

The Cryosphere Discuss., referee comment RC1 https://doi.org/10.5194/tc-2022-141-RC1, 2022 © Author(s) 2022. This work is distributed under the Creative Commons Attribution 4.0 License.

## **Comment on tc-2022-141**

Anonymous Referee #1

Referee comment on "Timescales of outlet-glacier flow with negligible basal friction: theory, observations and modeling" by Johannes Feldmann and Anders Levermann, The Cryosphere Discuss., https://doi.org/10.5194/tc-2022-141-RC1, 2022

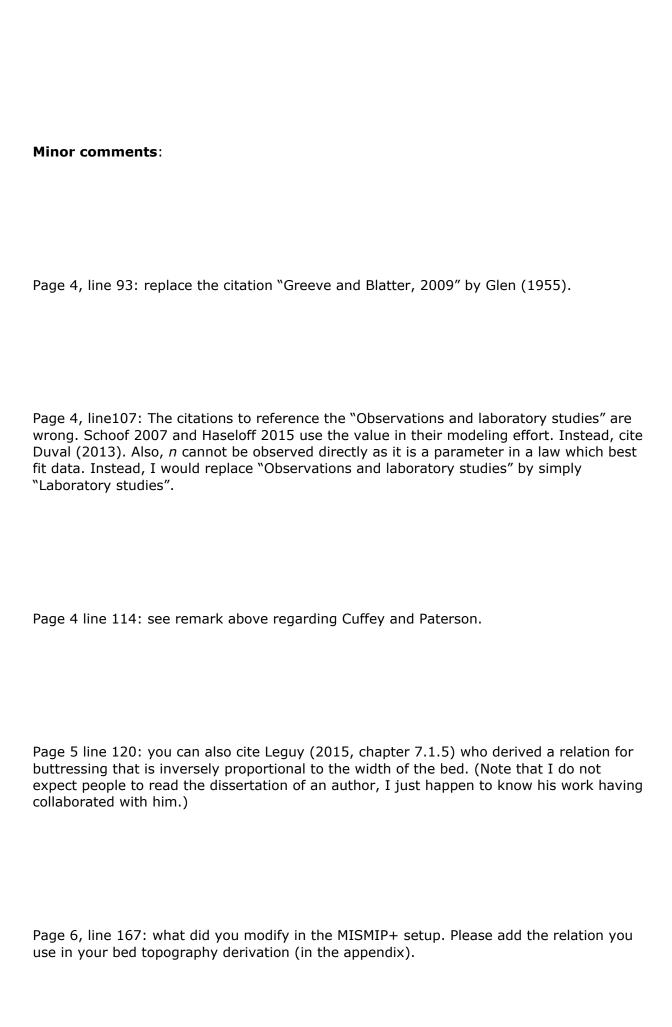
Review of Timescales of outlet-glacier flow with negligible basal friction: Theory, observations and modeling.

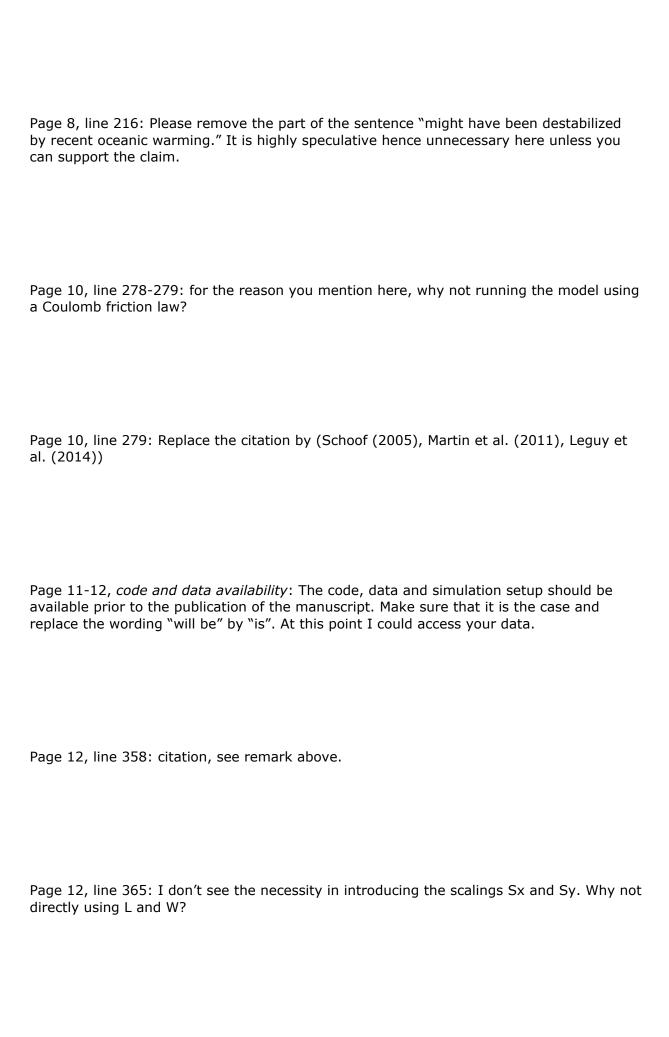
This paper uses the similarity principle applied to the SSA neglecting the basal friction with the goal to infer the time scale of marine ice stream retreats in Greenland and Antarctica. The paper considers idealized setup along with specifically chosen glaciers for Greenland and Antarctica and shows relatively good agreements with the theory.

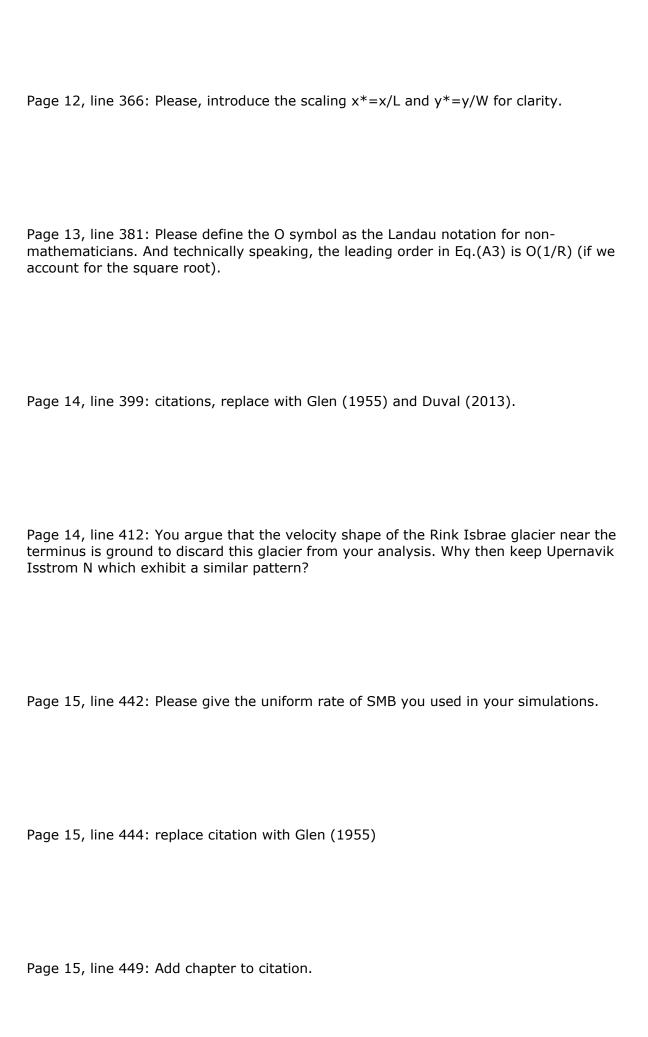
I found the paper really well written and organized. I would like to thank the authors to have spent the time on both aspects. I enjoyed reading this manuscript. While working with 3-D complex models is becoming more of a norm, it is refreshing to see that simple mathematical arguments (derived from equations used in the 3-D models) remain useful to understand or give a sense on dynamical principals. While the manuscript is very mathematically driven, the authors carefully left the details in the appendix while leaving the basic understandings of the method in the main text. Doing so results in a relatively short manuscript with little dilution from the mathematical details and well suited for a quick read.

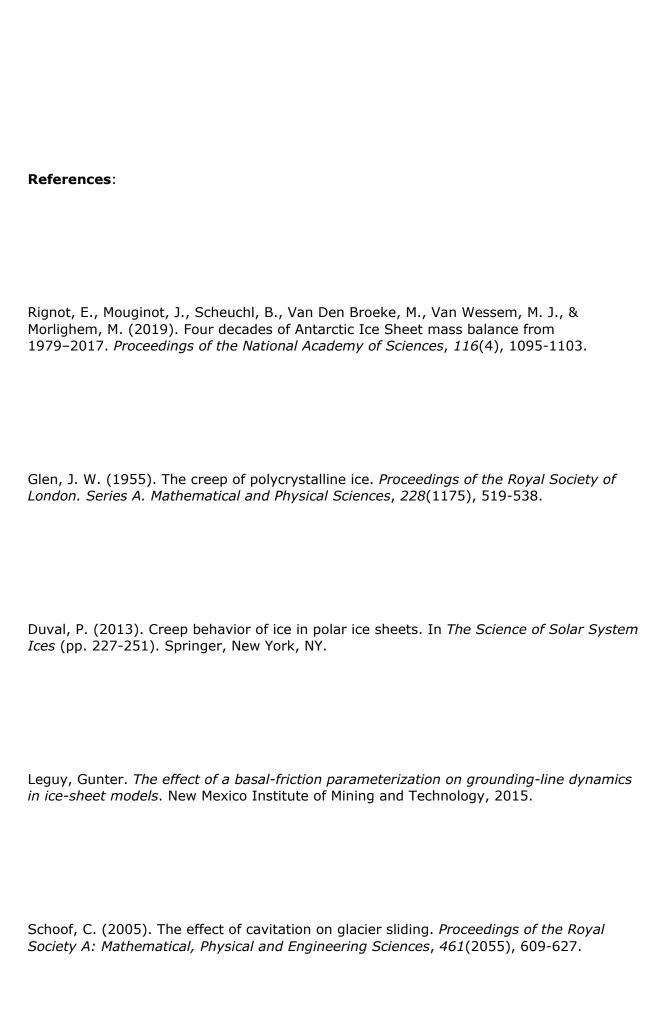
	vould fully support the publication of this publication after minor revision. Main and nor comments are following.
Ma	ain Comments
•	In comparing your similarity principle to Greenland glaciers, you set aside a couple of the glaciers and argued that physical properties of the glaciers break the similarity assumption. Did you check that it was simply the case that these glaciers behaved with respect to a similarity principal for which the main balance in the momentum equation is between the basal friction and the driving stress?
•	Since you choose to neglect the basal friction term in your similarity discretization, why did you choose a Weertman-type sliding law as opposed to a Coulomb-derived sliding law (Schoof (2005), Leguy et al. (2014), Tsai et al. (2015) ) in your idealized setup? A Coulomb sliding law has the advantage to go to zero at the groundline line by design. Please discuss this point in your manuscript.
•	How can you compare your Antarctic theoretical computation with actual retreat rates? Could you compare them using the data from Rignot et al. 2019? You have found an elegant way in obtaining a retreat rate with a simple method, it would be super useful to show that the order of magnitude matches current observation in a way.

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Figure 7: please of glacier (PIG).	give a reference value for	· the blue and red s	semi-circle for your reference









Martin, M. A., Winkelmann, R., Haseloff, M., Albrecht, T., Bueler, E., Khroulev, C., and Levermann, A.: The Potsdam Parallel Ice Sheet Model (PISM-PIK) – Part 2: Dynamic equilibrium simulation of the Antarctic ice sheet, The Cryosphere, 5, 727–740, doi:10.5194/tc-5-727-2011, 2011. 6

Leguy, G. R., Asay-Davis, X. S., & Lipscomb, W. H. (2014). Parameterization of basal friction near grounding lines in a one-dimensional ice sheet model. *The Cryosphere*, 8(4), 1239-1259.

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