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Climate of the Past Discussions

Interactive comment on "Assessing the impact of late Pleistocene megafaunal extinctions on global vegetation and climate" *by* M.-O. Brault et al.

Anonymous Referee #1

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Summary

Brault et al. explore the impact of late Pleistocene extinction of large terrestrial fauna on climate using the University of Victoria Earth System Climate Model (UVic ESCM). They assume that with the extinction of megafauna, tree-grazing in northern mid to high latitudes ceases and open grasslands are replaced by shrubs and trees. These vegetation shifts result in changes in the biogeophysical characteristics of the land surface (e.g. albedo) and changes in carbon fluxes. Brault et al. find a global warming of about 0.2 °C from biogeophysical effects alone in their Maximum Impact Scenario, which assumes the largest possible reforestation in the model. In a model simulation with free-evolving CO2 this warming is amplified by biogeochemical effects due to release of soil carbon and a slight increase in atmospheric CO2. Smaller but non-negligible

temperature effects are also found in scenarios with less extreme assumptions. Brault et al. conclude that megafaunal extinctions at the end of the Pleistocene could have had a small effect on climate.

General comments

This is an interesting paper, as it suggests that megafaunal extinctions could have resulted in non-negligible climate effects. The paper is well structured and clearly written. The methodology is sound and the conclusions are justified. My only criticism is that the paper provides little discussion of the robustness of results and differences/similarities with previous studies. Since only few studies exist that explore the climate effect of megafaunal extinctions specifically, the authors could draw on the body of literature about mid and high latitude reforestation/afforestation in the modern climate (e.g. Betts et al., Nature, 2000; Arora et al., Nature Geosc., 2011). How different are the results from those of these earlier studies? Are the discrepancies due to model differences or differences in boundary conditions (Pleistocene vs. modern)?

Specific comments:

p. 441, l. 11, "It is almost impossible to overlook": This phrase sounds awkward. Replace with "It is necessary to consider" or something similar.

p. 441, l. 13: Please clarify which processes do you refer to as "carbon sequestration".

p. 443, l. 22 and 28: The "2" in CO2 appears superscript instead of subscript.

p. 446, l. 17: Does "tree growth" include growth of shrubs? Please clarify.

p. 446, l. 23: "annual spread of surface albedo anomalies". It is unclear what you mean by "spread". Variation? Same comment applies to p. 448, l. 20.

p. 448, l. 9, "temperature response is not fully linear": linear with respect to which variable?

p. 451, l. 23-24: Which processes account for the reversal in atmospheric CO2?

p. 452, l. 7: Is ocean carbon changing in response to the vegetation changes in the free-CO2 experiment?

p. 452, l. 11: I am not sure this is a pertinent reference. In Cox et al., soil carbon release is associated with the reverse process (replacement of trees by grasslands)!

p. 454, last sentence, "we recommend a more thorough investigation of land surface processes. . .": Which kind of investigation do you have in mind? Please be more specific.

Fig. 1 caption, l. 2: There is an extra "both".

Figs. 2C and 3C: These figures are hard to read in the printed version of the manuscript.

Fig. 6: Panel A: I suggest to state in the figure caption that the panel displays global SAT anomalies. Panels C and D: I doubt the units (PgC) are correct?

Interactive comment on Clim. Past Discuss., 9, 435, 2013.