Data Paper

Greve Ralf. Geothermal heat flux distribution for the Greenland ice sheet, derived by combining a global representation and information from deep ice cores. Polar Data Journal. 2019, 3, p. 22–36. https://doi.org/10.20575/00000006.

(Received 7/20/2018; Accepted 1/30/2019)

1st submission

Editor Start Date: 7/20/2018

Editor Stop Date: 12/27/2018

Reviewer #1 (8/10/2018–9/17/2018)

Reviewer #2 (12/14/2018–12/19/2018)

Editor Comments to the Author:

We are very sorry to take time to peer review.

We received peer review results as below.

One reviewer requests Minor Revision to correct the text.

Please fix and post again.

Reviewer #1: anonymous

This manuscript by Greve presents an updated geothermal heat flux distribution for the Greenland ice sheet. The geothermal heat flux is an important boundary condition for ice sheet flow models, but observations of the geothermal heat flux are sparse and only exists at a few locations. In this work, a global representation of the geothermal heat flux is scaled for Greenland and using an ice sheet model, the global representation is modified so modelled and observed basal temperatures match closely at the five bore hole sites where observations are available.

The geothermal heat flux distribution presented here is an update of earlier work. In this work, a 5-km resolution ice sheet model was used with an improved climate forcing history. The ice flow modelling is well suited with the widely used SICOPOLIS model. The modelling simulations are well planned and the technical validation is done carefully. The presented geothermal heat flux distribution is a valuable contribution to the community and it will potentially be widely used.

The paper is well structured and clear and concise, and no further changes are needed.

Reviewer #2: anonymous

This is a concise, well written and useful paper.

I have only one comment and a few totally insignificant suggestions for changes in wording.

The comment is that the geothermal heat flux distribution shown in figure 3 is obviously much affected by the scarcity of data points inside the ice sheet, for a very good reason of course because there is not much that can be done about this problem. The cylindrically symmetric maximum around NGRIP seems a rather artificial artifact of the weighted interpolation procedure, the real spatial distribution is most likely different but it is impossible to do better. It seems extremely unlikely that the real heat flow maximum is located exactly at the location of NGRIP, where we happen to have information from a borehole, and the spatial footprint of the high heat flux area is also likely to be elongated in one direction or another or be composed of more than one area of locally high heat flux. This should be discussed briefly in the paper as a limitation imposed by the lack of data. Presenting the data without mentioning or discussing this artificial pattern seems inappropriate to me. The heat flux distribution in the southern part of the ice sheet seems much more credible.

The minor comments:

p. 3, l. 37: "rock boreholes" --> "bedrock boreholes"

p. 3, l. 42: "very similar" --> "similar"

p. 7, l. 130: "very closely" --> "closely"

p. 10, l. 202: "by straightforward, bilinear" --> "by bilinear"

p. 13, l. 260: "In other words, this means that the ..." --> "In other words, the"

p. 13, l. 265: "The authors" --> "These authors"

p. 13, l. 266: "very similar" --> "similar"

p. 17, figure caption: "rock-boreholes sites" --> "bedrock-borehole sites" (the plural should only be on one word rather than two)

Authors Response:

I thank both reviewers for their efforts. Please find below a point-to-point answer, in which the reviewers' comments appear in red, while my replies are written in black. In addition, I am attaching a diff file that shows in detail the changes made in the manuscript.

To Reviewer #1

This manuscript by Greve presents an updated geothermal heat flux distribution for the Greenland ice sheet. The geothermal heat flux is an important boundary condition for ice sheet flow models, but observations of the geothermal

heat flux are sparse and only exists at a few locations. In this work, a global representation of the geothermal heat flux is scaled for Greenland and using an ice sheet model, the global representation is modified so modelled and observed basal temperatures match closely at the five bore hole sites where observations are available.

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The paper is well structured and clear and concise, and no further changes are needed.

I wish to thank the reviewer for the very positive assessment of this work.

To Reviewer #2

I have only one comment and a few totally insignificant suggestions for changes in wording.

The comment is that the geothermal heat flux distribution shown in figure 3 is obviously much affected by the scarcity of data points inside the ice sheet, for a very good reason of course because there is not much that can be done about this problem. The cylindrically symmetric maximum around NGRIP seems a rather artificial artifact of the weighted interpolation procedure, the real spatial distribution is most likely different but it is impossible to do better. It seems extremely unlikely that the real heat flow maximum is located exactly at the location of NGRIP, where we happen to have information from a borehole, and the spatial footprint of the high heat flux area is also likely to be elongated in one direction or another or be composed of more than one area of locally high heat flux. This should be discussed briefly in the paper as a limitation imposed by the lack of data. Presenting the data without mentioning or discussing this artificial pattern seems inappropriate to me. The heat flux distribution in the southern part of the ice sheet seems much more credible.

This is a very good point. I have added a paragraph in Sect. 5 (“Due to the scarcity of the supporting points…”) to discuss the issue.

The minor comments:

p. 3, l. 37: "rock boreholes" --> "bedrock boreholes"

Changed throughout the manuscript.

p. 3, l. 42: "very similar" --> "similar"

Changed as suggested.

p. 7, l. 130: "very closely" --> "closely"

Changed as suggested.

p. 10, l. 202: "by straightforward, bilinear" --> "by bilinear"

Changed as suggested.

p. 13, l. 260: "In other words, this means that the ..." --> "In other words, the"

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Changed as suggested.

p. 13, l. 266: "very similar" --> "similar"

Changed as suggested.

p. 17, figure caption: "rock-boreholes sites" --> "bedrock-borehole sites" (the plural should only be on one word rather than two)

Changed as suggested.

Further changes

Formatting changed to the LaTeX (Overleaf) template provided by the *Polar Data Journal*.

Short Section 2 “Location” added to conform with the standards of the *Polar Data Journal*. Some more explanation added to the description of the runs (2)-(4) in Sect. 3.1.

“Data Citation” added at the end of the manuscript (NOTE: doi of data set still to be added).

2nd submission

Editor Start Date: 1/3/2019

Editor Stop Date: 1/30/2019

Editor Comments to the Author:

You have done precisely to the comments of the reviewer.

Editorial Office's note

Calculate checksum date: 1/31/2019

Algorithm:SHA256

Hash: 5c52acc238a19cc543f416c142d734658bbe235821a4772ed784d0d66d86df07

Path:

https://ads.nipr.ac.jp/portal/kiwa/ProductsSelect.action?referer=summary&downloadList=ADS%3AA20180227-001%3A2.00#

Original Data

Greve, R., Geothermal heat flux distribution for the Greenland ice sheet, derived by combining a global representation and information from deep ice cores. 2.00, Arctic Data archive System (ADS), 2.00, Japan, 2018, https://doi.org/10.17592/001.2018022701.

Postscript by editorial office,

The above Path had been not available. (accessed 2020-10-12)

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