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Interactive comment on "Combined biogeophysical and biogeochemical effects of large-scale forest cover changes in the MPI earth system model" *by* S. Bathiany et al.

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We fully agree that the implications of the discrepancies between the modelled and observed terrestrial carbon pools (especially boreal vegetation carbon and tropical soil carbon) need to be addressed in a more explicit way. We have therefore included another paragraph in Sect. 4.3 to explain why our basic conclusions are not affected by these differences:

"With regard to the discrepancies between the terrestrial carbon pools in MPI-ESM and observations the question arises how realistic the temperature sensitivities in Table 6 are. As MPI-ESM's climate sensitivity is approx. 3 °C (Friedlingstein et al., 2006),

the CO2 increase by some ppm in DB should translate into only some hundredth °C on global average, so the biogeophysical effects prevail by almost one order of magnitude. If boreal vegetation carbon pools are assumed to be as large as the observations, boreal deforestation would still lead to a cooling. The same argument applies for boreal afforestation. The assumption of linearity seems to be justified, as in Claussen et al. (2001) and Bala et al. (2007) synergies between biogeophysical and biogeochemical effects are found to be small. As mentioned in Sect. 2, observations also indicate less tropical soil carbon than is obtained in MPI-ESM. After deforestation, the secondary emissions from tropical soils amount to approx. 150 GtC, if the contribution of the living biomass, which has been partly put into the soil pools, is subtracted. If a reduction in equilibrium soil carbon by a factor of 2 is assumed, the secondary emissions would be reduced by 75 GtC. This would translate into a reduction in atmospheric CO2 concentration by about 10 ppm, as the airborn fraction of tropical emissions is between 45% and 15% during the experiment. This relatively small difference in CO2 cannot significantly alter the obtained global warming. As tropical soil carbon is also decreased after afforestation, a reduction in equilibrium soil pools and thus CO2 emissions would tend to cool the planet even more in AT. It can therefore be concluded that the sign of the obtained temperature changes is robust in spite of the significant uncertainties in terrestrial carbon pools."

Part of the discrepancy in boreal carbon pools arises from different definitions. In JSBACH, roots are already included in the pools labeled as living biomass. However, litter pools are accounted for separately. In our model setup, litter adds another 0.5-3 kgC/m2 to the living biomass of 0.5-3 kgC/m2 in the boreal forest areas. In Prentice et al. (2001), litter is already included in the 6.4 kg/m2 of spatial mean plant carbon from Dixon et al. (1994). This difference may somewhat reduce the discrepancy. To clarify this we reformulated the according sentence in Sect. 2 as follows:

"In comparison with Prentice et al. (2001), the model underestimates carbon pools of plants and litter in boreal latitudes (2-6 kg/m2 instead of a mean of 4-6 kg/m2), while soil carbon is too large in central and eastern Asia."

The spatial distribution of living biomass in South America in the control run may indeed also not be very realistic. The pattern with three isolated maxima reflects the primary productivity in this region, which is a result of the precipitation pattern in ECHAM5. The maximum in the Southwest results from the large soil moisture which also allows a high NPP.

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