Clim. Past Discuss., 10, C615–C617, 2014
www.clim-past-discuss.net/10/C615/2014/

Climate of the Past Discussions

Interactive comment on "North African vegetation-precipitation feedback in early and mid-Holocene climate simulations with CCSM3-DGVM" *by* R. Rachmayani et al.

Anonymous Referee #1

Received and published: 30 May 2014

The authors present a theoretical study in which they analyze the sign, strength, and underlying key processes of simulated vegetation precipitation feedback over North Africa during two episodes of the African Humid Period around 9ky bp and 6 ky bp. Specifically, the authors focus on the interaction between African Easterly Jet (AEJ) and Sahara / Sahel vegetation and precipitation changes. This study is particularly valuable as systematic, careful feedback analyses are rare. Even in the PMIP-2 comparison simulations presented earlier by Braconnot et al. (Clim Past 2007), no clear conclusions regarding mid-Holocene biogeophysical feedback could be drawn, because the simulations available lacked consistency. The authors conclude from their analysis that the biogeophysical feedback in Northern Africa is positive at multi-

millennial scale. Moreover the authors convincingly show that previous studies which found a negative biogeophysical feedback missed the important process of canopy evaporation. Finally, the authors find no multiple equilibrium vegetation-climate states for mid-Holocene climate, but some significant, albeit small, differences in present-day climate between simulations with different initial conditions. This is in line, although only qualitatively, with earlier studies using simple asynchronous biome – atmosphere coupling.

The study is clearly and concisely written. The set-up of numerical experiments is well constructed and convincingly serves its scientific purpose. The discussion is up to the point and very well readable. Therefore I am glad to recommend publication of the paper. I have got only a few minor comments which the authors might want to consider.

Minor comments:

On page 2067, the authors propose that the desert-albedo feedback, or so-called Charney feedback, does not play any important role in the feedback in contrast to AEJ dynamics. They argue that a decrease in surface albedo with increasing vegetation cover should enhance surface temperatures, while a surface cooling is needed for enhancing meridional temperature gradients and thus strengthening the AEJ and Sahel precipitation. However, a decrease in surface albedo due to vegetation encroachment does not lead to a surface warming, but to a surface cooling; the gain in net-surface radiation enhances the latent heat flux, not the sensible heat flux. This is clearly shown in Claussen (Climate Dynamics, 1997) for present-day, artificial Saharan greening and in Claussen and Gayler (Global Ecol. Biogeogr., 1997) for mid-Holocene greening. Actually, further analysis with a similar model system (ECHAM5 – BIOME 1 instead of ECHAM3 – BIOME 1) reveals a strengthening of the AEJ in mid-Holocene climate (unfortunately, this study is a diploma thesis by Anne Dallmeyer at Universität Hamburg, 2008, which is available in German only). In conclusion, I am convinced that desert-albedo feedback and AEJ dynamics are just two sides of the same coin, but not two different coins.

CPD
10, C615–C617, 2014

P. 2067, line 20: ‘soil albedoes’ does not seem to be a proper term. Better use ‘soil albedo values’ or ‘values of soil albedo’.

Fig. 1: I am puzzled by the colour code. Using rainbow colours for displaying a quantity of the same sign but just different amplitude is puzzling. Does a striking green indicate a completely different quality than a striking red or a yellow? I would suggest using different shades of the same colour – perhaps green for vegetation coverage. Rainbow colours for the other figures are fine, because red clearly marks negative, and blue, positive precipitation differences, and vice versa, for temperature differences.

Interactive comment on Clim. Past Discuss., 10, 2055, 2014.