

Supplementary Material 1 - Part1. Information about the studied sites.

Site	Abbreviation	Latitude	Longitude	Elevation (m)	Mean T (°C)	Precipitation (mm yr ⁻¹)	ETP (mm/year)	Bedrock	Tree species *	Year of stand establishment	Year of sampling	Stand age (years)	Stand age **	R95% (cm)	MAWS (mm)	Ho:H _{max}
Abr	AbrAaM	48°38'N	7°05'E	400	8.5	1250	1250	Vosgian sandstone	<i>Aa</i>	1940	1994; 1998; 2007	58	M	125	77	0.80
Ard	ArdPaM	49°52'N	4°48'E	390	8.0	1100	600	Blue-grey phyllites	<i>Pa</i>	1931; 1947	1977; 1997	-	M	110	123	0.59
Ard	ArdQpVO	49°52'N	4°48'E	390	8.0		600	Blue-grey phyllites	<i>Qp</i>	1831; 1855	1977; 1997	-	VO	110	120	0.59
Au1	Au1PaY	48°12'N	7°11'E	1080	8.5	1400	<pp	Brézouard granite, strong hydrothermal alteration	<i>Pa</i>	1950; 1970; 1978	1985; 1991; 1996	-	Y	100	84	0.53
Au1	Au1PaM	48°12'N	7°11'E	1080	8.5	1400	<pp	Brézouard granite, strong hydrothermal alteration	<i>Pa</i>	1950	1991; 1994; 1996	44	M	100	53	0.58
Au1	Au1PaVY	48°12'N	7°11'E	1080	8.5	1400	<pp	Brézouard granite, strong hydrothermal alteration	<i>Pa</i>	1978	1985; 1991	10	VY	100	56	0.52
Au1	Au1PaO	48°12'N	7°11'E	1080	8.5	1400	<pp	Brézouard granite, strong hydrothermal alteration	<i>Pa</i>	1905	1985; 1991; 1994; 1996	86	O	100	63	0.76
Au2	Au2FsVY	48°12'N	7°11'E	1080	8.5	1400	<pp	Brézouard granite, weak hydrothermal alteration	<i>Fs</i>	1970	1985	15	VY	135	49	0.70
Au2	Au2FsVO	48°12'N	7°11'E	1080	8.5	1400	<pp	Brézouard granite, weak hydrothermal alteration	<i>Fs</i>	1834	1985; 1991; 1994	156	VO	135	66	0.70
Bon	BonPaM	48°10'N	7°01'E	1100	5.0	1544	<pp	Valtin leucocrate granite	<i>Pa</i>	1918	1988	70	M	>80	32	0.70
Bre	BreAnY	46°30'N	4°38'E	650	9.0	1280	640	Vire Type granite	<i>An</i>	1976	2001	25	Y	100	66	0.67
Bre	BreFsY	46°30'N	4°38'E	650	9.0	1280	640	Vire Type granite	<i>Fs</i>	1976	2001	25	Y	80	50	0.75
Bre	BreFsVO	46°30'N	4°38'E	650	9.0	1280	640	Vire Type granite	<i>Fs</i>	~ 1826	1974; 2001	170	VO	95	76	0.75
Bre	BrePaY	46°30'N	4°38'E	650	9.0	1280	640	Vire Type granite	<i>Pa</i>	1976	2001	25	Y	130	119	0.66
Bre	BrePmY	46°30'N	4°38'E	650	9.0	1280	640	Vire Type granite	<i>Pm</i>	1976	2001	25	Y	80	64	0.84
Bre	BrePnY	46°30'N	4°38'E	650	9.0	1280	640	Vire Type granite	<i>Pn</i>	1976	2001	25	Y	110	106	0.84
Bre	BreQpY	46°30'N	4°38'E	650	9.0	1280	640	Vire Type granite	<i>Qp</i>	1976	2001	25	Y	110	89	0.59
CHS 01	CHS01QpO	46°10'17" N	5°14'22" E	260	11.2	1102	1102	Old Loam	<i>Qp</i>	1907	1995	88	O	130	180	0.79
CHS 03	CHS03QpVO	46°40'05" N	2°43'37" E	260	10.8	831	831	Clayey Sandstone	<i>Qp</i>	1880	1995	115	VO	75	75	0.88
CHS 35	CHS35QpVO	48°10'41" N	1°32'01" W	80	11.6	784	784	Greenschist	<i>Qp</i>	1894	1995	101	VO	70	72	1.00
CHS 57b	CHS57bQpVO	49°00'59" N	7°27'45" E	320	9.2	956	956	Quartzly Sandstone	<i>Qp</i>	1867	1995	128	VO	125	80	0.75
CHS 58	CHS58QpM	46°58'13" N	3°39'39" E	270	10.4	963	963	Stony Loam	<i>Qp</i>	1934	1995	61	M	150	135	0.88
CHS 61	CHS61QpO	48°31'23" N	0°40'48" E	220	10.2	750	750	Stony Loam	<i>Qp</i>	1907	1995	88	O	98	105	0.81
CHS 81	CHS81QpO	44°02'44" N	1°44'56" E	300	11.7	915	915	Clayey Sandstone	<i>Qp</i>	1897	1995	98	O	90	85	1.00
CHS 86	CHS86QpO	46°37'38" N	0°29'44" E	116	11.4	703	703	Stony Loam	<i>Qp</i>	1913	1995	82	O	125	78	0.84
DOU 23	DOU23PmY	46°09'47" N	1°49'33" E	610	10.0	1065	1065	Granite	<i>Pm</i>	1971	1995	24	Y	128	113	0.80
DOU 34	DOU34PmM	43°26'54" N	2°42'56" E	700	11.9	1242	1242	Schist	<i>Pm</i>	1947	1995	48	M	60	45	0.97
DOU 61	DOU61PmY	48°34'29" N	0°04'05" W	375	9.5	906	906	Quartzly Sandstone	<i>Pm</i>	1965	1995	30	Y	85	95	1.00
DOU 65	DOU65PmY	43°06'00" N	0°06'25" W	420	12.2	1522	1522	Stony Loam	<i>Pm</i>	1971	1995	24	Y	80	100	1.00
DOU 69	DOU69PmY	45°56'51" N	4°28'42" E	520	10.1	921	921	Gneiss	<i>Pm</i>	1971	1995	24	Y	70	78	0.87
EPC 08	EPC08PaY	49°56'51" N	4°48'35" E	480	8.2	1324	1324	Siltstone	<i>Pa</i>	1960	1995	35	Y	110	110	0.70
EPC 34	EPC34PaY	43°38'14" N	2°55'16" E	1020	8.6	1517	1517	Gneiss	<i>Pa</i>	1968	1995	27	Y	60	45	0.68
EPC 63	EPC63PaY	45°45'20" N	2°57'58" E	950	6.6	1043	1043	Basalt cinder	<i>Pa</i>	1967	1995	28	Y	160	80	0.82
EPC 71	EPC71PaM	47°00'33" N	4°07'06" E	600	9.4	1378	1378	Granite	<i>Pa</i>	1947	1995	48	M	130	90	0.84
EPC 81	EPC81PaM	43°26'31" N	2°26'05" E	820	10.1	1439	1439	Gneiss	<i>Pa</i>	1952	1995	43	Y	110	68	0.73
EPC 87	EPC87PaY	45°48'00" N	1°48'55" E	650	9.3	1312	1312	Granite	<i>Pa</i>	1972	1995	23	Y	90	85	0.68
EPC 88	EPC88PaO	48°14'02" N	7°06'14" E	660	7.9	1266	1266	Granite	<i>Pa</i>	1906	1995	89	O	110	60	0.96

*Tree species *Aa*=*Abies alba* Mill., *An*=*Abies nordmanniana* Spach, *Eu*=*Eucalyptus* (*E. grandis* W. Hill ex Maiden at Ita, unknown hybrid at Kon), *Fs*=*Fagus sylvatica* L., *Br*=mixed broadleaves, *Pa*=*Picea abies* (L.) Karst. , *Pn*=*Pinus nigra* Arnold, *Pm*=*Pseudotsuga menziesii* (Mirb.) Franco, *Qp*=*Quercus petraea* (Matt.) Liebl.

**Stand age VY=0-15 year, Y=16-40 year, M=41-70 year, O=71-100 year, VO>100 year. For tropical stands, stand age is indicated in years since planting.

Supplementary Material 1 - Part2. Information about the studied sites.

Site	Abbreviation	Latitude	Longitude	Elevation (m)	Mean T (°C)	Precipitation (mm yr ⁻¹)	ETP (mm/year)	Bedrock	Tree species *	Year of stand establishment	Year of sampling	Stand age (years)	Stand age **	R95% (cm)	MAWS (mm)	H ₀ :H _{max}
Fou	FouBrIY	48°23'N	1°8'W	175	12.9	868	485	Vire Type granite	Br	1965	2003	38	Y	146	91	0.68
Fou	FouBrIVY	48°23'N	1°8'W	175	12.9		485	Vire Type granite	Br	1995	2003	8	VY	140	90	0.68
Fou	FouBrIVO	48°23'N	1°8'W	175	12.9		485	Vire Type granite	Br	1880	2003	123	VO	154	89	0.78
Fou	FouBrIO	48°23'N	1°8'W	175	12.9		485	Vire Type granite	Br	1928	2003	75	O	150	94	0.86
Fou	FouFsY	48°23'N	1°8'W	175	12.9		485	Vire Type granite	Fs	1971	1996	25	Y	145	225	0.68
Fou	FouFsVY	48°23'N	1°8'W	175	12.9		485	Vire Type granite	Fs	1988	1996	8	Y	140	245	0.68
Fou	FouFsVO	48°23'N	1°8'W	175	12.9		485	Vire Type granite	Fs	1851	1996	145	VO	156	279	0.78
Fou	FouFsO	48°23'N	1°8'W	175	12.9		485	Vire Type granite	Fs	1915	1996; 2001	83	O	150	252	0.86
Gem	GemPaO	48°15'N	7°5'E	650	8.5	1120	<pp	Varied lithology gneiss	Pa	1904	1988; 1991	85	O	120	71	1.00
HET 03	HET03FsO	46°11'37" N	2°59'54" E	590	9.6	894	894	Micaschist	Fs	1908	1995	87	O	110	88	0.94
HET 09	HET09FsVO	42°55'53" N	1°16'56" E	1250	9.4	1339	1339	Schist	Fs	1843	1995	152	VO	120	98	0.56
HET 14	HET14FsO	49°10'57" N	0°51'23" W	90	10.4	888	888	Siltstone	Fs	1912	1995	83	O	100	95	0.91
HET 29	HET29FsM	47°50'16" N	3°32'34" W	50	11.7	1026	1026	Granite	Fs	1931	1995	64	M	100	143	0.81
HET 30	HET30FsVO	44°06'55" N	3°32'36" E	1400	4.9	1894	1894	Micaschist	Fs	1852	1995	143	VO	80	53	0.74
HET 54a	HET54aFsO	48°30'35" N	6°42'23" E	325	9.1	905	905	Stony Loam	Fs	1900	1995	95	O	120	113	0.83
HET 55	HET55FsO	49°10'15" N	5°00'17" E	250	9.9	977	977	Sandstones (Gaize)	Fs	1906	1995	89	O	125	80	0.85
HET 64	HET64FsM	43°09'01" N	0°39'29" W	400	13.3	1410	1410	Flysch	Fs	1928	1995	67	M	90	110	0.83
HET 65	HET65FsVO	43°01'36" N	0°26'12" E	850	10.1	1141	1141	Flysch	Fs	1835	1995	160	VO	100	88	0.76
HET 76	HET76FsO	49°42'39" N	1°19'34" E	210	9.5	972	972	Stony Loam	Fs	1908	1995	87	O	110	145	0.72
HET 81	HET81FsVO	43°24'38" N	2°10'40" E	700	9.8	1409	1409	Granodiorite	Fs	1887	1995	108	VO	110	100	0.88
HET 88	HET88FsM	48°06'21" N	6°14'50" E	400	9.3	1110	1110	Sandstones	Fs	1927	1995	68	M	110	100	0.77
Ita	ItaEu1	23°02'S	48°38'W	850	19.2	1370	968	Detritic sands	Eu	2004	2005	1	1	340	346	0.98
Ita	ItaEu3	23°02'S	48°38'W	850	19.2	1370	968	Detritic sands	Eu	2004	2007	3	3	400	408	0.98
Ita	ItaEu5	23°02'S	48°38'W	850	19.2	1370	968	Detritic sands	Eu	1998	2003	5	5	400	484	0.98
Kon	KonEu1	4°33'S	11°54'E	100	25.0	1200	1630	Continental sands	Eu	2005	2006	1	1	340	244	0.80
Kon	KonEu3	4°33'S	11°54'E	100	25.0	1200	1630	Continental sands	Eu	1998	2001	3	3	400	287	0.90
Kon	KonEu6	4°33'S	11°54'E	100	25.0	1200	1630	Continental sands	Eu	1992	1998	6	6	400	288	0.90
Kon	KonEu7	4°33'S	11°54'E	100	25.0	1200	1630	Continental sands	Eu	1992	1999	7	7	400	271	0.95
Kon	KonEu8	4°33'S	11°54'E	100	25.0	1200	1630	Continental sands	Eu	1992; 2001	2000; 2009	8	8	400	305	0.95
PL 20	PL20PnVO	42°15'56" N	8°50'49" E	1100	9.6	1566	1566	Granodiorite	Pn	1822	1995	173	VO	120	108	1.00
PL 41	PL41PnM	47°39'36" N	2°05'58" E	140	10.9	743	743	Non-Calcareous Sandy Deposits	Pn	1950	1995	45	M	90	78	0.85
SP 07	SP07AaO	44°42'36" N	3°57'57" E	1300	6.1	1452	1452	Gneiss	Aa	1915	1995	80	O	95	80	0.75
SP 09	SP09AaVO	42°51'52" N	1°20'43" E	1100	9.4	1446	1446	Quartzic Schist	Aa	1827	1995	168	VO	40	65	0.83
SP 38	SP38AaO	45°25'17" N	6°07'53" E	1100	8.3	1264	1264	Stony Loam	Aa	1901	1995	94	O	110	78	0.82
SP 63	SP63AaVO	45°26'51" N	3°31'39" E	1040	7.1	1222	1222	Gneiss	Aa	1887	1995	108	VO	70	65	0.67
Vau	VauPmY	46°10'N	4°38'E	770	7.0	1000	<pp	Vosges Volcanic tuf	Pm	1970	1993	23	Y	85	78	0.74
Vau	VauPmM	46°10'N	4°38'E	770	7.0	1000	<pp	Vosges Volcanic tuf	Pm	1950	1993	43	M	85	65	0.81

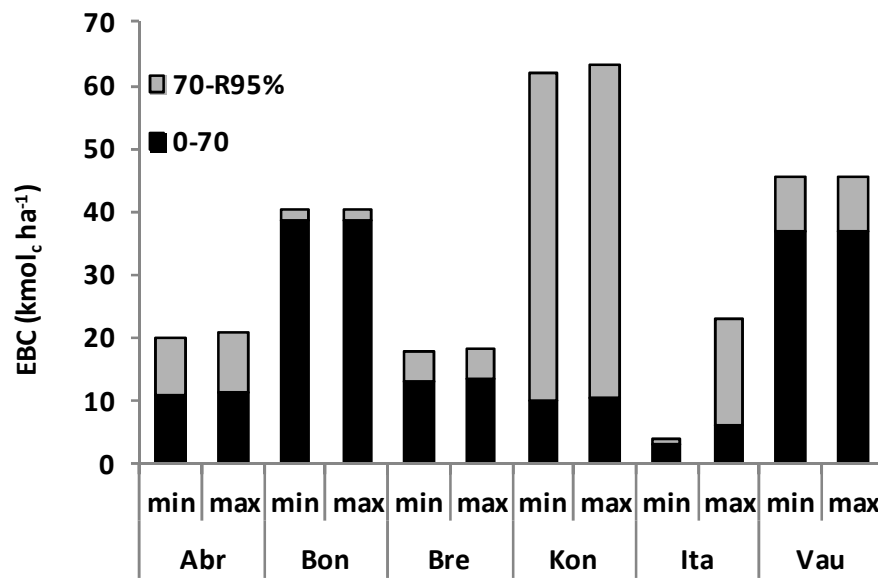
*Tree species Aa=Abies alba Mill., An=Abies nordmanniana Spach, Eu=Eucalyptus (*E. grandis* W. Hill ex Maiden at Ita, unknown hybrid at Kon), Fs=Fagus sylvatica L., Br=mixed broadleaves, Pa=Picea abies (L.) Karst. , Pn=Pinus nigra Arnold, Pm=Pseudotsuga menziesii (Mirb.) Franco, Qp=Quercus petraea (Matt.) Liebl.

**Stand age VY=0-15 year, Y=16-40 year, M=41-70 year, O=71-100 year, VO>100 year. For tropical stands, stand age is indicated in years since planting.

Supplementary Material 2. Summary of the limits of detection used

	Limit of detection	Sites with values < detection limit
N (%)	0.005	Fou, Ita
K exch. (cmolc/ kg)	0.01	Ita, Kon
Na exch. (cmolc/ kg)	0.01	Abr, Aub, Bre, Gem, Ita, Kon
Ca exch. (cmolc/ kg)	0.01	Au2, Bre, Ita
Mg exch. (cmolc/ kg)	0.01	Bon, Bre, Ita, Kon, Vau
Mn exch. (cmolc/ kg)	0.005	Bon, Bre, Gem, Ita, Vau
H exch. (cmolc/ kg)	0.05	Aub, Au2, Bon, Bre, Fou, Gem, Ita, Kon, Vau
Al exch. (cmolc/ kg)	0.1	Ita, Kon
Fe exch. (cmolc/ kg)	0.01	Abr, Bre, Fou, Gem, Ita, Vau
K ₂ O Tot (%)	0.05	Ita, Kon
Na ₂ O Tot (%)	0.07	Aub, Gem, Ita, Kon, Vau
CaO Tot (%)	0.02	Ita, Kon

Supplementary Material 3. Minimum and maximum EBC stocks ($\text{kmol}_c \text{ha}^{-1}$) down to 70 cm depth and to R95% at sites with data below detection limit.



Supplementary Material 4. Correlation (Kendall) between soil properties. The average values for each depth, each site, each species and each stand age were used. Data from 49 sites were computed except for total elements (11 sites). n.s. = not significant ($p>0.05$).

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Supplementary Material 5. Variable importance, expressed through the increase in MSE of predictions (%IncMSE), as measured by Random Forests performed on our dataset to predict H0:Hmax (standardized forest productivity index). Different datasets were used as predictors: (1) soil parameters for the 0-10cm layer (variance explained: 12.05%) and (2) soil parameters for the 0-10cm layer and climatic parameters (variance explained: 13.98%). Predictors related to climate are mentioned in red.

