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Soil organic carbon dynamics from agricultural management practices under climate change

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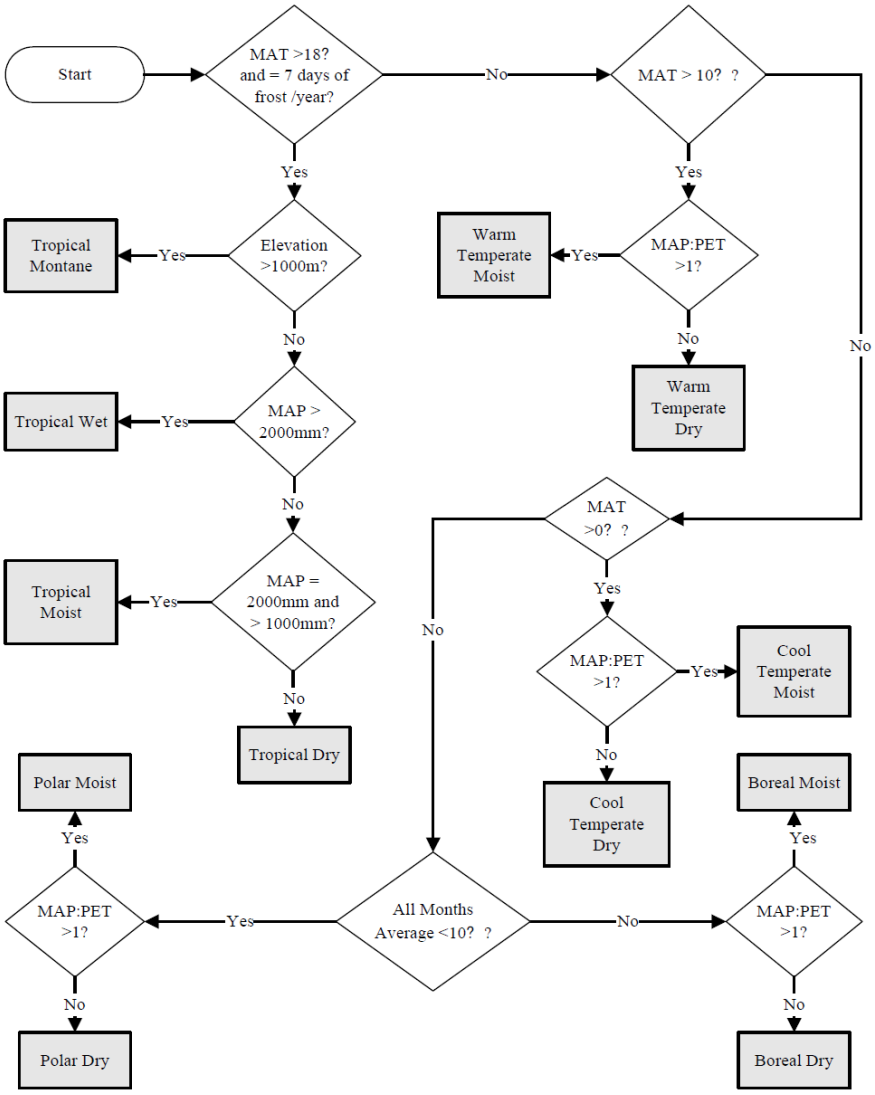

Figure S1: Climate region classification scheme according to the IPCC (2006). Polar moist, polar dry and tropical montane regions have been excluded from this analysis, as these are regions without cropland.

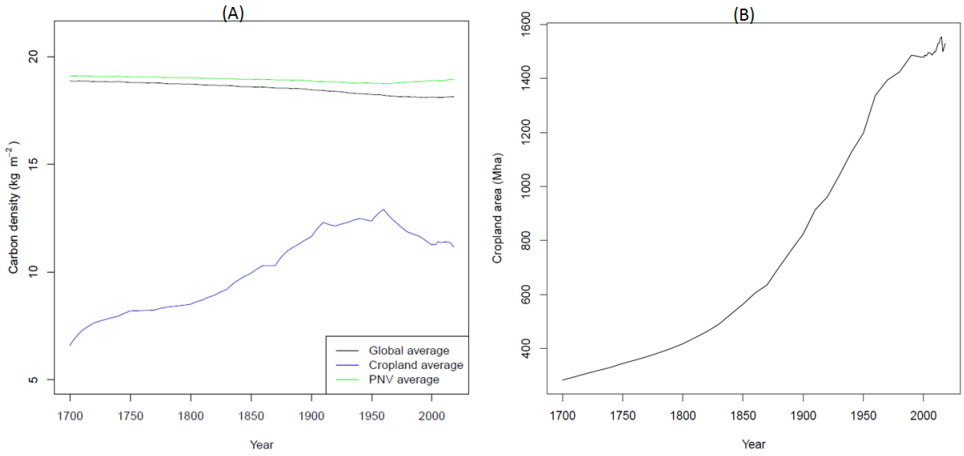

Figure S2: Time series of carbon density (kg m^{-2}) of global average, cropland average and PNV average from year 1700 to 2018 (A) and global cropland area in million hectares (Mha) from year 1700 to 2018 (B). Cropland carbon densities increase as long as the addition of new high-carbon density land through land expansion outbalances the slow decline of SOC stocks on existing cropland.

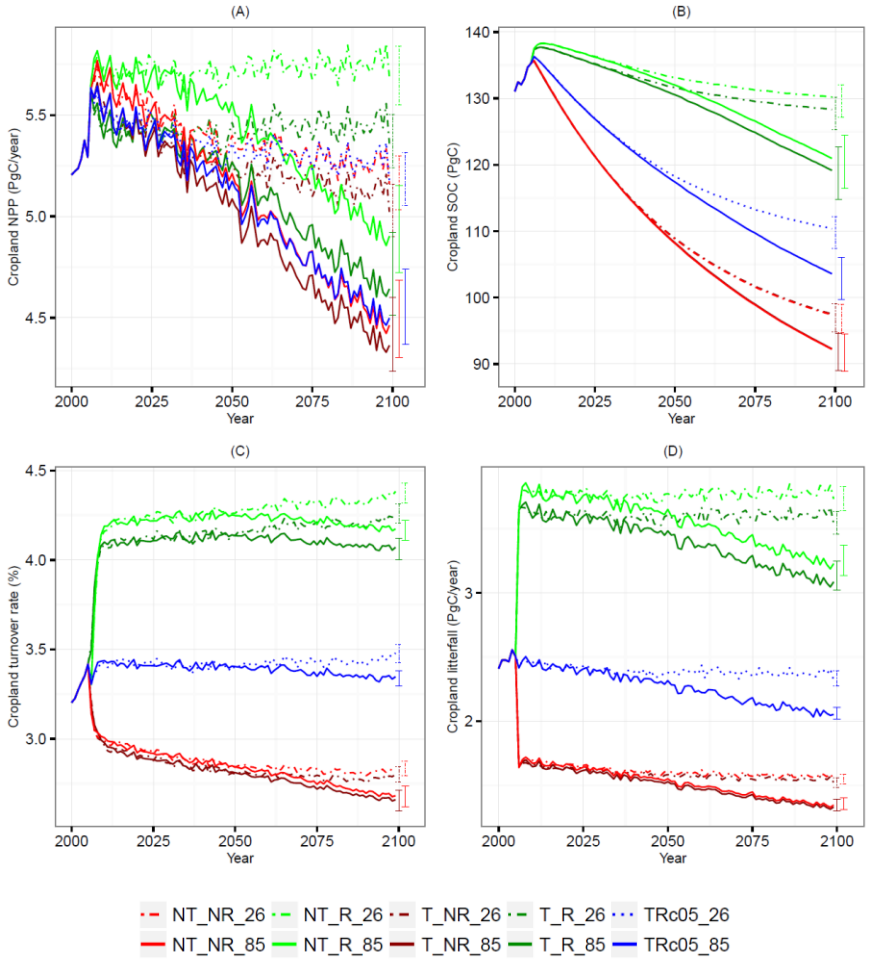

Figure S3: Global sums of cropland NPP (A), cropland SOC (B), cropland turnover time (C), and cropland litterfall (D) for cropland from 2000-2005 for default management inputs and from 2006-2099 under constant cropland area of 2005 for five different management scenarios as in Figure 3, but with constant [CO_2] level from 2005 until the end of the century (378.8 ppm). Same legend as in Figure 3.

Note to Figure S3:

In RCP8.5, [CO_2] is projected to increase to a level of more than 900 ppm until the end of the century, while in RCP2.6 [CO_2] it is assumed to be at 420 ppm (Fig. S3 in the Supplement). Results from simulations with constant [CO_2] over the entire simulation period between the years 2006 and 2099 show that differences for cropland SOC as well as for cropland NPP between the two climate change scenarios become more prominent. Total global NPP with static [CO_2] is considerably smaller in RCP8.5 compared to RCP2.6 and decreases significantly until the end of the century in all management systems (Fig. S3A in the Supplement). If production decreases in RCP8.5, inputs from residues into the soil also decrease with time and as a result, cropland SOC stocks are lower and decrease compared to RCP2.6 (Fig. S3B in the Supplement), while the turnover rate is stable (Fig. S3C in the Supplement). RCP2.6 with static [CO_2] shows higher SOC stocks compared to RCP8.5, as production is higher in a colder climate (compared to RCP8.5), while at the same time turnover rates are lower. This suggests that under standard RCP climate input assumptions, CO_2 fertilization effects in RCP8.5 driven by increasing [CO_2] compensate for damages from warmer climates and increases in turnover rates in order to sustain NPP. These compensating effects result in the small differences between the RCP2.6 and RCP8.5 found in the analysis in Chapter 4.2.

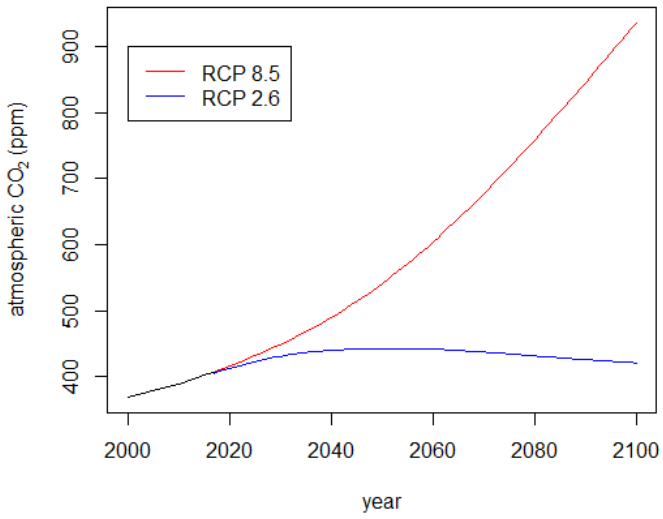

Figure S4: Atmospheric $C0_2$ concentration input for model runs for RCP2.6 and RCP8.5.

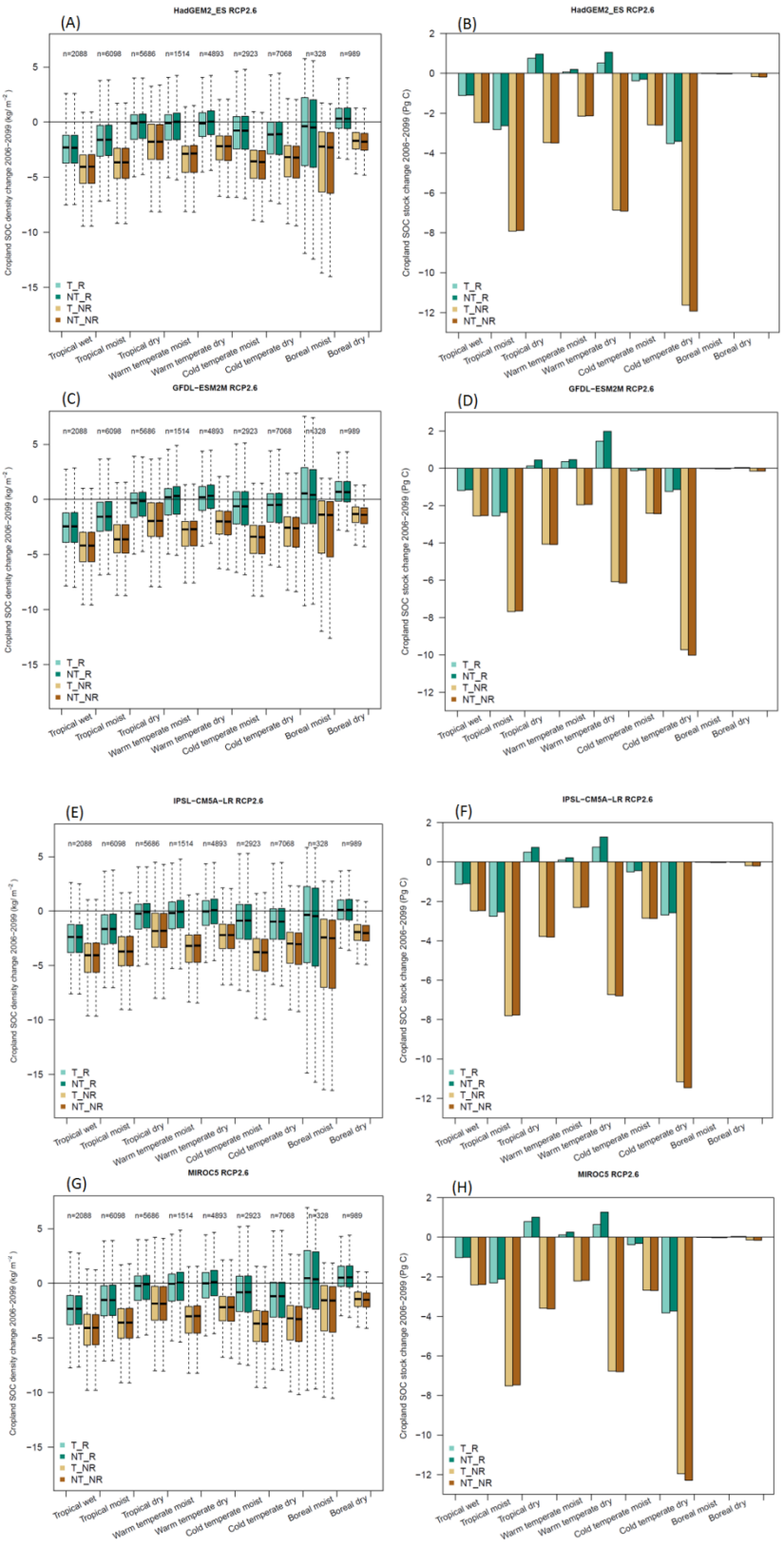

Figure S5: Boxplots of cropland SOC density change (kg/m²) and bar plots of total cropland SOC change (Pg C) between the year 2006 and 2099 for the four GCMs HadGEM2_ES (A, B), GFDL-ESM2M (C, D), IPSL-CM5A-LR (E, F), MIROC5 (G, H) in RCP2.6 for different climatic regions classified by the IPCC (2006) and the four management systems T_R, NT_R, T_NR, and NT_NR.

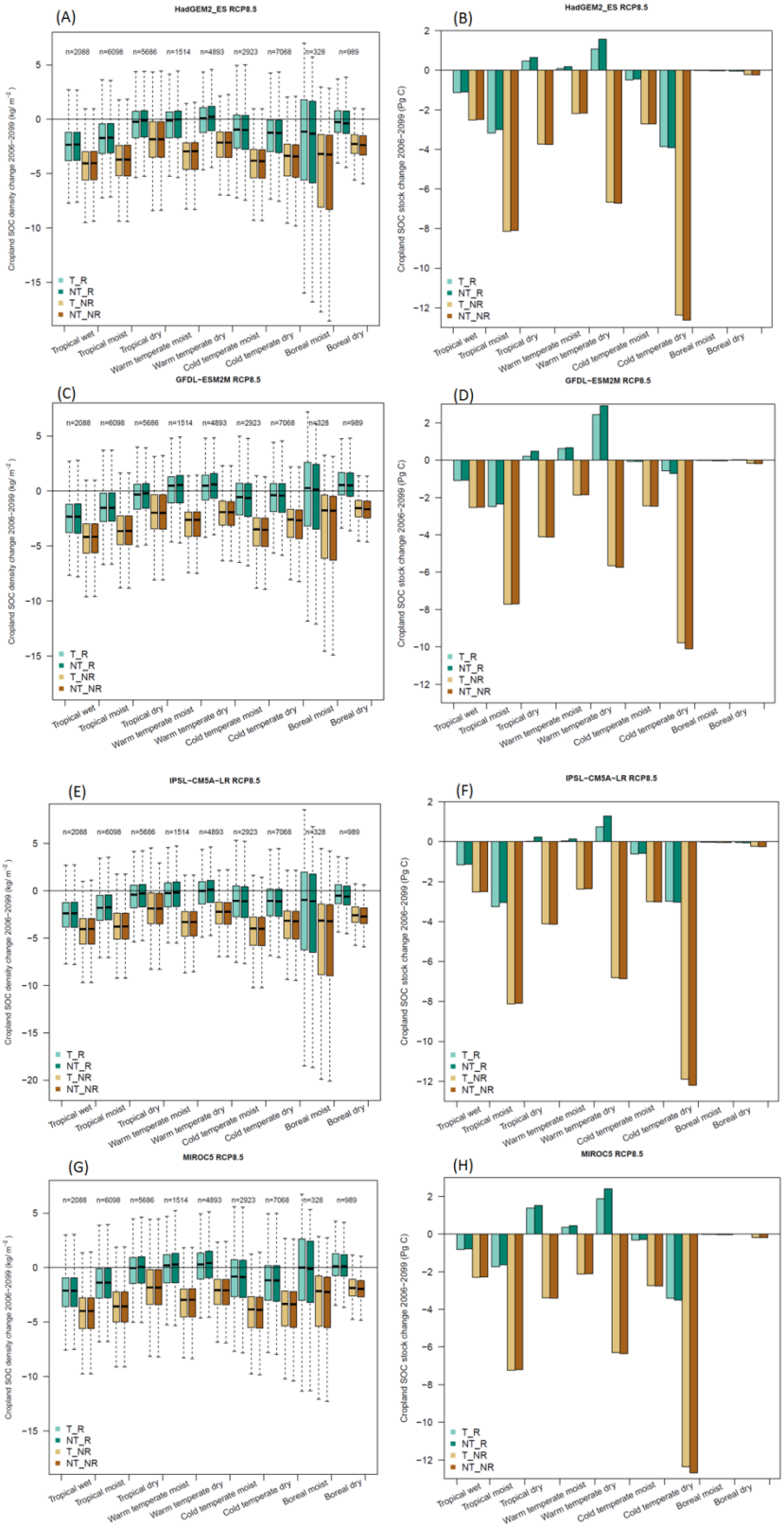

Figure S6: Boxplots of cropland SOC density change (kg/m²) and bar plots of total cropland SOC change (Pg C) between the year 2006 and 2099 for the four GCMs HadGEM2_ES (A, B), GFDL-ESM2M (C, D), IPSL-CM5A-LR (E, F), MIROC5 (G, H) in RCP8.5 for different climatic regions classified by the IPCC (2006) and the four management systems T_R, NT_R, T_NR, and NT_NR.

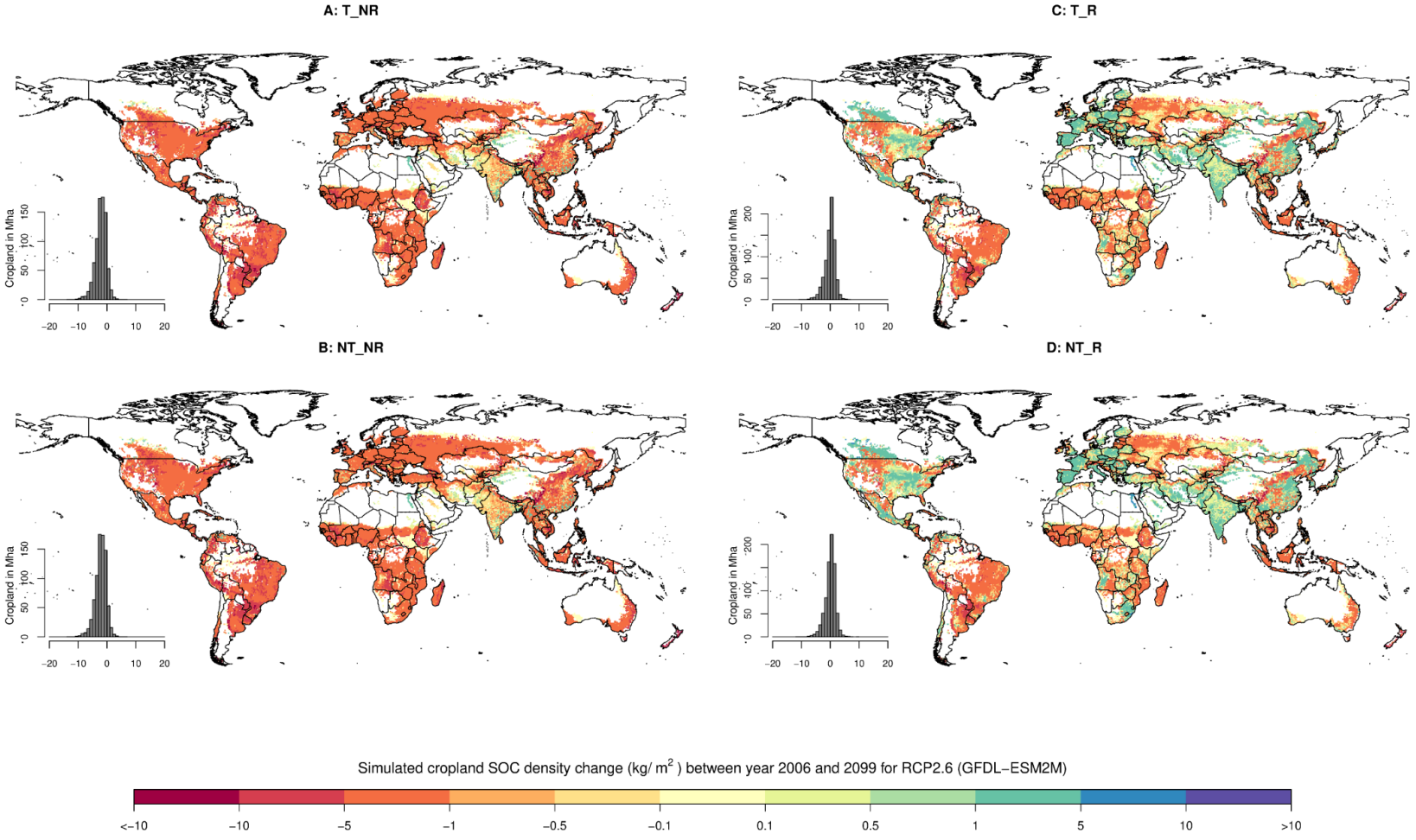

Figure S7: Simulated SOC density change between the year 2006 and 2099 (kg m^{-2}) as in Fig. 4, but for RCP2.6 and GFDL_ESM2M.

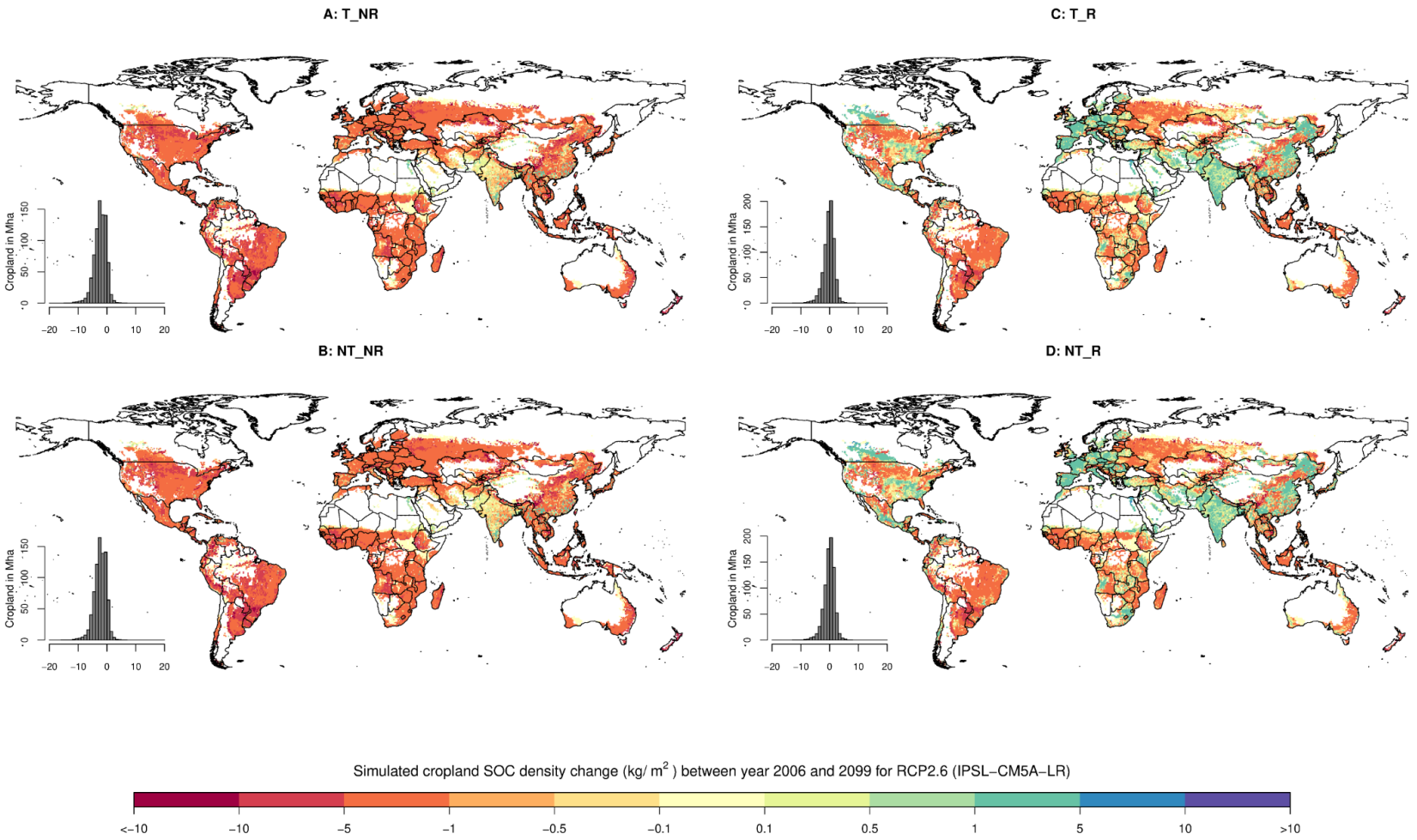

Figure S8: Simulated SOC density change between the year 2006 and 2099 (kg m^{-2}) as in Fig. 4, but for RCP2.6 and IPSL-CM5A-LR.

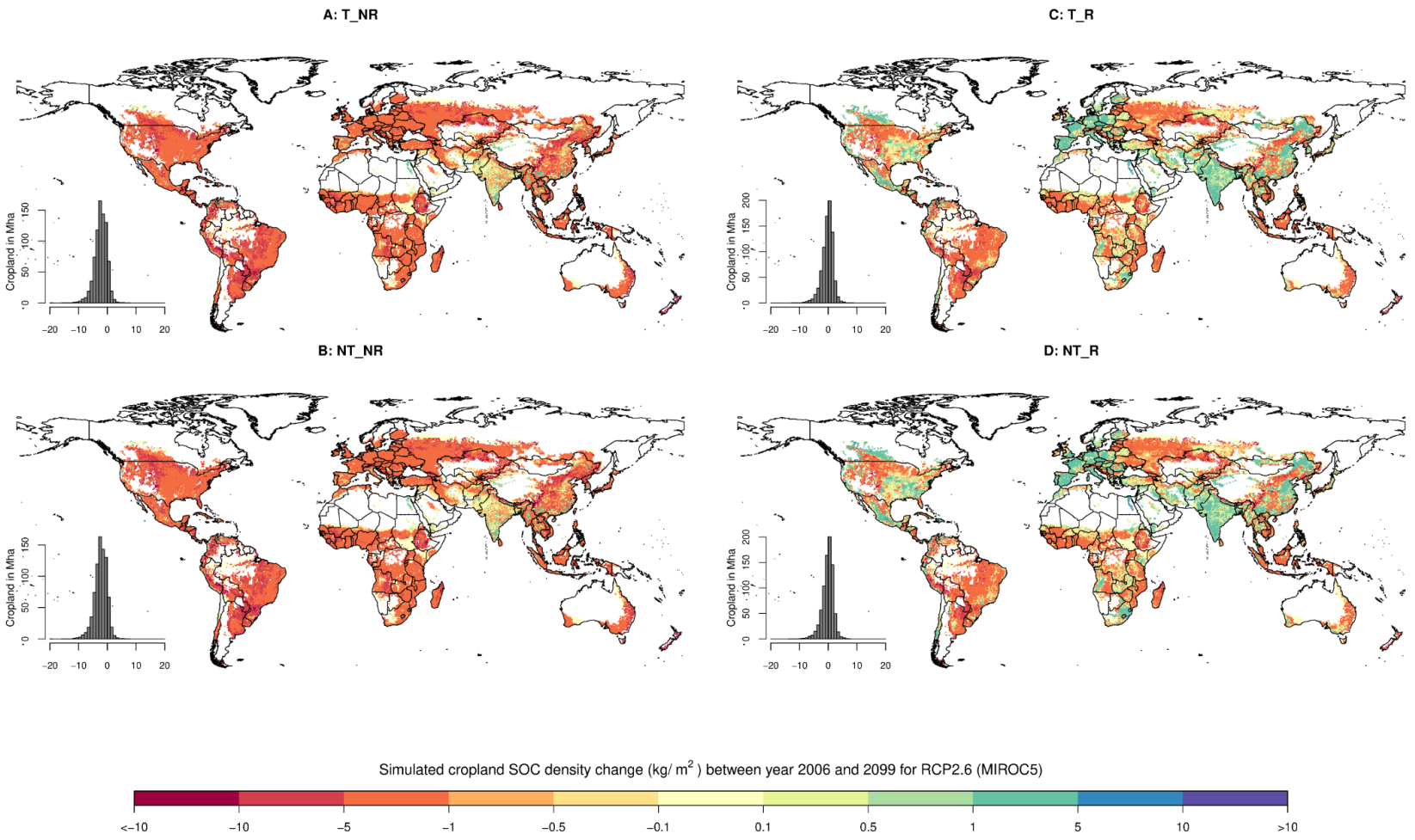

Figure S9: Simulated SOC density change between the year 2006 and 2099 (kg m^{-2}) as in Fig. 4, but for RCP2.6 and MIROC5.

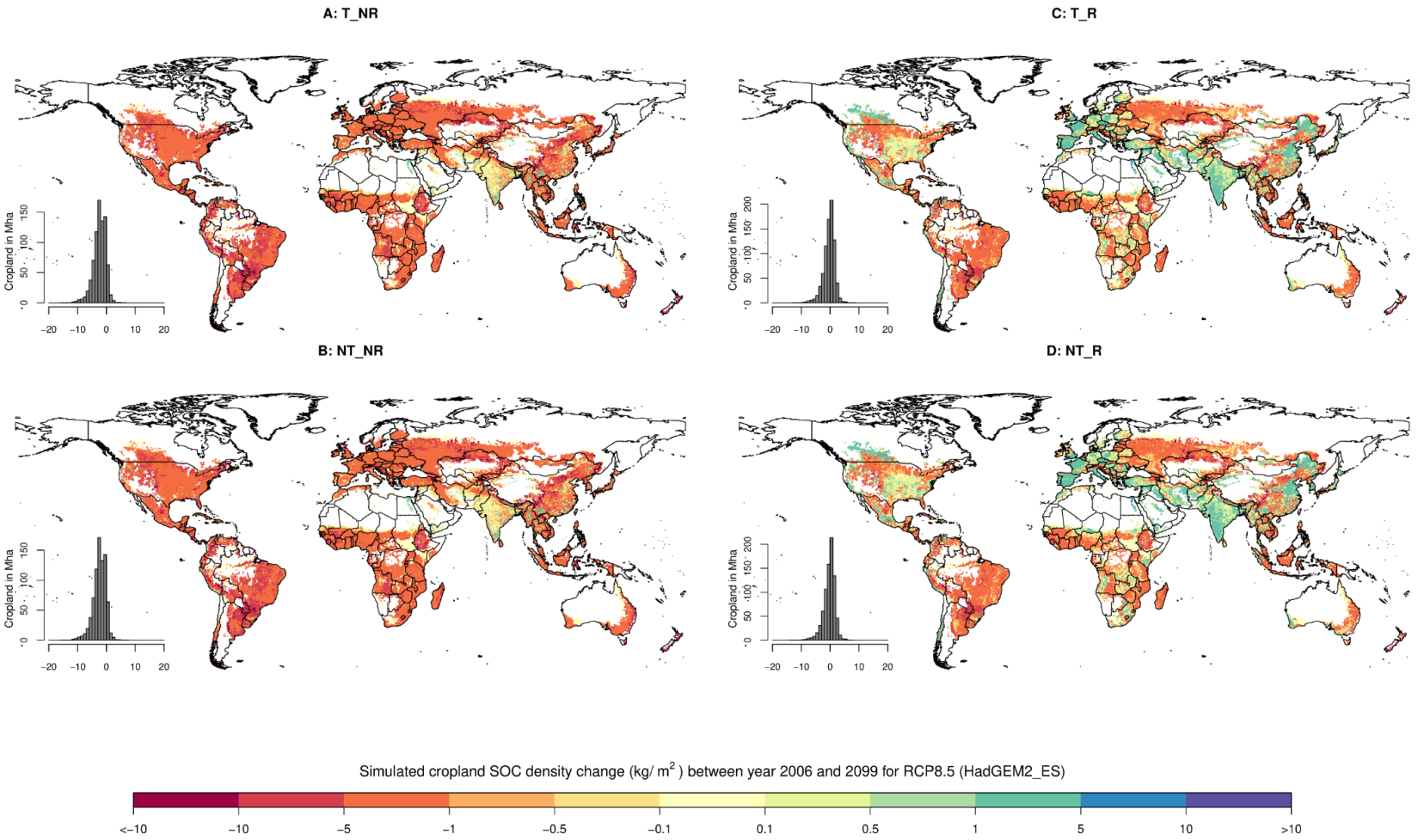

Figure S10: Simulated SOC density change between the year 2006 and 2099 (kg m^{-2}) as in Fig. 4, but for RCP8.5 and HadGEM2_ES.

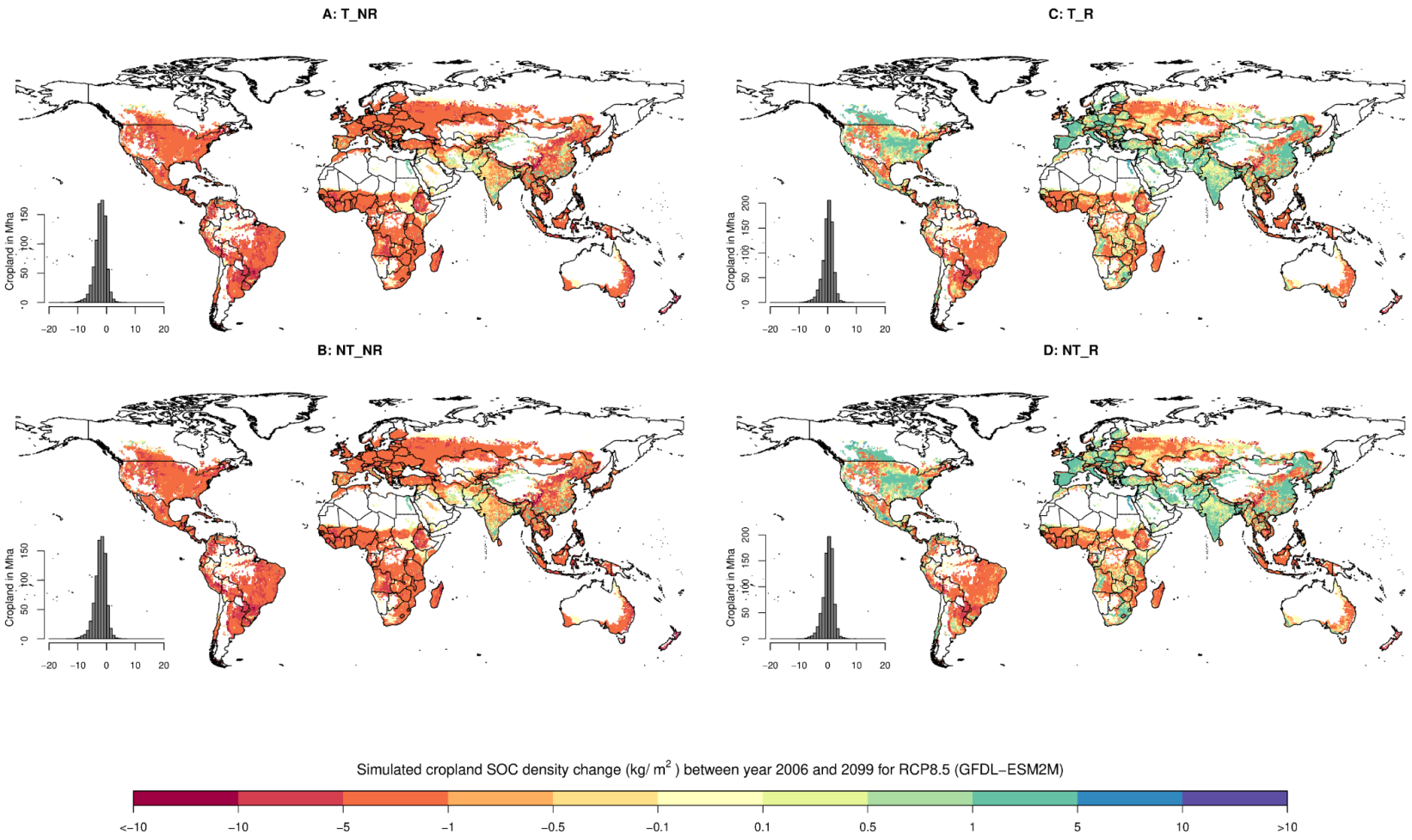

Figure S11: Simulated SOC density change between the year 2006 and 2099 (kg m^{-2}) as in Fig. 4, but for RCP8.5 and GFDL-ESM2M.

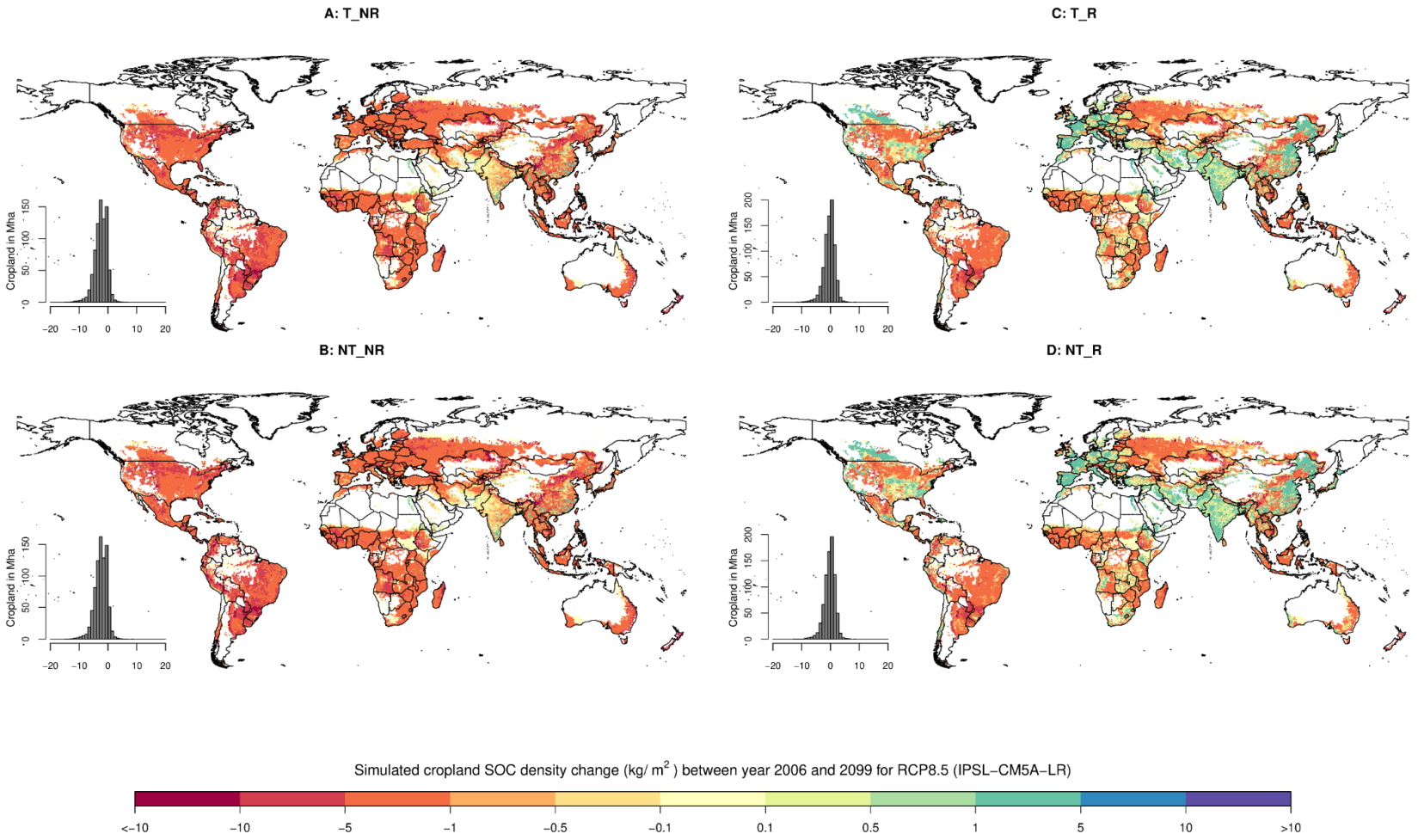

Figure S12: Simulated SOC density change between the year 2006 and 2099 (kg m^{-2}) as in Fig. 4, but for RCP8.5 and IPSL-CM5A-LR.

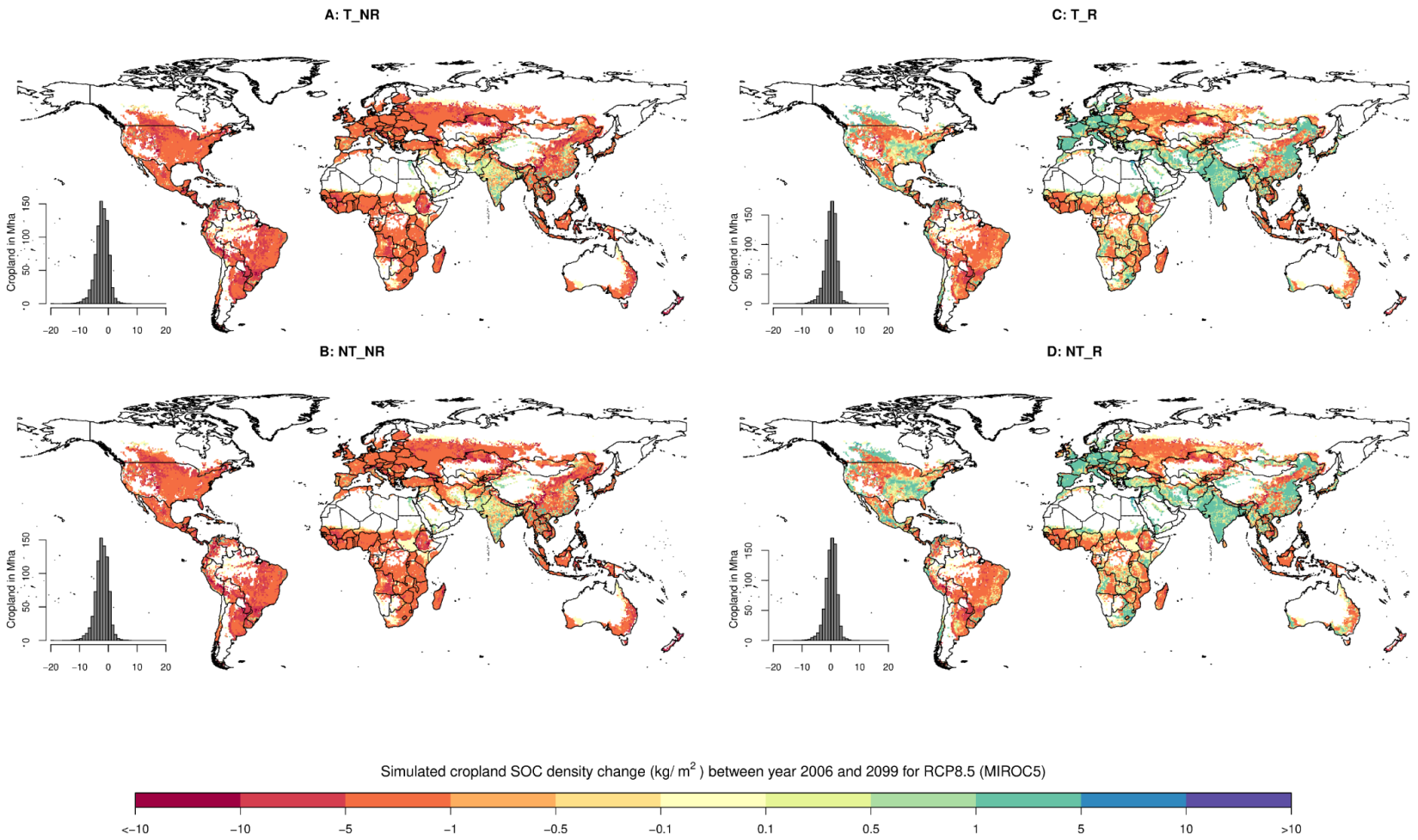

Figure S13: Simulated SOC density change between the year 2006 and 2099 (kg m^{-2}) as in Fig. 4, but for RCP8.5 and MIROC5.