For Biogeosciences

Title

Dynamics and environmental drivers of methane and nitrous oxide fluxes at the soil and ecosystem levels in a wet tropical forest

Authors

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Supplementary material

Table S1. Results of the Kolmogorov-Smirnov tests (p level < 0.05) comparing CH_4 and N_2O flux distributions at ecosystem and upland-soil level between wettest and driest seasons. Corresponding data are shown in Figure 3.

	CH_4		**N_2O**	
	Alternative hypothesis	**p value**	**Alternative hypothesis**	**p value**
		Ecosystem fluxes		
Driest vs. Wettest	Greater	< 0.001	Less	0.020
		Upland soil fluxes		
Driest vs. Wettest	Greater	< 0.001	Greater	< 0.001

Table S2. Fluxes from Table 1 transformed into the most commonly used units in the literature for data contextualisation. Means, standard deviations (SD) and medians of ecosystem and upland soil CH_4 and N_2O fluxes per season (wettest and driest) in the Guyaflux tropical forest, French Guiana.

Conversion factors: from nmolCH_4 to mgCH_4 x 1.604 x 10^{-5}, from nmolN_2O to mgN_2O x 4.4013 x 10^{-5}.

	Wettest			Driest			Global average		
Fluxes	**Mean**	**SD**	**Median**	**Mean**	**SD**	**Median**	**Mean**	**SD**	**Median**
Ecosystem flux									
nmol m^{-2} s^{-1}									
CH_4	2.9	3.9	2.8	-0.8	3.8	-0.6	1.5	4.0	1.4
N_2O	0.5	0.7	0.4	0.5	0.8	0.6	0.6	0.8	0.5
mg m^{-2} day^{-1}									
CH_4	4.0	5.4	3.9	-1.1	5.3	-0.8	2.0	5.6	1.9
N_2O	1.9	2.8	1.4	2.0	3.2	2.1	2.2	3.1	1.8
kg ha^{-1} yr^{-1}									
CH_4	14.6	19.7	14.2	-4.1	19.2	-3.1	7.5	20.4	7.0
N_2O	6.9	10.1	5.0	7.2	11.6	7.7	7.9	11.2	6.6
Upland soil flux									
nmol m^{-2} s^{-1}									
CH_4	-0.8	0.5	-0.8	-1.8	0.5	-1.8	-1.1	0.7	-1.0
N_2O	0.1	0.1	0.1	0.0	0.1	0.0	0.1	0.1	0.1
mg m^{-2} day^{-1}									
CH_4	-1.0	0.6	-1.1	-2.4	0.7	-2.5	-1.6	0.9	-1.4
N_2O	0.3	0.3	0.3	0.1	0.2	0.1	0.2	0.3	0.2
kg ha^{-1} yr^{-1}									
CH_4	-3.8	2.4	-4.0	-8.9	2.6	-9.3	-5.7	3.4	-5.1
N_2O	1.1	1.0	1.0	0.3	0.8	0.2	0.8	1.0	0.8

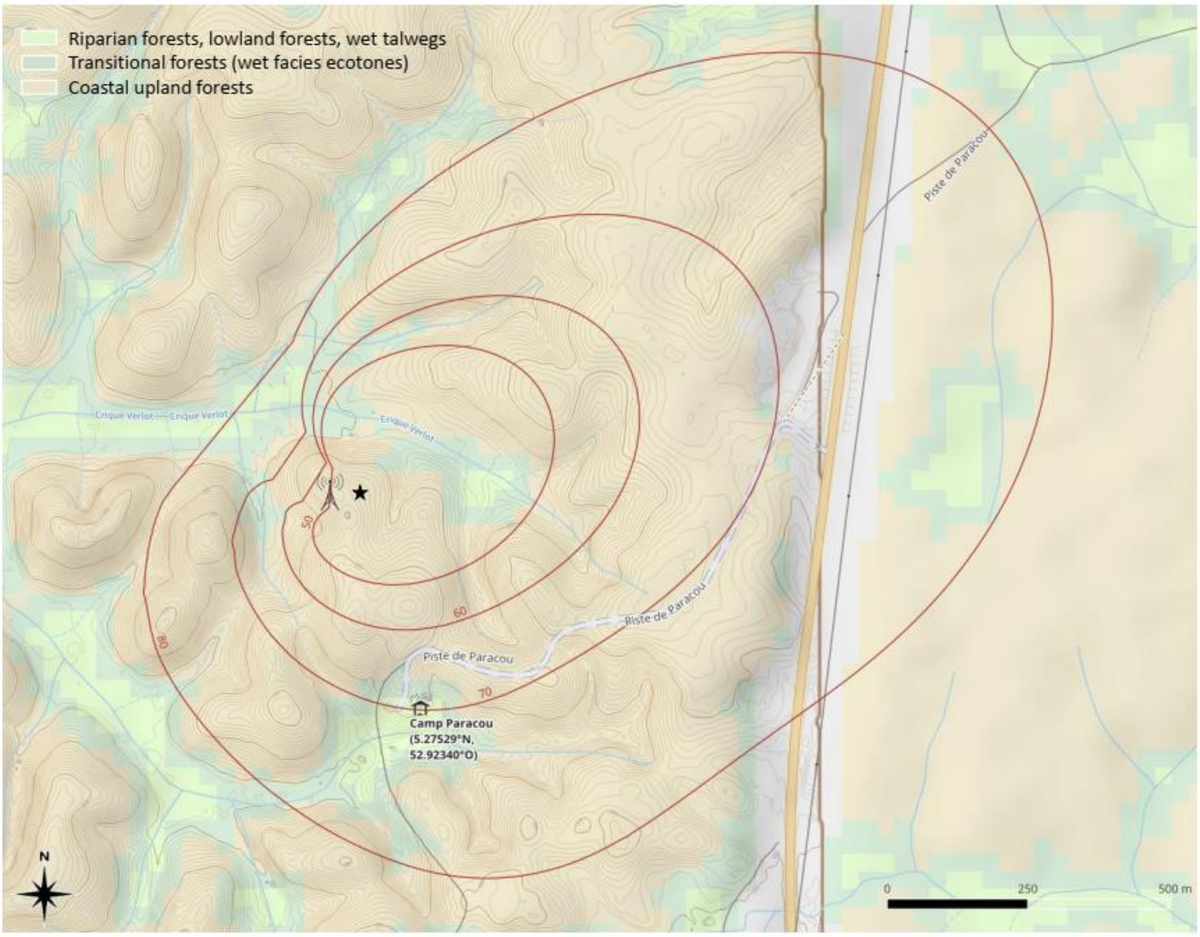

Figure S1. Map showing the combination of both the recent annual cumulative footprint climatology for Guyaflux as part of a FLUXNET2015 study (Fang et al., 2024) and the spatial distribution of different forest habitats (Guitet et al., 2015). The red curves show the footprint percentiles at 10% intervals, from 50% (inner), to 80% (outer). The black star, near the flux tower, show the location of the 13 automated soil chambers.

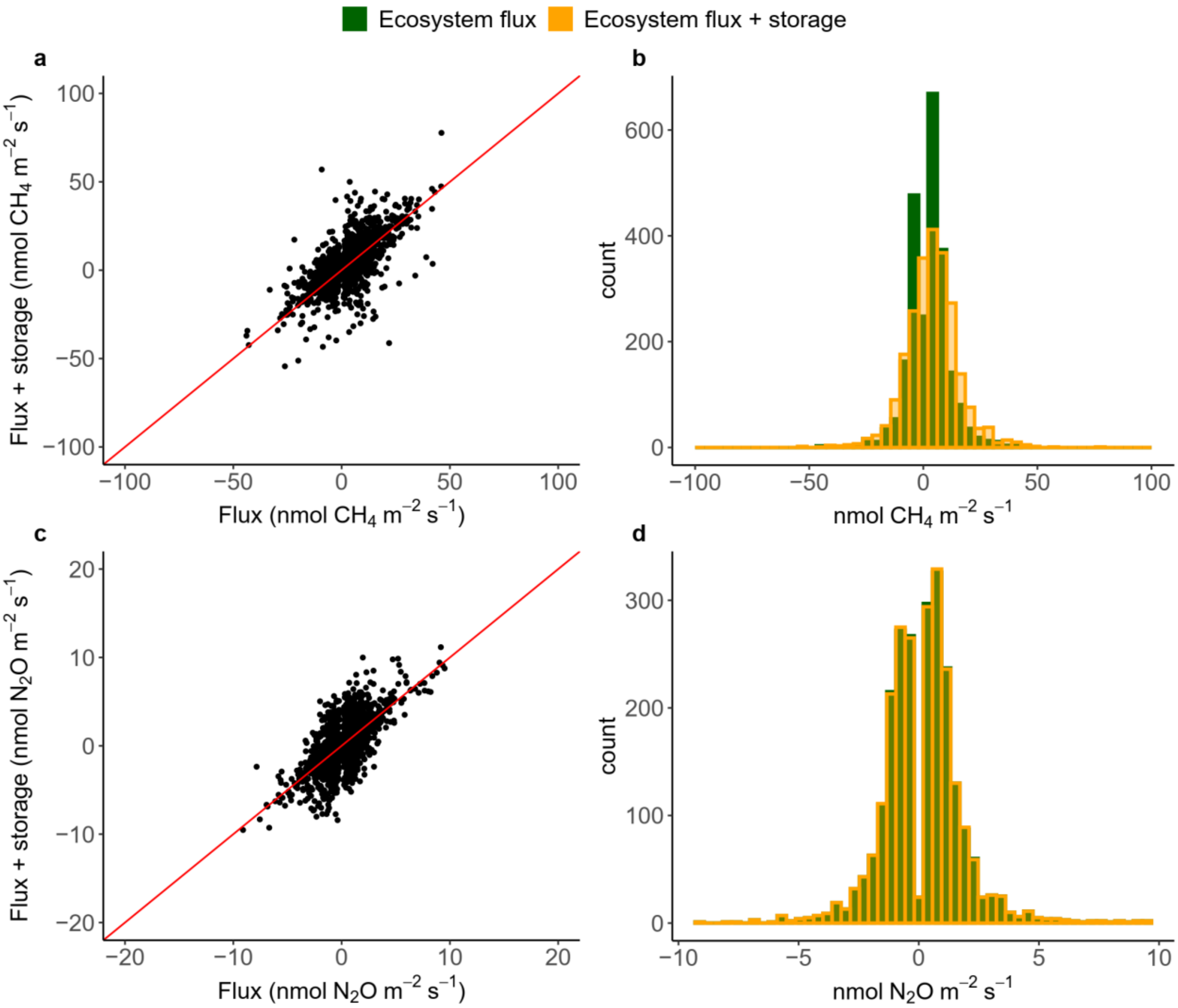

Figure S2. Relationships between the half-hourly fluxes of (a) CH_4 and (c) N_2O, as measured by the eddy covariance technique, and the same fluxes corrected by the storage term (i.e. the accumulation of CH_4 and N_2O within the forest canopy at night when Rg < 5 W m^{-2}).The line represents the 1:1 relationship. Corresponding density plots of corrected and non-corrected half-hour fluxes of (b) CH_4 and (d) N_2O. Data from the Guyaflux tower from 1 January, 2017 to 11 January, 2018, French Guiana.

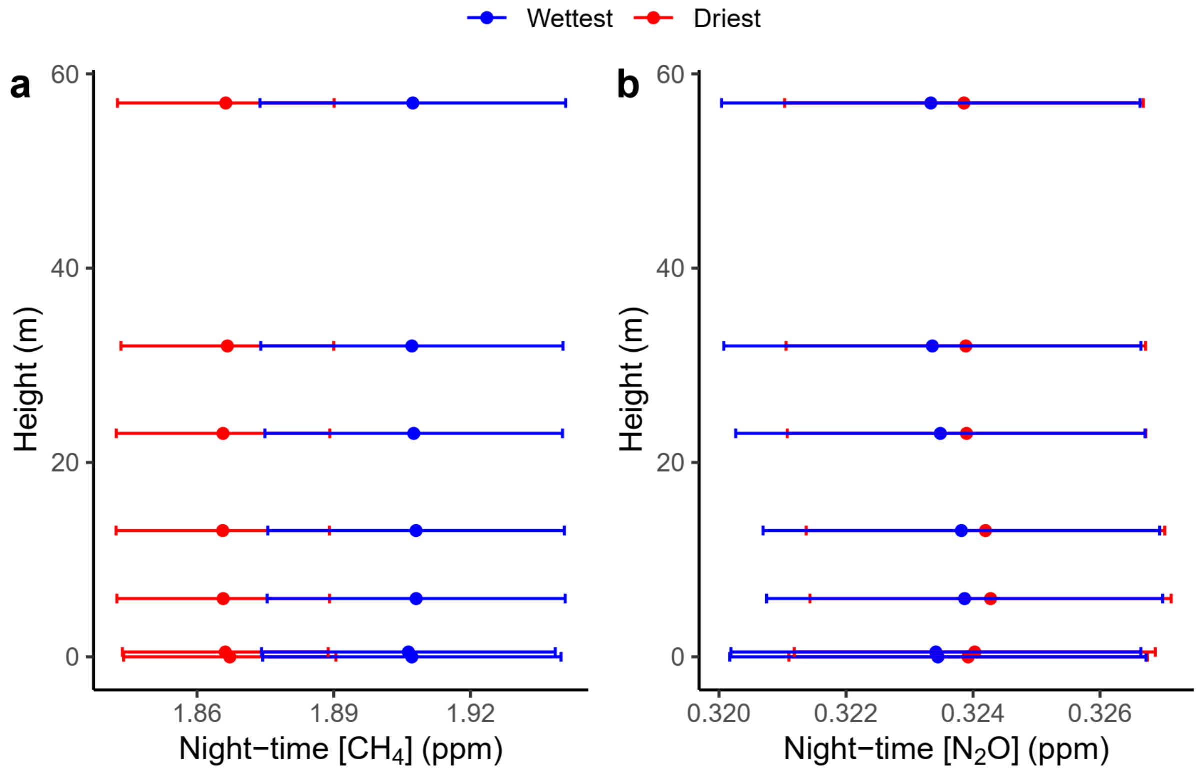

Figure S3. Night-time (Rg < 5 W m^{-2}) averaged vertical profiles for (a) [CH_4] and (b) [N_2O] measured on an upland forest near the Guyaflux tower for the wettest (blue) and driest (red) seasons from 1 January, 2017 and 11 January, 2018, French Guiana.

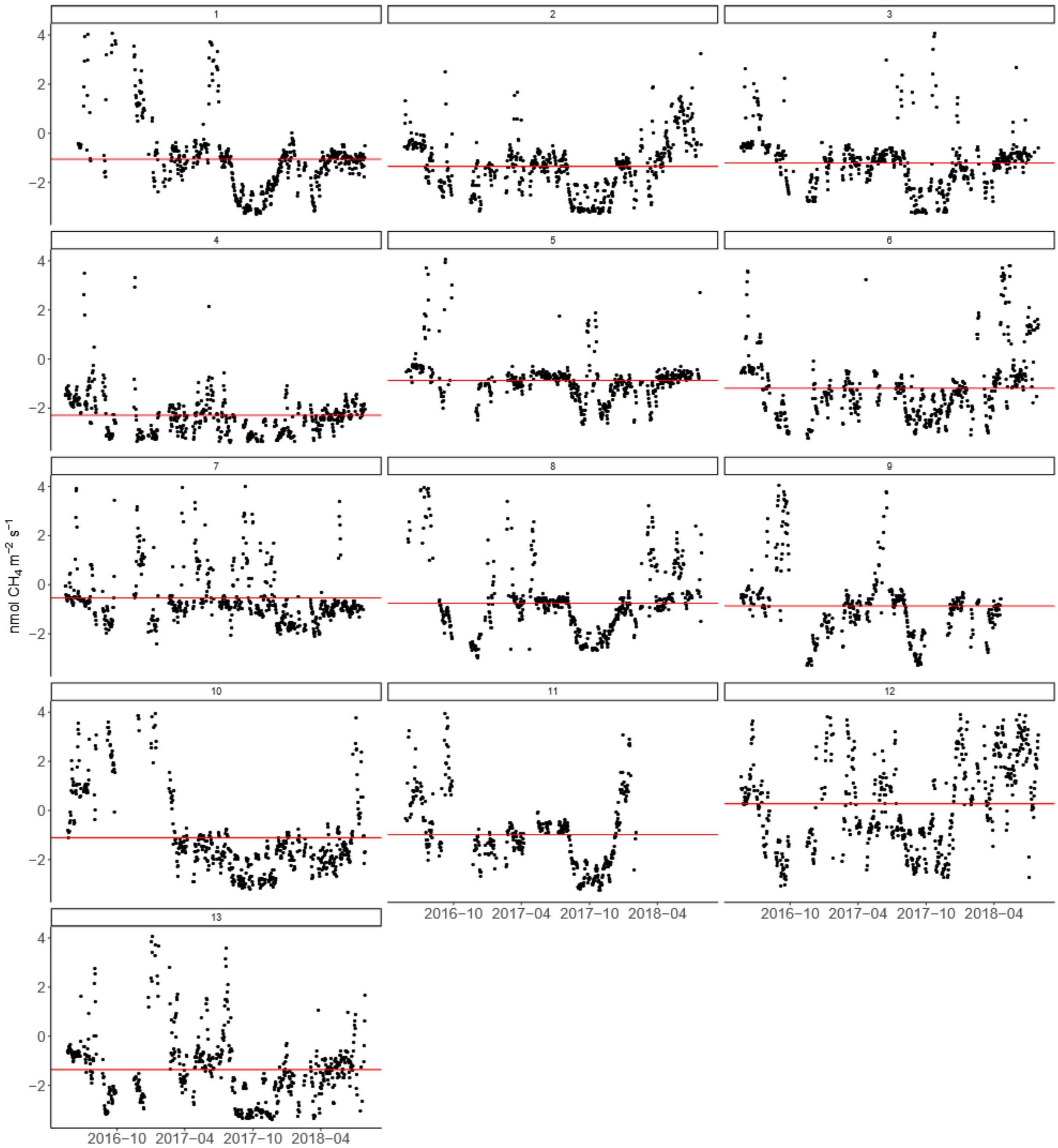

Figure S4. Average daily upland soil CH_4 fluxes per soil chamber (1 to 13) from 17 May, 2016 to 2 August, 2018 in the Guyaflux tropical forest, French Guiana. Fluxes were estimated with a 5-min closure time (see Sect. 2.5, "Chamber-based CH_4 and N_2O flux computation", for more details). All panels have the same limits on the y-axis. The horizontal red lines indicate the average flux line for each chamber.

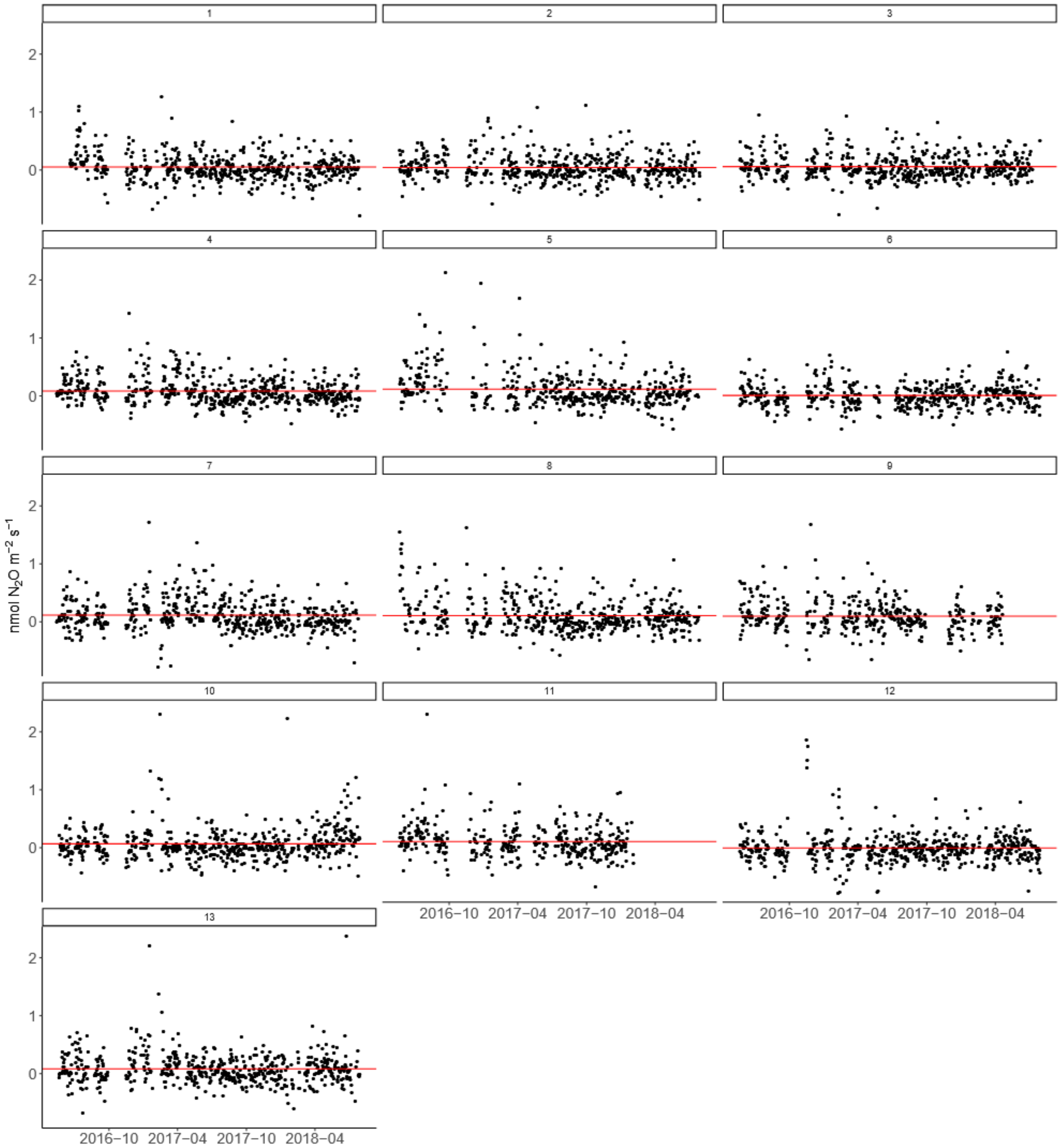

Figure S5. Average daily upland soil N_2O fluxes per soil chamber (1 to 13) from 17 May, 2016 to 2 August, 2018 in the Guyaflux tropical forest, French Guiana. Fluxes were estimated with a 25-min closure time (see Sect. 2.5, "Chamber-based CH_4 and N_2O flux computation", for more details). All panels have the same limits on the y-axis. The horizontal red lines indicate the average flux line for each chamber.

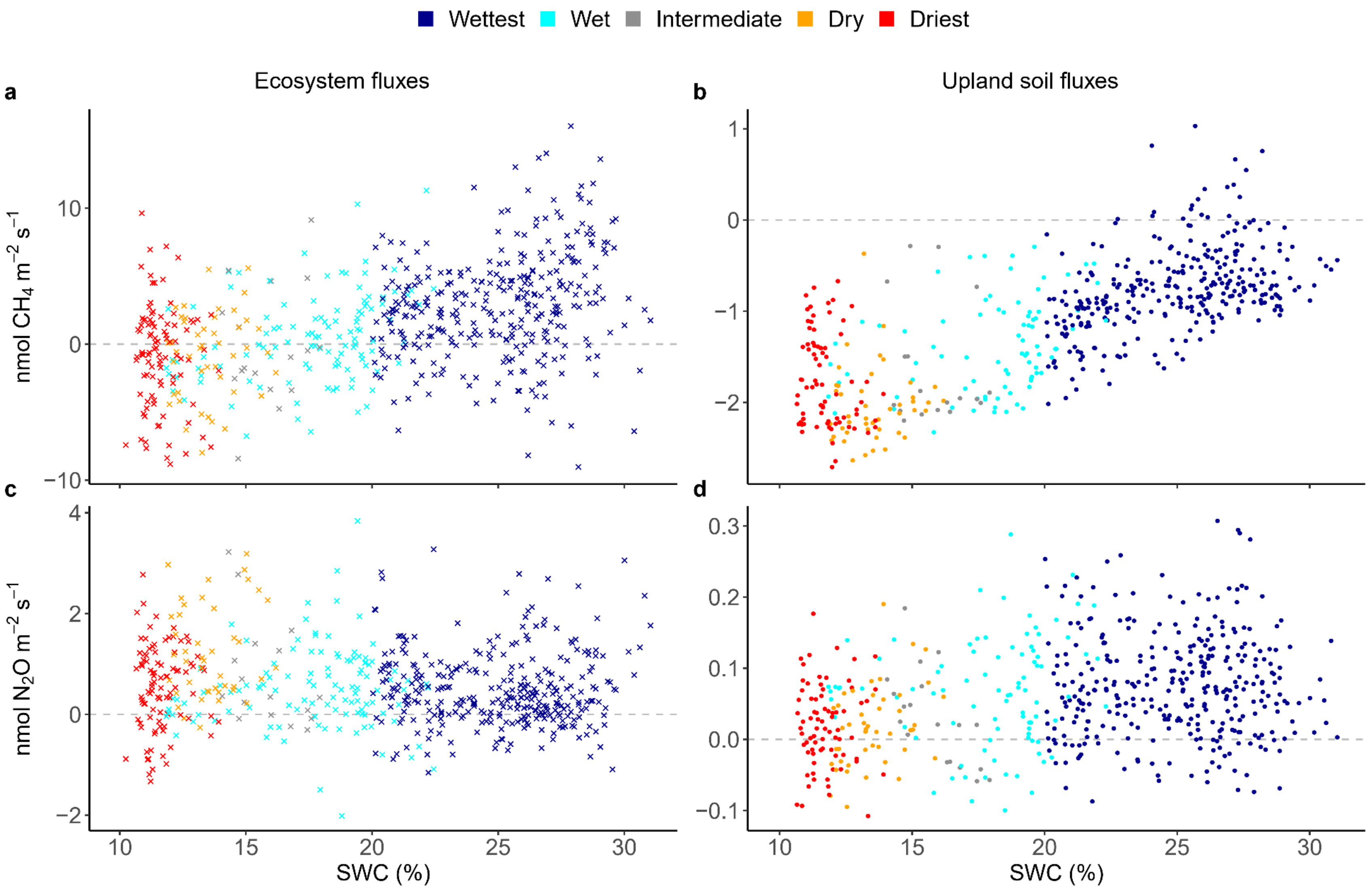

Figure S6. Relationships between average daily soil water content (SWC), and average daily ecosystem (crosses on the left) and upland soil (solid dots on the right) fluxes of (a-b) CH_4 and (c-d) N_2O for the wet, intermediate, and dry seasons, and two contrasted seasons defined as wettest (dark blue dots) and driest (red dots), from 17 May, 2016 to 2 August, 2018 in the Guyaflux tropical forest, French Guiana. Positive fluxes indicate emissions and negative fluxes indicate uptake.

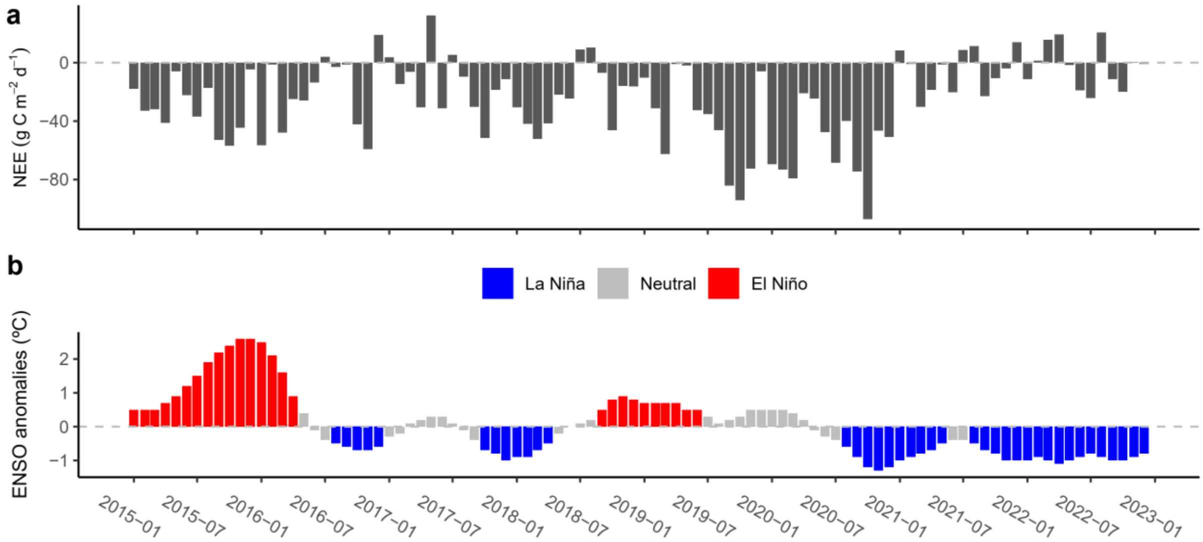

Figure S7. (a) Monthly accumulated net ecosystem exchange (NEE) and (b) El Niño-Southern Oscillation Event (ENSO) anomalies: cold (blue, known as La Niña) and warm (red, known as El Niño) periods based on a threshold of +/- 0.5ºC for the Oceanic Niño Index (https://origin.cpc.ncep.noaa.gov).

References

Fang, J., Fang, J., Chen, B., Zhang, H., Dilawar, A., Guo, M., Liu, S.: Assessing Spatial Representativeness of Global Flux Tower Eddy-Covariance Measurements Using Data from FLUXNET2015, Sci. Data., 11, 569, https://doi.org/10.1038/s41597-024-03291-3, 2024.

Guitet, S., Brunaux, O., De Granville, J. J., Gonzalez, S., Richard-Hansen, C., Sabatier, D.: Catalogue des habitats forestiers de Guyane, ONF-Direction de l'environnement, de l'aménagement et du logement de Guyane (DEAL), 2015.