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Climate of the Past Discussions

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

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Comment: Yes, we have one more paper in preparation, in which we discuss the behavior of MOC in the Northern Hemisphere in the 10xDGVM experiment. With 1x pCO2, deep water is formed in the northern and southern Pacific. With 10x or 16x pCO2, deep water is mainly formed in the northern Pacific. The relatively vigorous northern MOC in 10xDGVM is mainly a consequence of Arctic variability, which increases the northern MOC from ∼11.3 Sv to 16.9 Sv.

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 remain whatever the CO2 there.

Ans: Yes, we agree that high pCO2 leads to an increase in precipitation over the tropical zones. As shown in Fig. 1b, precipitation in the southern subtropical decreases significantly from 1xDGVM to 10xDGVM/16xDGVM. In contrast, precipitation in the northern subtropical increases remarkable from 1xDGVM to 10xDGVM/16xDGVM. As a result, subtropical grasses remain under high pCO2.

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.

Ans: The minimum annual precipitation of 100 mm/yr is a necessary condition for vegetation to establish, but not sufficient. That is, if this precipitation rate under 100 mm/yr, none PFT could establish. On the other hand, if precipitation is above 100 mm/yr, the large-scale distribution of vegetation is determined by temperature and competition for light, water and space among PFTs.

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

Ans: Theoretically, high ambient pCO2 should enhance plant growth. Though the model allows to manually changing physiological pCO2, we chose to use the modern value because 1) when physiological pCO2 is prescribed to 10x pre-industrial levels, tree PFTs collapse. This indicates that the current physiological parameterization in DGVM may unable to work appropriately under extremely high pCO2. And 2) laboratory experiments show that high pCO2 does not necessarily enhance plant productivity, because other conditions (e.g. availability of nutrients such as Nitrogen and Phosphorus) appear to quickly become limiting.

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

Ans: Low latitude: 30°S-30°N, mid-latitude: 30-50 °S/°N, high latitude: 60-90 °S/°N

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