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Climate of the Past Discussions

Interactive comment on "Modelling the Early Weichselian Eurasian Ice Sheets: role of ice shelves and influence of ice-dammed lakes" *by* V. Peyaud et al.

V. Peyaud et al.

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[cpd]egu Answer to Lev Tarassof (referee)

The referee raised two issues on the climate forcing :

1) "The extent to which solar forcing dominates climate during glacial conditions especially when represented by the summer solstice value at 65N."
answer : In our model we assumed a sinusoidal variation of temperature along the year. Thus we did not take into account for changes in the season lengh. On the other hand, Ablation is highly non linear with temperature. With the sinusoidal assumption

we calculated a pdd factor. We used differents averaged temperature and Tjja temperature (around 0 to 1C $^\circ$ as observed close to ice sheet margins) : usually PDD appens during six month but around 50% are concentrated in the warmest month.

The corresponding figure can be presented if the referees would like to see it.

Neverthess, it would be very interesting to compare ours results to a variable season lengh.

2)"The extent to which climate sensitivity to solar forcing changes between interglacial and glacial conditions."
answer : If we considere no changes in the climate between 95 and 90 ka BP, the ISM model builds two small ice sheets on Scandinavia and Barents-Kara that cannot merge together (even under stationnary glacial climate). This is the reason why we decided to find a way to constraint the coldest climate that occured earlier (at 95 kyr according to insolation).

"question about pg 224) the referee ask why is there no temperature dependence in the shelf calving model given that present day Antarctic shelf fronts are constrained by regional isotherms? What impact might this absence have?"
answer : There is no explicit temperature dependance in the ice shelf calving model. Nevertheless temperature (at the surface and below the ice shelf) is taken into account by the mass balance (surface ablation and basal melting under the ice shelf). If the ice shelf thickness decreases below our calving criterion ; its front can be subjected to calving.

"question about pg 227-228) the referee doubts of the pertinence with using a derived mid-late Holocene climate sensitivity during glacial periods (ie to reconstruct the 95 ka climate from 90 ka fields), especially because of large differences in surface albedo

CPD
3, S270–S274, 2007

EGU

and surface topography"
answer : Obviously, when albedo raises, the sensitivity decreases because there is less energy at the surface. We observed results of the lmd5 (AGCM) time slice for the mid holocene. We calculated the annual temperature difference between 21 and 15 kry BP (over the eurasian ice sheets) and between 6 and 0 kry BP (no ice sheets in Eurasia). This temperature difference was corrected to altitude changes (vertical gradient=7$C.km^{-1}$). on average, we found 1.67C between 15 and 21 kyr (with ice sheet albedo) and 1.34C between 6 and 0 kyr BP.
The interpretation is difficult because greenhouse gaz concentrations are different during these period. Nevertheless we dont observe a strong sentivity. See the table 1 below :

One can notice that the uncertainty on the lapse rate (used to correct from topography changes) prevent us to estimate correctly the sensitivity. However insolation changes seems to affect surface temperature during glacial periods.

"pg 230-231) the referee would like to see more caveats in the discussion of calving at lacustrine margins."
answer : We agree with the comments of the referee and will we add modify the text to enlight these points.

"The referee is also uncomfortable with our marine calving."
answer : Our calving is based on the Lagrangian scheme that depends of the ice slhelf front tickness (see the article). This thickness is principaly controled by basal melting under the ice shelves. Considering the Barents and Kara Seas, we used a homogeneous basal melting wich varies from 2.0 m/a (during the warmest period) to 0.2 m/a (at the coldest period). During warmest period, the basal melting must prevent ice shelve formation (our 2.0 m/a are therefore a minimum bound). During the glacial period, an extremely low basal melting (let say 0.0 m/a) would help the inception but

CPD
3, S270–S274, 2007

EGU

would have no impact on the ice shelve deglaciation. If the basal melting is to high (> surface mass balance) it would prevent the ice shelve developpment.
"pg 232 : See answer to issue 1)"

We also modified the figure 1, as requested by the referee.

CPD
3, S270–S274, 2007

EGU

period	ΔI (soltice 65N)	DT (no altitude correction)	albedo	ΔCO_2
15-21	+50 $W.m^{-2}$	1.67C (4.64C)	high	+30 ppmV (O.3C)
6-0	+27 $W.m^{-2}$	1.34C (1.41C)	low	

Table 1: *Informations extracted from Lmd5 agcm simulation performed for 21, 15, 6 and 0 ky BP. Summary of the informations presented earlier : Insolation variations, corresponding temperature changes with (and without) altitude corrections, aldebo and CO2 concentration changes.*