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Climate of the Past Discussions

Interactive comment on "Spatial distribution of Pleistocene/Holocene warming amplitudes in Northern Eurasia inferred from geothermal data" *by* D. Yu. Demezhko et al.

Anonymous Referee #1

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The paper tries to establish a spatial distribution of the magnitude of the postglacial warming (Pleistocene – Holocene, PHW). The authors make use of existing data on ground surface temperature histories for 48 locations. In principle, this is a challenging and very interesting task and certainly contributes to the current paleoclimatic research. However, the paper has some shortcomings, mainly due to lack of data but also interpretation, in my opinion.

Most important, as seen in figure 1 and 2, is the missing data on the Fennoscandian Shield. It is well known that temperatures during the last glacial maximum (LGM) and hereafter varied spatially significantly in this region. For instance, Hubberten et

al. (2004) infer from a combination of proxy data, inverse ice-sheet modeling and a atmospheric general circulation model that at the western margin of Scandinavia the mean annual surface air temperature was -5 °C during the LGM, with a maritime climate. The data from the central Kola peninsula and Eastern Karelia used in the paper could have experienced low temperatures during this time, but this is most probably due to the periglacial conditions which have prevailed there for longer times (Siegert, 2001). Influence of cold continental air masses and katabatic winds from the glaciers are possible reasons for this.

However, I cannot follow the arguments for the low (-23 °C) temperatures at the glacier base in the Kola region. As the authors mention, thermophysical processes at a glacier's base are quite complicated, and many parameters must be known for a complete ascertainment of its properties. Inversion results from the immediate vicinity of the Kola super-deep borehole, and the borehole itself show only moderate Weichselian temperatures which are 4 K - 7 K lower than today (Rath and Mottaghy, 2006). Results from Outokumpu, Finland (Kukkonen & Safanda, 1996) als show only about 7 K lower temperatures than today. Furthermore, the authors themselves cite Kukkonen & Johelet (2003) who find a postglacial warming of 8±4.5 K for the Fennoscandian Shield, using an extensive data set. Regarding North America, a work by Rolandone et al. (2003) emphasizes the spatial variation of glacier base temperature conditions. Their inversion results from different locations which were covered by the Laurentide ice sheet imply melting conditions at the glacier base with a corresponding small PHW. To summarize, there is no doubt that currents in the North Atlantic have a major influence on climatic changes in Eurasia. However, in my opinion the concept about the warming center and related interpretations are not supported by data. Therefore, using this PHW model for paleoclimatic corrections of measured heat flow values is certainly risky. The paper could benefit from a deeper critical discussion on this with appropriate citations.

The data and discussion for the eastern study area is very interesting and more con-

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sistent. I suggest to extend this part.

Some specific comments:

- Page 609, line 8-15: there are works which consider the variation of thermal properties, as well as their temperature dependence (Mottaghy & Rath, 2006; Rath & Mottaghy, 2005). In particular, neglecting latent heat effects may result in an overestimation of PHW.
- On the same page, the authors mention that they consider these effects (regarding the second survey area) - but no further explanation/discussion is given. This could be extended.
- Page 613, line 2: there is not enough data presented to support this conclusion.
- Ice sheet model: the authors mention a comparison with data from Greenland. It would be nice to see this in a plot.
- Page 613, line 24: Assuming constant thermal properties of ice and rock should be discussed and justified. What is the influence of P-T variations?

Hubberten et al. (2004), 'The periglacial climate and environment in northern Eurasia during the Last Glaciation', Quaternary Science Reviews 23, 1333–1357.

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Kukkonen, I. T. & Safanda, J. (1996), 'Palaeoclimate and structure: the smost important factors controlling subsurface temperatures in crystalline rocks. A case study from Outokumpu, eastern Finland', Geophys. J. Int 126, 101–112.

Mottaghy, D. & Rath, V. (2006), 'Latent heat effects in subsurface heat transport modelling and their impact on palaeotemperature reconstructions', Geophysical Jounal International 164, 236-245, doi:10.1111/j.1365-246X.2005.02843.x.

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Rath, V., Mottaghy, D., 2005, Paleoclimate on the Kola Peninsula (Russia) from inversion of subsurface temperatures, Poster, 30. General Assembly, European Geophysical Union, 24-29 April 2005, Vienna.

Rolandone, F.; Mareschal, J. C. & Jaupart, C. (2003), 'Temperatures at the base of the Laurentide Ice Sheet inferred from borehole temperature data', Geophys. Res. Lett. 30(18), 1944.

Siegert, M. J.; Dowdeswell, J. A.; Hald, M. & Svendsen, J. (2001), 'Modelling the Eurasian Ice Sheet through a full Weichselian glacial cycle', Global and Planetary Change 31, 367–385.

Interactive comment on Clim. Past Discuss., 3, 607, 2007.