Clim. Past Discuss., 9, C2601–C2604, 2013
www.clim-past-discuss.net/9/C2601/2013/


Climate of the Past Discussions

# *Interactive comment on* "Investigating vegetation-climate feedbacks during the early Eocene" *by* C. A. Loptson et al.

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Received and published: 15 November 2013

Thank you for the comments and suggestions. We have addressed these point-by-point below:

*"there are many arguments that stand out without scientific evidences except for broad, sometimes wild, speculations *e.g., page 4716 about sea ice extent; page 4718 about albedo due to changes in cloud). Here you really need a plot of sea ice or cloud fraction to support your arguments."*

Temperature changes due to surface albedo, cloud albedo or water vapour/GHGs are backed up in the Energy Balance Model section. We realise that this is not immediately obvious, as this section comes after the other results sections, so we have now referred



the reader to the EBM section where necessary. We agree that plots of sea ice and cloud cover changes would be useful, so have now included them in the paper.

*"First, there are quite a few major previous studies, which are missing. They include, but not limited to, 1) Sloan and Rea (1995, 119, 275-292, Palaeogeography, Palaeoclimatology, Palaeoecology, hereafter, P3), 2) Shellito et al. (2003, 193, 113-123, P3), 3) Shellito and Sloan (2006, 50, 1-17, Global and Planetary Change, hereafter GPC), 4) Shellito and Sloan (2006, 50, 18-32, GPC), and 5) Utescher and Mosbrugger (2007, 247, 243-271, P3)."*

This is a fair point. We have now included references and some discussion of these papers in the introduction.

*"(1) there are many EMIC model studies (e.g., Claussen et al., GRL, 1999; Wang et al., GRL on dynamic vegetation and last glacial inception, 2005; Wang et al., Climate Dynamics on the Holocene vegetation-climate feedbacks, 2005); 2) there are fully-coupled climate-vegetation model studies (e.g., Notaro et al., Global Change Biology, 2008, Wang et al., Climate of the Past, 2008, Liu et al., Quaternary Science Reviews, 2007)."*

In the abstract, it is stated that "Vegetation-climate feedbacks play an important role in the present day, but are often neglected in paleoclimate modelling studies", but this follows on from discussion of the early Eocene climate and was supposed to be taken in this context. We have now changed the wording to "these paleoclimate modelling studies" to make this clearer.

These papers you have mentioned all describe Holocene studies, so we have cited some of them in the introduction, but have not described them in any detail.

*"Third, this study has claimed that vegetation-climate feedbacks (albedo and hydrology) are mostly positive (see page, 4715, lines 20-21). This is not valid at all the time and for all the models. Notaro et al. (2008, Global Change Biology) and*

*Wang et al. (2008, Climate of the Past) have carried out some detailed analyses of vegetation-climate feed- backs, and found out there may be possible negative vegetation-precipitation feedback (hydrology) in FOAM and CCSM for the Holocene."*

OK. This qualification (that vegetation feedbacks are not always positive on a regional scale for all time periods and all models) has been added to the paper, including these references.

*"Fourth, could you elaborate what you mean by "The global annual mean SAT difference between the simulations with MOSES 2.1 and MOSES 2.2 is larger at higher CO2 concentrations, resulting in a higher climate sensitivity in the SHRUB simulations than the EoMIP HadCM3L simulations."? I was a bit concerned by swapping 2.2 with 2.1 version."*

This statement is comparing the climate sensitivity of the experiments described in our paper with the HadCM3L results described in Lunt et.al. (2012).

All of the simulations described in our paper were run with MOSES 2.1, but previous studies e.g. Lunt et.al. (2012), used MOSES 2.2. Although this is an older version of the land surface scheme, it is necessary to use MOSES 2.1 in order to couple HadCM3L to TRIFFID (as mentioned in the Methods section).

*"Fifth, could you explain what you mean by "This is due to a combination of differences in surface albedo, where broadleaf trees replace needleleaf trees, and albedo due to changes in clouds."? I cannot follow your arguments here."*

This means that the changes in albedo due to vegetation (surface albedo) and clouds (planetary albedo) both contribute to the cooling seen in these regions when the vegetation coverage changes. We have changed the wording in our paper to clarify this.

*"Sixth, it will help to see how ground evaporation and transpiration have changed between fixed and dynamic vegetation simulations."*

OK. Plots showing changes in evapotranspiration have been added to the paper.



*"Finally, the 2-D figures are very hard to read the color scales, and the panel plots are too small to make sense."*

OK. We have made the colour scales larger so that they are easier to read .

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Interactive comment on Clim. Past Discuss., 9, 4705, 2013.