

## ***Interactive comment on “Climate reconstruction from pollen and $\delta^{13}\text{C}$ using inverse vegetation modeling. Implication for past and future climates” by C. Hatté et al.***

**C. Hatté et al.**

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Please find our responses to reviewers' comments that greatly helped to improve the manuscript. We thus add several sentences to better describe advantages, limitations and improvements of the method we propose here.

- at the end of "2.2.1. BIOME4 vegetation model" to specify that BIOME4 accounts for physiological changes of plant to adapt environmental changes but doesn't account for genetic evolution

- in the "2.2.2. Inverse modeling procedure" to specify the simulation duration to show that this procedure is not computationally consuming and to propose improvement for future works.

- at the end of "3.3 contribution to paleoclimatology" to specify that upstream errors that may derived from both geochemical and palynological studies are not correct by our approach but are perpetuated. This short paragraph allows us to design an improvement for future study, the use of PFT instead of biomes.

Below are the answers to the specifics items pointed out by reviewers.

Reviewer # 1

-; "[...] This ability of plants [...] to modify their traits in response to the climate and CO2 changes is not well accounted in vegetation models yet. This general limitation might be commented in the paper. " => changes in physiological response are accounted in vegetation model, as BIOME4. So that stomatal aperture adaptation to humidity, CO2 concentration, ... is here, but there is no genetic evolution in this model. A plant remains the same and can only adapt by opening or closing the stomates. This results in changes in production parameters (NPP, LAI, ...) and isotopic fractionation.

- "It would be good to include a brief comparison of advantages and shortcomings of the new approach with the modern analogue method." => We add some sentences within the paper to further decline limitations of inverse modeling, this should further address this point.

- "Are monthly changes in the incoming solar irradiation due to altered orbital parameters accounted in the BIOME4 simulations?" => no they are not and this surely induces biases in our reconstruction. This could be an improvement for further studies

- "line 12: ... rough estimate of computational costs of this procedure" => a complete simulation for the 40 points of La Grande Pile lasts about 4 hours on a regular PC (no need for workstation). Each point requires from 1000 to more than 2000 iterations to reach convergence.

- "Figures: please note in the Figure 1 caption that the scale of the x-axis is inverse. [...]" => Done

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- "[...] Axis labels of this figure are too small and not easy to read." => They are now enlarged.

Reviewer # 2

- "What this manuscript does lack is thorough discussion of potential errors, limitations to the approach, and suggestions for further improvement." => This was effectively poorly developed. We add a sentence at the end of the 3.3. paragraph that should address this point.

- "Another interesting point that is passed over by the authors is the opportunity to reconstruct seasonal changes in climate." => Both annual and seasonal reconstructions are available. Here we focus on annual since seasonal parameters were already published in QSR (Rousseau et al., 2006). Nevertheless in a larger context, relationships between biome (or PFT),  $\delta^{13}\text{C}$  and seasonality are now under study, based on new datasets that include competition between species (realized niche versus potential niche as in this paper).

- "[...] C4 plants [...]" => there is no evidence of C4 plants occurrence at La Grande Pile during Eemian.  $\delta^{13}\text{C}$  remains very negative all along the studied series. Even during glacial time, i.e. under low  $\text{CO}_2$  concentration and water stress, there is no occurrence of C4 plants in Western Europe. This is based on loess paleoclimatological studies.

Prof. Pavel Tarasov

- "I would suggest to add word "data" or "records" after pollen and  $\delta^{13}\text{C}$  in the title => we added "records"

- "blue bands used to indicate event stratigraphy and correlate the records should be either made transparent ..." => we changed them for translucent grey bars that would ease the reading

- "page 74, lines 18-19: should be written "reduce" not "reduces"" => we don't agree: "Application" is the subject of "reduce", S should remain

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- "page 75, line 1-5 [...] available palaeoclimatic reconstructions CAN NOT BE SIMULATED by climate models." => OK

- "you are too strict in criticizing "modern analogue technique"" => we add sentences to better develop advantages and limitations of the inverse modeling method. It should contain elements for the discussion

- "page 77 line 14: I suggest "the La Grande Pile Eemian" => we followed P. Tarasov's suggestion and correct this locution as often as it appears in the text.

- "page 82, lines 10-20 [...] ppmv 300 can help in understanding future, if modern CO2 values [...]" => 280-300 ppmv is regular CO2 concentration of interglacial periods whereas 360ppmv is modern one. Difference between what was expected at 300 and what is at 360ppmv gives a first view of how CO2 increase impacts vegetation. It's true that to mimic post-modern conditions we would have to run with 420 or more, but we did not.

- "Page 85, line 18. Should be factor of 2" => it is factor of two.

- "Acknowledgements: please replace YYY and XXX ..." => It's done.

For the authors, Christine Hatté

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Interactive comment on Clim. Past Discuss., 5, 73, 2009.

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