Clim. Past Discuss., 7, C1977–C1978, 2011
www.clim-past-discuss.net/7/C1977/2011/

Climate of the Past Discussions

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

Anonymous Referee #2

Received and published: 6 December 2011

Review of Vegetation-climate interactions in the warm mid-Cretaceous by Zhou et al.

This paper describes ocean-atmosphere-vegetation simulations of the Cretaceous using an up to date climate model (CCSM). To my knowledge, this is the first time that such a complex model is applied to the Cretaceous time period. The paper is well written and clear. The authors first describe the effect of increasing the atmospheric CO2 from 1X to 10X (a 16X run has also been performed). They then spend a lot of times to describe the difference between a 10X run with a vegetation model and a 10X run with bare ground. They show that the inclusion of vegetation induces a 1°C warming. This warming is focused over the high latitudes where the masking of snow forest plays the main role. Conversely, the low latitude continents undergo a cooling owing to the radiative cooling linked to the evapotranspiration effect of plants. The role of the ocean

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dynamics is also emphasized but seems to be of secondary importance. I have no major comments on this paper though I regret the lack of details on the description of the oceanic circulation. I guess the authors may prepare a kind of part 2 describing the type of deep waters, where they are formed etc... Indeed, I would be very happy to have the authors trying to explain why the ocean dynamics in their model is so insensitive to an increase in atmospheric CO2 (from 1 to 10 times!!!). What is the role of the sea-ice cover, of the hydrological cycle ... Changes in the MOC is larger when adding the vegetation than with a 10 times increase in atmopsheric CO2. However, it is clearly visible on the Figure 1b that the precipitation changes mainly occur between 1X and 10X. Weak changes are simulated when adding the vegetation.

Specific questions:

p.2810 – l.1-9, I do not agree with the conclusions, higher CO2 induces an increase in the precipitation over the low latitudes and not a decrease as written in the ms (see the Figure 1b). They attribute the retreat of subtropical grasses in the southern latitudes to an enhanced subtropical subsidence. Why does this scenario not occur in the northern subtropics? Subtropical grasses remains whatever the CO2 there.

In the table 1, the minimum annual precipitation for establishment of vegetation is 100 mm/yr whatever the PFT required. Can you comment on that? I am surprised that water requirement for plants is invariant. Only the temperature and its monthly distribution seem important in determining which PFT is adapted.

Is there a fertilization effect on plants with increasing CO2? If yes, can you give the CO2 range where it is important?

In the Table 3, please modify the last line by replacing Northern by Southern.

Legend Figure 5: Can you define what you call Low, Mid and High latitude, i.e. 0-15° for low latitude? Etc ...

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