Supplementary material

N14C: a plant-soil nitrogen and carbon cycling model to simulate terrestrial ecosystem responses to atmospheric nitrogen deposition

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Table S1(a). C:N ratios (g g^{-1}) of vegetation

	Broadleaf		Conifer		Herbs		Shrubs	
	C:N	ref	C:N	ref	C:N	ref	C:N	ref
foliage	20.5	1	38.5	1	21.2	2	24.2	2
	18.3	2	38.5	2	23.0	8	39.9	9
	25.1	3	43.8	4	21.2	3	23.6	3
	26.0	4	62.5	5	20.9	7	33.7	10
	33.3	5	51.0	6			27.5	7
	30.1	6	41.1	7				
	20.7	7						
coarse	57.0	11	219.5	4				
	228.7	4						
fine roots	42.4	12	46.3	12	50.0	8		
	40.4	4	39.3	4				
bole	449.1	4	449.2	4				
	294.1	5	454.5	5				
branches	145.6	4	117.6	4			83.5	9
	200.0	5	192.3	5			90.9	10

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Table S1(b). Derived distributions (coarse *vs* fine) of NPP and maximum and minimum C:N ratios. The NPP distributions for trees are based on data in Scarascia-Mugnozza et al. (2000) and Jarvis et al. (2001). The values for grasses and shrubs are assumed. Minimum and maximum C:N ratios for fine tissue were obtained by assuming the foliage ratios to vary by ± 25%.

	frctn of NPP	frctn coarse	frctn fine	frctn NPP coarse	frctn NPP fine	CN mean	CN max	CN min		C coarse	N coarse	C fine max C:N	N fine max C:N	C fine min C:N	N fine min C:N
Broadleaved trees															
foliage	0.29	0	1	0.000	0.290	25	31	19		0.000	0.0000	0.145	0.0047	0.145	0.008
fine roots	0.22	0	1	0.000	0.220	41	41	41		0.000	0.0000	0.110	0.0027	0.110	0.003
coarse roots	0.06	0.5	0.5	0.029	0.029	143	143	143		0.014	0.0001	0.014	0.0001	0.014	0.000
branches	0.23	0.5	0.5	0.113	0.113	173	173	173		0.057	0.0003	0.057	0.0003	0.057	0.000
stems	0.21	1	0	0.206	0.000	372	372	372		0.103	0.0003	0.000	0.0000	0.000	0.000
			overall	0.35	0.65				total	0.174	0.0007	0.326	0.0077	0.326	0.011
									CN ratio		247		42		30
Conifers															
foliage	0.19	0	1	0.000	0.190	46	57	34		0.000	0.0000	0.095	0.0017	0.095	0.003
fine roots	0.19	0	1	0.000	0.190	43	43	43		0.000	0.0000	0.095	0.0022	0.095	0.002
coarse roots	0.11	0.5	0.5	0.055	0.055	219	219	219		0.028	0.0001	0.028	0.0001	0.028	0.000
branches	0.22	0.5	0.5	0.110	0.110	155	155	155		0.055	0.0004	0.055	0.0004	0.055	0.000
stems	0.29	1	0	0.290	0.000	452	452	452		0.145	0.0003	0.000	0.0000	0.000	0.000
			overall	0.46	0.55				total	0.228	0.0008	0.273	0.0044	0.273	0.005
									CN ratio		284		63		50
Herbs															
foliage	0.50	0	1	0.000	0.500	22	27	16		0.000	0.000	0.250	0.0093	0.250	0.015
fine roots	0.50	0	1	0.000	0.500	50	50	50		0.000	0.000	0.250	0.0050	0.250	0.005
			overall	0.00	1.00				total	0.000	0.000	0.500	0.0143	0.500	0.020
									CN ratio				35		24
Shrubs															
foliage	0.45	0	1	0.000	0.450	30	37	22		0.000	0.000	0.225	0.0060	0.225	0.010
fine roots	0.40	0	1	0.000	0.400	60	60	60		0.000	0.000	0.200	0.0034	0.200	0.003
branches	0.15	0	1	0.000	0.150	87	87	87		0.000	0.000	0.075	0.0009	0.075	0.0009
			overall	0.00	1.00				total	0.000	0.000	0.500	0.010	0.500	0.014
									CN ratio				49		35

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Table S1(c). Nutrient retention factors (NRF) for fine plant material and biomass turnover rate constants ($f_{coarse,litter}$, $f_{fine,litter}$)

	NRF[a]		$f_{coarse,litter}$	$f_{fine,litter}$
PFT	high C:N	low C:N	a^{-1}	
broadleaf	0.30	0.36	0.004	0.1
conifer	0.19	0.25	0.005	0.1
herbs	0.32	0.38	-	0.3
shrubs	0.29	0.35	-	0.1

[a] estimated by assuming that 50% of foliar N is retained at litterfall, while all N from other plant material is lost

Table S2(a). Site information: locations, plant functional types, climate, N deposition, sampling year, references to source data.

Site		lat	long	PFT	MAT ^{o}C	MAP mm	ΔT_{SW} ^{o}C	ΔN_{dep} g m^{-2} a^{-1}	sampling year	Refs.
Grizedale	GB	54.3	-3.0	B	9.5	1800	7	3.02	2005	1
Harste bøg	DE	51.6	9.9	B	8.2	607	12	1.68	1990	2, 3, 4
Lüneburger Heide	DE	53.2	10.0	B	8.4	804	12	1.06	1990	2, 5
Mid East Oak mean	GB	52.7	-3.2	B	10.0	927	7	2.94	1998	6
Mid West Oak mean	GB	52.7	-4.0	B	10.3	2072	7	1.77	1998	6
North Coast Oak mean	GB	53.2	-3.9	B	11.0	1574	7	3.57	1998	6
Snowdonia Oak mean	GB	53.0	-4.0	B	10.5	2234	7	2.58	1998	6
Winterswijk	NL	52.0	6.7	B	9.8	673	10	3.23	1990	2, 3, 7
Flakaliden	SE	64.2	19.8	C	2.1	577	12	0.23	2000	8, 9
Gårdsjön	SE	58.1	12.0	C	6.9	1100	12	0.95	1990	2, 3, 4, 10
Harderwijk	NL	52.2	5.4	C	9.2	763	10	3.28	1990	2, 3
Harplinge	SE	56.5	12.5	C	7.8	674	12	2.12	1990	2, 3, 11
Höglwald	DE	48.3	11.1	C	8.1	872	12	2.24	1990	2, 3, 12, 13
Klosterhede	DK	56.3	8.2	C	8.1	860	10	1.60	1990	2, 13
Leuvenum	NL	52.3	5.7	C	9.6	789	10	4.69	1990	2, 3, 7, 14
Risdalsheia	NO	58.4	8.2	C	5.0	1400	13	1.51	1990	15, 16
Solling	DE	51.5	9.5	C	6.4	1090	12	2.77	1990	2, 3, 13
Strasan	SE	60.9	16.0	C	4.1	751	12	0.38	2000	8, 14, 17
Uddevalla	SE	58.5	11.7	C	5.9	857	12	0.92	2000	8, 18
Westerberg	DE	53.4	9.1	C	8.6	852	12	3.88	1990	2, 3, 14, 19
Wingst	DE	53.4	9.0	C	8.7	874	12	3.42	1990	2, 3, 14, 19
Gwy	GB	52.5	-3.7	H	8.3	2258	7	1.89	2005	20
Lake District podzol typical	GB	54.5	-3.3	H	7.0	2710	7	2.52	2005	21
Lake District ranker typical	GB	54.5	-3.3	H	7.0	2710	7	3.50	2005	21
Makevatn1	NO	58.3	6.4	H	7.4	2200	13	2.75	2005	22
Makevatn2	NO	58.3	6.4	H	7.4	2200	13	2.75	2005	22
Oygard1	NO	58.6	6.1	H	6.2	2300	13	1.63	2005	22
Oygard2	NO	58.6	6.1	H	6.2	2300	13	1.63	2005	22
Scoat Tarn	GB	54.5	-3.3	H	8.5	2217	7	2.21	2005	21, 23
Snowdon	GB	53.1	-4.0	H	5.3	3652	7	1.69	2005	24
Sourhope	GB	55.5	-2.2	H	6.2	1234	7	2.41	2005	24
Allt a Mharcaidh	GB	57.1	-3.8	S	6.0	1210	7	0.87	2005	1, 24
Clocaenog	GB	53.0	-3.5	S	8.2	1741	7	1.54	2000	25, 26. 27
Culardoch	GB	57.1	-3.3	S	4.7	980	7	1.20	2005	1
Glensaugh	GB	56.9	-2.6	S	6.2	1201	7	1.54	2005	24
Makevatn3	Nor	58.3	6.4	S	7.4	2200	13	2.75	2005	22
Mols	DK	56.4	11.0	S	9.4	758	10	2.12	2000	26, 27, 28
Oldebrook	NL	52.4	5.9	S	10.1	1042	10	2.69	2000	26, 27
Oygard3	NO	58.6	6.1	S	6.2	2300	13	1.63	2005	22
Pwllpeiran	GB	52.4	-3.8	S	5.0	2200	7	1.36	2005	1
Ruabon	GB	53.0	-3.1	S	9.3	1010	7	1.99	2000	29
Thursley	GB	51.2	-0.7	S	9.7	808	7	1.57	2005	1

Table S2(b). Site information: soil properties and leaching fluxes.

Site	soil type	soil pH	soil depth m	bypass	soil C pool g m^{-2}	soil N pool g m^{-2}	ΔN_{inorg} g m^{-2} a^{-1}	ΔDOC g m^{-2} a^{-1}	ΔDON g m^{-2} a^{-1}	CN g g^{-1}
Grizedale	Podzol	4.2	0.14	0	10753	425	0.16	10.2	-	25.3
Harste bøg	Luvisol	4.3	0.30	0	6180	460	1.28	-	-	13.4
Lüneburger Heide	Podzol	4.0	0.30	0	5130	310	0.05	-	-	16.5
Mid East Oak mean	Podzol	4.5	0.27	0	6615	347	0.36	3.1	-	19.1
Mid West Oak mean	Podzol	4.9	0.25	0	4994	263	0.83	8.6	-	19.0
North Coast Oak mean	Podzol	4.6	0.23	0	7086	353	0.17	9.9	-	20.1
Snowdonia Oak mean	Podzol	4.7	0.24	0	8168	397	0.06	13.7	-	20.6
Winterswijk	Podzol-Luvisol	3.8	0.30	0	11000	770	1.00	-	-	14.3
Flakaliden	Podzol	4.3	0.15	0	2870	92	0.05	-	-	31.2
Gårdsjön	Podzol	3.9	0.30	0	11660	376	0.01	-	-	31.0
Harderwijk	Arenosol	4.3	0.30	0	6357	273	0.43	-	-	23.3
Harplinge	Podzol	4.0	0.30	0	9500	490	1.92	-	-	19.4
Höglwald	Acrisol	4.1	0.30	0	4720	271	3.15	-	-	17.4
Klosterhede	Podzol	4.0	0.30	0	7320	244	0.01	-	-	30.0
Leuvenum	Arenosol	3.4	0.30	0	8800	250	1.00	-	-	35.2
Risdalsheia	Leptosol	4.1	0.12	1	8916	496	0.60	9.7	0.28	18.0
Solling	Cambisol	4.1	0.12	0	9430	398	1.40	-	0.06	23.7
Strasan	Podzol	4.3	0.15	0	2180	67	0.05	-	-	32.5
Uddevalla	Podzol	4.8	0.15	0	5130	164	0.05	-	-	31.3
Westerberg	Podzol	3.5	0.30	0	9270	294	2.64	-	-	31.5
Wingst	Cambisol	3.6	0.30	0	4580	177	2.92	-	-	25.9
Gwy	Histosol-Podzol	3.7	0.20	1	12472	603	0.18	-	-	20.7
Lake District podzol typical	Podzol	4.6	0.37	0	7800	630	0.00	-	0.20	12.4
Lake District ranker typical	Leptosol	4.3	0.23	1	11200	700	0.77	3.6	0.20	16.0
Makevatn1	Leptosol	4.6	0.10	1	6672	295	0.95	6.5	0.39	22.6
Makevatn2	Leptosol	4.5	0.13	1	8994	469	1.15	6.5	0.40	19.2
Oygard1	Leptosol	4.4	0.10	1	5485	195	0.05	8.8	0.14	28.1
Oygard2	Leptosol	4.4	0.08	1	5277	247	0.68	8.8	0.46	21.4
Scoat Tarn	Histosol-Podzol	3.9	0.20	1	13390	760	0.49	-	-	17.6
Snowdon	Leptosol	4.2	0.10	1	5917	400	0.87	8.5	-	14.8
Sourhope	Podzol	4.3	0.10	0	6018	442	0.14	11.3	-	13.6
Allt a Mharcaidh	Leptosol-Histosol-Podzol	3.8	0.20	1	11213	237	0.01	-	-	47.3
Clocaenog	Podzol	4.4	0.17	0	10747	225	0.51	23.7	0.47	47.8
Culardoch	Leptosol	4.6	0.21	1	12157	477	0.08	9.8	-	25.5
Glensaugh	Podzol	4.0	0.10	0	8200	713	0.05	15.1	-	11.5
Makevatn3	Leptosol	4.5	0.10	1	7082	369	0.72	6.5	0.33	19.2
Mols	Podzol	4.6	0.20	0	3418	212	0.12	5	0.11	16.1
Oldebrook	Podzol	3.8	0.16	0	4222	203	1.24	13.5	0.60	20.8
Oygard3	Leptosol	4.2	0.10	1	6170	268	0.28	8.8	0.43	23.0
Pwllpeiran	Podzol	4.0	0.17	0	11635	824	0.50	7.5	-	14.1
Ruabon	Podzol	4.5	0.10	0	10536	315	0.03	8.8	-	33.4
Thursley	Podzol	4.9	0.22	0	3460	141	0.01	4.1	-	24.5

Table S2(c). Site properties: references.

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Table S3. Radiocarbon data (% absolute modern) for topsoils of N. Europe developed under trees and non-trees. Data were compiled for samples collected between 1990 and 2010 (mean 2002.5 for trees, 2005.8 for non-trees). Where necessary, data for more than one horizon were amalgamted to give a single topsoil value. The average ^{14}C contents of 108.6 (sd 5.1) for trees and 98.7 (sd 10.4) for non-trees differ significantly ($p < 0.001$).

soils under trees									soils under non-trees											
date	^{14}C	ref	date	^{14}C	ref	date	^{14}C	ref	date	^{14}C	ref	date	^{14}C	ref	date	^{14}C	ref	date	^{14}C	ref
2002	108.7	1	2002	111.1	1	1997	111.5	3	2007	106.5	7	2007	107.3	7	2007	105.3	7	2007	105.4	7
2002	111.0	1	2002	111.8	1	2000	114.8	4	2007	103.0	7	2007	108.0	7	2007	93.4	7	2005	101.5	8
2002	112.3	1	2002	91.0	1	2001	110.3	5	2007	105.8	7	2007	107.5	7	2007	60.6	7	2005	106.2	8
2002	110.2	1	2002	97.9	1	2008	108.7	6	2007	107.2	7	2007	89.9	7	2007	100.5	7	2005	105.0	8
2002	110.0	1	2002	99.1	1	2007	103.1	7	2007	96.9	7	2007	98.7	7	2007	96.2	7	2005	98.3	8
2002	110.5	1	2002	111.4	1	2007	105.9	7	2007	101.0	7	2007	95.1	7	2007	110.1	7	1993	91.3	9
2002	113.6	1	2002	110.8	1	2007	109.0	7	2007	70.0	7	2007	103.6	7	2007	122.2	7	1993	93.0	9
2002	109.6	1	2002	109.2	1	2007	107.8	7	2007	88.8	7	2007	109.5	7	2007	101.1	7	1993	86.2	9
2002	113.4	1	2002	114.5	1	2007	107.6	7	2007	95.5	7	2007	98.8	7	2007	107.5	7	2002	94.2	10
2002	110.9	1	1996	115.3	2	2007	111.9	7	2007	82.7	7	2007	83.9	7	2007	104.9	7	2002	94.0	10
2002	111.3	1	1996	108.5	2	2007	108.9	7	2007	99.3	7	2007	87.7	7	2007	90.8	7	2002	101.1	10
2002	111.7	1	1997	105.0	3	2007	107.0	7	2007	103.9	7	2007	106.5	7	2007	111.0	7	2002	85.3	10
2002	110.5	1	1997	106.2	3	2007	98.6	7	2007	107.2	7	2007	93.9	7	2007	84.2	7			
2002	106.2	1	1997	109.5	3	2007	119.6	7	2007	109.9	7	2007	98.8	7	2007	108.2	7			
2002	104.4	1	1997	105.0	3	2007	102.0	7	2007	104.4	7	2007	105.2	7	2007	93.7	7			

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Table S4. Site specific parameters. Bold values are means, italics indicate no adjustment (f_{DOC}, k_{P1P2}), or obtained by difference (f_{slow}). PFT = plant functional type; B broadleaved trees, C conifer, H herbs, S shrubs.

Site		lat	long	PFT	k_{immobN}	$\Delta N_{fix,pris}$	f_{fast}	f_{slow}	f_{pass}	f_{gr}	$\Delta N_{immobN2,max}$	f_{DOC}	k_{denitr}	k_{P1P2}
Grizedale	GB	54.3	-3.0	B	1.80E-04	0.275	0.377	*0.603*	0.0197	0.599	1.14	2.74E-02	3.78E-02	*0.050*
Harste bøg	DE	51.6	9.9	B	1.80E-04	0.360	0.565	*0.425*	0.0210	0.399	0.92	2.74E-02	3.78E-02	*0.050*
Lüneburger Heide	DE	53.2	10.0	B	2.36E-04	0.326	0.469	*0.516*	0.0250	0.504	1.15	2.74E-02	4.74E-02	*0.050*
Mid East Oak mean	GB	52.7	-3.2	B	2.22E-04	0.296	0.465	*0.521*	0.0258	0.556	1.13	2.74E-02	5.14E-02	*0.050*
Mid West Oak mean	GB	52.7	-4.0	B	1.80E-04	0.267	0.516	*0.474*	0.0210	0.532	0.92	2.74E-02	3.78E-02	*0.050*
North Coast Oak mean	GB	53.2	-3.9	B	2.22E-04	0.260	0.448	*0.536*	0.0298	0.554	1.27	2.74E-02	4.86E-02	*0.050*
Snowdonia Oak mean	GB	53.0	-4.0	B	2.02E-04	0.357	0.390	*0.593*	0.0314	0.597	1.23	2.74E-02	4.34E-02	*0.050*
Winterswijk	NL	52.0	6.7	B	1.80E-04	0.360	0.377	*0.604*	0.0314	0.442	0.92	2.74E-02	3.78E-02	*0.050*
					2.00E-04	**0.313**	**0.451**	***0.534***	**0.0256**	**0.523**	**1.09**	***0.0274***	**0.0428**	***0.050***
Flakaliden	SE	64.2	19.8	C	7.34E-05	0.240	0.565	*0.426*	0.0210	0.496	0.92	2.74E-02	5.66E-02	*0.050*
Gårdsjön	SE	58.1	12.0	C	7.34E-05	0.355	0.383	*0.598*	0.0314	0.516	1.06	2.74E-02	3.78E-02	*0.050*
Harderwijk	NL	52.2	5.4	C	1.10E-04	0.360	0.564	*0.422*	0.0282	0.620	1.38	2.74E-02	4.88E-02	*0.050*
Harplinge	SE	56.5	12.5	C	7.34E-05	0.360	0.481	*0.503*	0.0313	0.414	0.92	2.74E-02	3.78E-02	*0.050*
Höglwald	DE	48.3	11.1	C	7.35E-05	0.360	0.565	*0.426*	0.0210	0.414	0.92	2.74E-02	3.78E-02	*0.050*
Klosterhede	DK	56.3	8.2	C	1.07E-04	0.274	0.519	*0.467*	0.0292	0.543	1.38	2.74E-02	3.78E-02	*0.050*
Leuvenum	NL	52.3	5.7	C	1.10E-04	0.241	0.377	*0.604*	0.0314	0.620	1.38	2.74E-02	5.66E-02	*0.050*
Risdalsheia	NO	58.4	8.2	C	1.08E-04	0.341	0.494	*0.491*	0.0236	0.421	1.24	2.74E-02	4.55E-02	*0.050*
Solling	DE	51.5	9.5	C	9.72E-05	0.323	0.447	*0.536*	0.0283	0.475	1.01	2.74E-02	4.81E-02	*0.050*
Strasan	SE	60.9	16.0	C	1.10E-04	0.240	0.565	*0.426*	0.0210	0.530	0.94	2.74E-02	5.66E-02	*0.050*
Uddevalla	SE	58.5	11.7	C	1.09E-04	0.282	0.565	*0.426*	0.0225	0.480	1.06	2.74E-02	5.46E-02	*0.050*
Westerberg	DE	53.4	9.1	C	7.34E-05	0.307	0.377	*0.604*	0.0314	0.446	0.93	2.74E-02	5.49E-02	*0.050*
Wingst	DE	53.4	9.0	C	7.64E-05	0.311	0.565	*0.426*	0.0210	0.414	0.92	2.74E-02	3.78E-02	*0.050*
					9.19E-05	**0.307**	**0.497**	***0.489***	**0.0263**	**0.491**	**1.08**	***0.0274***	**0.0470**	***0.050***
Gwy	GB	52.5	-3.7	H	1.43E-04	0.309	0.491	*0.468*	0.0715	0.620	1.38	2.74E-02	3.78E-02	*0.050*
Lake District podzol typical	GB	54.5	-3.3	H	2.15E-04	0.240	0.599	*0.375*	0.0527	0.511	1.34	2.74E-02	5.02E-02	*0.050*
Lake District ranker typical	GB	54.5	-3.3	H	2.09E-04	0.275	0.540	*0.425*	0.0651	0.606	1.27	2.74E-02	4.69E-02	*0.050*
Makevatn1	NO	58.3	6.4	H	1.69E-04	0.275	0.670	*0.308*	0.0583	0.540	1.18	2.74E-02	5.23E-02	*0.050*
Makevatn2	NO	58.3	6.4	H	1.45E-04	0.337	0.632	*0.339*	0.0671	0.531	0.93	2.74E-02	4.39E-02	*0.050*
Oygard1	NO	58.6	6.1	H	1.66E-04	0.248	0.689	*0.291*	0.0535	0.609	1.29	2.74E-02	5.39E-02	*0.050*
Oygard2	NO	58.6	6.1	H	1.46E-04	0.240	0.683	*0.295*	0.0558	0.484	0.92	2.74E-02	5.33E-02	*0.050*
Scoat Tarn	GB	54.5	-3.3	H	1.43E-04	0.360	0.491	*0.468*	0.0715	0.620	1.32	2.74E-02	3.78E-02	*0.050*
Snowdon	GB	53.1	-4.0	H	1.43E-04	0.294	0.710	*0.273*	0.0556	0.535	0.94	2.74E-02	5.18E-02	*0.050*
Sourhope	GB	55.5	-2.2	H	2.15E-04	0.240	0.662	*0.317*	0.0715	0.545	1.38	2.74E-02	5.66E-02	*0.050*
					1.69E-04	**0.282**	**0.617**	***0.356***	**0.0623**	**0.560**	**1.19**	***0.0274***	**0.0485**	***0.050***
Allt a Mharcaidh	GB	57.1	-3.8	S	6.56E-05	0.240	0.491	*0.475*	0.0565	0.620	0.92	2.74E-02	5.66E-02	*0.050*
Clocaenog	GB	53.0	-3.5	S	6.56E-05	0.240	0.491	*0.479*	0.0477	0.620	0.92	2.74E-02	5.63E-02	*0.050*
Culardoch	GB	57.1	-3.3	S	8.03E-05	0.292	0.580	*0.392*	0.0619	0.564	1.25	2.74E-02	5.13E-02	*0.050*
Glensaugh	GB	56.9	-2.6	S	9.84E-05	0.278	0.616	*0.354*	0.0715	0.414	1.38	2.74E-02	5.66E-02	*0.050*
Makevatn3	Nor	58.3	6.4	S	9.84E-05	0.240	0.589	*0.378*	0.0715	0.414	1.38	2.74E-02	5.66E-02	*0.050*
Mols	DK	56.4	11.0	S	9.84E-05	0.240	0.572	*0.393*	0.0715	0.446	1.38	2.74E-02	5.66E-02	*0.050*
Oldebrook	NL	52.4	5.9	S	9.84E-05	0.360	0.723	*0.262*	0.0713	0.487	1.38	2.74E-02	5.66E-02	*0.050*
Oygard3	Nor	58.6	6.1	S	9.84E-05	0.360	0.734	*0.251*	0.0640	0.468	1.38	2.74E-02	5.66E-02	*0.050*
Pwllpeiran	GB	52.4	-3.8	S	8.62E-05	0.334	0.648	*0.326*	0.0658	0.465	1.01	2.74E-02	4.62E-02	*0.050*
Ruabon	GB	53.0	-3.1	S	9.09E-05	0.243	0.519	*0.444*	0.0609	0.592	1.34	2.74E-02	5.59E-02	*0.050*
Thursley	GB	51.2	-0.7	S	9.83E-05	0.344	0.737	*0.249*	0.0477	0.571	1.38	2.74E-02	5.66E-02	*0.050*
					8.90E-05	**0.288**	**0.609**	***0.364***	**0.0628**	**0.515**	**1.25**	***0.0274***	**0.0551**	***0.050***

Table S5. Observed and simulated means for broadleaved (B) and coniferous (C) trees at sites in the NIPHYS and CANIF projects (see References), *n* = number of sites. Values in italics indicate a significant difference ($p < 0.05$) between observed and simulated values. N_{dep} is throughfall.

			broadleaf			conifer	
	range of MAP (mm)		890 - 1192			890 - 1192	
	range of MAT (^{o}C)		5.4 - 7.5			1.0 - 8.5	
	range of N_{dep} (g m^{-2} a^{-1})		0.91 - 2.23			0.19 - 2.22	
		n	obs	sim	*n*	obs	sim
soil C	kg m^{-2}	5	6.91 (2.05)	6.69 (0.95)	6	6.85 (2.83)	8.05 (0.96)
soil N	g m^{-2}	5	385 (152)	423 (80)	6	334 (181)	302 (92)
soil C:N	g g^{-1}	5	18.6 (3.2)	16.1 (3.0)	6	22.7 (6.6)	28.1 (5.8)
ΔN_{inorg}	g m^{-2} a^{-1}	3	0.13 (0.11)	0.01 (0.02)	5	0.67 (0.78)	0.36 (0.28)
NPP	gC m^{-2} a^{-1}	5	604 (135)	470 (110)	6	627 (229)	595 (102)
biomass	kgC m^{-2}	5	*15.7 (3.0)*	*11.3 (2.0)*	6	*11.0 (2.5)*	*16.7 (2.3)*

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Table S6. Summary of GB Countryside Survey data used in this work (from Carey et al., 2008; Emmett et al., 2010).

vegetation	year	*n*	MAP		MAT		N_{dep}		soil C				soil N				soil C:N			
									kg m^{-2}				g m^{-2}				g g^{-1}			
			mm		°C		g m^{-2} a^{-1}		obs		sim		obs		sim		obs		sim	
			min	max	min	max	min	max	mean	SD	mean	SD	mean	SD	mean	SD	mean	SD	mean	SD
broadleaf	1998	47	548	3431	7.9	12.1	0.4	5.7	7.61	1.67	5.76	0.89	512	140	403	60	15.7	5.1	14.3	1.1
	2007	44	486	3431	8.0	11.8	0.4	5.7	6.86	2.28	6.00	0.97	495	169	425	63	14.6	4.9	14.1	1.0
conifer	1998	63	785	3432	7.1	11.4	0.8	4.2	8.28	1.91	7.46	0.62	414	124	289	37	21.1	6.0	25.9	1.6
	2007	61	770	3432	7.1	11.4	0.7	4.2	7.39	2.83	7.56	0.58	384	139	295	40	19.8	5.7	25.8	1.9
neutral grassland	1998	117	573	2125	7.1	12.1	0.4	4.2	6.62	1.41	6.13	0.81	548	125	492	74	12.5	3.4	12.5	0.5
	2007	114	573	2125	7.1	12.1	0.4	4.2	6.83	2.46	6.22	0.83	559	194	502	78	12.7	3.9	12.4	0.4
acid grassland	1998	52	1038	3808	5.7	10.5	0.5	5.0	8.62	1.51	6.98	1.09	488	130	594	93	18.5	4.6	11.7	0.4
	2007	44	601	3808	5.7	11.0	0.5	5.0	7.74	2.96	7.08	1.13	471	184	603	99	17.2	4.5	11.8	0.4
heath (shrub)	1998	58	713	3103	5.3	10.9	0.4	4.2	8.62	1.50	8.82	1.79	362	128	404	93	25.7	6.7	22.0	0.9
	2007	47	713	3103	5.3	10.9	0.4	4.2	9.27	3.63	8.53	1.70	419	168	387	86	23.4	7.3	22.1	0.8
bog (shrub)	1998	98	879	3808	5.3	10.3	0.4	2.4	7.83	1.38	8.12	1.32	320	135	374	65	27.3	7.9	21.7	0.6
	2007	61	713	3808	5.3	10.3	0.4	2.4	8.01	3.97	7.74	1.40	363	208	355	69	24.3	7.8	21.9	0.6
average									7.81		7.20		445		427		19.4		18.0	
weighted average									7.65		7.13		451		429		19.0		17.7	

Carey PD, Wallis S, Chamberlain PM, Cooper A, Emmett BA, Maskell LC, McCann T, Murphy J, Norton LR, Reynolds B, Scott WA, Simpson IC, Smart SM, Ullyett JM. Countryside Survey: UK Results from 2007. NERC/Centre for Ecology & Hydrology, 105pp; 2008.

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Table S7. Comparison of predicted and observed C and N topsoil pools at GB Countryside Survey sites (data from Carey et al., 2008; Emmett et al., 2010). Regression slopes are given for variations of C and N topsoil pools at different sites with MAT and N deposition. Slopes significantly different from zero ($p < 0.05$) are shown in bold.

vegetation	year	*n*	MAT				N deposition			
			C pool		N pool		C pool		N pool	
			kgC m^{-2} / ^{o}C		gN m^{-2} / ^{o}C		kgC / (gN_{dep} a^{-1})		gN / (gN_{dep} a^{-1})	
			obs	sim	obs	sim	obs	sim	obs	sim
broadleaf	1998	47	-0.11	-0.04	-8	**-19**	-0.30	**0.63**	4	**35**
	2007	44	-0.48	0.04	6	-7	-0.30	**0.67**	13	**42**
conifer	1998	63	-0.25	**-0.19**	2	**-17**	-0.22	**0.36**	7	**19**
	2007	61	-0.19	**-0.17**	5	**-17**	-0.38	**0.33**	-19	**23**
neutral grassland	1998	117	**-0.34**	**-0.53**	-9	**-57**	0.07	**0.91**	31	**69**
	2007	114	-0.02	**-0.57**	9	**-59**	0.64	**0.96**	62	**79**
acid grassland	1998	52	-0.21	**-0.63**	12	**-64**	0.05	**0.91**	17	**65**
	2007	44	-0.02	**-0.61**	33	**-62**	0.60	**0.88**	32	**67**
heath (shrub)	1998	58	0.05	**-0.94**	13	**-52**	0.19	**1.42**	16	**59**
	2007	47	0.11	**-0.96**	7	**-52**	**1.60**	**1.40**	**71**	**59**
bog (shrub)	1998	98	-0.09	**-1.04**	-15	**-55**	0.49	**2.14**	**81**	**93**
	2007	61	0.61	**-1.11**	-19	**-58**	0.84	**2.53**	**141**	**115**
average			-0.08	-0.56	3	-43	0.27	1.10	38	60

Carey PD, Wallis S, Chamberlain PM, Cooper A, Emmett BA, Maskell LC, McCann T, Murphy J, Norton LR, Reynolds B, Scott WA, Simpson IC, Smart SM, Ullyett JM. Countryside Survey: UK Results from 2007. NERC/Centre for Ecology & Hydrology, 105pp; 2008.

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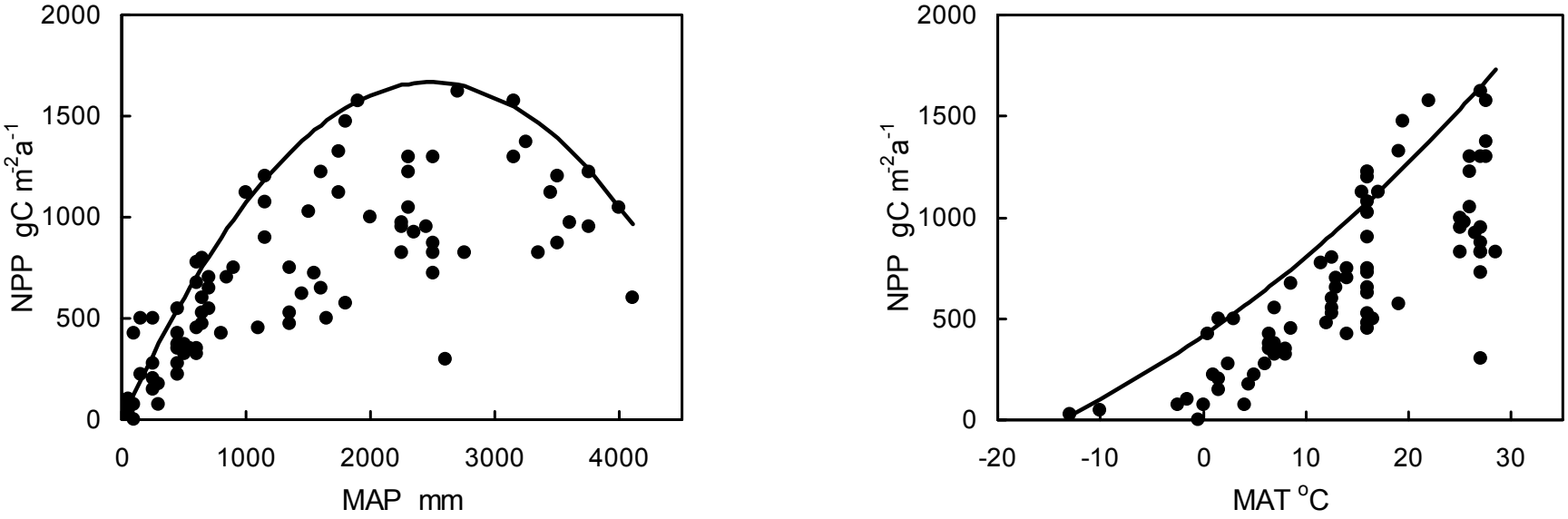

Figure S1. Estimation of NPP_{max} from data compiled by Chapin et al. (2002). The lines are quadratic 90% quantile regression fits to mean annual precipitation (MAP) and mean annual temperature (MAT). The equations are;

$NPP_{max} = 1.34\ MAP - 2.70 \times 10^{-4}\ MAP^2$

$NPP_{max} = 415 + 35.2\ MAT + 0.384\ MAT^2$

Chapin III, FS, Matson PA, Mooney HA. Principles of Terrestrial Ecosystem Ecology. Springer, New York; 2002.

Figure S2. Locations of sites used for fitting

Circles: broadleaved trees
Crosses: conifers
Squares: herbs
Triangles: shrubs

Figure S3. Locations of NIPHYS-CANIF sites

Circles: broadleaved trees
Crosses: conifers

Figure S4. Locations of Countryside Survey sites

(a) Broadleaved trees
(b) Conifers
(c) Neutral grassland
(d) Acid grassland
(e) Heather
(f) Bog

Note that some points represent more than one site.

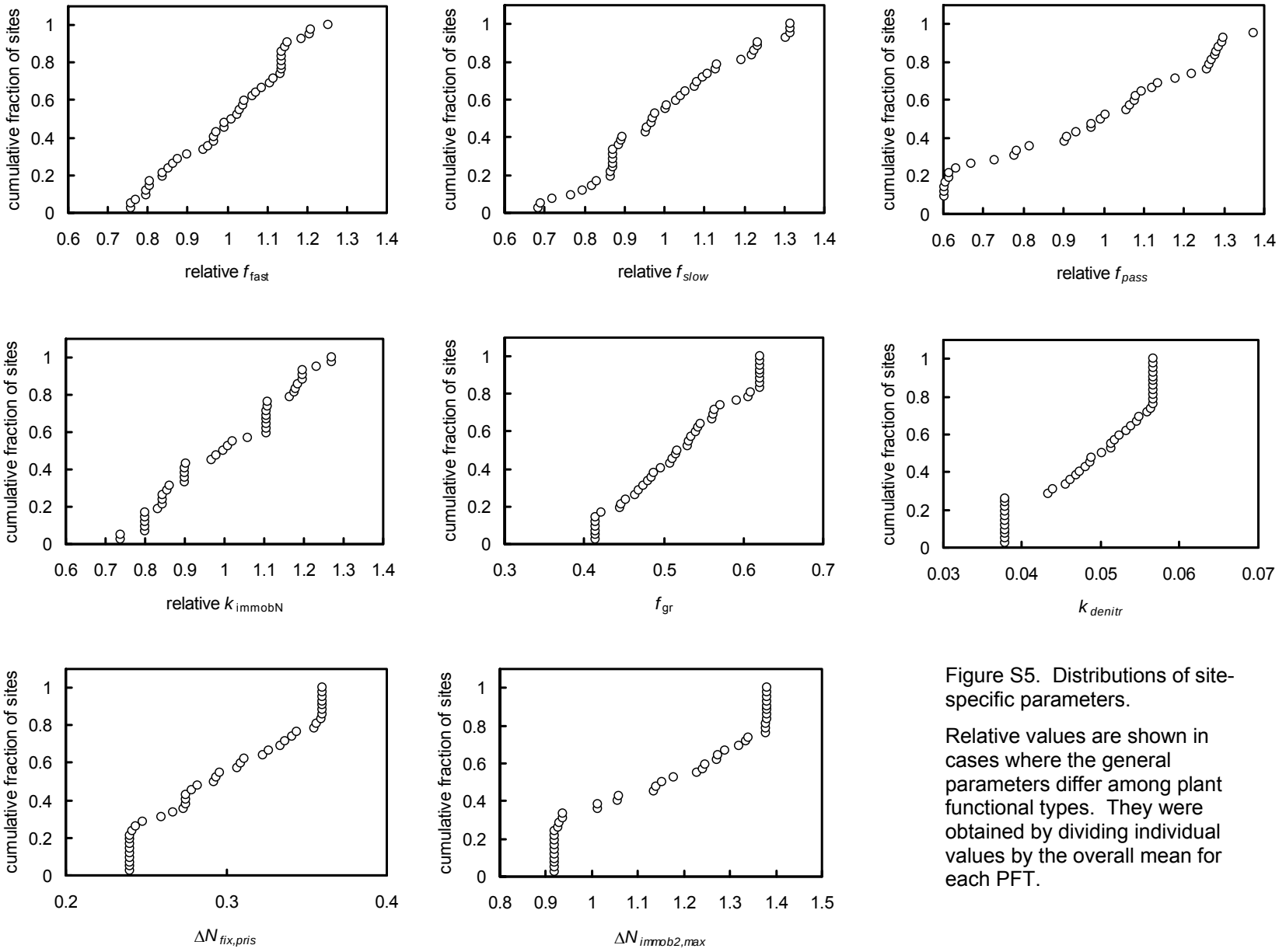

Figure S5. Distributions of site-specific parameters.

Relative values are shown in cases where the general parameters differ among plant functional types. They were obtained by dividing individual values by the overall mean for each PFT.

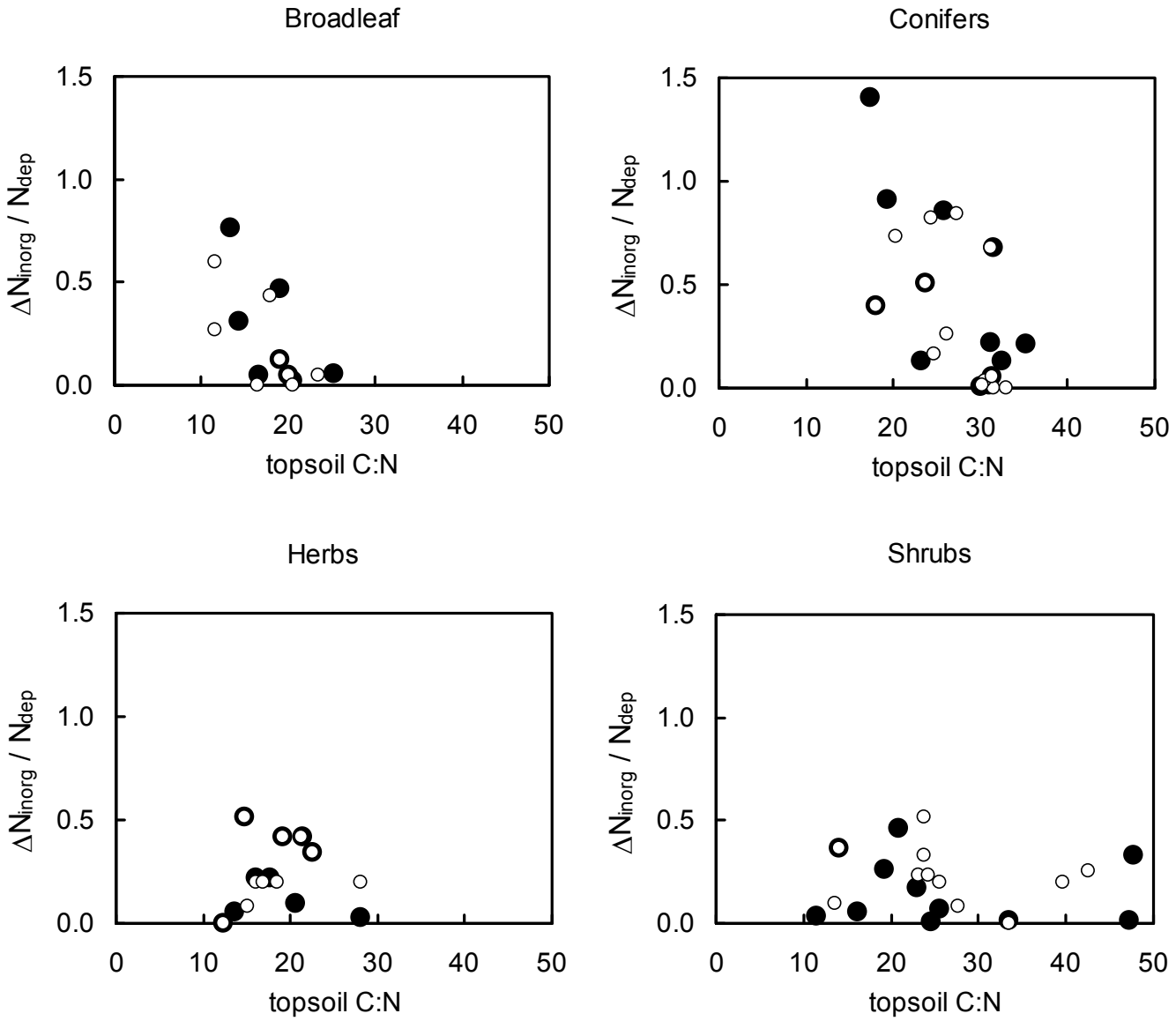

Figure S6. Relationships between the ratio (inorganic N leaching flux / N deposition) and topsoil C:N ratio. Observed points are shown by closed circles, simulated ones (site specific) by open circles.