SUPPORTING INFORMATION

Experimental evidence shows minor contribution of nitrogen deposition to global forest carbon sequestration

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This file contains:

- Supplementary Figures S1–S8
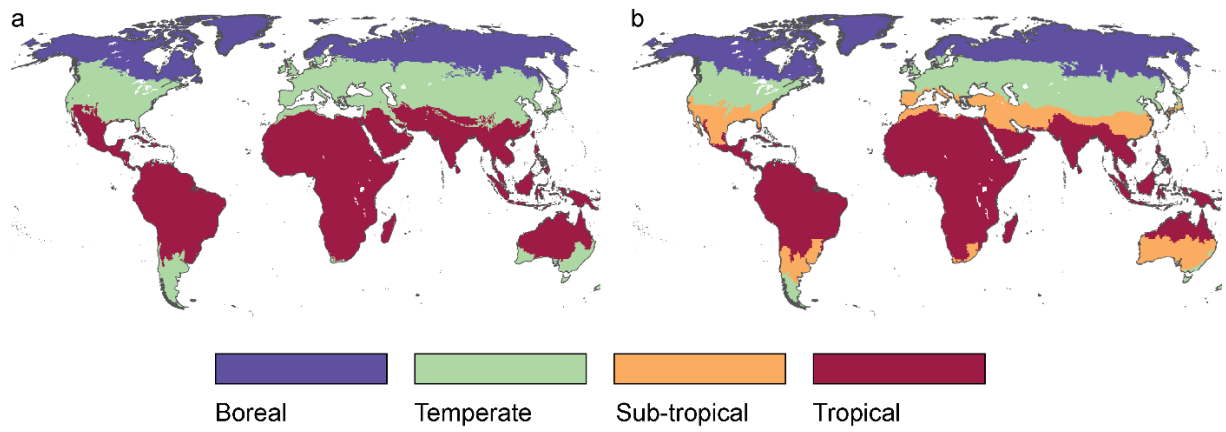- Supplementary Tables S1–S5

Supplementary Figures

Figure S1 (a) Used biome delineation (based on a combination of WWF ecoregions and FAO Global Ecological zones (GEZ), **(b)** global biomes according to FAO GEZ (FAO, 2012).
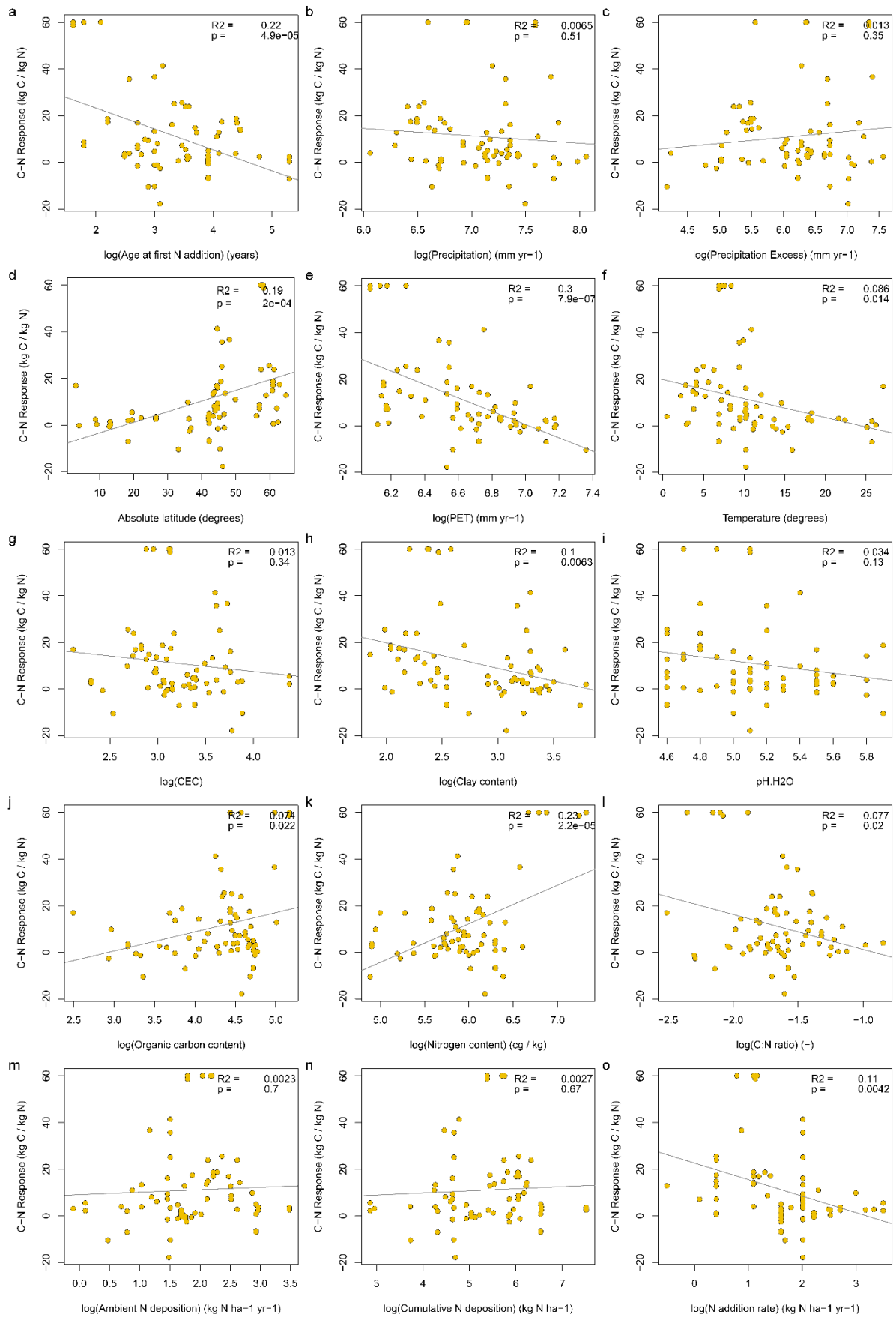
Figure S2 Scatter plots showing linear regressions of predictor variables against C-N response. p values differ from those presented in Table S2 because (i) C-N response is not log-transformed for easier interpretation and no random structure is introduced.
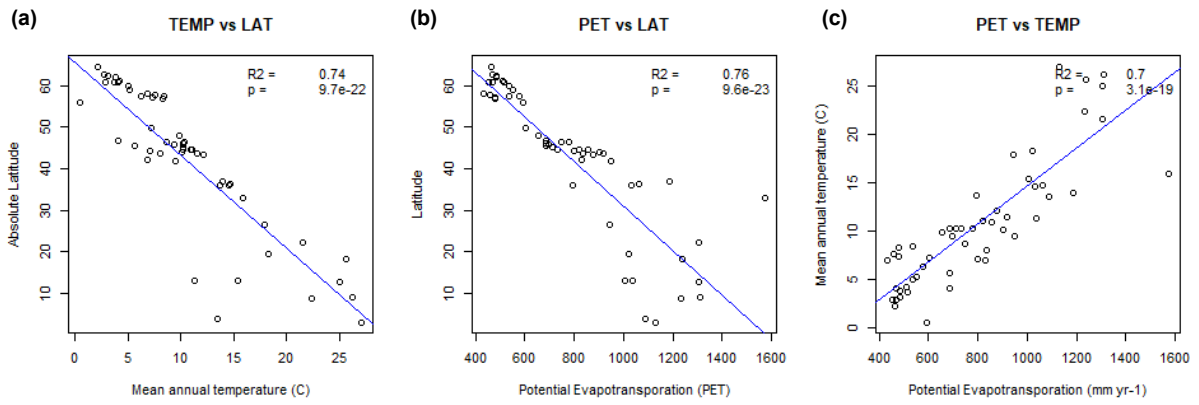
(a) TEMP vs LAT

(b) PET vs LAT

(c) PET vs TEMP

Figure S3 Correlation between **a**, mean annual temperature and absolute latitude, **b**, absolute latitude and potential evapotranspiration, **c**, potential evapotranspiration and mean annual temperature in experimental locations. Each dot represents an experimental plot in the database.
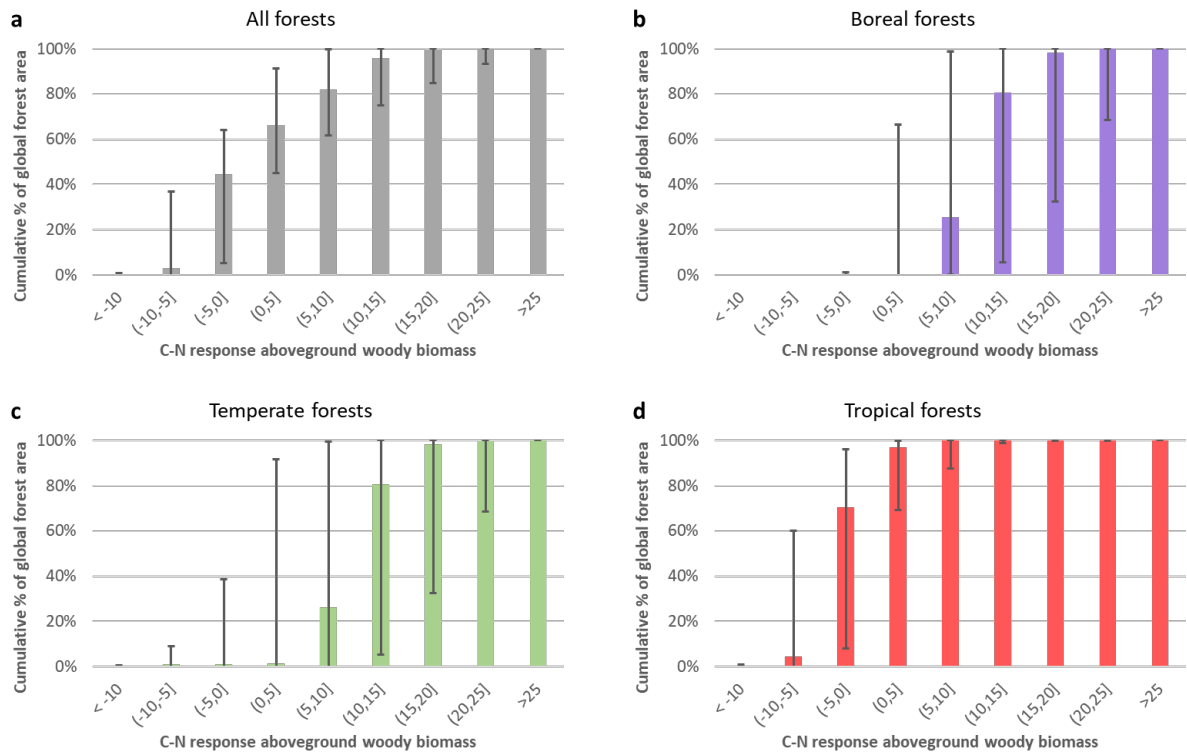
Figure S4 Cumulative frequency histogram showing frequency of predicted mean C-N response (frequency = km^2 for which response is predicted) for a, all forests, b, boreal forests, c, temperate forests and d, tropical forests. Error bars show cumulative frequency distributions for C-N responses based on the upper and lower bound of the 95% Confidence Interval.
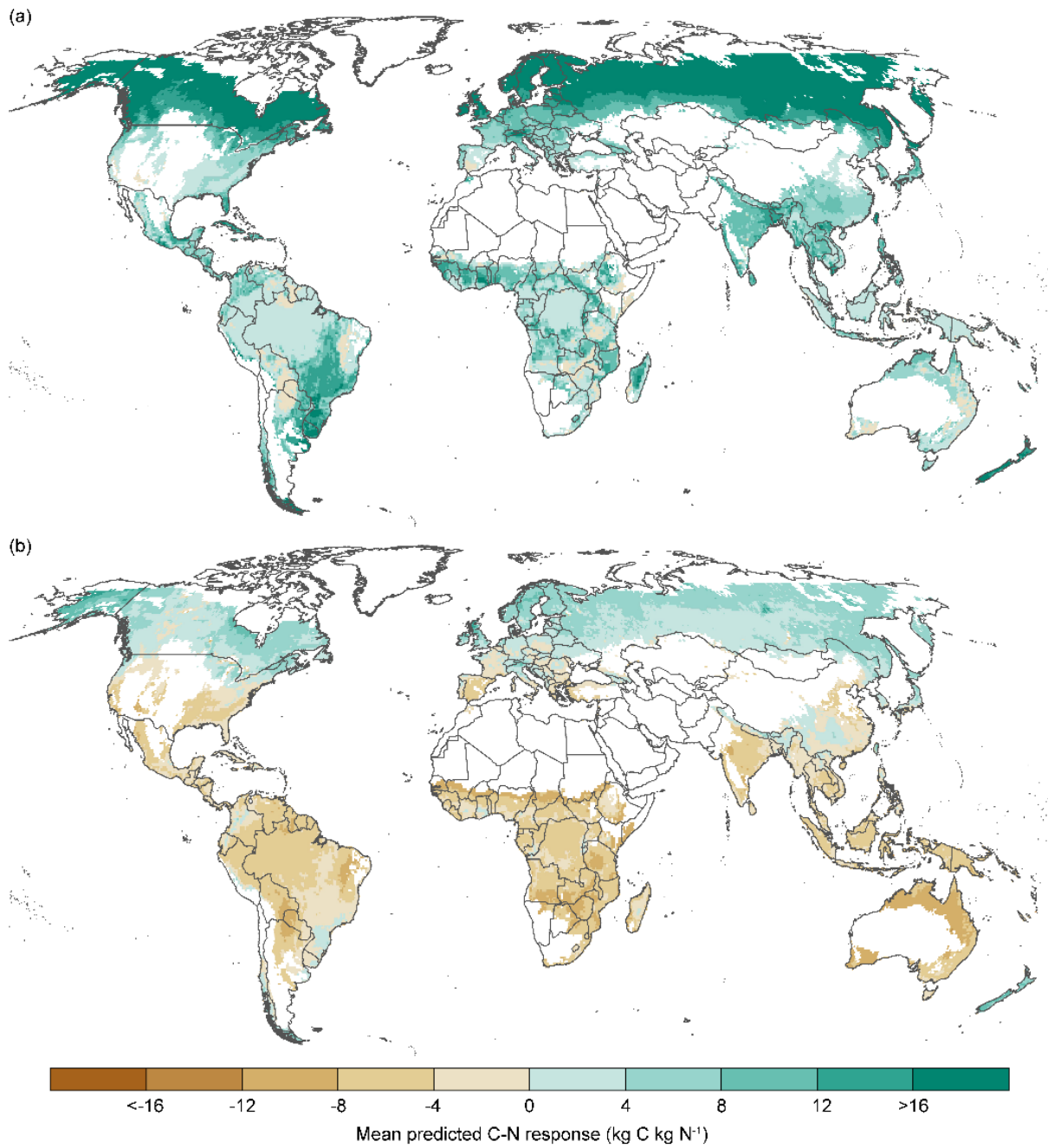
Figure S5 a, upper and b, lower boundaries of 95% CI for predicted C-N response, as shown in **Figure 1**.
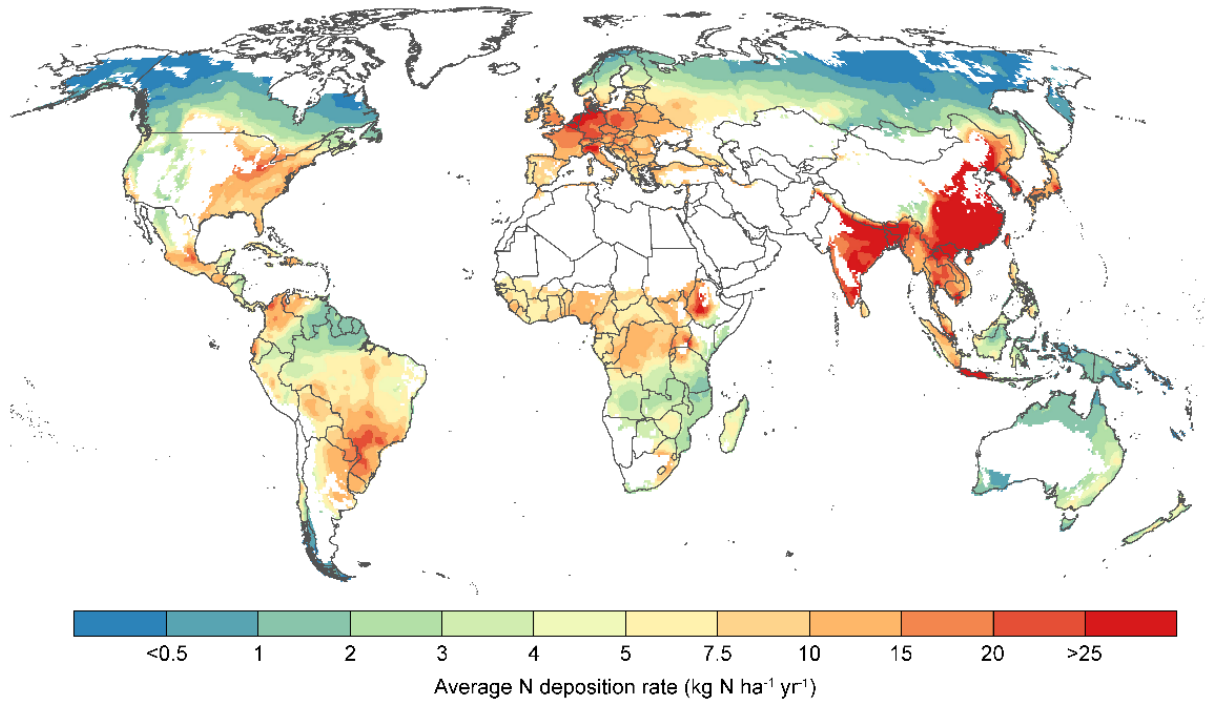
Figure S6 N deposition to forests for the year 2010 used for estimating the N-induced C sink, data from Schwede et al. (2018). Grid cells with forest area <5% are masked.
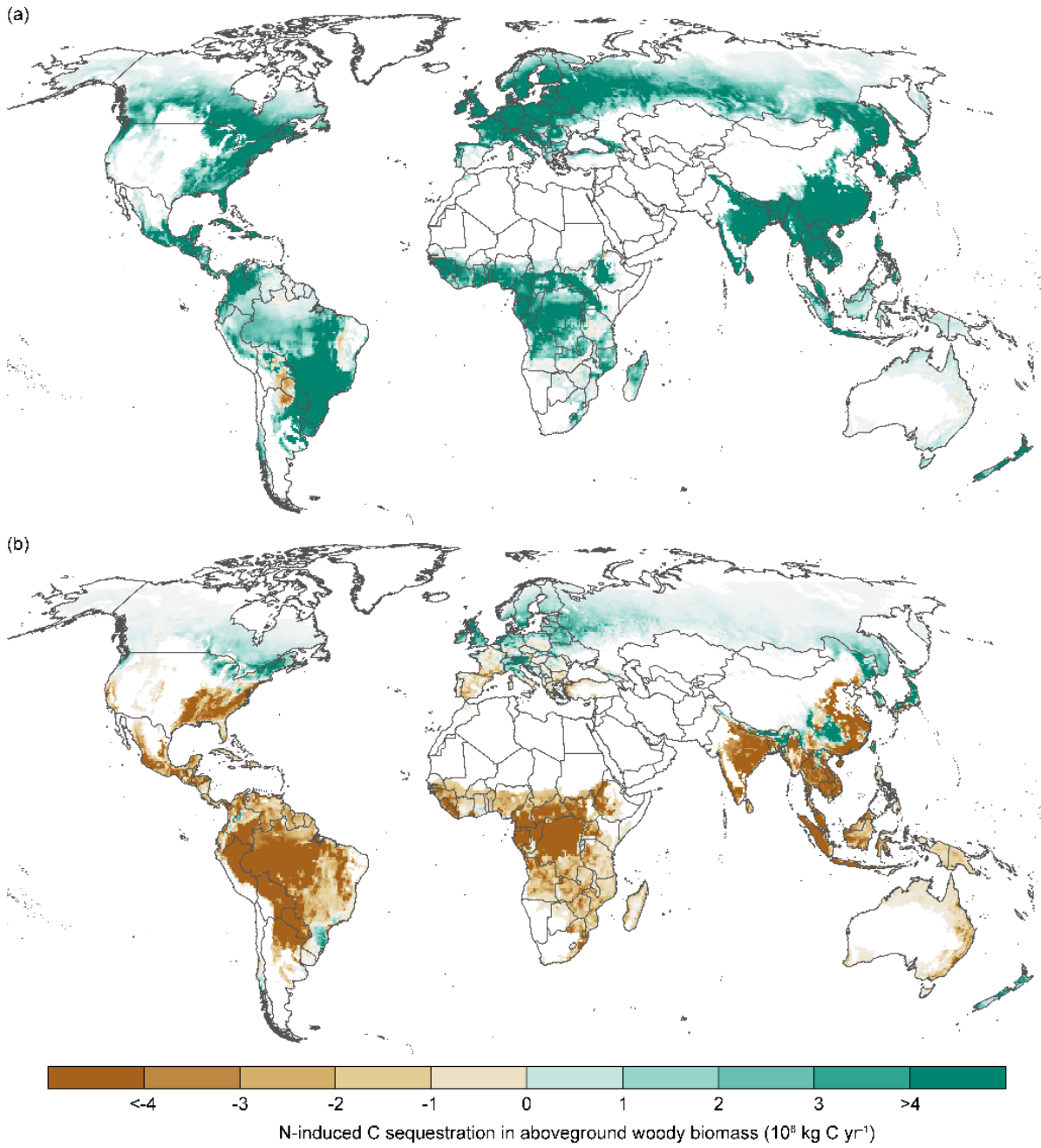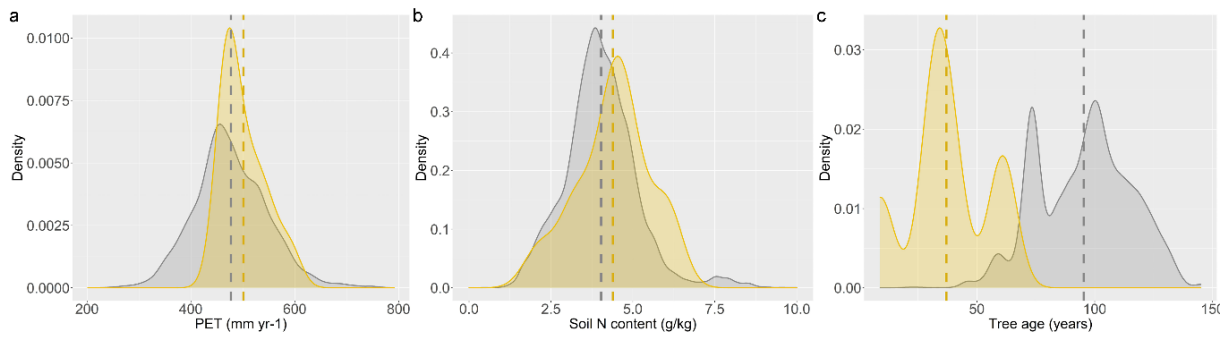
Figure S7 a, upper and b, lower bound of 95% CI for N-induced C sequestration in forest aboveground woody biomass predicted by overlay of C-N responses with N deposition, as shown in **Figure 2**a.

Boreal forests

Temperate forests
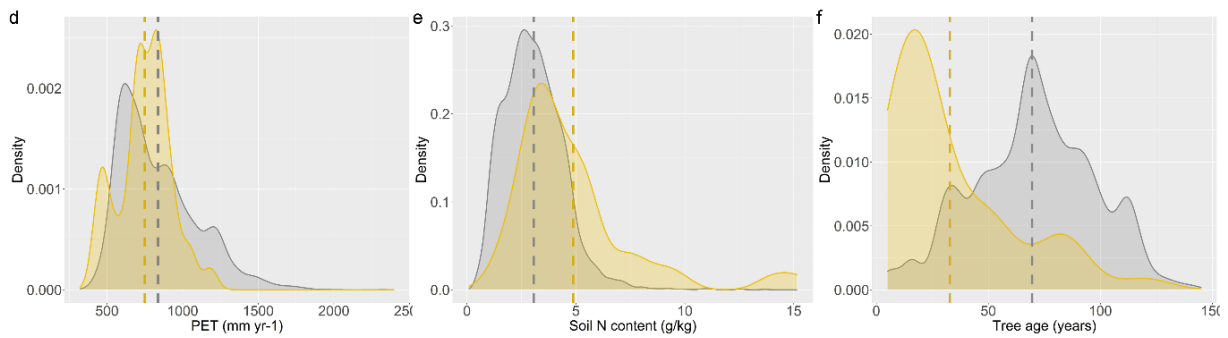
Tropical forests
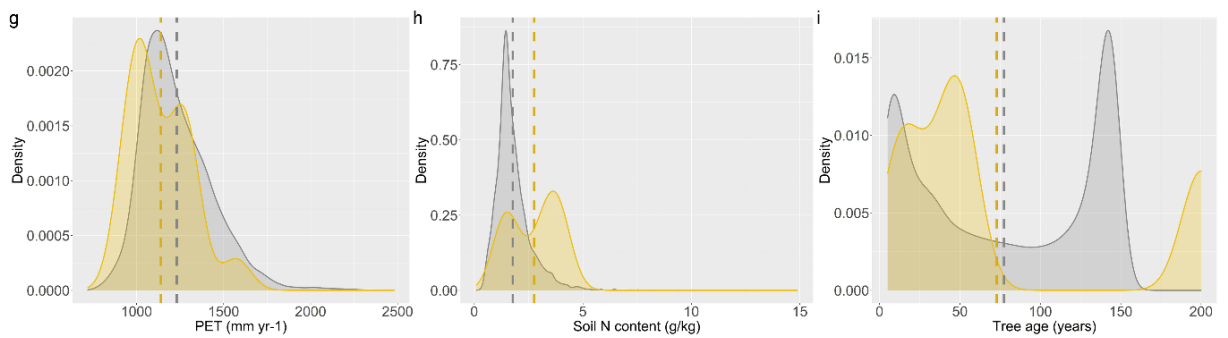
All forests
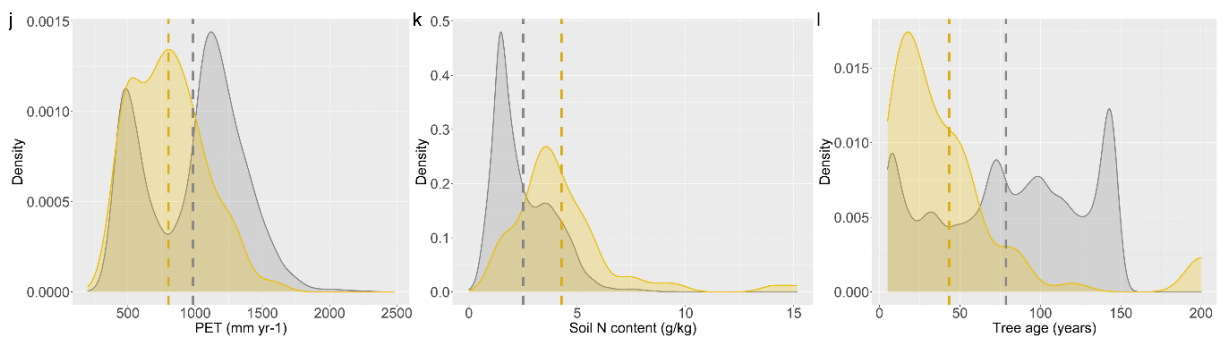
Figure S8 Density plots showing the distribution of predictor variables (PET, soil N content and tree age) in the database (yellow) and in global forests (grey) for boreal forests (a–c), temperate forests (d–f), tropical forests (g–i) and for all forests (j–l). Dashed lines indicate the average value of the variable in the database (yellow) and in forests (grey). For the density plots showing distribution in the database, frequency refers to 'number of observations', while for the density plots showing distribution in global forests, frequency refers to 'number of km² forest'.

Supplementary Tables

Table S1 Classification of WWF ecoregions (Olson et al., 2001) and aggregation to biome classification used in this study. Grid cells classified as 'other' based on WWF ecoregions were classified as either boreal, temperate or tropical based on FAO Global Ecological Zones (Figure S1b). The final biome delineation used in our study is shown in Figure S1a.

Biome ID	WWF Ecoregion	Biome classification for this study
1	Tropical and subtropical moist broadleaf forests	Tropical
2	Tropical and subtropical dry broadleaf forests	Tropical
3	Tropical and subtropical coniferous forests	Tropical
4	Temperate broadleaf and mixed forests	Temperate
5	Temperate Coniferous Forest	Temperate
6	Boreal forest / taiga	Boreal
7	Tropical and subtropical grasslands, savannas and shrublands	Tropical
8	Temperate grasslands, savannas and shrublands	Temperate
9	Flooded grasslands and savannas	Other
10	Montane grasslands and shrublands	Other
11	Tundra	Boreal
12	Mediterranean Forests, woodlands and scrubs	Temperate
13	Deserts and xeric shrublands	Other
14	Mangroves	Tropical
98	Lakes	Other
99	Rock and ice	Other

Table S2 Results of the meta-regression for individual predictors of C-N response, including model intercept, coefficient with 95% CI, pseudo R2 (indicating the proportional reduction in the variance components of a model compared to a model with no moderators) and Akaike Information Criterion (AIC). ***= p<0.01; **= p<0.05, *=p<0.1

Predictor variable	Intercept	Coefficient	Lower-95%	Upper-95%	psR2	AIC
Log(age)	4.1***	-0.21**	-0.36	-0.07	33.2	77.0
log(NDEP)	3.4***	-0.03	-0.20	0.14	0.0	83.7
log(NDEPcum)	3.5***	-0.04	-0.18	0.10	0.0	83.5
Log(Nadd)	3.6***	-0.15*	-0.30	0.01	15.7	80.8
log(PET)	8.7***	-0.80***	-1.14	-0.46	56.3	69.2
TEMP	3.5***	-0.02*	-0.03	0.00	11.5	81.1
log(PREC)	3.6***	-0.04	-0.21	0.13	0.0	84.8
log(PE)	3.3***	0.00	-0.09	0.09	0.0	85.2
log(CEC)	3.0***	0.09	-0.15	0.34	0.0	83.7
log(CLAY)	3.8***	-0.19	-0.43	0.06	18.1	82.1
log(OC)	2.9***	0.10	-0.04	0.24	6.6	82.9
Log(C:N)	3.1***	-0.11	-0.34	0.12	1.4	84.2
log(SoilN)	1.7***	0.27***	0.09	0.46	22.1	76.9
pH	4.3***	-0.20	-0.50	0.09	10.9	82.6
Absolute latitude (LAT)	2.9***	0.01***	0.004	0.02	34.2	76.3

Age = average stand age at start of experiment (years), **NDEP** = ambient N deposition rate (kg N ha^{-1} yr^{-1}, year 2010), **NDEPcum** = cumulative N deposition during 50 years prior to start of experiment (kg N ha^{-1}), **Nadd** = average N addition rate during the experiment (kg N ha^{-1} yr^{-1}), **PET** = potential evapotranspiration (mm yr^{-1}), **TEMP** = mean annual temperature (degree Celsius), **PREC** = mean annual precipitation (mm yr^{-1}), **PE** = precipitation excess (mm yr^{-1}), **CEC** = cation exchange capacity in 0–30cm, **CLAY** = soil clay content 0–30cm (g kg^{-1}), **OC** = soil organic carbon content 0–30cm (g kg^{-1}), **C:N** = soil C:N ratio 0–30cm (-), **SoilN** = soil N content 0–30cm (g kg^{-1}), **pH** = soil pH 0–30cm, **LAT** = absolute latitude (degrees).

Table S3 Share of global forest area in regions with a high confidence in positive C-N response (C-N > 0, p<0.05), with a high confidence in a negative C-N response (C-N < 0, p<0.05) and where the direction of the C-N response is uncertain, for different forest biomes.

	Boreal	Temperate	Tropical	Total
Positive C-N response (p<0.05)	21%	13%	2%	36%
Negative C-N response (p<0.05)	0%	0%	5%	5%
Insignificant C-N response	0%	8%	51%	59%
Total	21%	21%	58%	100%

Table S4 Forest area, total and average N deposition, average C-N response, and total and average N-induced C sequestration per forest biome as presented in Table 4, but using the classification of biomes according to FAO Global Ecological Zones (GEZ), see Figure S1b.

	Forest area (km^2 x 10^6)	Total N dep (Tg yr^{-1})	Average N dep (kg ha^{-1} yr^{-1})	C-N response (-)	Total C seq. (Tg yr^{-1})	Average C seq. (kg ha^{-1} yr^{-1})
Boreal	7.3	1.3	1.8	11 (4–20)	15 (5–26)	19 (7–36)
Temperate	4.6	4.3	9.3	5 (1–9)	20 (4–40)	44 (8–87)
Sub-tropical	2.7	4.5	16.7	2 (-1–7)	10 (-6–29)	37 (-22–109)
Tropical	17.2	13.0	7.6	0 (-4–5)	-3 (-58–67)	-2 (-34–39)
World	31.8	23.1	7.3	2 (-2–7)	41 (-55–163)	13 (-17–51)

Table S5 Differences in estimated N-induced C sequestration between this study and Du and De Vries (2018), based on mean C-N response, N deposition and forest area per biome.

Biome	Study	C-N response (kg C kg N^{-1})	N deposition (kg N ha^{-1} yr^{-1})	Forest area (ha x 10^7)	N-induced C seq. (Tg C yr^{-1})
Boreal	Du & De Vries	14	2	122	34
	This study	11	2	68	13
Temperate	Du & De Vries	5	12	97	58
	This study	4	10	68	25
Tropical	Du & De Vries	4	7	187	52
	This study	0	8	183	3
Global	Du & De Vries		7	406	144
	This study		7	319	41