Earth Syst. Dynam. Discuss., 3, C425–C429, 2012
www.earth-syst-dynam-discuss.net/3/C425/2012/

Earth System Dynamics Discussions

Interactive comment on "The influence of vegetation dynamics on anthropogenic climate change" *by* U. Port et al.

U. Port et al.

ulrike.port@zmaw.de

Received and published: 21 September 2012

Dear reviewer,
in our first reply, some of your comments remained unanswered or the answer was not complete. Here, we complete the reply.

Typos:
488/29 *leads* should be *leads to*,
488/29 *respond* should be *response*,
489/17 *Tree* should be *Three*,
498/7 *due* should be *due to*
We will correct them.

Additional item to:
Referee: Does leaf area index respond to climate and CO2 in the STAT simulation? If so, it should be stated clearly. Note that even vegetation fractional cover does not change, change in leaf area index due to CO2 fertilization would feedback on climate. Yes, LAI changes in the STAT and STAT_PS simulation. We will state this more clearly.

Author: Yes, LAI changes in the STAT and STAT_PS simulation. We will change 490/19 to:
However, the plant productivity, Leaf Area Index (LAI), and canopy conductance respond to the increased atmospheric CO2 concentrations.
490/26 to:
Regarding climate, differences between the DYN and the STAT simulation can be attributed to biogeographical shifts and further differences in plant productivity, LAI, and canopy conductance.
491/3 to:
Plant productivity, LAI, and canopy conductance respond to changed environmental conditions.

Additional item to:
Referee: "Since the vegetation cover changes are strongest at the end of the simulation..."
This statement is weak too. Two questions here: first, what is the metrics used here to quantify the strength of the vegetation cover change? Second, without any quantification, how will the reader know that the vegetation cover changes are strongest at the end of simulation?

Author: We will change 491/19 to:
The impact of vegetation cover changes on climate and on the carbon cycle are analysed in detail averaged over the last 30 years of the simulations (2270-2300) since

from 2260 the vegetation cover tends to stabilise.

Additional item to:
Referee: "However, CO2 fertilisation becomes non-effective in regions of stronger water stress due to elevated temperatures (in parts of the Amazon region and central desert regions)".
It is just stated above that the tree decline in Amazon is due to water stress, but here the decline is attributed to elevated temperature.

Author: We will specify the reasons for tree cover decline in the Amazon region in 493/27:
However, CO2 fertilisation becomes non-effective in regions of stronger water stress due to elevated temperatures and reduced precipitation (in parts of the Amazon region and central desert regions).

Additional item to:
Referee: "The smaller cloud cover leads to a cooling since the loss of thermal radiation is larger and thus net long wave radiation is smaller."
Presumably, a decrease in latent heat flux as a result of smaller tree cover in DYN should decrease low cloudiness, increasing solar flux reaching the surface and thus warming the surface. But the statement here seems to suggest that the cloud feedback is dominated by changes in high cloudiness and associated longwave flux. Without showing anything associated with changes in cloud cover and shortwave and longwave flux, it's not clear what is going on in the model.

Author: After analysing the changes in specific humidity quantitatively, we can show more clearly that the water vapour feedback cause a loss in thermal radiation and thus a cooling.
We will change the paragraph 498/9-498/22 to:
The biogeophysical effect of vegetation cover shifts on climate in the Amazon region

is a slight warming by 0.07 K and a decrease in precipitation by 2.8 %. Compared to the STAT_PS simulation, tree cover is smaller in the DYN simulation leading to less evapotranspiration initiating two counteracting effects. Lower evapotranspiration rates cause a warming since sensible heat fluxes are higher and latent heat fluxes are lower. Furthermore, weaker evapotranspiration leads to a cooling as specific humidity is smaller and thus the loss of thermal radiation is larger. However, the cooling due to the smaller specific humidity is weaker than the warming due to the decrease in latent heat flux. In sum, the biogeophysical effect causes a warmer and dryer Amazon region. Cox et. al 2004 suggest that a forest dieback results in a stronger reduction of precipitation rates than we find and leaves temperature unaffected. The decline in tree cover suggested by Cox et. al 2004 is stronger than in our results. Therefore, a weaker response in precipitation is plausible. Why the results differ for temperature changes remains unclear.

Referee: Fig. 11 should be Fig. 12
Author: You are right. The change it.

Additional item to:
Referee: If we think there is an approximately linear relationship between radiative forcing and global mean temperature change, and there is an approximately logarithmic relationship between radiative forcing and CO2 concentration, then there should be a logarithmic relationship between CO2 and temperature.

Author: We agree. The cooling due to vegetation dynamics is stronger by 0.09 K when calculated based on a logarithmic assumption compared to a linear assumption. Thus, we will skip the part were we calculate the biogeochemical effect from the difference in atmospheric CO_2 concentration between the DYN and STAT simulation based on a linear assumption. We will rather stay with the qualitatively conclusion, that the biogeochemical effect is the dominate effect

and a cooling, as the biogeophysical effect is small and not significant, while the net effect is a cooling by 0.22 K.
If you are interested in the detailed derivation of the biogeochemical effect based on a logarithmic relation, please see our reply to the comments by C. Jones.

Referee: Fig. 3 and 4 can be combined together.
Author: Yes, we will combine them.

Referee: Fig. 8: In addition to the difference between STAT and CTL, why not show the difference in NPP between dynamic (DYN) and control (CTL) as well?
Author: The label for Figure 8 is wrong. Figure 8 shows the differences between the DYN and the CTL simulation. We will correct it. The differences between DYN and STAT are not noticeable at this scale of NPP. Thus, showing both plots (for DYN - CTL and STAT - CTL) is not needed.

Referee: Fig. 13: The unit in evapotranspiration is given in $10^7 mm/day$*, but how can evapotranspiration change by the order of* $10^7 mm/day$*?*
Author: Something went wrong during the analysis process and the unit got wrong. We will correct that.