

Interactive comment on “Vegetation-climate interactions in the warm mid-Cretaceous” by J. Zhou et al.

Anonymous Referee #1

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Overall quality:

The submitted manuscript by Zhou et al. presents a worthwhile study that considers the role of modelled vegetation in the warm-poles problem of past warm climates. The paper presents a detailed analysis of cause-and-effect regarding the vegetation-climate-ocean interaction by using output from a dynamic vegetation model coupled to an AOGCM. They find that whilst realistic vegetation drives a warming of the mid and high latitudes under high CO₂ scenarios, a corresponding weakening of the MOC reduces the overall warming effect. Previous modelling studies did not incorporate dynamic vegetation and a full 3D ocean and so did not incorporate the sensitivity of the MOC to CO₂ induced vegetation-climate changes. This paper therefore advances on previous Cretaceous modelling studies by suggesting that realistic vegetation alone

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does not go as far to reconcile high-latitude data-model mismatches as previously suggested. Overall the paper is well-structured, concise and gives good reference to previous studies.

Individual issues:

- 1) The authors could give an indication of the spatial resolution of the AOGCM in km, particularly for the ocean (i.e. at the equator). Does the relatively low spatial resolution present any problems when it comes to representing the oceanic connectivity of the Arctic and therefore the meridional heat transport into this region?
- 2) The authors could briefly give some references regarding the performance of the model against the pre-industrial/modern climate. Are there any model deficiencies that would potentially affect this study? i.e. how well is the modern MOC modelled at this spatial resolution?
- 3) The authors could expand on the term physiological CO₂ concentration (p2807,L24). In setting this to 355 ppmv would this potentially overestimate canopy evapotranspiration fluxes to the atmosphere under higher atmospheric CO₂ values? Would this physiological forcing have an impact on the surface climatology?
- 4) Clarify some of the units and terminology used to describe the equilibrium state of the experiments. i.e. the linear trend for global vegetation cover is on the order of 10⁻³/century could this be described better?
- 5) As the authors are aware, a problem that persists with the modelling of warm greenhouse climates are the continental interiors, (i.e. Siberian Interior). Models predict continental interiors similar to the present whereas geological climate proxies suggest more equable climates (reduced seasonality). Does realistic vegetation go some way to reconcile this mismatch? Figure 2 and 3 suggest not. Could this be commented upon.
- 6) The proxy-model comparison of Figure 3 suggests potential problems in the low

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latitudes (at 10xDGVM) which would persist at lower CO₂. The authors identify this proxy-model mismatch (p2810 L15), could they expand on why this mismatch exists?

Interactive comment on Clim. Past Discuss., 7, 2803, 2011.

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