**Climate
of the Past
Discussions**

Interactive
Comment

Interactive comment on "Impact of CO$_2$ and climate on the Last Glacial Maximum vegetation" *by* M.-N. Woillez et al.

D. Christine (Referee)

christine.delire@meteo.fr

General comment:

This paper present a very interesting modeling study of the relative impacts of CO2 and climate on the vegetation at the Last Glacial Maximum. It has broad implications for past climate inferences from vegetation proxy data (pollen, charcoal etc).This issue has been tackled by a few modeling groups but mostly with just one model. The authors here present results from a different model, with a large number of numerical experiments that allows for a detailed and very interesting analysis of the results. The paper is very well structured, clear, and easy to read.

My main issue is the following:

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The simulation of the current distribution of vegetation forced by climate observation is not very good in the mid latitudes (Fig 3, a). The Boreal Broadleaved Summergreen (BoBS) trees seem to outcompete temperate trees (Fig 3, 5). Similarly, their NPP (Fig. 14) seems very high (although this is forced by IPSL_CM4 climate and could be due to biases in the climate). I wonder if the exaggerate dominance of this PFT does not affect the sensitivity of the results presented here. Couldn't the increased dominance of broadleaved trees under LGM conditions be partly due to the too highly competitive BoBS ? or to temperate trees that might not be competitive enough ? Similarly, I would argue that the underestimation of grasses in the current climate might play a role in the low sensitivity of tree cover to the LGM climate. These two issues should be discussed by the authors.

Specific comments :

P8 l 4-16 and Table 2: Did the authors really save 1000 years of 6-hourly outputs from the LGM climate simulated by IPSL_CM4_v1 ? The authors didn't select the last century or so and repeated this forcing X times ? This should be better explained.

P10. L4: Some vegetation models take into account frozen grounds. For the S limit of the forest, another explanation for the overestimation of forest cover is land-use.

P10. L5: The fact that grasses can't grow below trees in ORCHIDEE can't be used as an argument here. CLM-DGVM, also based on LPJ, doesn't allow grasses under trees but overestimates grasses (Bonan & Levis, J. of Climate, 2006)

P11. L23: "... since oak forests were present over the Iberian peninsula ... ". The sole presence of an oak forest over the Iberian peninsula doesn't seem enough to prove that IPSL_CM4 simulates a climate closer to an interstadial. It does over Spain, but what about the rest of the Globe ?

P16 L6: the argument that grasses are not allowed to grow under trees is not really valid here either and it is also not necessary. In models where grasses are allowed to

grow below trees, they are still shaded by the trees and only grow if the tree canopy is sparse. The same is true in nature, grasses don't grow under dense canopies.

Technical corrections:

Check citations (parenthesis etc . . .)

Check past tens usage

P8. L22: To improve clarity, use "CRU timeseries" instead of "CRU data" to differentiate from the CRU climatology.

P10. L15. Define global foliage projective cover and how it is calculated in the model.

P10. L26-28 : This sentence is hard to understand. The authors should rephrase it.

P11 L2: "where ORCHIDEE" instead of "when ORCHIDEE"

P11. L4: "the region of the Great Lakes". I believe the authors are talking about the African Great Lakes region. It should be specified because of the possible confusion with the Great Lakes region of North America (although it was covered by ice during the LGM).

P11 L6: ". . .Fig 7) and are replaced by . . ."

P11. L7: ". . . over most parts . . ."

P12. L1 : "LGMG" instead of "LGMP".

P12. L14-22: The definition of LAI (may be not needed), surface of global projective cover and surface of presence should be moved to section 3.2 when these concepts are 1st used.

P12. L 22: ". . . differentiate these two variables because the amplitude . . ."

P12 L.24: ". . .because grasses cannot . . ."

P12 L24-25 : I'd suggest splitting the sentence in 2: ". . . below trees in ORCHIDEE. It

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is the forest disappearance that can allow . . ."

P13 L5: suggestion: "does not affect tree growth and glacial . . ."

P14 L22 and P15 L12: ". . . Northern Hemisphere . . . "

P14 L 24: suggestion "C3 grasses expand . . ."

P14 L25: "Parts of the . . ."

P21 L 24: suggestion: "change in climate affects . . ."

P21 L26: ". . .productivity in this zone . . ."

P22 L14: "have different sensitivities . . ."

Improve colormap for Fig 1 (negative, positive)

Fig 2: - suggestion: mask out precips<100 mm/yr to avoid big increases in Sahara - figure caption : use LGMP like in the main text

Fig 3: the North Pole seems to have risen from the waters at LGM. The authors should check the northern most latitude band.

Fig 3, 4, 5, 12, 15: The authors could drop Antarctica, this would free up space and allow for larger figures.

Fig 15: increase size of legend

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