
stress exponent in (Glen, 1953, 1955; Qi et al., 2017; Treverrow et al.,
2012).
- Page 9. Line 30: Remove “Therefore”.
- Page 14. Line 3: The low stress different n value is also shown and commented on in
(Bons et al., 2018).
- Page 16. Line 7: I don’t think you have spelt out “SIBM”. Earlier in the manuscript (see
page 2 comment) you use GBM. Maybe replace GBM with SIBM or better
with SIGBM. Just pick one to be consistent and then change all
occurrences.

Page 17. Line 20: Remove the first sentence. Results using a flow law shown to be wrong are irrelevant.

Page 17. Line 31. I think the term “margins” will be confusing here. You have used margins earlier and so the context is set. Is it also worth mentioning other potentially high stress settings such as basal zones and lateral shear margins?

Bons, P. D., Kleiner, T., Llorens, M. G., Prior, D. J., Sachau, T., Weikusat, I., and Jansen, D., 2018, Greenland Ice Sheet: Higher Nonlinearity of Ice Flow Significantly Reduces Estimated Basal Motion: *Geophysical Research Letters*, v. 45, no. 13, p. 6542-6548.

Durham, W. B., Heard, H. C., and Kirby, S. H., 1983, Experimental deformation of polycrystalline h₂O ice at high-pressure and low-temperature - preliminary-results: *Journal of Geophysical Research*, v. 88, p. B377-B392.

Glen, J. W., 1953, Rate of flow of polycrystalline ice: *Nature*, v. 172, no. 4381, p. 721-722.

-, 1955, The creep of polycrystalline ice: *Proceedings of the Royal Society of London Series A-Mathematical and Physical Sciences*, v. 228, no. 1175, p. 519-538.

Qi, C., Goldsby, D. L., and Prior, D. J., 2017, The down-stress transition from cluster to cone fabrics in experimentally deformed ice: *Earth and Planetary Science Letters*, v. 471, p. 136-147.

Treverrow, A., Budd, W. F., Jacka, T. H., and Warner, R. C., 2012, The tertiary creep of polycrystalline ice: experimental evidence for stress-dependent levels of strain-rate enhancement: *Journal of Glaciology*, v. 58, no. 208, p. 301-314.