Climate of the Past Discussions, 1, S7–S9, 2005
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European Geosciences Union

Climate of the Past Discussions

Interactive comment on "Quantifying the effect of vegetation dynamics on the climate of the Last Glacial Maximum" *by* A. Jahn et al.

Anonymous Referee #2

Received and published: 13 July 2005

General comments

The paper by Jahn et al. discusses paleoclimate simulations performed with the CLIMBER-2 model to analyse the effect of vegetation feedbacks in the LGM climate compared to the impacts of icesheets and lowered atmospheric CO2 concentrations. As far as I know, this is the first model study that uses an interactive vegetation model to address this issue and in this respect the methodology is certainly novel. The authors apply a ‘factor separation technique’ to separate and quantify the different effects. The presented results are interesting for the paleoclimatic community. For instance, the analysis shows that the synergy between icesheets and lowered CO2 concentrations produces an additional cooling, and the effect of vegetation is regionally more important than the CO2 effect. I would propose to include the discussion of the complementary experiments that focus on the comparison between vegetation feed-

backs and oceanic feedbacks in this paper. In my view, without these experiments the analysis of the effect of vegetation dynamics on the LGM climate (as promised in the title) is incomplete. I see no good reason to discuss the complementary experiments in a separate paper. In addition, I have some questions (outlined below) concerning the methodology and the processes behind the effects that they have identified, so I would suggest that the authors provide a more detailed explanation in some instances. To summarize, I would support publication of this paper in CP after minor revisions.

Specific comments

- Page 4, Methods section: please give information on the duration of the experiments.

- Page 6, line 2: Why is the atmospheric CO2 content lowered to 190 ppmv instead of 200 ppmv in earlier publications (e.g., Ganopolski et al. 1998)? And sea level lowered by 115m compared to 105 m? Why not stick to the same LGM setup? Please explain

- Page 7. As I understand it, with ice sheets and 200 ppmv CO2 concentration, the THC is in the warm mode described by Ganopolski & Rahmstorf (2001), while it shifts to the glacial cold mode if the CO2 concentration is lowered to 190 ppmv. If this is the case, then the result appears to be different from Ganopolski & Rahmstorf (2001), who simulate the cold THC mode when prescribing 200 ppmv CO2 and (presumably) identical LGM icesheets. Why is the result different? Have they used a different version of CLIMBER?

- Page 7: with only glacial CO2 levels as a forcing, the northward oceanic heat transport is strengthened. Does this mean that the model simulates a THC in the “glacial warm mode” similar to the mode found with icesheet forcing (+7 Sv, + 0.2 PW)? Please explain.

- Page 8: Including the vegetation feedback triggers a shift from the glacial warm mode to the cold mode. Please explain what process is responsible for this shift. The THC stability diagrams published by Ganopolski and Rahmstorf (2001) suggest that the shift

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is caused by an increase in freshwater forcing to the North Atlantic Ocean. So the question is: how does cooling associated with the vegetation feedback enhance the freshwater forcing? I have the same squestion for the lowering in CO2 level from 200 to 190 ppmv, and for the synergy feedback. All these effect cause additional cooling, but I would expect that the freshwater input from the atmosphere would be smaller in a cooler climate. Or is it related to expansion of sea ice, producing an enhanced freshwater flux?

- Page 7/8: About the synergy between icesheets and CO2: does it produce an additional cooling on top of the separate effects which triggers the THC shift to cause further cooling? If so, could the authors explain what causes this initial cooling?

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