Supplement of Earth Syst. Dynam., 10, 685–709, 2019
https://doi.org/10.5194/esd-10-685-2019-supplement

Earth System Dynamics
Open Access
EGU

Supplement of

Disequilibrium of terrestrial ecosystem CO_2 budget caused by disturbance-induced emissions and non-CO_2 carbon export flows: a global model assessment

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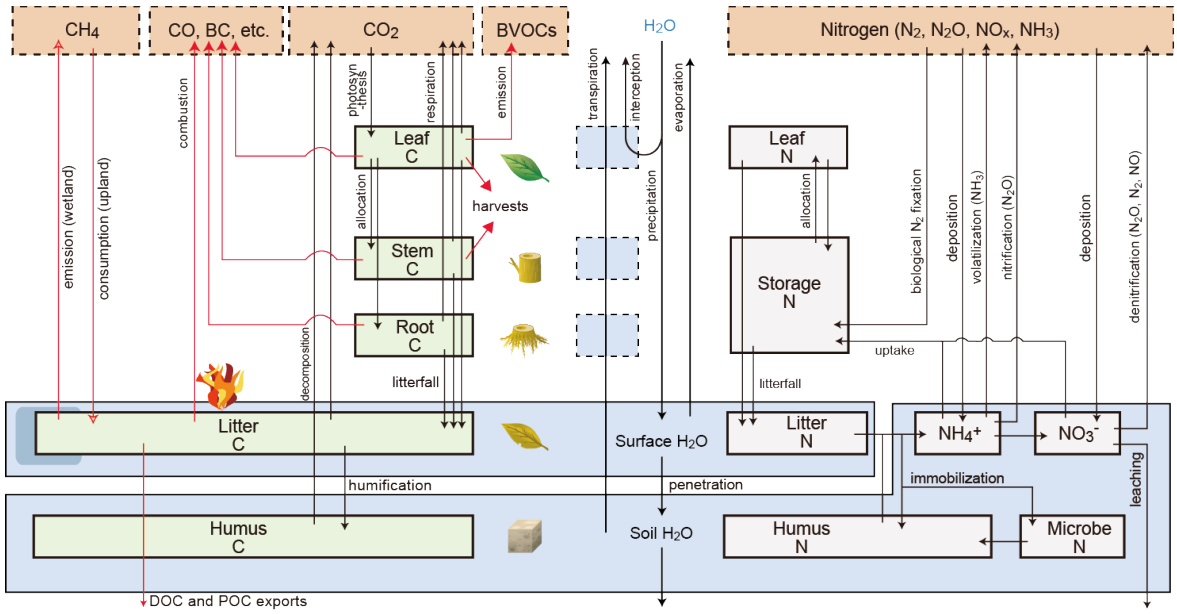

Figure S1. Schematic diagram of the VISIT model. Red arrows indicate minor carbon flows.

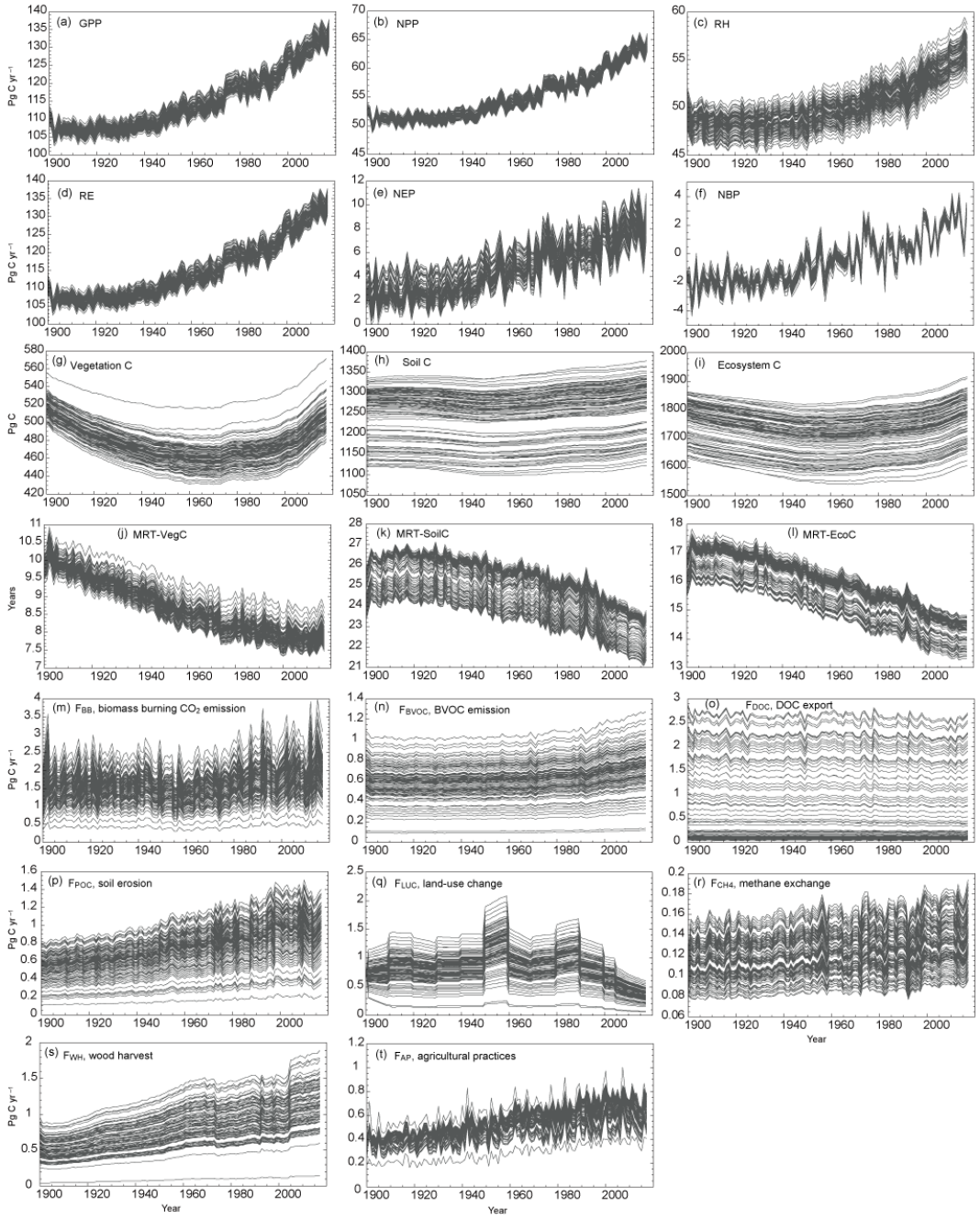

Figure S2. Results of 146 ensemble simulations using perturbed parameter values for MCFs.

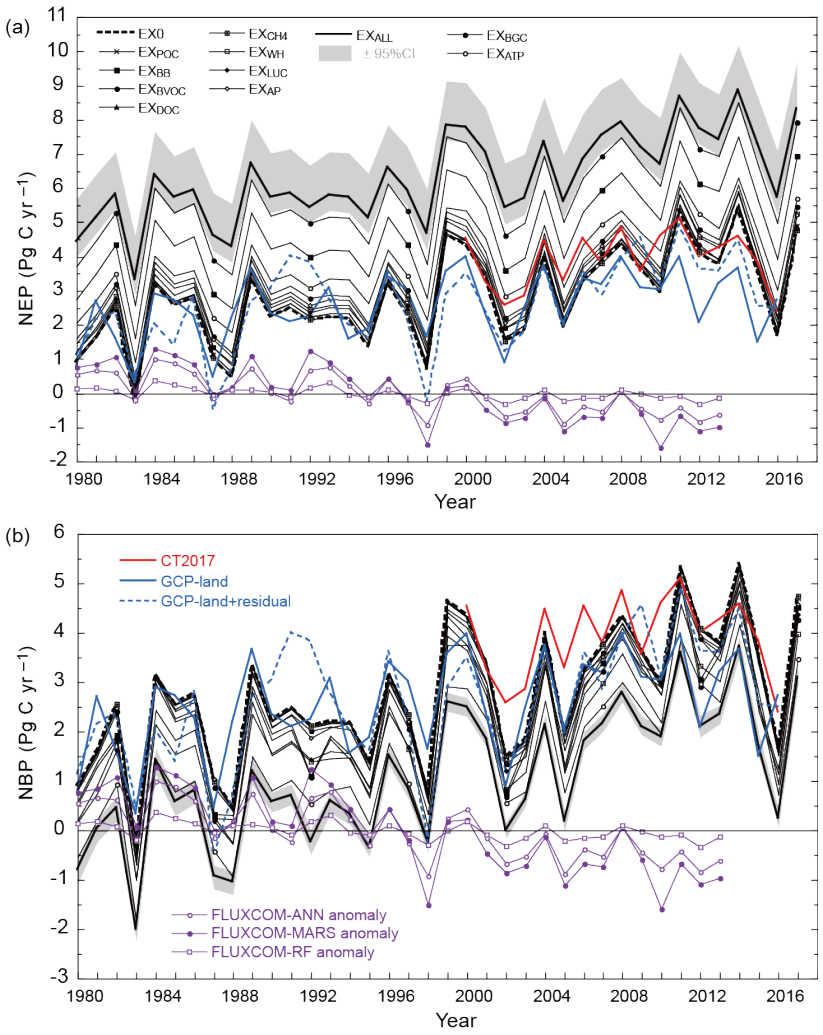

Figure S3. Time series of simulated terrestrial carbon budget in late decades. (**a**) NEP and (**b**) NBP simulated in various experiments. Shaded areas show the 95% confidence interval for EX_{ALL}. Also shown are estimates from CarbonTracker 2017 (CT2017), two Global Carbon Project (GCP) syntheses (land and land + residual), and FLUXCOM data (anomalies from the mean) as rendered by three upscaling methods.

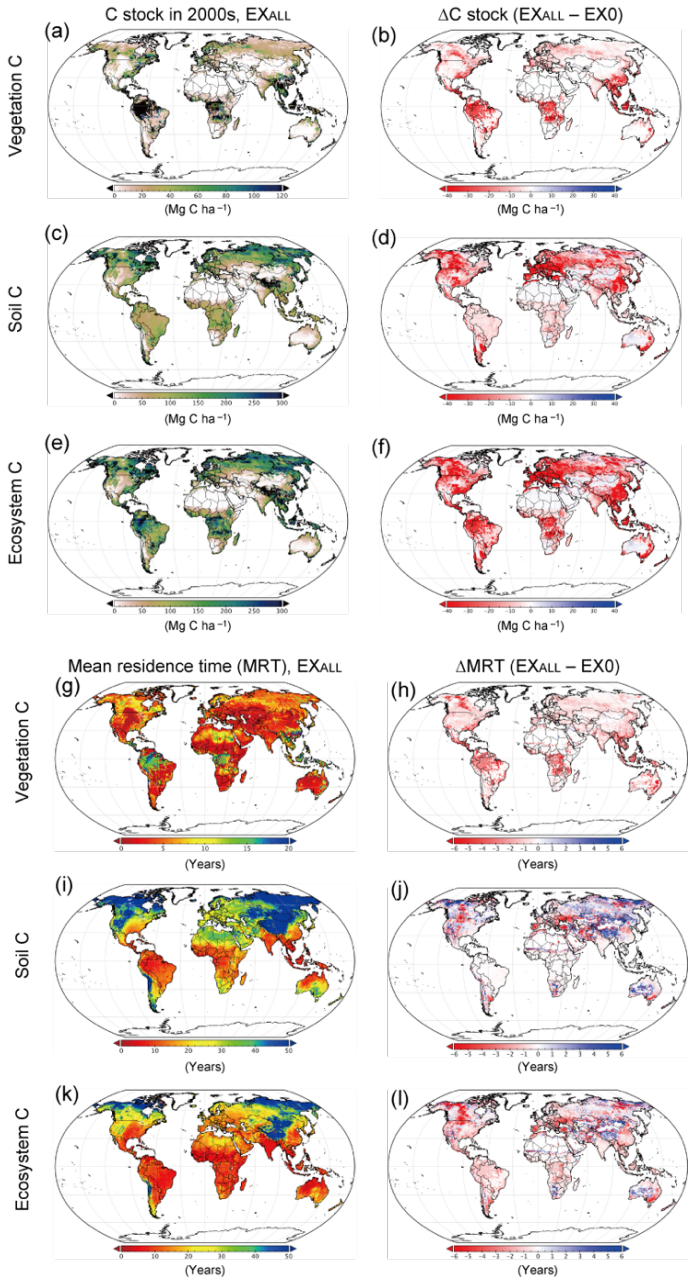

Figure S4. Maps of vegetation carbon, soil organic carbon, and ecosystem carbon in 2000–2009 from EX_{ALL} showing their distributions (top three plots, left column) and mean residence times (bottom three plots, left column) and their differences from EX0 estimates (right column).

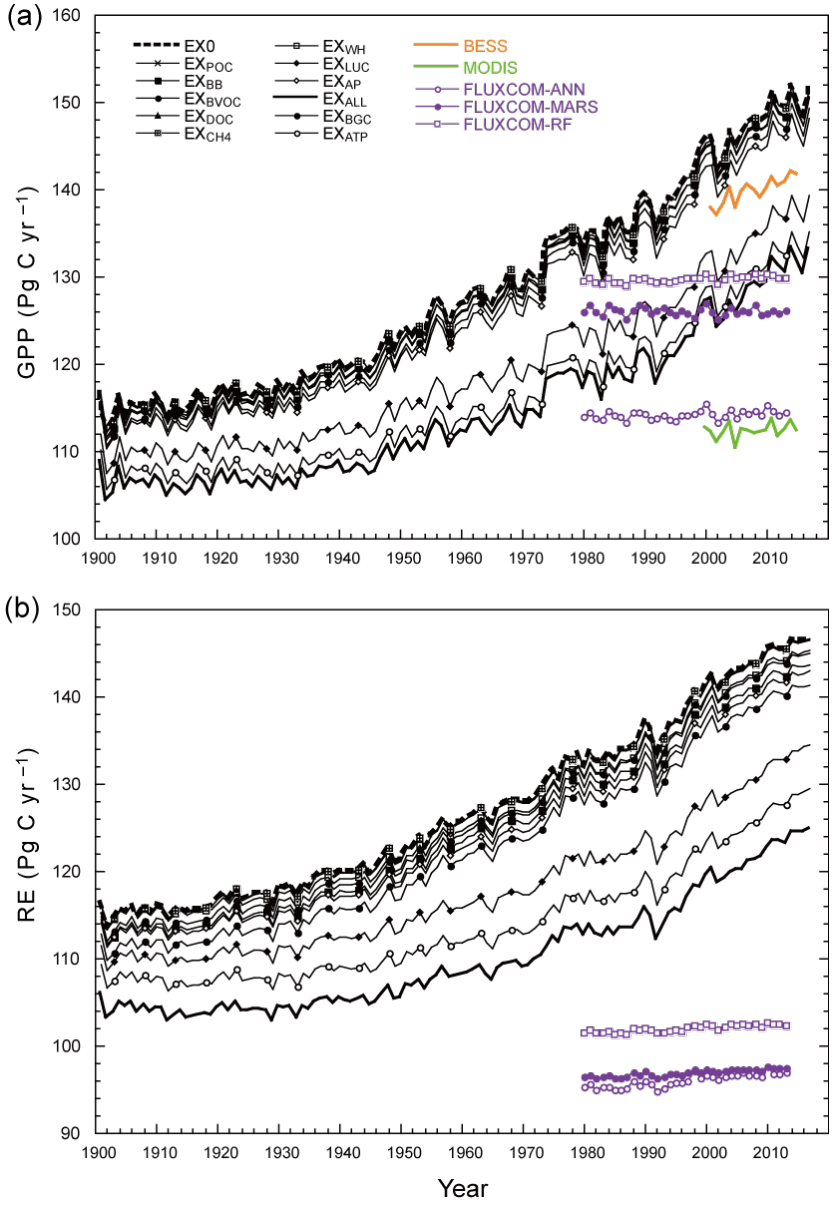

Figure S5. Time series of (**a**) GPP and (**b**) RE simulated by VISIT in various experiments plus estimates from BESS (Jiang and Ryu, 2016), MODIS (Zhao et al., 2006), and FLUXCOM data as rendered by three upscaling methods (Tramontana et al., 2016).

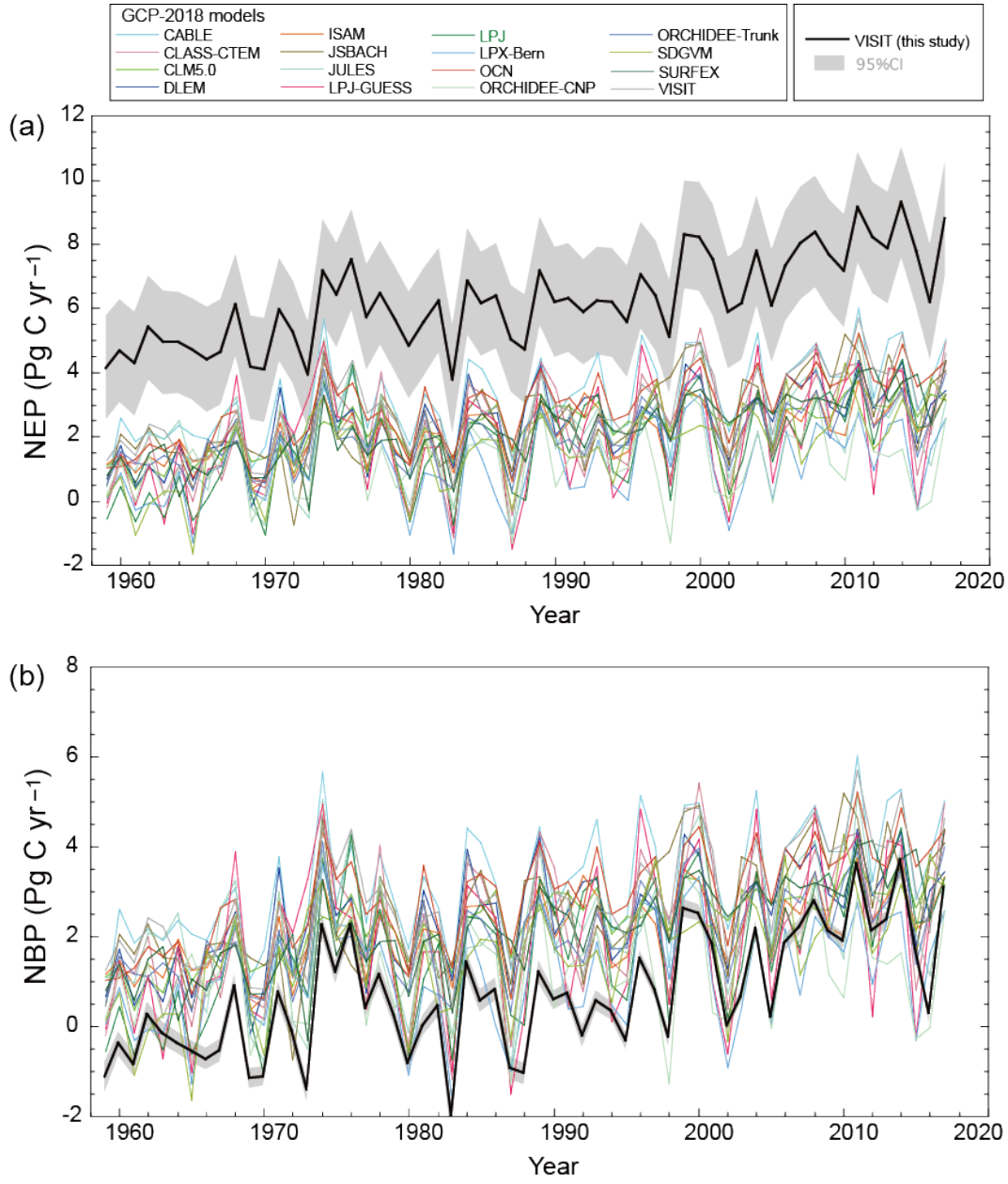

Figure S6. Comparison of (**a**) NEP and (**b**) NBP from simulations by VISIT and other models in the GCP synthesis (Le Quéré et al., 2018).

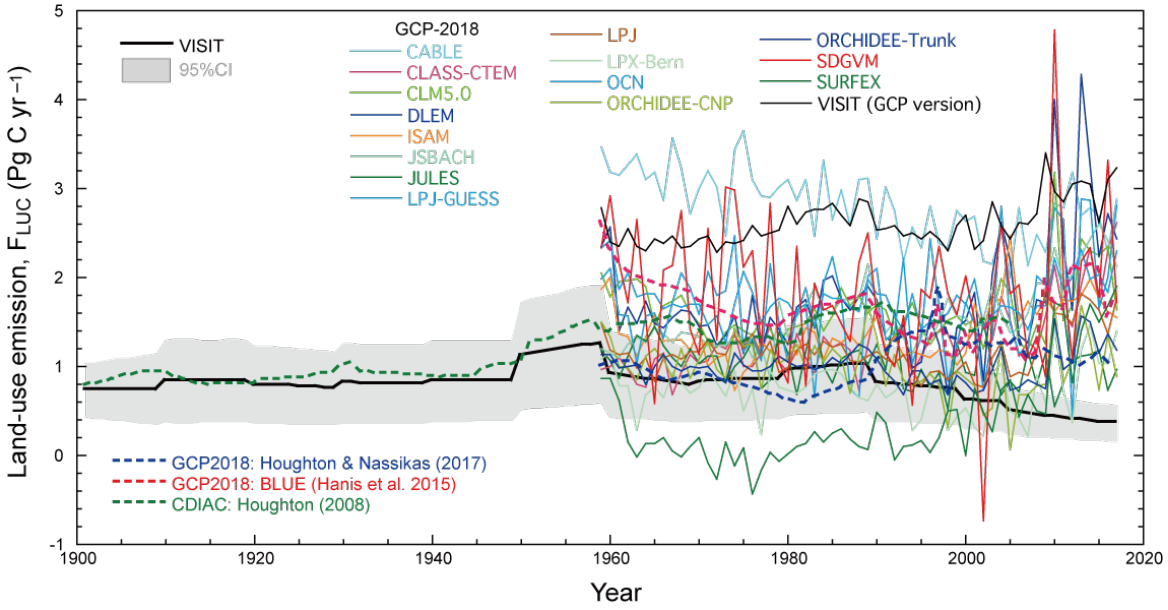

Figure S7. Comparison of simulated land-use emissions (F_{LUC}) from VISIT and other models in the GCP synthesis (Le Quéré et al., 2018).

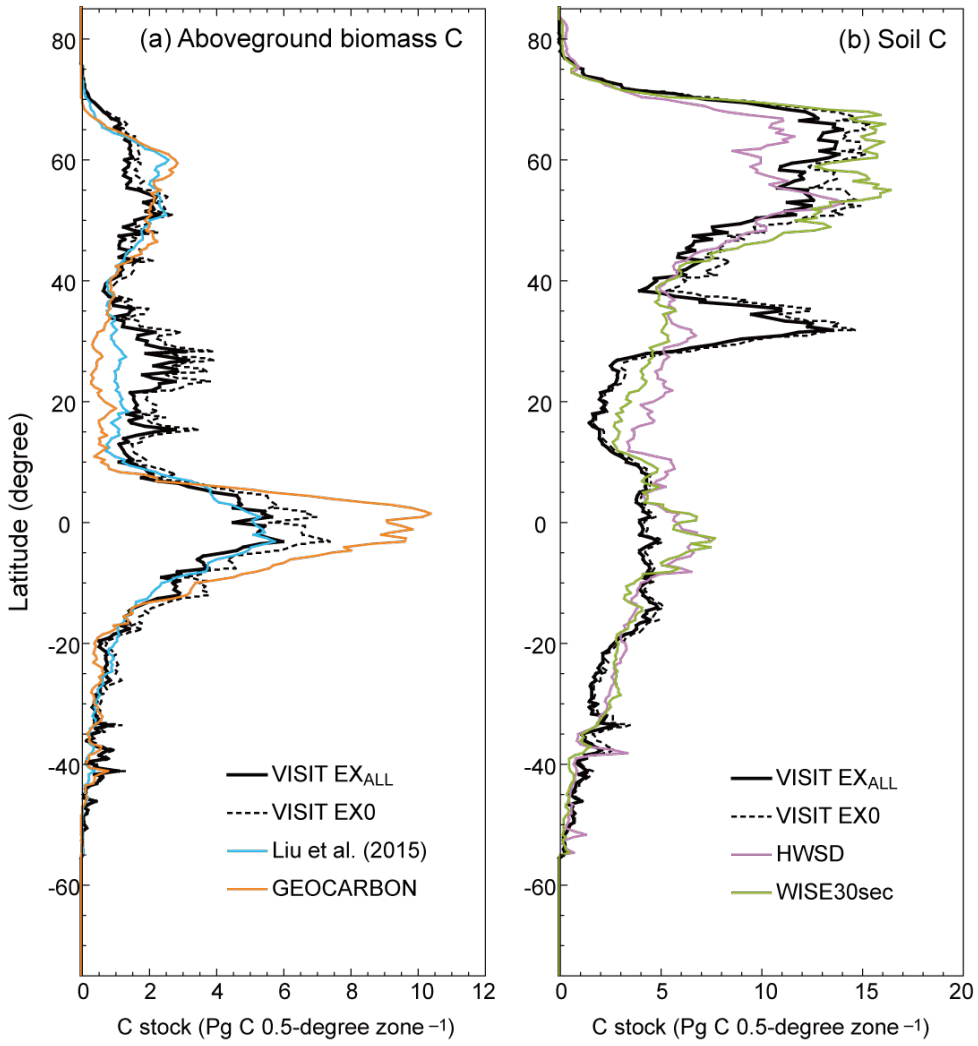

Figure S8. Latitudinal distribution of (**a**) aboveground biomass carbon and (**b**) soil organic carbon simulated by VISIT in EX0 and EX_{ALL} experiments. Also shown in (**a**) are distribution from Liu et al. (2015) and GEOCARBON (Avitabile et al., 2014). Also shown in (**b**) are distributions from the Harmonized World Soil Database (FAO/IIASA/ISRIC/ISSCAS/JRC, 2012) and WISE30sec (Batjes, 2016).

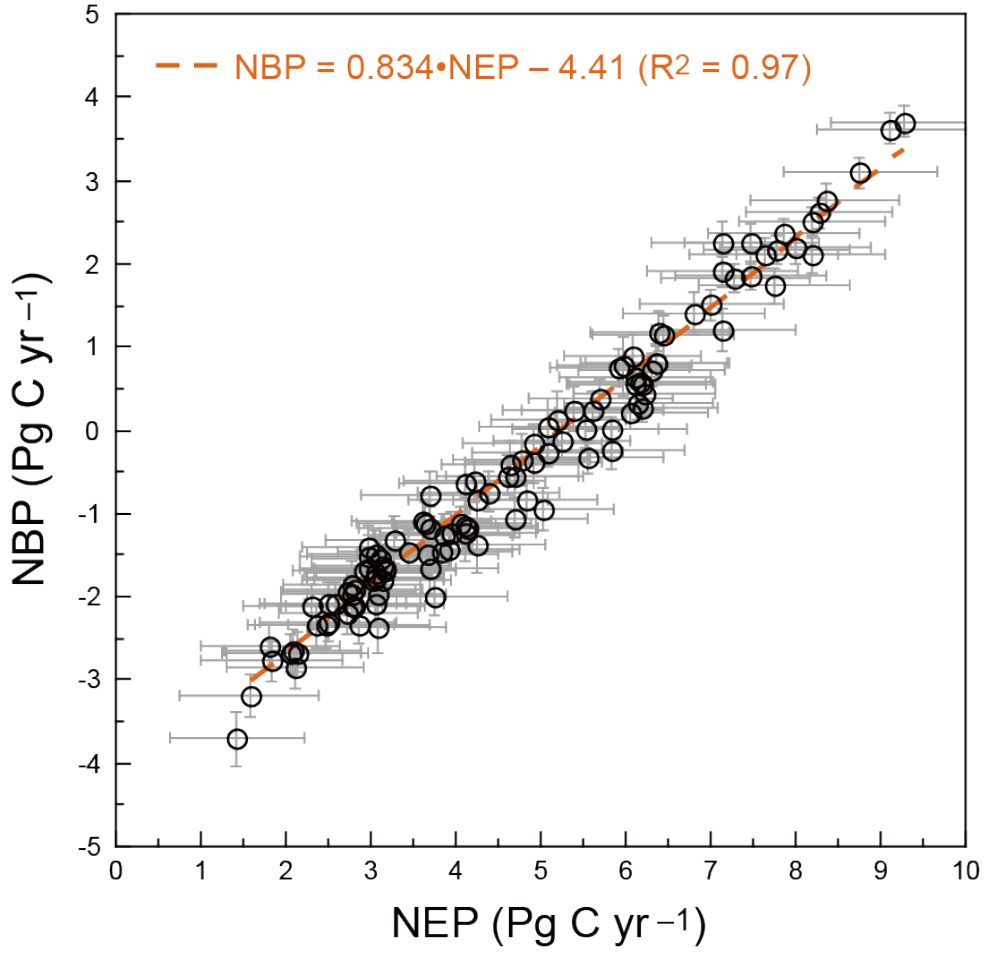

Figure S9. Scatter diagram of global annual NEP and NBP for the period 1901–2016. Error bars shown in grey. Red dashed line shows the linear regression (R^2 = 0.97).

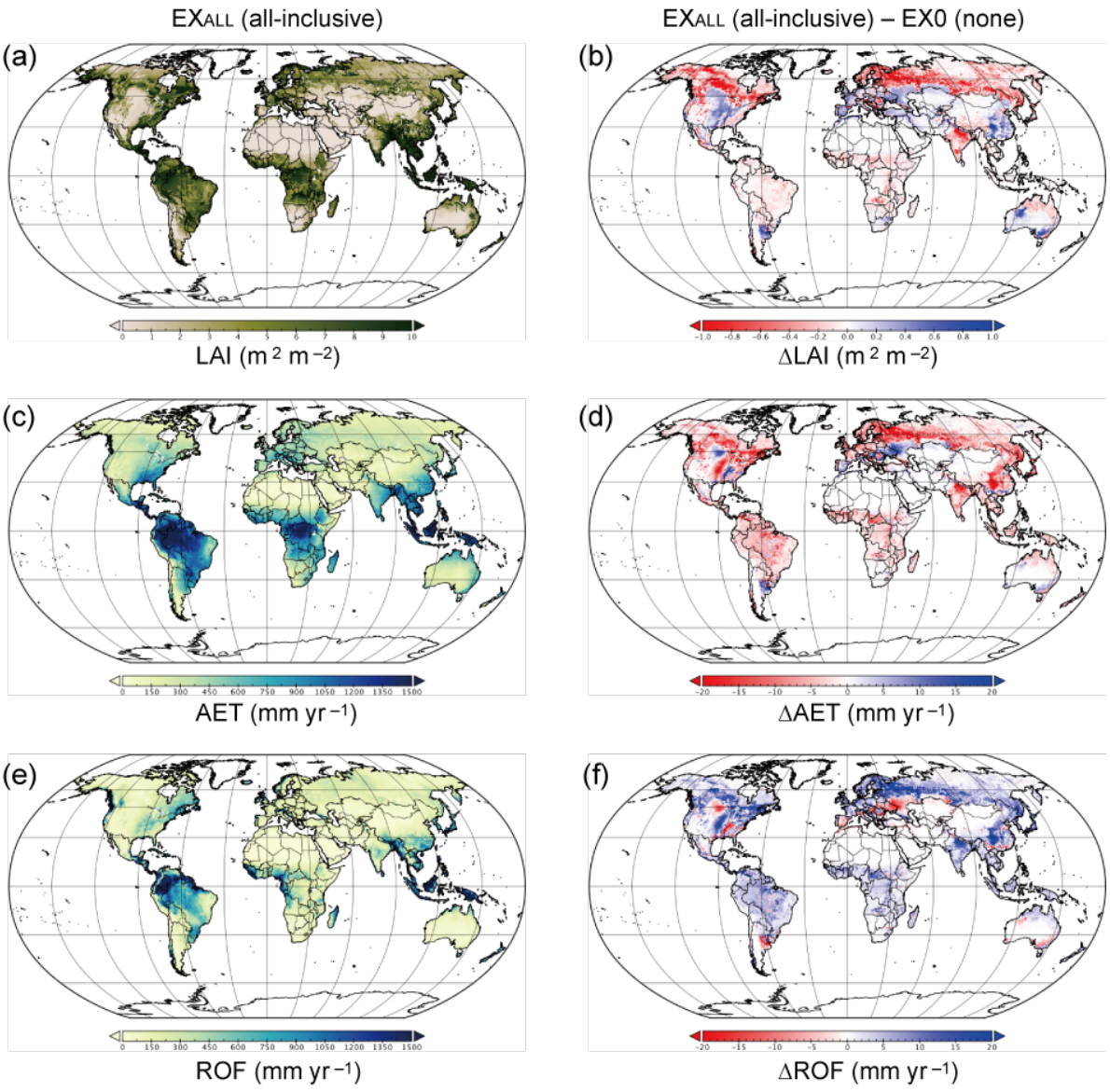

Figure S10. Global distribution of the simulated water budget from EX_{ALL} for 2000–2009. (**a**) Mean annual leaf area index (LAI) and (**b**) its difference from EX0, (**c**) actual evapotranspiration (AET) and (**d**) its difference from EX0, and (**e**) runoff discharge (ROF) and (**f**) its difference from EX0.

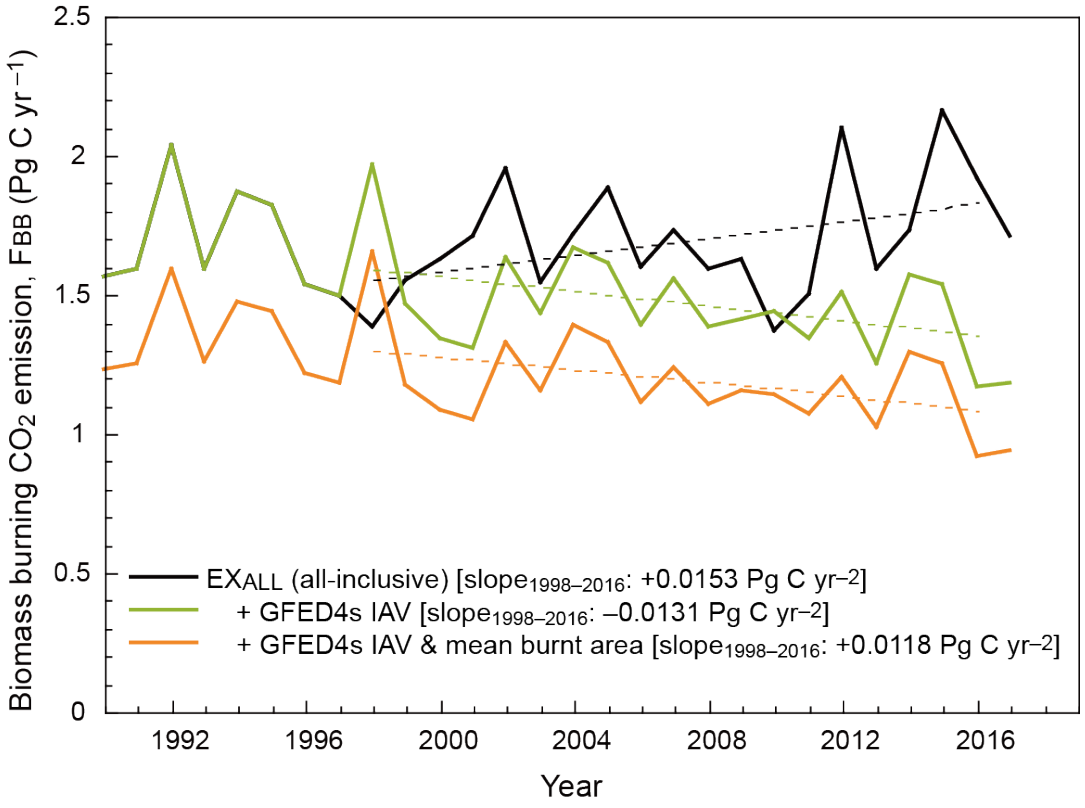

Figure S11. Time series of F_{BB} in the EX_{ALL} simulation, the interannual variability (IAV) constrained by satellite data (GFED4s), and the IAV and mean burnt area constrained by the observational data. Regression curves for 1998–2017 are shown by dashed lines.

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