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Climate of the Past Discussions

Interactive comment on "Geothermal evidence of the Late Pleistocene-Holocene orbital forcing (example from the Urals, Russia)" *by* D. Y. Demezhko and A. A. Gornostaeva

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This is an interesting paper attempting to link variations in surface heat flux at one site in the Urals with orbital forcing. The variations in surface heat flux are inferred from a 5km deep temperature profile in hole SG-4, in the Urals. The ground surface temperature history (GSTH) at SG-4 was studied in a previous publication (Demezhkov and Shchapov, 2001). The heat flux is derived with a very straightforward relationship between variations in ground surface temperature and heat flux (eq. 3). One needs to go back to the first paper to see the original temperature profile data, which is unfortunate.

The SHFH appears to correlate with the solar insulation curves for the Northern hemi-

sphere. This is an interesting result which I found surprising because it implies a linear relation between variations in solar insulation and heat flux. The GSTH that is used as input is smoother than the one in the 2001 paper, and seems dominated by a single frequency which happens to be the same as that dominating the insulation curve. Is the suggested correlation an artifact of the smoothing that has selected the proper frequency in the GSTH? The GSTH covers 80,000 years while the SHFH covers only 35,000 years. Would the correlation remain for the entire 80,000 years? It might be that the resolution of the GSTH decreases with time and does not allow the reconstruction of the SHFH, but one would have a lot more confidence that the correlation displayed in Figure 2 is real if it could be demonstrated over a longer time interval.

Authors from the same group had also determined surface heat flux changes from a borehole in Karelia (Demezhko et al., 2013) which suggest a similar correlation between SHFH and solar insulation. Contrarily to the Urals, Karelia was covered by an ice sheet during the last glacial cycle and it is difficult to understand how the relationship between ground surface conditions and solar heat flux could be same for a site covered by an ice sheet and a site free of ice, with the ratio of heat flux to insulation being 0.0012-0.0013 for both sites.

Incidentally, we find about the same values for the ground surface temperatures during the last glacial maximum in Canada as in Europe (Chouinard and Mareschal, 2009). The difference between Canada and Europe is that present ground temperatures are much higher in Europe than in Canada with stronger perturbations of the temperature profile in Europe. Were we to apply a similar analysis to derive SHFH in Canada, would we find that the ratio between heat flux and solar insulation is only 0.0003?

Two minor comments:

-It would be useful to state that there was no ice cover over that part of the Urals during the LGM.

-The equation 3 in the paper was actually derived in Carslaw and Jaeger (1959, p 63,

equation 8).

Chouinard C. & Mareschal, J.C. (2009) Ground surface temperature history in southern Canada: Temperatures at the base of the Laurentide ice sheet and during the Holocene, EPSL, 277, 280-289.

Demezhko, D.Y., Cornosteava, A.A., Tarkhanov, G.V., & Esipko, O.A. (2013). 30,000 years of ground surface temperature and heat flux changes in Karelia ..., Bulletin of Geography, 6, 7-25.

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