

Interactive comment on “Reconstructing glacier-based climates of LGM Europe and Russia – Part 2: A dataset of LGM climates derived from degree-day modelling of palaeoglaciers” by R. Allen et al.

Anonymous Referee #2

Received and published: 20 December 2007

"Reconstructing glacier-based climates of LGM Europe and Russia" applies the methodology described in Part 1 to constraining LGM climate for Europe and Russia. The paper has some substantive conclusions wrt regional tendencies for glaciation and associated temperature thresholds that are worthy of publication in CP. However, as detailed below, the paper is somewhat misleading in its title and claims (no actual reconstruction is presented). Furthermore, echoing the point already raised by a reviewer of part 1, more care needs to be put into the logic of constraints versus results and in general overall clarity of presentation. I therefore recommend acceptance only

after moderate revisions that address the points below.

:::: Detailed points ::::

Title:

#I find the title mis-leading: this is not a reconstruction, but a constraint of LGM era glacier-based climates. The methodology as it stands is unable to create a probability distribution for climate, since it can't resolve between various temperature/precipitation pairs nor between possible lapse rates. This mis-direction is furthered in the abstract:

"10 presented in this paper. A simple glacier-climate model was used to establish the optimum LGM climate conditions for each region from a suite of over 4000 model climates using the principle of zero cumulative mass balance. Clear regional trends are present in the reconstructed LGM climates; temperature anomalies north of the Alps are 2 C and 5 C larger than those in the western and eastern Mediterranean, respectively. In"

#As currently constrained, the model can't establish the optimum LGM climate conditions, only a suite of temperature/precip pairs. And given problems with the restricted range of possible lapse rates as detailed below, I don't see the basis for the stated 2C and 5C temperature anomalies. Furthermore, any meaningful reconstruction needs to incorporate uncertainty estimates and these should be included in the abstract.

#I also find a significant deficiency with the range of allowed surface lapse rates. Recent work (Marshall et al, Int. J. Clim., 2006) has shown for instance that Ellesmere surface temperatures have effective surface temperature lapse rates of 4 K/km over a 2 year measurement interval, with variations controlled by atmospheric dynamics. As such, I'm not sure how accurate the determined temperature ranges are.

pg 1172:

"The LGM glacier reconstructions required to constrain glacier-climate model (Allen et al., 2007a) simulations of LGM climate were constructed by overlaying the INQUA

GIS dataset on top of the USGS "gtopo30 arcsec" DEM (USGS, 1996). Using this combined approach to reconstruct LGM glacier topography yielded 182 discrete LGM 15 glacier profiles from 29 mountainous regions across Western Europe and Black Sea region. Results from individual glaciers within each mountain region were combined to produce a regional climate reconstruction (Table 1). Results from individual sites"

#I suspect that the INQUA dataset could have easily missed some pastglaciers. A discussion of what impact this would have on the results would be useful.

pg 175, 6-7:

"of 0.67 (Benn and Evans, 1998). The LGM climate that returned the highest cost function was assumed to be the optimum. A cost function was used for sites containing"

#terminology problem: generally try to minimize cost functions, maximize fitness functions

pg 176:

"If, however, for the purposes of interpretation the precipitation anomaly is calculated in percentage terms and assumed to be constant across all regions, then relative differences can be inferred. The following results are taken from the simulations using"

#The assumption of constant percentage difference across all regions has little basis, especially given the exponential dependence of saturation vapour pressure on temperature and the strong regional atmospheric dynamical controls on precipitation associated with storm track displacement,...

pg 1177

"The climate anomaly results from the 0% glacial coverage simulations can be interpreted as representing the maximum cooling of the present day climate (per precipitation anomaly) at the onset of glaciation. In the Ural Mountains this threshold exhibits"

#I do not understand what "per precipitation anomaly" means. Only later in the para-

graph is it stated "assuming present day precipitation". This needs to be stated up front to understand the chain of logic.

7 Discussion:

#This is an awefully long paragraph. Please break it up into digestible chunks.

pg 1181

"8 Conclusions

A dataset of 36 new and independent LGM European climate estimates derived from European Quaternary glaciers has been described. It was designed to be fully independent

I thought 36 was the number of regions. Aren't there 150 potential temperature/precip sets for each site?

pg 1182

"This dataset will enable glacial-geological evidence to contribute to our understanding of the European climate for the first time at the continental scale (Allen et al., 2007b). Moreover this work has developed and tested a new and simple method which"

#I would argue that previous ice-sheet modelling exercises for Eurasia would have also enabled "glacial-geological evidence to contribute to our understanding..."

Fig 4:

#I don't understand from the caption how LGM Annual Precipitation is derived especially given that the overall heading is "Present Day Annual Precipitation". Or is this just the present-day precip?

Interactive comment on Clim. Past Discuss., 3, 1167, 2007.