The Cryosphere Discuss.,
https://doi.org/10.5194/tc-2018-218-RC2, 2019


The Cryosphere Discussions
Open Access
EGU



# *Interactive comment on* "A surface energy and mass balance model for simulations over multiple glacial cycles" *by* Andreas Born et al.

**Anonymous Referee #2**

Received and published: 3 January 2019

First of all, I want to apologize to the authors and the editor for my late reply but some unforeseen circumstances have made a quicker reply impossible.

This paper by Born and colleagues describes a multi-layer layer snowpack and energy balance models which is suitable for large icesheet simulations on multi-millennial time scales. The snowpack model (BESSI) is part of the IceBern2D model and it has been tested with climatological data (ERA-Interim) in terms of its energy and mass conservation. The only shortcoming of this fast and efficient snowpack model is that it strongly depends on the value of atmospheric emissivity and the sensible heat exchange coefficient. The paper itself is well structured and has been written in a clear way.

This paper is a valuable contribution to the Cryosphere Community specifically for



Printer-friendly version

Discussion paper

those interested in computationally efficient global snowpack models needed for interactive glacial–interglacial climate/icesheet model simulations of the past or large ensembles for future scenarios.

I would recommend this paper for publication in TC after the addressing the following remarks (my major point being the model/data availability, see below).

**Major Comments**

- My one major criticism of this paper is that the authors do not state if and how the model/data will be made available (this affects how I scored the significance of this paper). The journal's data policy requires the following: "If the data are not publicly accessible, a detailed explanation of why this is the case is required". The authors mention that BESSI is part of IceBern2D but because IceBern2D does not seem to be publicly available (as far as I can tell), I suspect that neither will be BESSI. If this is really the case, than, in my point of view, this would be a bad decision in the light of scientifc transparency and reproducibility. The Cryosphere Community would defineltly benefit from making every model code and associated data publicly available (you can't simply reproduce such a complex model from scratch). As a best practise example, see Krapp et al. (2017). However, this is a decision to be made by the editor and/or in general by the editoral board of TC and not by me as a reviewer so I leave the final decision here to the editor. (I am sorry if this sounds a bit harsh but I strongly feel that we as a community need to be more transparent with what we do and show and I sense that Open Access is just one part of Open Science; for example: https://www.practicereproducibleresearch.org).
- I find the title misleading. The authors do not show any glacial cycle simulation results.

- In the abstract you write "... even a marginal bias will develop into an erroneous solution over the long integration time and when amplified by strong positive feedback mechanisms": I am not sure that this is shown in the paper so please rephrase.
- In the introduction, what is the benefit of having mutiple layers compared to a single layer? Is it possible to run BESSI in "single layer mode"; this would then allow a direct comparison of the effect of a single vs. multi-layer snowpack model.
- Sect 2.1: As BESSI is integrated onto IceBern2D what is the reason that you didn't use the fully coupled version of IceBern2D/BESSI?
- What about the contribution due to latent heat exchange in Eq (7)?
- The parameterizations of the different terms in the surface energy balance (Sec 2.3.1) indicate a few uncertainties: snow albedo ($Q_{SW}$), atmospheric emissivity ($Q_{LW}$), and wind speed and air pressure ($Q_{SH}$)
  - What are the expected uncertainty ranges for each of those terms (as presented for $Q_{SH}$)
  - E.g., atmospheric emissivity varies with cloud cover, snow albedo varies with liquid water content or dust particles, wind speed varies non-uniformly across an ice sheet, and air pressure changes with with ice sheet height
- What are the vertical jumps in Fig. 5 a) and b) and 6 a)?
- p.19, l.1: In principle, BESSI could also be evaluated against snow temperature profile data from mountain glaciers, e.g., Gilbert et al. (2016), their Fig. 6 a–d and Fig. 9 (firnification data)
- I don't see the added value of Sect 5; it is rather confusing for the reader to start again with another model setup with a different climate model; I can't see why

this section is important at all and thus this section fells short compared to the rest of the paper

## Minor Comments

- accumulation rate $A$ and pressure change $\Delta p$ should be added to Table 1
- replace 273K with $T_0 = 273.15\,K$ throughout the manuscript

## References


- Krapp, M., Robinson, A., and Ganopolski, A.: SEMIC: an efficient surface energy and mass balance model applied to the Greenland ice sheet, The Cryosphere, 11, 1519-1535, https://doi.org/10.5194/tc-11-1519-2017, 2017.
- Gilbert, A., Vincent, C., Six, D., Wagnon, P., Piard, L., and Ginot, P.: Modeling near-surface firn temperature in a cold accumulation zone (Col du Dôme, French Alps): from a physical to a semi-parameterized approach, The Cryosphere, 8, 689-703, https://doi.org/10.5194/tc-8-689-2014, 2014.



Interactive comment on The Cryosphere Discuss., https://doi.org/10.5194/tc-2018-218, 2018.





Printer-friendly version

Discussion paper