Input-driven versus turnover-driven controls of simulated changes in soil carbon due to land-use change

S S Nyawira[1,2], J E M S Nabel[1], V Brovkin[1] & J Pongratz[1]

[1]Max Planck Institute for Meteorology (MPI-M), Bundestrasse 53, 20146 Hamburg, Germany

[2]International Max Planck Research School on Earth System Modelling (IMPRS-ESM), Bundestrasse 53, 20146 Hamburg, Germany

E-mail: sylvia.nyawira@mpimet.mpg.de

June 2017

Supplementary Material

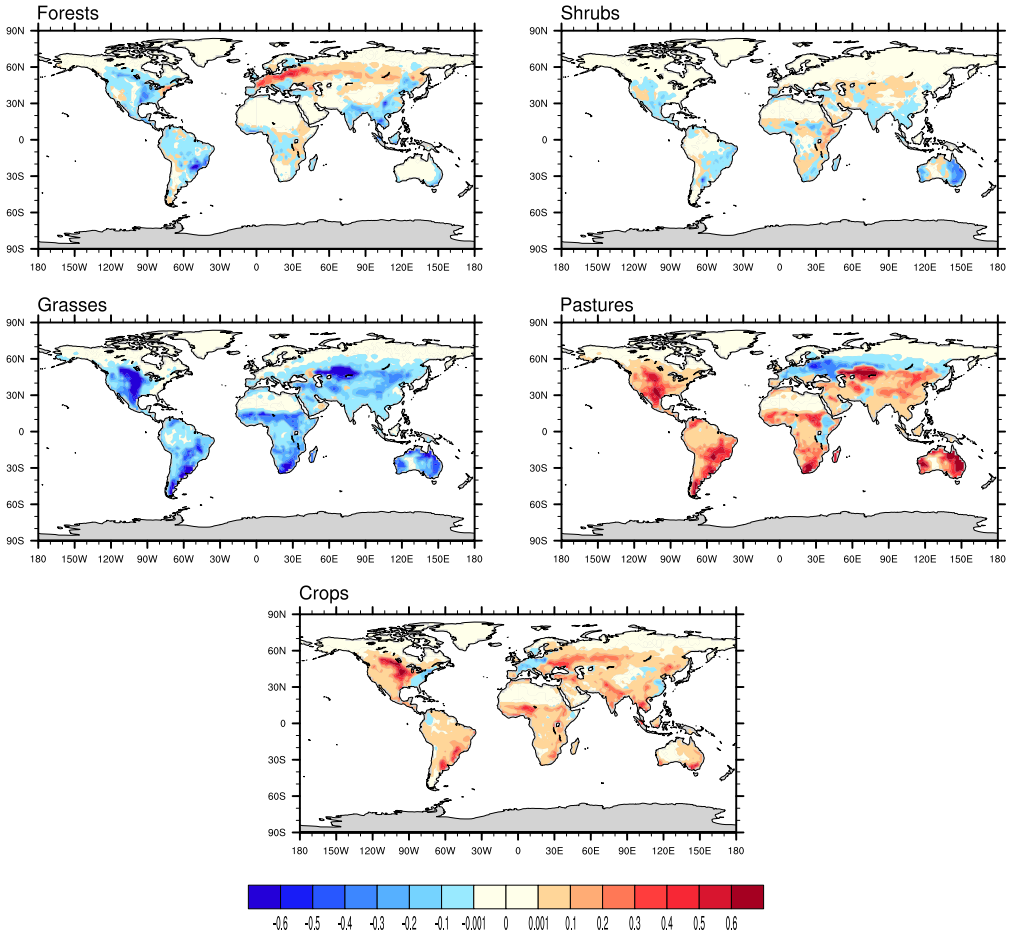


Figure S1: Differences between the applied present day (2005) and pre-industrial (1860) land cover maps. The difference represents the fraction of the grid cell that has increased or decreased in present-day compared to pre-industrial land cover.

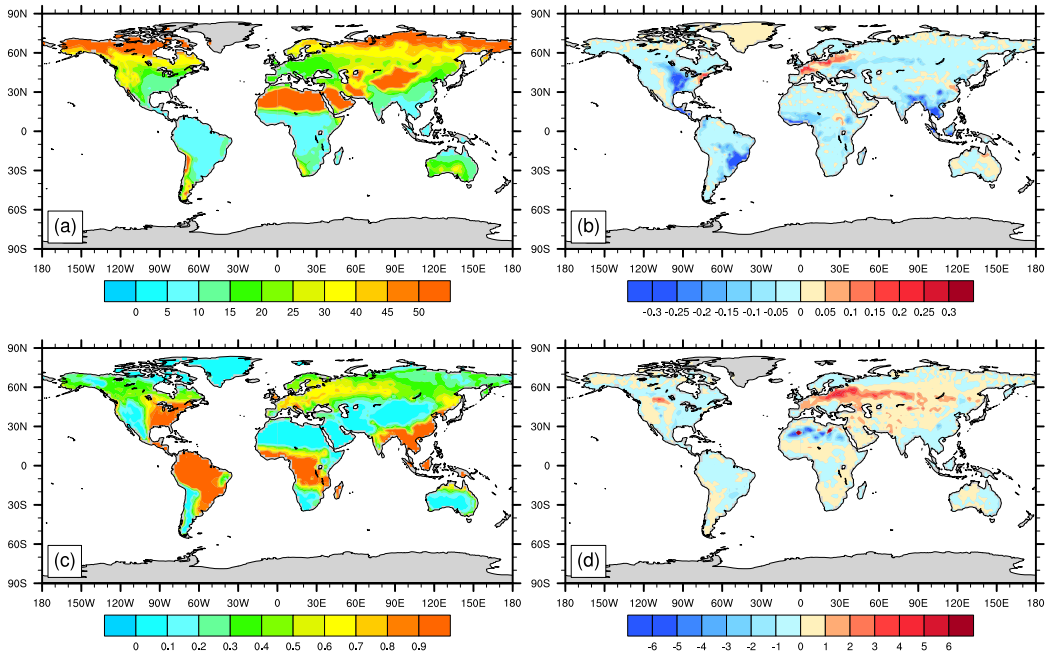
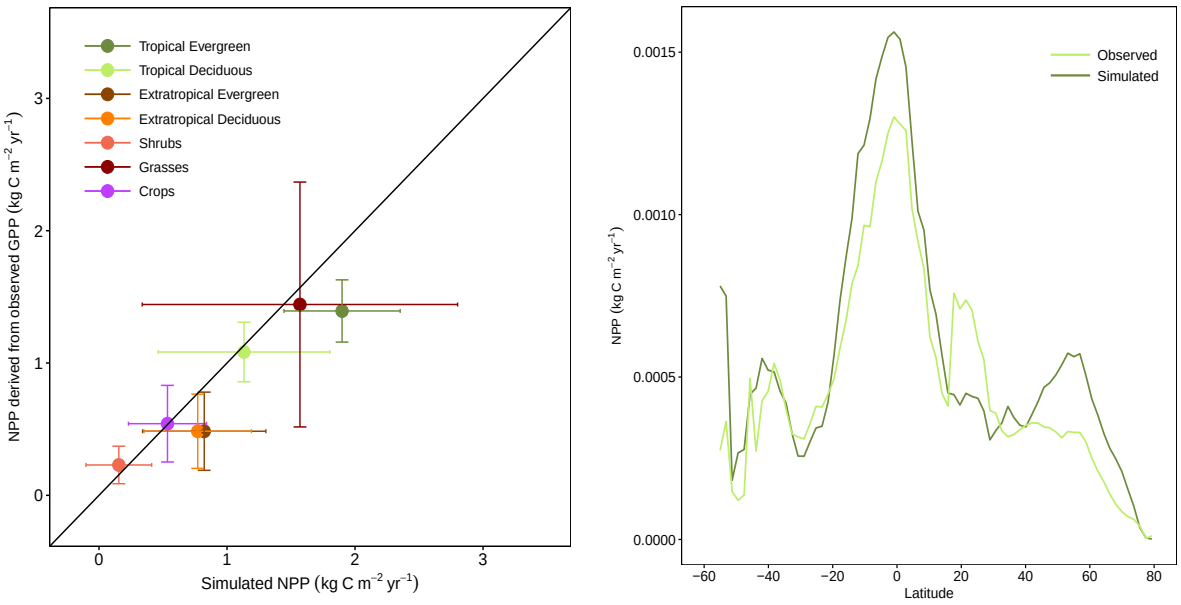


Figure S2: The different terms contributing to the input-driven, turnover-driven and the synergy soil carbon change for the LCM simulations (including land management). (a) Turnover time in years for the pre-industrial simulation ($\tau_{soil,1860}$), (b) difference in the litter fluxes between the present-day and pre-industrial simulation (Δf) in kg C m^{-2}. Multiplying these two terms gives the input-driven term in Figure 1. (c) Equilibrium litter fluxes to the soil for the pre-industrial simulation in kg C m^{-2} ($f_{veg \rightarrow soil,1860}$), and (d) difference in the turnover times between the present-day and pre-industrial simulation ($\Delta \tau$) in years. Multiplying these two terms gives the turnover-driven term in Figure 1.



(a) NPP for different PFTs

(b) Land zonal mean NPP

Figure S3: (a) Comparison of the NPP simulated by JSBACH with the NPP derived from observations of gross primary production (GPP). The dot represents the mean, the horizontal error bar represents the spatial standard deviation for the model and the vertical error bar shows the spatial standard deviation for the observations. The mean was taken over the grid boxes where the PFT existed in the observations. (b) The global zonal mean NPP for all the PFT types in the model and for all the vegetation types in the observations. The zonal mean was obtained by weighting the NPP with the cover fraction for every PFT and vegetation type. The NPP was obtained from the GPP by assuming 50% is lost through autotrophic respiration. The GPP data is described in Tramontana et al. (2016), while the remapping of the biomes in the observations to JSBACH PFTs can be found in the supplementary material of Nyawira et al. (2016).

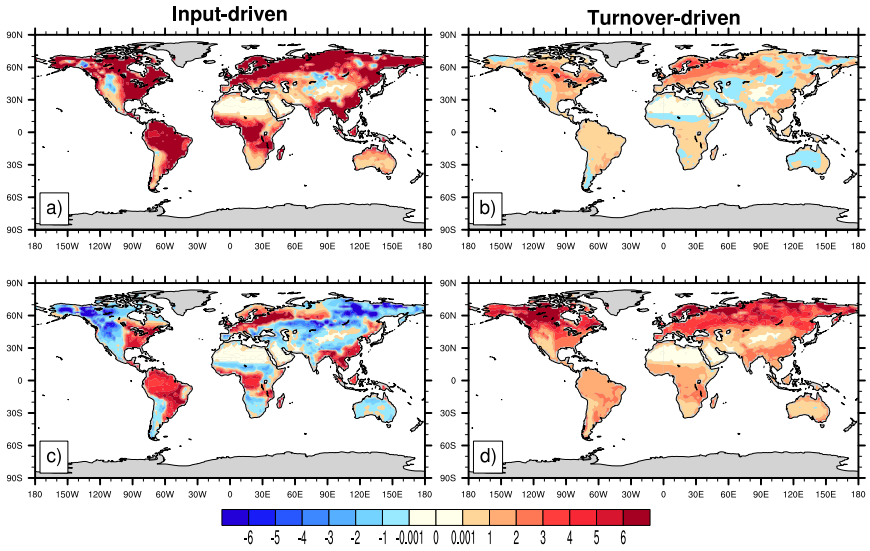


Figure S4: The simulated input-driven and turnover-driven changes in kg C m^{-2} following afforestation in the idealized LUC simulations. (a) and (b) represent the input-driven and turnover-driven changes following afforestation on croplands, (c) and (d) represent the input-driven and turnover-driven changes following afforestation on pastures.

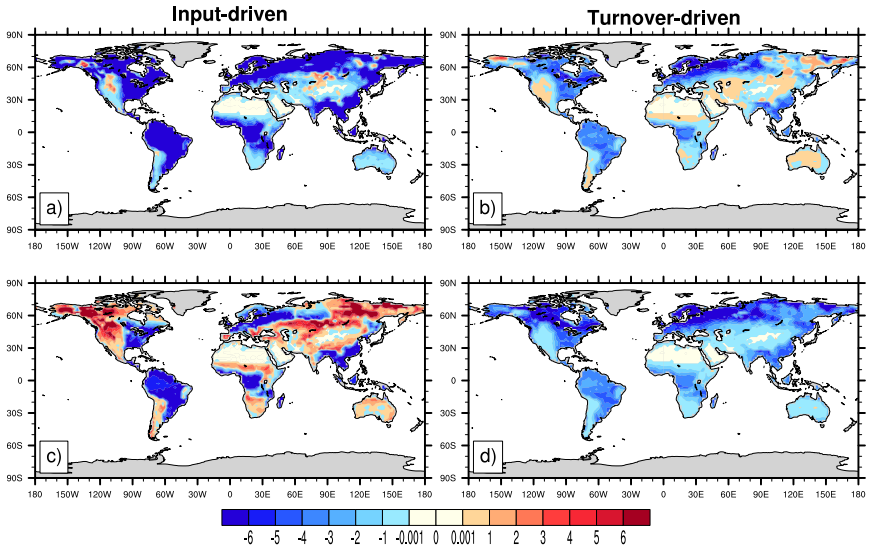


Figure S5: The simulated input-driven and turnover-driven changes in kg C m^{-2} following deforestation in the idealized LUC simulations. (a) and (b) represent the input-driven and turnover-driven changes following deforestation for croplands, (c) and (d) represent the input-driven and turnover-driven changes following deforestation for pastures.

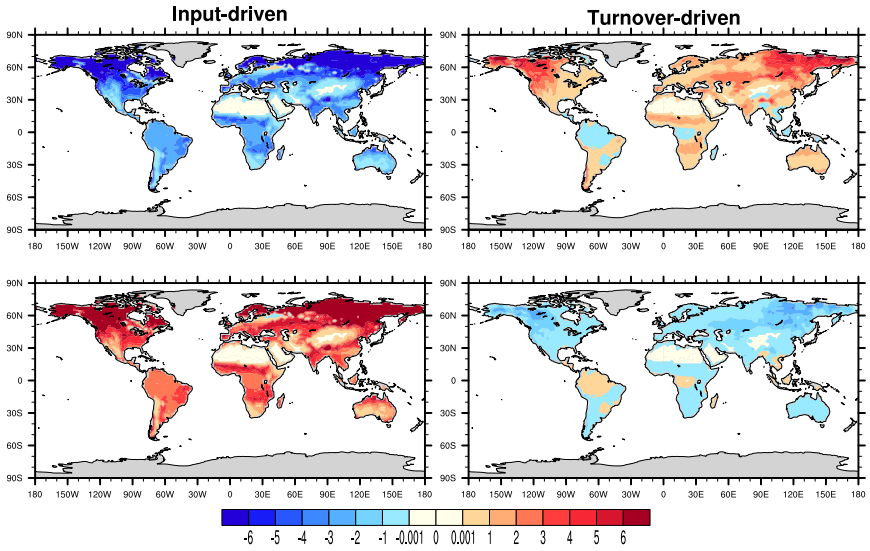


Figure S6: The simulated input-driven and turnover-driven changes in kg C m^{-2} following conversion of grasslands to croplands and vice versa in the idealized LUC simulations. (a) and (b) represent the input-driven and turnover-driven changes for the conversion of grasslands to croplands, (c) and (d) represent the input-driven and turnover-driven changes following conversion of croplands to grasslands.

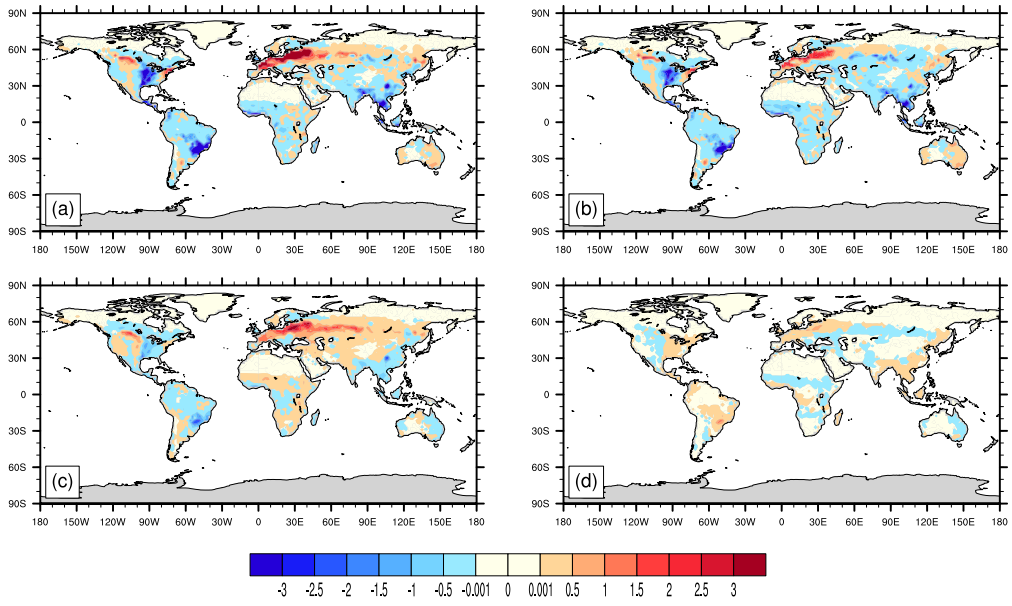


Figure S7: Global separated soil carbon changes in kg C m^{-2} for the LCC simulations (excluding land management). The controls are obtained using equation 5 and taking the LCC_1860 equilibrium as the reference. (a) Total soil carbon changes, (b) contribution of the input-driven changes, (c) contribution of the turnover-driven changes and (d) contribution of the synergy effects. Compare to Fig. 1 for results including land management.

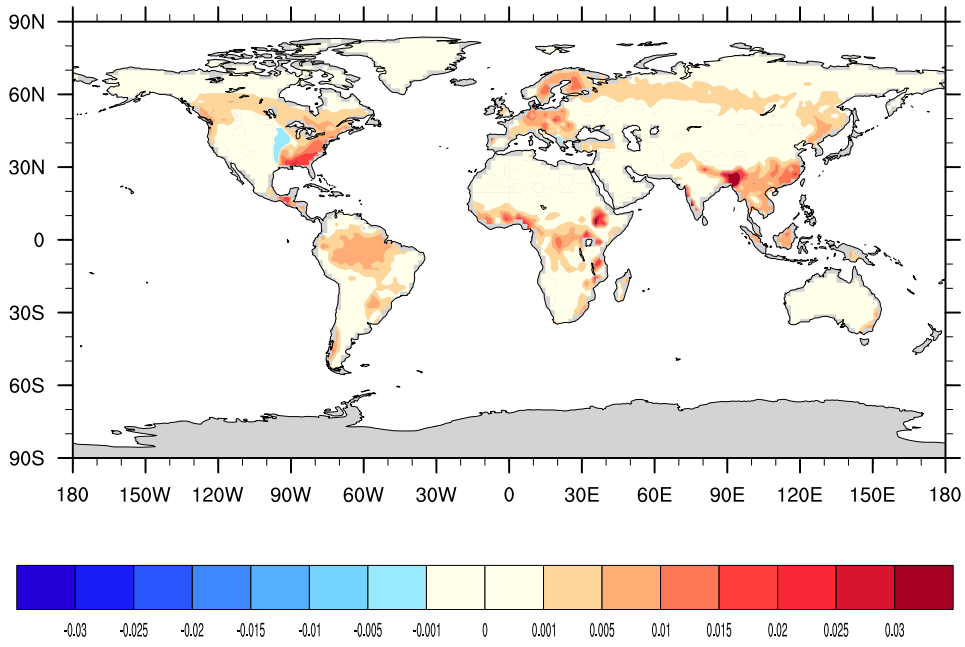


Figure S8: The difference between the litter fluxes resulting from wood harvest for the present-day land use (2005) and the pre-industrial land use (1860) in kg C m^{-2}. The difference was obtained by subtracting the 1860 wood harvest litter fluxes from the 2005 wood harvest litter fluxes. The positive difference shows a higher litter flux from wood harvest in 2005 compared to 1860.

Nyawira S S, Nabel J E M S, Don A, Brovkin V & Pongratz J 2016 *Biogeosciences* **13**(19), 5661–5675.
Tramontana G, Jung M, Schwalm C R, Ichii K, Camps-Valls G, Ràduly B, Reichstein M, Arain M A, Cescatti A, Kiely G, Merbold L, Serrano-Ortiz P, Sickert S, Wolf S & Papale D 2016 *Biogeosciences* **13**(14), 4291–4313.