Supplement for: Carbon cycling in mature and regrowth forests globally: a macroecological synthesis based on the global Forest Carbon (ForC) database

Contents

Appendix S1. Duplicates and Conflicting Records within ForC

Status of duplicates and conflicting records within ForC

ForC v3.0 contains potential duplicates that have arisen from importing intermediary data sets with overlap in data. In particular, the recent imports of *SRDB* and *GROA* resulted in the introduction of numerous potential duplicates. *SRDB* and *ForC* were developed independently (but with different foci), resulting in numerous duplicates. The *GROA* database was developed semi-independently, incorporating *ForC* data partway through its development. For records retaining the same site names, *GROA* duplicates were not imported into *ForC* (although they were checked against corresponding *ForC* records, and differences reconciled). There were, however, some records entered into *GROA* independently of *ForC*, resulting in mismatched names.

Prior to the merging of the three databases (*ForC* v2.0, *SRDB*, and *GROA*), there were potential duplicates within the *ForC* and *SRDB* portions, the latter an artifact of how data were recorded in *SRDB* and imported into *ForC. GROA* has no known duplicates, with several steps having been taken to ensure independence of the records within the database.

To the extent possible, we used automated scripts in R to detect and remove duplicate records in the creation of *ForC-simplified.*

Handling within-plot duplicates

Duplicate records within a plot and taken in the same year were reconciled as follows. Replicate measurements (*i.e.*, replicates from within a single study) were averaged. Records that subsumed others—-*i.e.*, the time period included that of ≥ 2 other records or dates were unknown and therefore conflicted with ≥ 2 other records—were removed. For each group of duplicate records—*i.e.*, measurements of the same variable in the same plot at the same time—one record was assigned precedence as follows. If duplicates were exact matches, one was dropped. When measurement periods overlapped or were not specified, precedence was given first to records representing longer measurement periods (*i.e.*, multi-year mean over a single year) and then to more recently published values. We manually reviewed duplicates that differed only in methodology, assigning precedence to the record employing a more comprehensive approach (*e.g.*, inclusion of understory, lianas, or bamboo as opposed to just trees) or using a favored methodology.

Handling duplicate sites

To handle cases where duplicate records had different site and/or plot names (and often slightly different geographic coordinates), we detected potential duplicates and, for those that had not yet been resolved, included only one in *ForC-simplified* and the analyses that were based on it. Potential duplicates were defined as records for the same variable made in the same year (when known) on stands of similar age and in the same geographic area (see Methods). Because records of stand age often lack precision and were sometimes recorded differently in different intermediary databases, we considered records to be potential duplicates when ages fell within one of several broad age groups: <10, 10-50, 50-100, and >100 years (or mature and of undefined age). We then generated groups of potential duplicates grouped by variable, geographic area, stand age grouping, and measurement year.

Within each group, we flagged records as potential duplicates–and excluded them from *ForC-simplified* until they can be reconciled–as follows. Because *GROA* is believed to contain no duplicates, all records originating from *GROA* were assumed independent, and any other records within the group flagged as potential duplicates. If all records originated from *ForC v2.0* or *SRDB*, we gave precedence to *ForC* records, flagging *SRDB* records as potential duplicates. If duplicates remained (within *ForC v2.0* or *SRDB*), we selected a record for retention based on citation year, keeping the oldest (presumably original) citations for most variables. For eddy-covariance variables (NEP, GPP, R_{eco}), we retained the record associated with the most recent publication (most often Pastorello *et al* 2020), as these data are commonly re-assessed using new analysis methods. If publication years were the same, we randomly selected one record.

This approach was conservative in that it removed some legitimately independent records. Future refinement of this process and manual review of potential duplicates will be needed to include legitimately-independent records in ForC-simplified and in analyses.

Table S1. Numbers of records by biome and age class

	n records	
Biome	Mature	Young
Boreal climate zones		
Boreal broadleaf	3	326
Boreal conifer	**491**	**919**
Boreal Other	46	151
Excluded climate zones		
Other broadleaf	6	111
Other conifer	30	45
Other Other	6	29
Temperate climate zones		
Temperate broadleaf	**650**	**3159**
Temperate conifer	**563**	**2730**
Temperate Other	159	2363
Tropical climate zones		
Tropical broadleaf	**835**	**2576**
Tropical conifer	3	1
Tropical Other	8	0

Sample sizes refer to data set after merging of duplicates, removal of stands with no age or history data, and removal of managed and disturbed stands. For vegetation type, “Other” refers to stands that are mixed broadleaf/ conifer or that have not been classified. Focal biomes are indicated in bold.

Table S2. Model parameter estimates for age trends and biome differences in young forests

Variable	Parameter	Estimate	SE	t_{value}
NEP	log10(stand.age)	0.58	0.76	0.77
	BiomeTemperate broadleaf	1.33	1.26	1.05
	BiomeTemperate conifer	-2.52	0.7	-3.59
	BiomeBoreal conifer	0.2	1.05	0.19
	log10(stand.age):BiomeTemperate conifer	3.35	0.88	3.83
	log10(stand.age):BiomeBoreal conifer	-0.16	0.97	-0.16
GPP	log10(stand.age)	1.99	2.31	0.86
	BiomeTemperate broadleaf	11.76	3.86	3.05
	BiomeTemperate conifer	11.15	2.08	5.35
	BiomeBoreal conifer	5.23	3.96	1.32
	log10(stand.age):BiomeTemperate conifer	1.44	2.69	0.54
	log10(stand.age):BiomeBoreal conifer	0.13	3.31	0.04
NPP	log10(stand.age)	-0.27	0.68	-0.4
	BiomeTropical broadleaf	12.05	1.83	6.59
	BiomeTemperate broadleaf	7.29	1.31	5.58
	BiomeTemperate conifer	5.63	1.33	4.22
	BiomeBoreal conifer	4.34	1.56	2.79
$ANPP$	log10(stand.age)	6.48	0.95	6.83
	BiomeTropical broadleaf	-2.56	1.54	-1.66
	BiomeTemperate broadleaf	4.86	1.32	3.69
	BiomeTemperate conifer	1.37	1.18	1.16
	BiomeBoreal conifer	2.93	2.75	1.06
	log10(stand.age):BiomeTemperate broadleaf	-6.76	1.24	-5.45
	log10(stand.age):BiomeTemperate conifer	-5.29	1.24	-4.28
	log10(stand.age):BiomeBoreal conifer	-6.8	1.91	-3.55
$ANPP_{woody}$	log10(stand.age)	2.31	0.68	3.4
	BiomeTemperate broadleaf	-1.21	1.28	-0.94
	BiomeTemperate conifer	-0.76	0.91	-0.83
	BiomeBoreal conifer	-2.34	1.21	-1.94
$ANPP_{stem}$	log10(stand.age)	0.06	0.46	0.14
	BiomeTropical broadleaf	2.25	0.96	2.33
	BiomeTemperate broadleaf	2.68	0.72	3.73
	BiomeTemperate conifer	1.93	0.71	2.7
	BiomeBoreal conifer	0.72	0.92	0.78
$ANPP_{branch}$	log10(stand.age)	0.24	0.23	1.08
	BiomeTemperate broadleaf	0.18	0.45	0.4
	BiomeTemperate conifer	-0.01	0.35	-0.03
$ANPP_{foliage}$	log10(stand.age)	1.66	0.2	8.12
	BiomeTropical broadleaf	0.24	0.6	0.41

(continued)

Variable	Parameter	Estimate	SE	t_{value}
	BiomeTemperate broadleaf	-0.61	0.4	-1.54
	BiomeTemperate conifer	-1.26	0.39	-3.23
	BiomeBoreal conifer	-2	0.46	-4.34
$ANPP_{litterfall}$	log10(stand.age)	0.74	1.84	0.4
	BiomeTropical broadleaf	2.97	2.88	1.03
	BiomeTemperate broadleaf	0.68	3.34	0.2
$ANPP_{repro}$	-	-	-	-
$ANPP_{folivory}$	-	-	-	-
M_{woody}	-	-	-	-
$BNPP$	log10(stand.age)	0.97	0.39	2.5
	BiomeTropical broadleaf	2.85	0.88	3.24
	BiomeTemperate broadleaf	0.66	0.7	0.94
	BiomeTemperate conifer	0.67	0.65	1.03
	BiomeBoreal conifer	-0.16	0.8	-0.2
$BNPP_{coarse}$	log10(stand.age)	0.04	0.09	0.41
	BiomeTemperate broadleaf	0.42	0.2	2.14
	BiomeTemperate conifer	0.52	0.16	3.17
	BiomeBoreal conifer	0.26	0.21	1.22
$BNPP_{fine}$	log10(stand.age)	1.46	0.32	4.56
	BiomeTropical broadleaf	2.6	0.61	4.29
	BiomeTemperate broadleaf	-0.87	0.54	-1.62
	BiomeTemperate conifer	-0.14	0.5	-0.29
	BiomeBoreal conifer	-1.05	0.63	-1.66
R_{eco}	log10(stand.age)	0.91	0.6	1.52
	BiomeTropical broadleaf	22.74	2.28	9.95
	BiomeTemperate broadleaf	10.5	1.36	7.71
	BiomeTemperate conifer	11.08	1.17	9.5
	BiomeBoreal conifer	6.02	1.56	3.87
R_{auto}	-	-	-	-
$R_{auto-ag}$	-	-	-	-
R_{root}	log10(stand.age)	1.04	0.5	2.07
	BiomeTropical broadleaf	6.31	1.01	6.27
	BiomeTemperate broadleaf	2	0.89	2.25
	BiomeTemperate conifer	2.39	0.86	2.79
	BiomeBoreal conifer	-0.15	1.2	-0.13
R_{soil}	log10(stand.age)	0.31	0.33	0.93
	BiomeTropical broadleaf	12.55	0.85	14.83
	BiomeTemperate broadleaf	8.99	0.64	13.99
	BiomeTemperate conifer	7.96	0.6	13.26

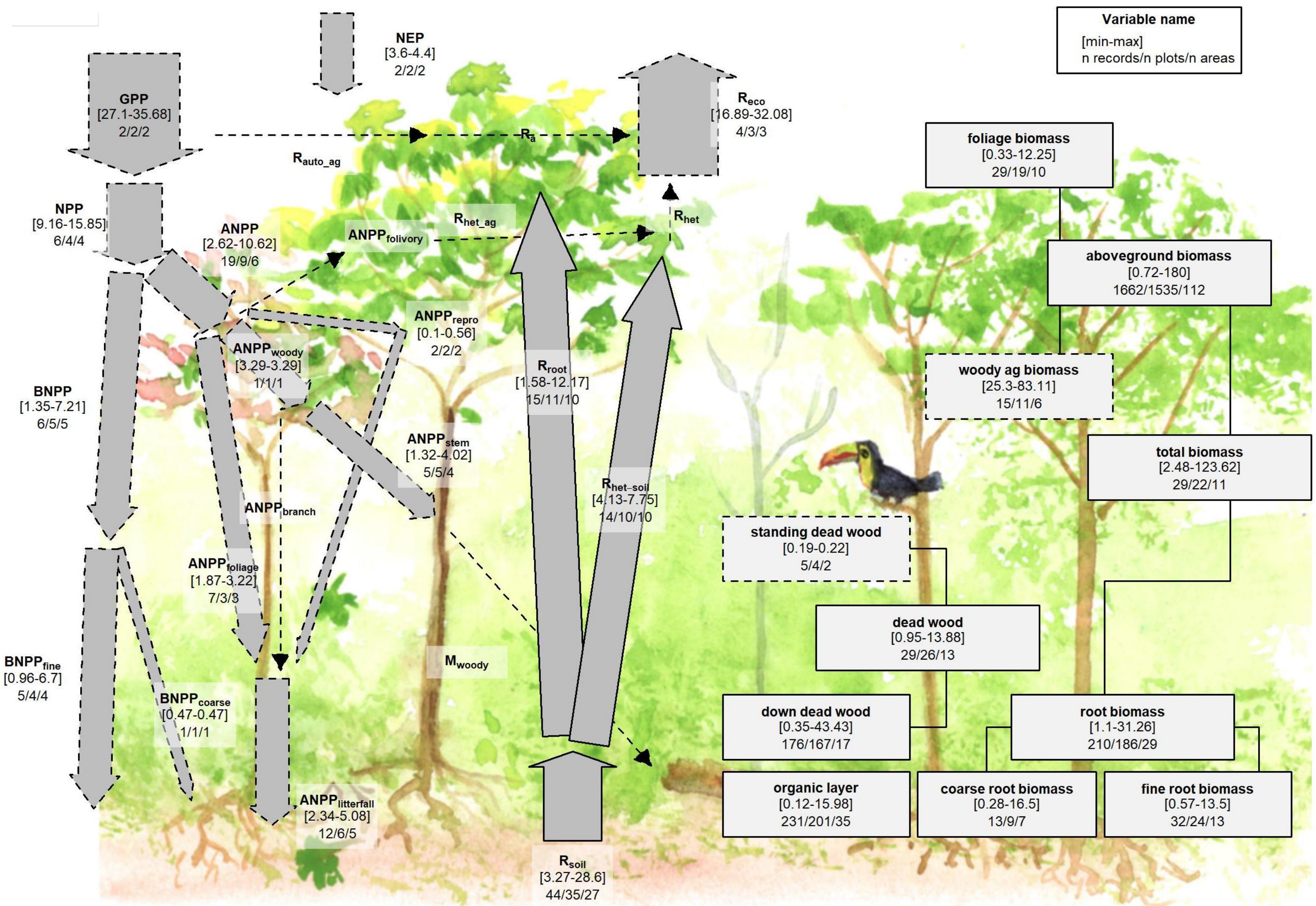
(continued)

Variable	Parameter	Estimate	SE	t_{value}
	BiomeBoreal conifer	4.98	1.03	4.81
$R_{het-soil}$	log10(stand.age)	0.18	0.42	0.42
	BiomeTropical broadleaf	5.88	0.75	7.84
	BiomeTemperate broadleaf	4.15	0.74	5.64
	BiomeTemperate conifer	3.88	0.68	5.72
	BiomeBoreal conifer	3.29	0.94	3.49
B_{tot}	log10(stand.age)	53.84	12.49	4.31
	BiomeTropical broadleaf	-8.52	16.39	-0.52
	BiomeTemperate broadleaf	-42.69	33.86	-1.26
	BiomeTemperate conifer	-33.81	23.78	-1.42
	BiomeBoreal conifer	-70.4	88.23	-0.8
	log10(stand.age):BiomeTemperate broadleaf	27.83	23	1.21
	log10(stand.age):BiomeTemperate conifer	22.27	19.25	1.16
	log10(stand.age):BiomeBoreal conifer	17.33	50.55	0.34
B_{ag}	log10(stand.age)	56.94	1.89	30.11
	BiomeTropical broadleaf	-16.72	3.4	-4.92
	BiomeTemperate broadleaf	-59.33	5.87	-10.11
	BiomeTemperate conifer	-42.82	5.24	-8.17
	BiomeBoreal conifer	-39.58	13.99	-2.83
	log10(stand.age):BiomeTemperate broadleaf	13.16	4.04	3.26
	log10(stand.age):BiomeTemperate conifer	-1.5	3.69	-0.41
	log10(stand.age):BiomeBoreal conifer	-10.67	8.09	-1.32
$B_{ag-wood}$	log10(stand.age)	43.25	28.16	1.54
	BiomeTropical broadleaf	-11.68	37.64	-0.31
	BiomeTemperate broadleaf	-39.81	40.45	-0.98
	BiomeTemperate conifer	-138.39	42.31	-3.27
	BiomeBoreal conifer	-74.75	154.24	-0.48
	log10(stand.age):BiomeTemperate broadleaf	29.83	38.33	0.78
	log10(stand.age):BiomeTemperate conifer	100.06	40.6	2.46
	log10(stand.age):BiomeBoreal conifer	23.72	93.18	0.25
$B_{foliage}$	log10(stand.age)	2.73	0.57	4.76
	BiomeTropical broadleaf	0.65	0.86	0.76
	BiomeTemperate broadleaf	0.93	0.8	1.16
	BiomeTemperate conifer	-4.34	1.57	-2.77
	BiomeBoreal conifer	-1.29	4.42	-0.29
	log10(stand.age):BiomeTemperate broadleaf	-2.04	0.72	-2.83
	log10(stand.age):BiomeTemperate conifer	3.55	1.17	3.03
	log10(stand.age):BiomeBoreal conifer	-0.61	2.57	-0.24
B_{root}	log10(stand.age)	10.34	0.93	11.14
	BiomeTropical broadleaf	-1.47	1.53	-0.96
	BiomeTemperate broadleaf	-8.2	1.69	-4.84
	BiomeTemperate conifer	-9.72	1.59	-6.13
	BiomeBoreal conifer	-5.86	3.98	-1.47
	log10(stand.age):BiomeTemperate broadleaf	2.04	1.4	1.45
	log10(stand.age):BiomeTemperate conifer	0.81	1.36	0.59

(continued)

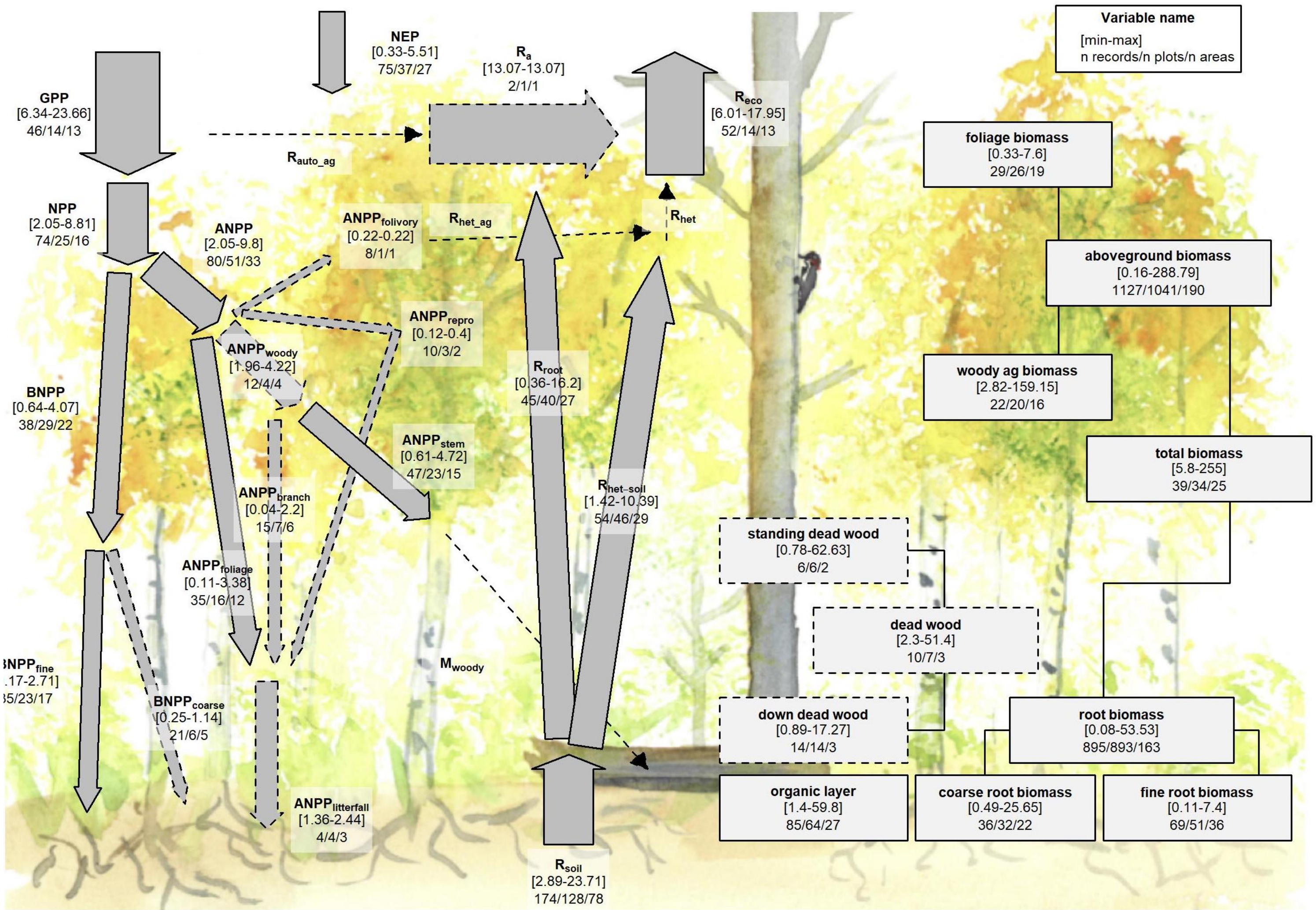
Variable	Parameter	Estimate	SE	t_{value}
	log10(stand.age):BiomeBoreal conifer	-0.19	2.49	-0.08
$B_{root-coarse}$	log10(stand.age)	5.78	1.01	5.7
	BiomeTropical broadleaf	-0.5	4.71	-0.11
	BiomeTemperate broadleaf	5.65	3.07	1.84
	BiomeTemperate conifer	-16.45	8.23	-2
	BiomeBoreal conifer	-61.67	8.54	-7.22
	log10(stand.age):BiomeTemperate broadleaf	-5.56	1.64	-3.39
	log10(stand.age):BiomeTemperate conifer	15.29	5.89	2.6
	log10(stand.age):BiomeBoreal conifer	33.3	4.28	7.79
$B_{root-fine}$	log10(stand.age)	0.96	0.37	2.62
	BiomeTropical broadleaf	1.37	0.67	2.05
	BiomeTemperate broadleaf	2.24	0.5	4.46
	BiomeTemperate conifer	5.94	0.49	12.11
	BiomeBoreal conifer	0.51	2.29	0.22
	log10(stand.age):BiomeTemperate broadleaf	-0.81	0.45	-1.81
	log10(stand.age):BiomeTemperate conifer	-3.27	0.42	-7.75
	log10(stand.age):BiomeBoreal conifer	0.14	1.32	0.11
DW_{tot}	log10(stand.age)	2.6	2.86	0.91
	BiomeTropical broadleaf	2.1	4.04	0.52
	BiomeTemperate broadleaf	18.37	9.48	1.94
	log10(stand.age):BiomeTemperate broadleaf	-1.49	5.38	-0.28
$DW_{standing}$	-	-	-	-
DW_{down}	log10(stand.age)	2.87	1.72	1.67
	BiomeTropical broadleaf	4.26	3.59	1.19
	BiomeTemperate broadleaf	15.46	12.05	1.28
	BiomeTemperate conifer	45.37	6.7	6.77
	BiomeBoreal conifer	45.22	11.02	4.1
	log10(stand.age):BiomeTemperate broadleaf	-9.13	7.81	-1.17
	log10(stand.age):BiomeTemperate conifer	-13.93	3.46	-4.03
	log10(stand.age):BiomeBoreal conifer	-22.37	7.06	-3.17
OL	log10(stand.age)	0.46	0.84	0.55
	BiomeTropical broadleaf	3.5	2.32	1.51
	BiomeTemperate broadleaf	20.09	3.53	5.69
	BiomeTemperate conifer	-1.69	3.05	-0.55
	BiomeBoreal conifer	28.53	6.53	4.37
	log10(stand.age):BiomeTemperate broadleaf	-4.84	2.24	-2.16
	log10(stand.age):BiomeTemperate conifer	6.56	1.73	3.79
	log10(stand.age):BiomeBoreal conifer	4.77	4.14	1.15

Figure S1. C cycle diagram for young tropical broadleaf forests.



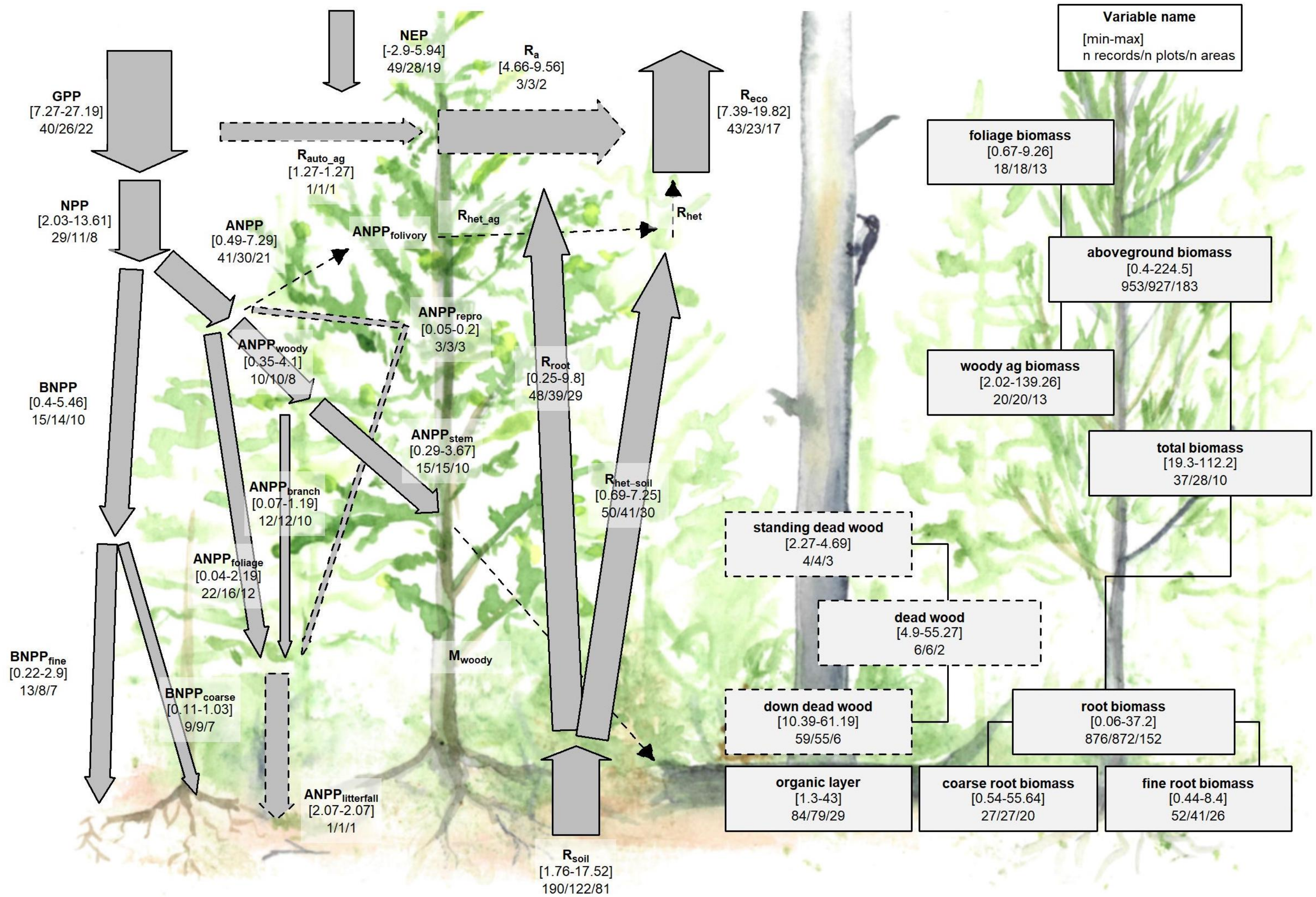
C cycle diagram for young tropical broadleaf forests. Arrows indicate fluxes (Mg C ha^{-1} yr^{-1}); boxes indicate stocks (Mg C ha^{-1}), with variables as defined in Table 1. Presented are observed ranges, where geographically distinct areas are treated as the unit of replication. Note that variables differ in geographical and age representation, resulting in potential imbalances (Figs. S5-S30). All units are Mg C ha^{-1} yr^{-1} (fluxes) or Mg C ha^{-1} (stocks). Dashed shape outlines indicate variables with records from <7 distinct geographic areas, and dashed arrows indicate fluxes with no data. To illustrate the magnitude of different fluxes, arrow width is proportional to the square root of the mean of the corresponding flux.

Figure S2. C cycle diagram for young temperate broadleaf forests.



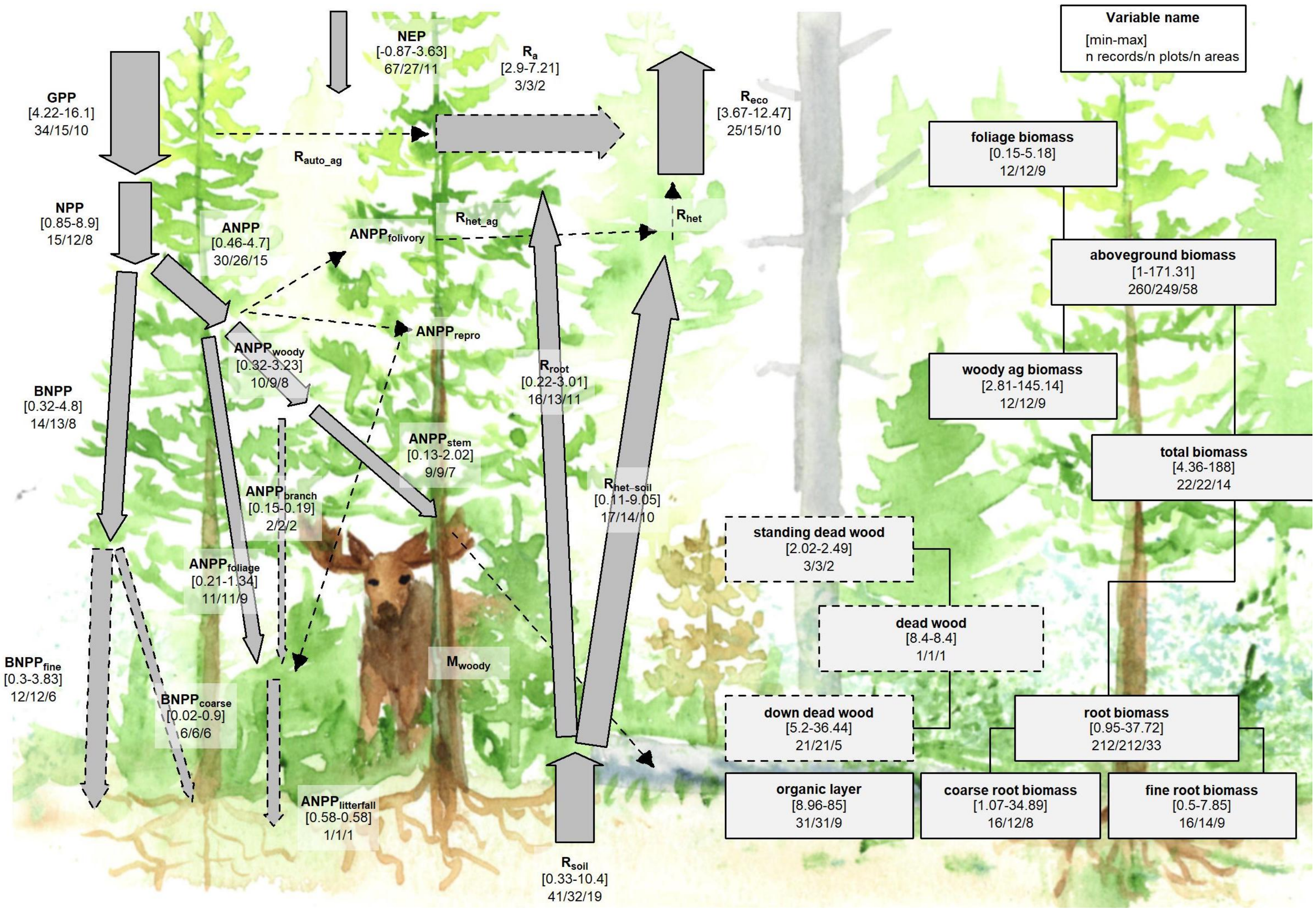
C cycle diagram for young temperate broadleaf forests. Arrows indicate fluxes (Mg C ha^{-1} yr^{-1}); boxes indicate stocks (Mg C ha^{-1}), with variables as defined in Table 1. Presented are observed ranges, where geographically distinct areas are treated as the unit of replication. Note that variables differ in geographical and age representation, resulting in potential imbalances (Figs. S5-S30). All units are Mg C ha^{-1} yr^{-1} (fluxes) or Mg C ha^{-1} (stocks). Dashed shape outlines indicate variables with records from <7 distinct geographic areas, and dashed arrows indicate fluxes with no data. To illustrate the magnitude of different fluxes, arrow width is proportional to the square root of the mean of the corresponding flux.

Figure S3. C cycle diagram for young temperate conifer forests.



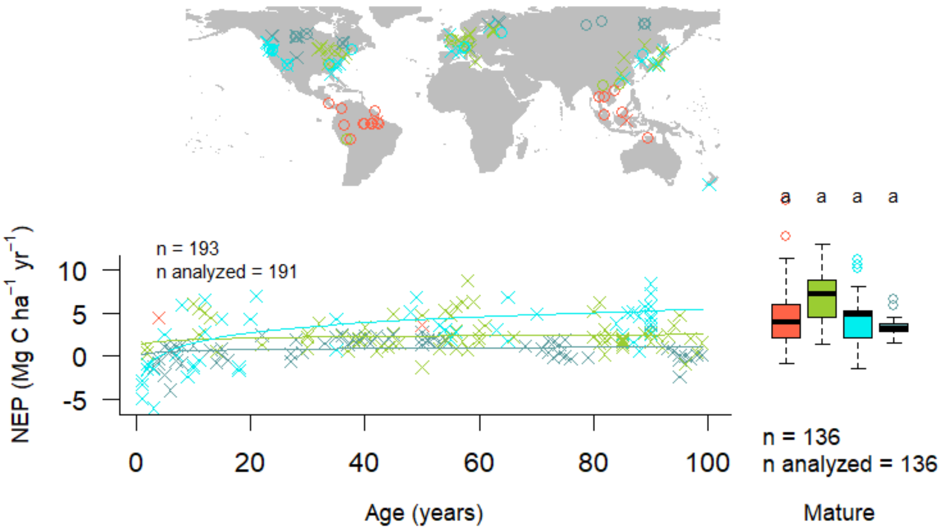
C cycle diagram for young temperate conifer forests. Arrows indicate fluxes (Mg C ha^{-1} yr^{-1}); boxes indicate stocks (Mg C ha^{-1}), with variables as defined in Table 1. Presented are observed ranges, where geographically distinct areas are treated as the unit of replication. Note that variables differ in geographical and age representation, resulting in potential imbalances (Figs. S5-S30). All units are Mg C ha^{-1} yr^{-1} (fluxes) or Mg C ha^{-1} (stocks). Dashed shape outlines indicate variables with records from <7 distinct geographic areas, and dashed arrows indicate fluxes with no data. To illustrate the magnitude of different fluxes, arrow width is proportional to the square root of the mean of the corresponding flux.

Figure S4. C cycle diagram for young boreal conifer forests.



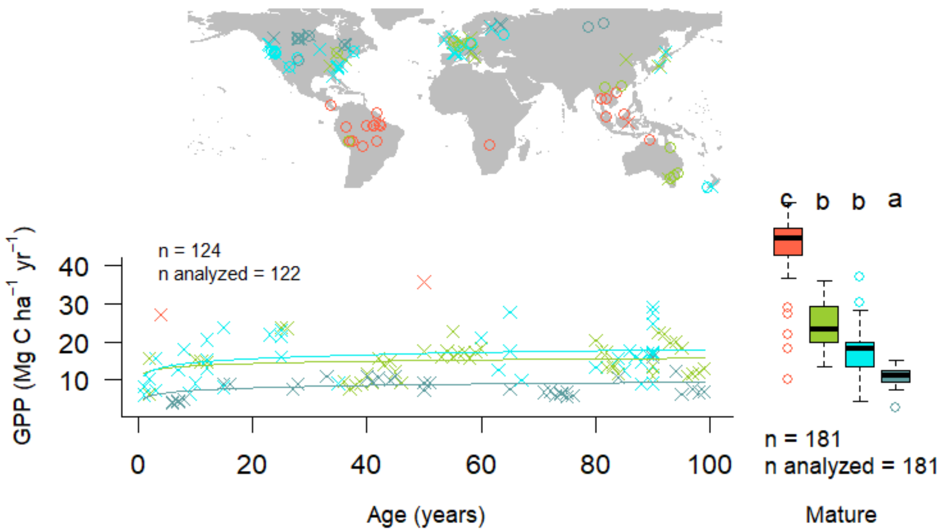
C cycle diagram for young boreal conifer forests. Arrows indicate fluxes (Mg C ha^{-1} yr^{-1}); boxes indicate stocks (Mg C ha^{-1}), with variables as defined in Table 1. Presented are observed ranges, where geographically distinct areas are treated as the unit of replication. Note that variables differ in geographical and age representation, resulting in potential imbalances (Figs. S5-S30). All units are Mg C ha^{-1} yr^{-1} (fluxes) or Mg C ha^{-1} (stocks). Dashed shape outlines indicate variables with records from <7 distinct geographic areas, and dashed arrows indicate fluxes with no data. To illustrate the magnitude of different fluxes, arrow width is proportional to the square root of the mean of the corresponding flux.

Figure S5. Age trends and biome differences for NEP



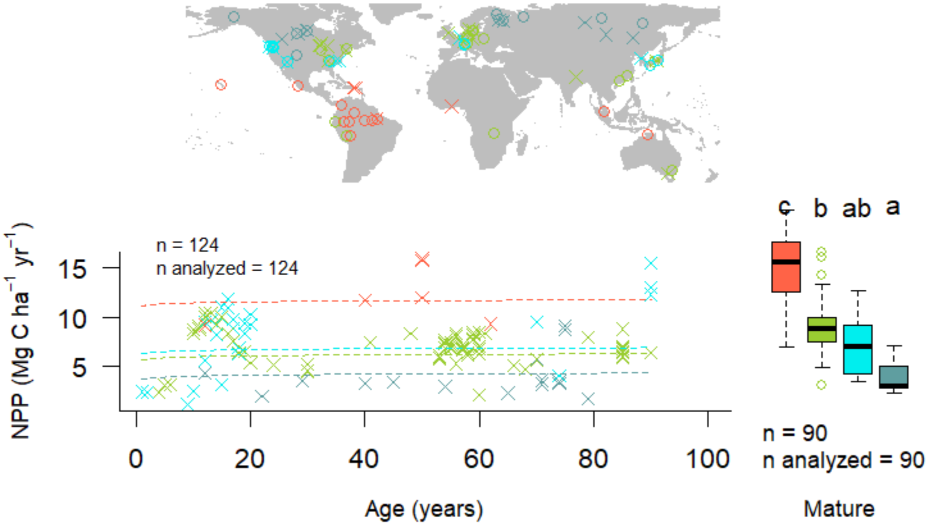
Age trends and biome differences for NEP. Map shows data sources (x and o indicate young and mature stands, respectively). In each panel, the left scatterplot shows age trends in forests up to 100 years old, as characterized by a linear mixed effects model with fixed effects of log10(age) and biome. The fitted line indicates the effect of age (solid lines: significant at $p<0.05$, dashed lines: non-significant), and non-parallel lines indicate a significant log10(age) x biome interaction. Boxplot illustrates distribution across mature forests, with different letters indicating significant differences between biomes. Data from biomes that did not meet the sample size criteria (see Methods) are plotted, but lack regression lines (young forests) or test of differences across biomes (mature forests).

Figure S6. Age trends and biome differences for *GPP*



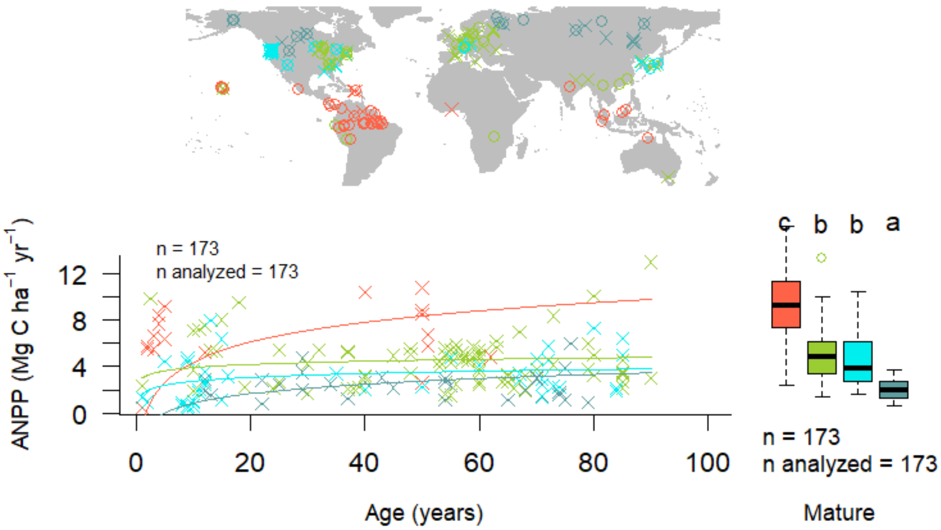
Age trends and biome differences for *GPP*. Map shows data sources (*x* and *o* indicate young and mature stands, respectively). In each panel, the left scatterplot shows age trends in forests up to 100 years old, as characterized by a linear mixed effects model with fixed effects of log10(age) and biome. The fitted line indicates the effect of age (solid lines: significant at $p<0.05$, dashed lines: non-significant), and non-parallel lines indicate a significant log10(age) x biome interaction. Boxplot illustrates distribution across mature forests, with different letters indicating significant differences between biomes. Data from biomes that did not meet the sample size criteria (see Methods) are plotted, but lack regression lines (young forests) or test of differences across biomes (mature forests).

Figure S7. Age trends and biome differences for NPP



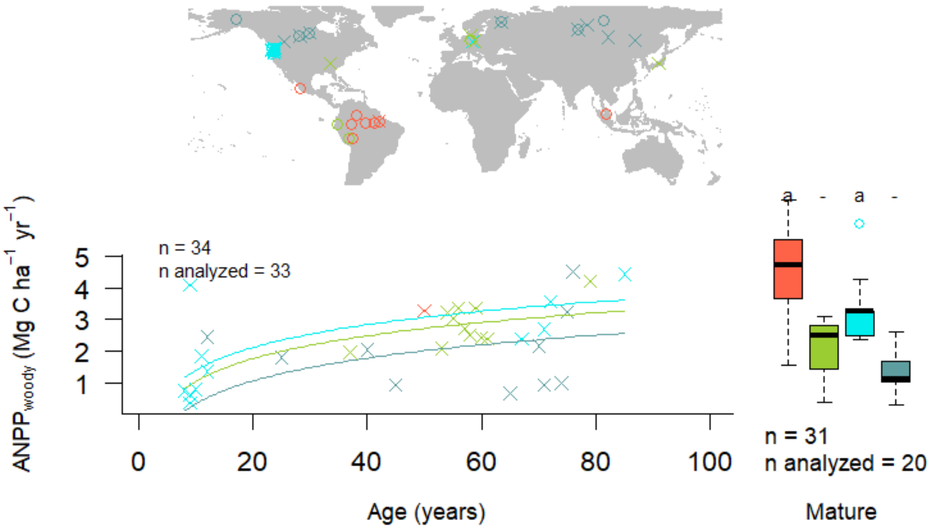
Age trends and biome differences for NPP. Map shows data sources (x and o indicate young and mature stands, respectively). In each panel, the left scatterplot shows age trends in forests up to 100 years old, as characterized by a linear mixed effects model with fixed effects of log10(age) and biome. The fitted line indicates the effect of age (solid lines: significant at $p<0.05$, dashed lines: non-significant), and non-parallel lines indicate a significant log10(age) x biome interaction. Boxplot illustrates distribution across mature forests, with different letters indicating significant differences between biomes. Data from biomes that did not meet the sample size criteria (see Methods) are plotted, but lack regression lines (young forests) or test of differences across biomes (mature forests).

Figure S8. Age trends and biome differences for $ANPP$



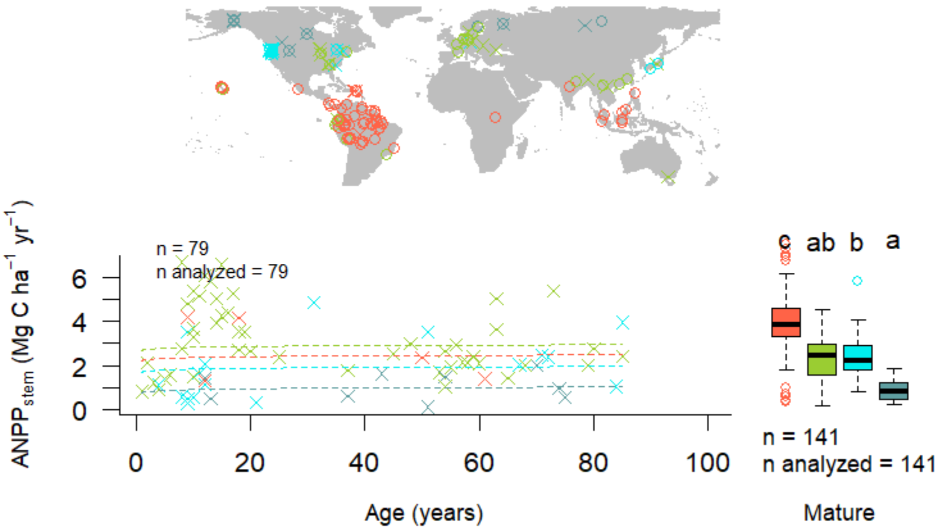
Age trends and biome differences for $ANPP$. Map shows data sources (x and o indicate young and mature stands, respectively). In each panel, the left scatterplot shows age trends in forests up to 100 years old, as characterized by a linear mixed effects model with fixed effects of log10(age) and biome. The fitted line indicates the effect of age (solid lines: significant at p<0.05, dashed lines: non-significant), and non-parallel lines indicate a significant log10(age) x biome interaction. Boxplot illustrates distribution across mature forests, with different letters indicating significant differences between biomes. Data from biomes that did not meet the sample size criteria (see Methods) are plotted, but lack regression lines (young forests) or test of differences across biomes (mature forests).

Figure S9. Age trends and biome differences for $ANPP_{woody}$



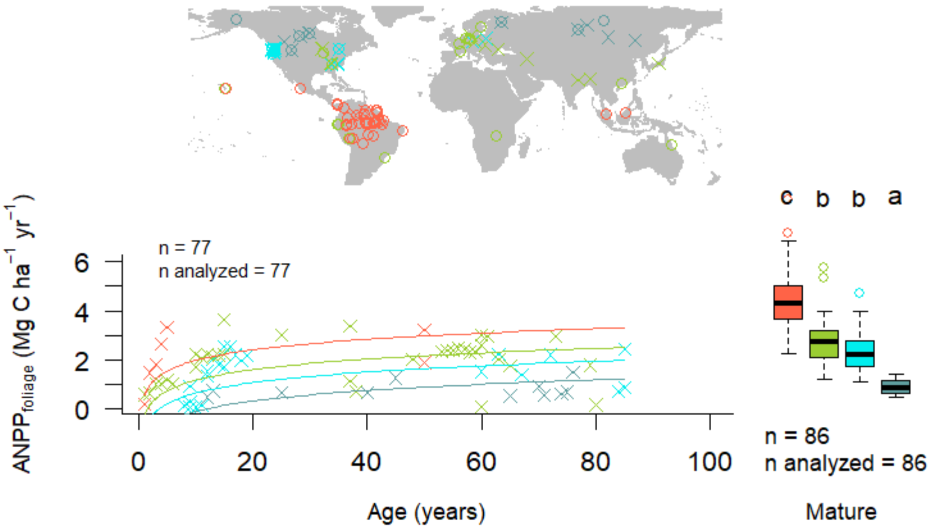
Age trends and biome differences for $ANPP_{woody}$. Map shows data sources (x and o indicate young and mature stands, respectively). In each panel, the left scatterplot shows age trends in forests up to 100 years old, as characterized by a linear mixed effects model with fixed effects of log10(age) and biome. The fitted line indicates the effect of age (solid lines: significant at $p<0.05$, dashed lines: non-significant), and non-parallel lines indicate a significant log10(age) x biome interaction. Boxplot illustrates distribution across mature forests, with different letters indicating significant differences between biomes. Data from biomes that did not meet the sample size criteria (see Methods) are plotted, but lack regression lines (young forests) or test of differences across biomes (mature forests).

Figure S10. Age trends and biome differences for $ANPP_{stem}$



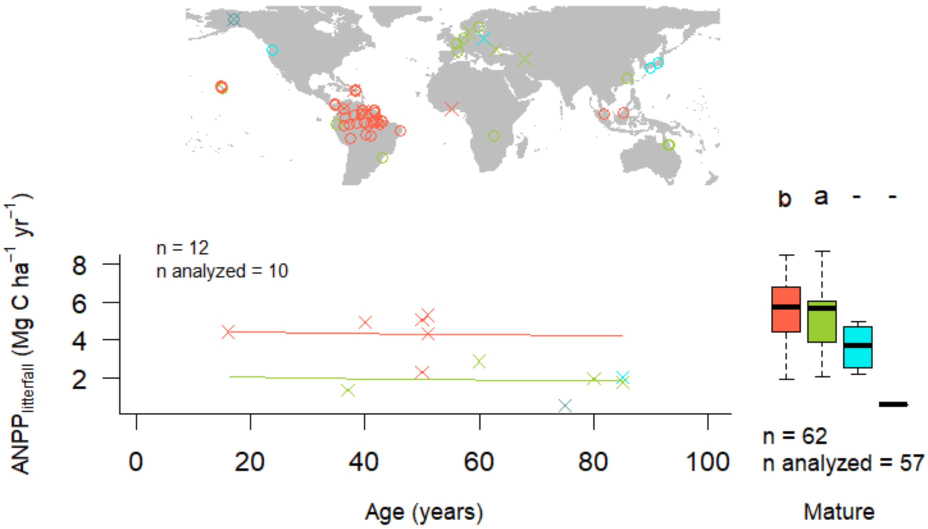
Age trends and biome differences for $ANPP_{stem}$. Map shows data sources (x and o indicate young and mature stands, respectively). In each panel, the left scatterplot shows age trends in forests up to 100 years old, as characterized by a linear mixed effects model with fixed effects of log10(age) and biome. The fitted line indicates the effect of age (solid lines: significant at p<0.05, dashed lines: non-significant), and non-parallel lines indicate a significant log10(age) x biome interaction. Boxplot illustrates distribution across mature forests, with different letters indicating significant differences between biomes. Data from biomes that did not meet the sample size criteria (see Methods) are plotted, but lack regression lines (young forests) or test of differences across biomes (mature forests).

Figure S11. Age trends and biome differences for $ANPP_{foliage}$



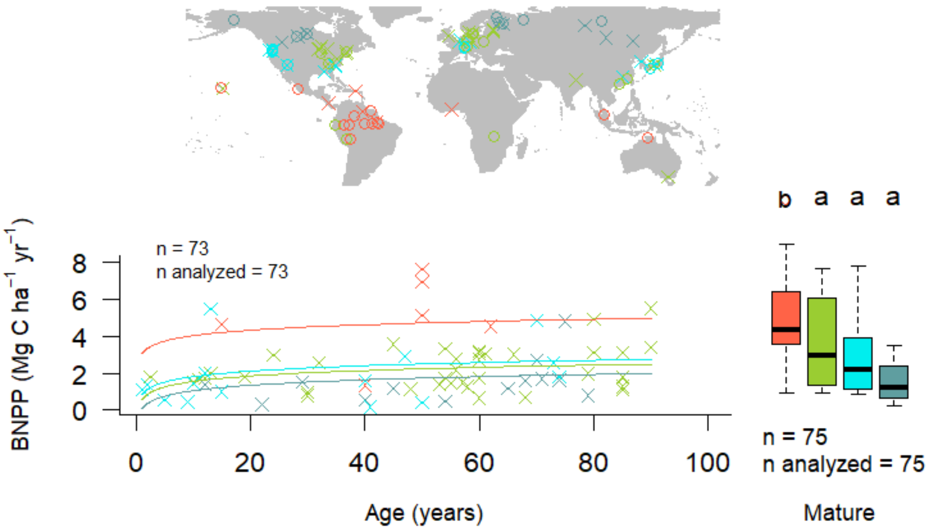
Age trends and biome differences for $ANPP_{foliage}$. Map shows data sources (x and o indicate young and mature stands, respectively). In each panel, the left scatterplot shows age trends in forests up to 100 years old, as characterized by a linear mixed effects model with fixed effects of log10(age) and biome. The fitted line indicates the effect of age (solid lines: significant at p<0.05, dashed lines: non-significant), and non-parallel lines indicate a significant log10(age) x biome interaction. Boxplot illustrates distribution across mature forests, with different letters indicating significant differences between biomes. Data from biomes that did not meet the sample size criteria (see Methods) are plotted, but lack regression lines (young forests) or test of differences across biomes (mature forests).

Figure S12. Age trends and biome differences for $ANPP_{litterfall}$



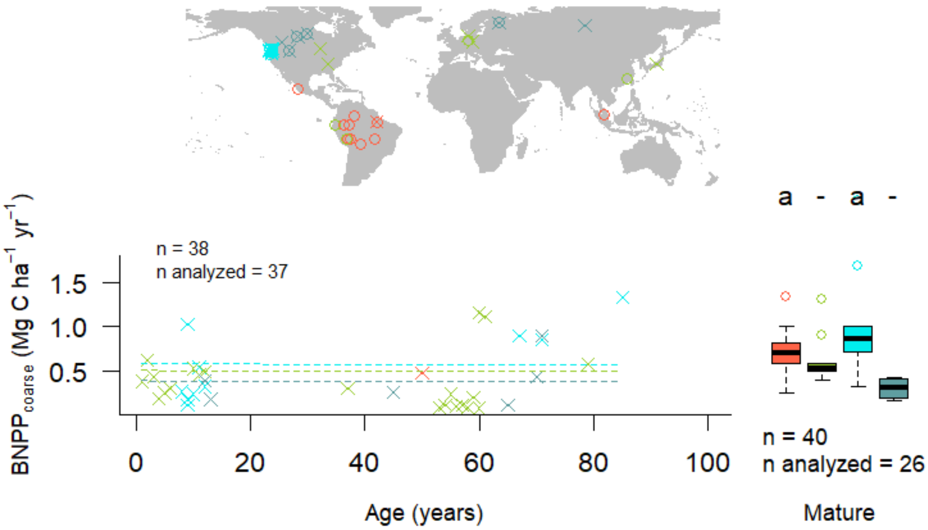
Age trends and biome differences for $ANPP_{litterfall}$. Map shows data sources (x and o indicate young and mature stands, respectively). In each panel, the left scatterplot shows age trends in forests up to 100 years old, as characterized by a linear mixed effects model with fixed effects of log10(age) and biome. The fitted line indicates the effect of age (solid lines: significant at p<0.05, dashed lines: non-significant), and non-parallel lines indicate a significant log10(age) x biome interaction. Boxplot illustrates distribution across mature forests, with different letters indicating significant differences between biomes. Data from biomes that did not meet the sample size criteria (see Methods) are plotted, but lack regression lines (young forests) or test of differences across biomes (mature forests).

Figure S13. Age trends and biome differences for $BNPP$



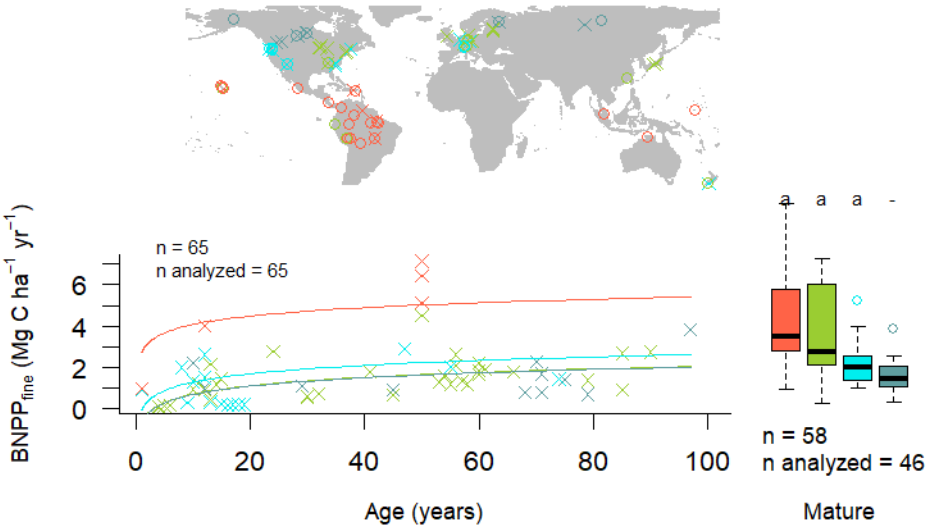
Age trends and biome differences for $BNPP$. Map shows data sources (x and o indicate young and mature stands, respectively). In each panel, the left scatterplot shows age trends in forests up to 100 years old, as characterized by a linear mixed effects model with fixed effects of log10(age) and biome. The fitted line indicates the effect of age (solid lines: significant at $p<0.05$, dashed lines: non-significant), and non-parallel lines indicate a significant log10(age) x biome interaction. Boxplot illustrates distribution across mature forests, with different letters indicating significant differences between biomes. Data from biomes that did not meet the sample size criteria (see Methods) are plotted, but lack regression lines (young forests) or test of differences across biomes (mature forests).

Figure S14. Age trends and biome differences for $BNPP_{coarse}$



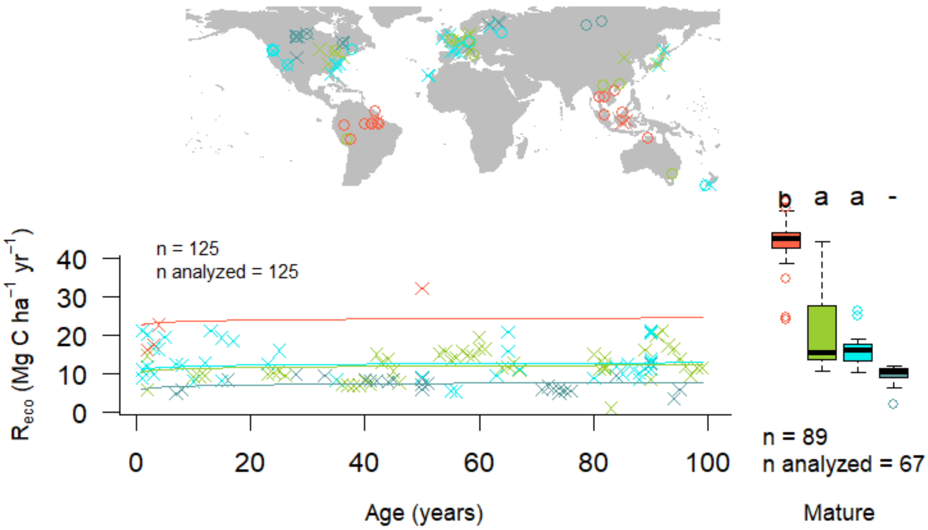
Age trends and biome differences for $BNPP_{coarse}$. Map shows data sources (x and o indicate young and mature stands, respectively). In each panel, the left scatterplot shows age trends in forests up to 100 years old, as characterized by a linear mixed effects model with fixed effects of log10(age) and biome. The fitted line indicates the effect of age (solid lines: significant at p<0.05, dashed lines: non-significant), and non-parallel lines indicate a significant log10(age) x biome interaction. Boxplot illustrates distribution across mature forests, with different letters indicating significant differences between biomes. Data from biomes that did not meet the sample size criteria (see Methods) are plotted, but lack regression lines (young forests) or test of differences across biomes (mature forests).

Figure S15. Age trends and biome differences for $BNPP_{fine}$



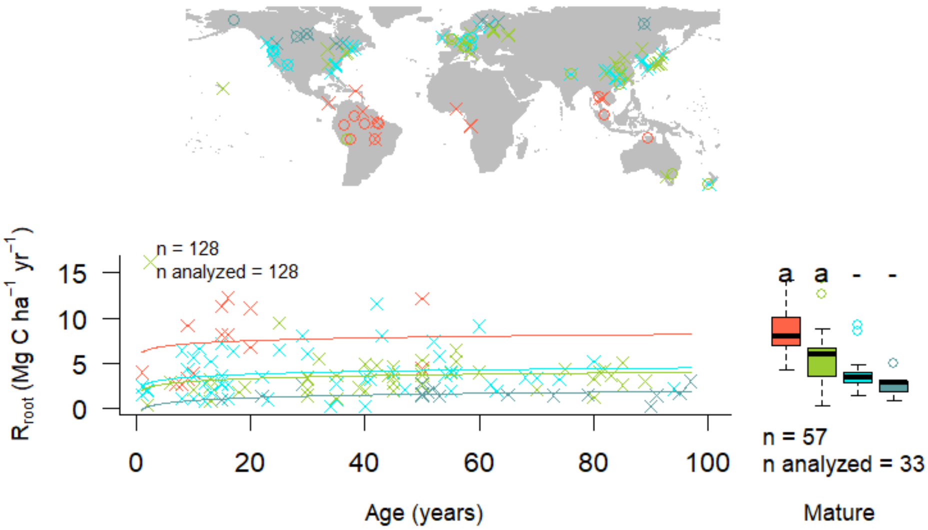
Age trends and biome differences for $BNPP_{fine}$. Map shows data sources (x and o indicate young and mature stands, respectively). In each panel, the left scatterplot shows age trends in forests up to 100 years old, as characterized by a linear mixed effects model with fixed effects of log10(age) and biome. The fitted line indicates the effect of age (solid lines: significant at p<0.05, dashed lines: non-significant), and non-parallel lines indicate a significant log10(age) x biome interaction. Boxplot illustrates distribution across mature forests, with different letters indicating significant differences between biomes. Data from biomes that did not meet the sample size criteria (see Methods) are plotted, but lack regression lines (young forests) or test of differences across biomes (mature forests).

Figure S16. Age trends and biome differences for R_{eco}



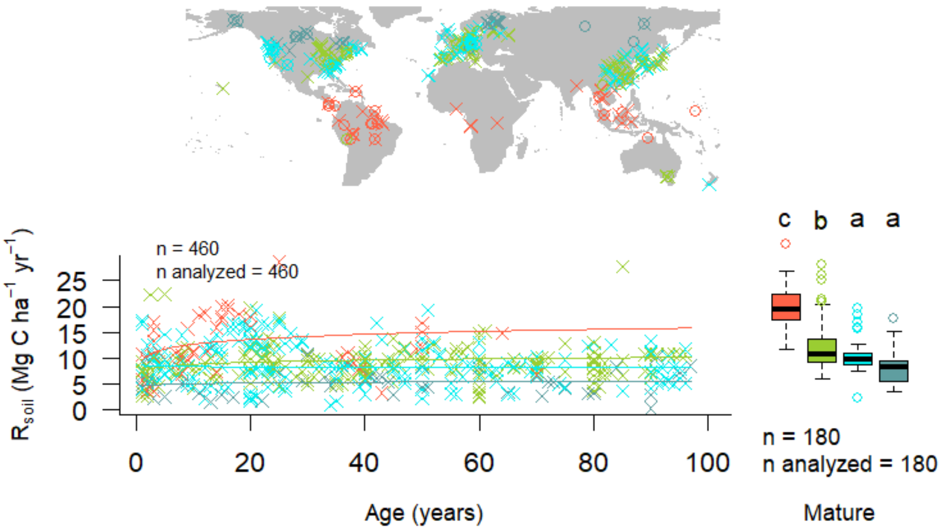
Age trends and biome differences for R_{eco}. Map shows data sources (x and o indicate young and mature stands, respectively). In each panel, the left scatterplot shows age trends in forests up to 100 years old, as characterized by a linear mixed effects model with fixed effects of log10(age) and biome. The fitted line indicates the effect of age (solid lines: significant at $p<0.05$, dashed lines: non-significant), and non-parallel lines indicate a significant log10(age) x biome interaction. Boxplot illustrates distribution across mature forests, with different letters indicating significant differences between biomes. Data from biomes that did not meet the sample size criteria (see Methods) are plotted, but lack regression lines (young forests) or test of differences across biomes (mature forests).

Figure S17. Age trends and biome differences for R_{root}



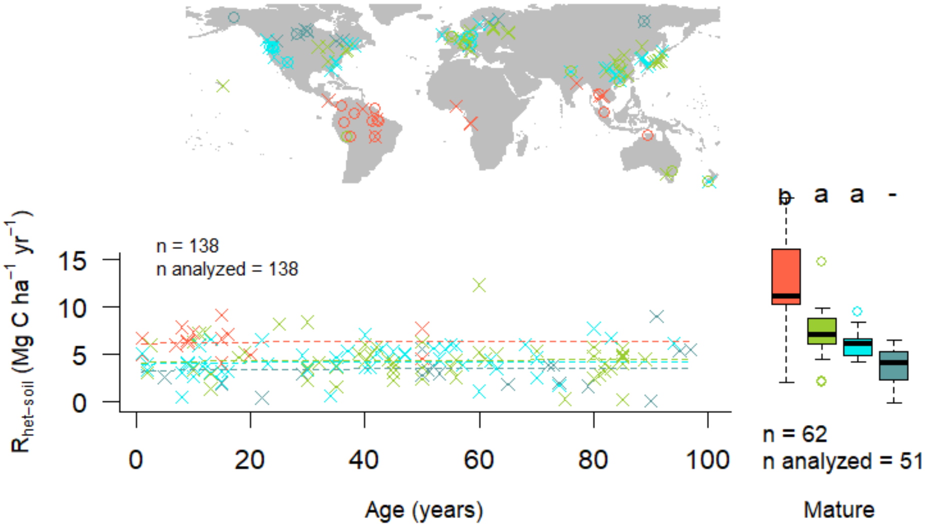
Age trends and biome differences for R_{root}. Map shows data sources (x and o indicate young and mature stands, respectively). In each panel, the left scatterplot shows age trends in forests up to 100 years old, as characterized by a linear mixed effects model with fixed effects of log10(age) and biome. The fitted line indicates the effect of age (solid lines: significant at p<0.05, dashed lines: non-significant), and non-parallel lines indicate a significant log10(age) x biome interaction. Boxplot illustrates distribution across mature forests, with different letters indicating significant differences between biomes. Data from biomes that did not meet the sample size criteria (see Methods) are plotted, but lack regression lines (young forests) or test of differences across biomes (mature forests).

Figure S18. Age trends and biome differences for R_{soil}



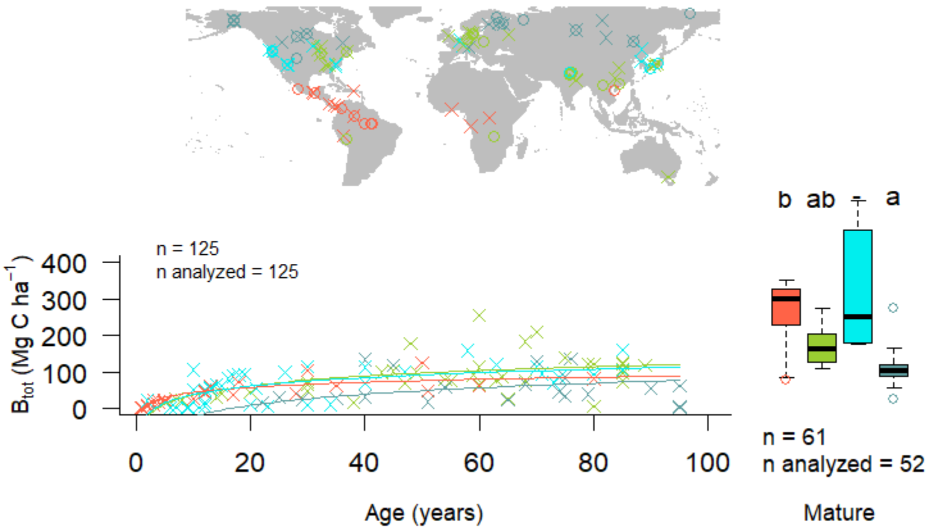
Age trends and biome differences for R_{soil}. Map shows data sources (x and o indicate young and mature stands, respectively). In each panel, the left scatterplot shows age trends in forests up to 100 years old, as characterized by a linear mixed effects model with fixed effects of log10(age) and biome. The fitted line indicates the effect of age (solid lines: significant at p<0.05, dashed lines: non-significant), and non-parallel lines indicate a significant log10(age) x biome interaction. Boxplot illustrates distribution across mature forests, with different letters indicating significant differences between biomes. Data from biomes that did not meet the sample size criteria (see Methods) are plotted, but lack regression lines (young forests) or test of differences across biomes (mature forests).

Figure S19. Age trends and biome differences for $R_{het-soil}$



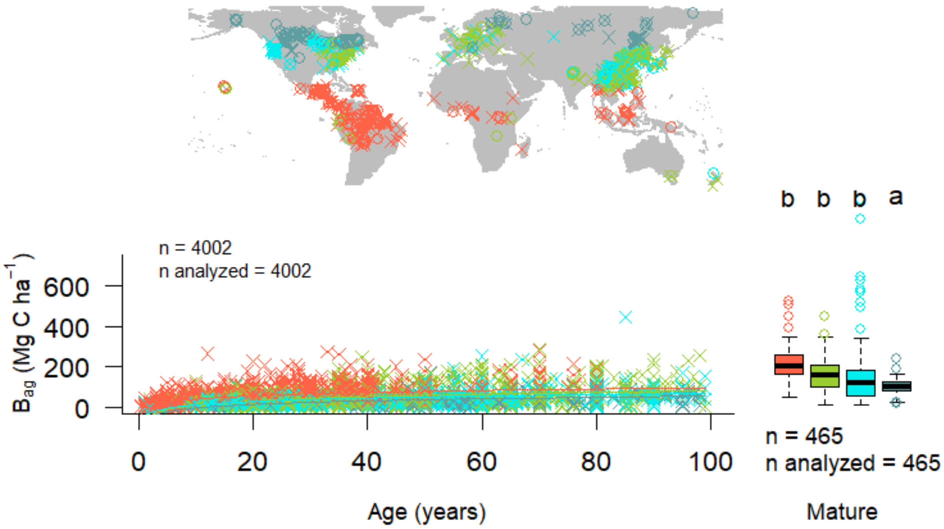
Age trends and biome differences for $R_{het-soil}$. Map shows data sources (x and o indicate young and mature stands, respectively). In each panel, the left scatterplot shows age trends in forests up to 100 years old, as characterized by a linear mixed effects model with fixed effects of log10(age) and biome. The fitted line indicates the effect of age (solid lines: significant at p<0.05, dashed lines: non-significant), and non-parallel lines indicate a significant log10(age) x biome interaction. Boxplot illustrates distribution across mature forests, with different letters indicating significant differences between biomes. Data from biomes that did not meet the sample size criteria (see Methods) are plotted, but lack regression lines (young forests) or test of differences across biomes (mature forests).

Figure S20. Age trends and biome differences for B_{tot}



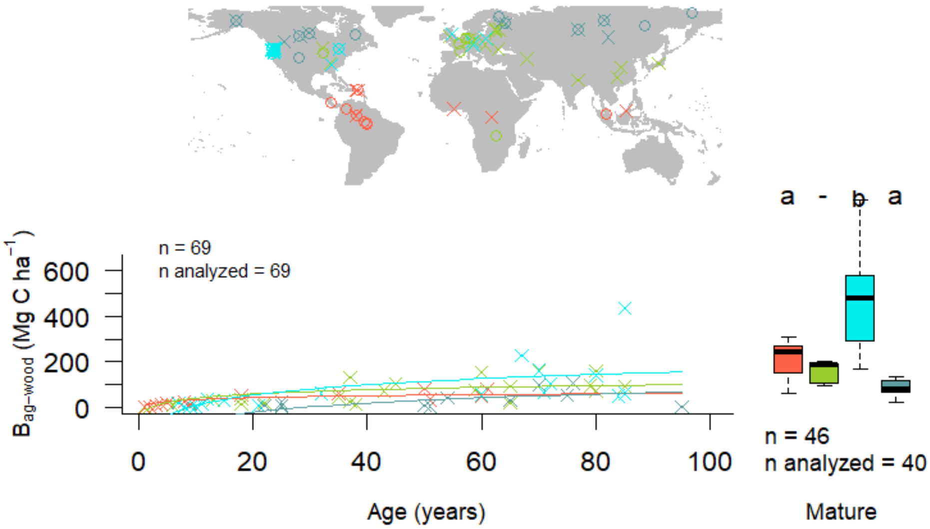
Age trends and biome differences for B_{tot}. Map shows data sources (x and o indicate young and mature stands, respectively). In each panel, the left scatterplot shows age trends in forests up to 100 years old, as characterized by a linear mixed effects model with fixed effects of log10(age) and biome. The fitted line indicates the effect of age (solid lines: significant at $p<0.05$, dashed lines: non-significant), and non-parallel lines indicate a significant log10(age) x biome interaction. Boxplot illustrates distribution across mature forests, with different letters indicating significant differences between biomes. Data from biomes that did not meet the sample size criteria (see Methods) are plotted, but lack regression lines (young forests) or test of differences across biomes (mature forests).

Figure S21. Age trends and biome differences for B_{ag}



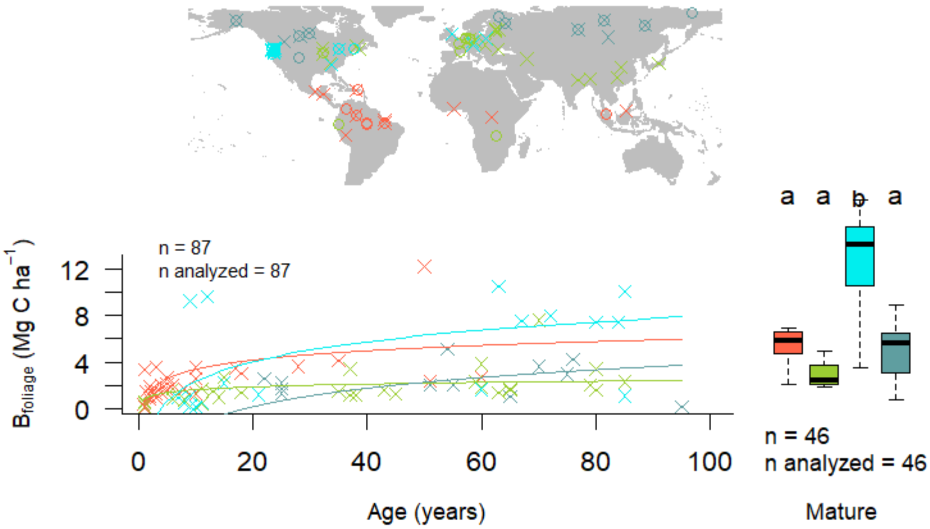
Age trends and biome differences for B_{ag}. Map shows data sources (x and o indicate young and mature stands, respectively). In each panel, the left scatterplot shows age trends in forests up to 100 years old, as characterized by a linear mixed effects model with fixed effects of log10(age) and biome. The fitted line indicates the effect of age (solid lines: significant at $p<0.05$, dashed lines: non-significant), and non-parallel lines indicate a significant log10(age) x biome interaction. Boxplot illustrates distribution across mature forests, with different letters indicating significant differences between biomes. Data from biomes that did not meet the sample size criteria (see Methods) are plotted, but lack regression lines (young forests) or test of differences across biomes (mature forests).

Figure S22. Age trends and biome differences for $B_{ag-wood}$



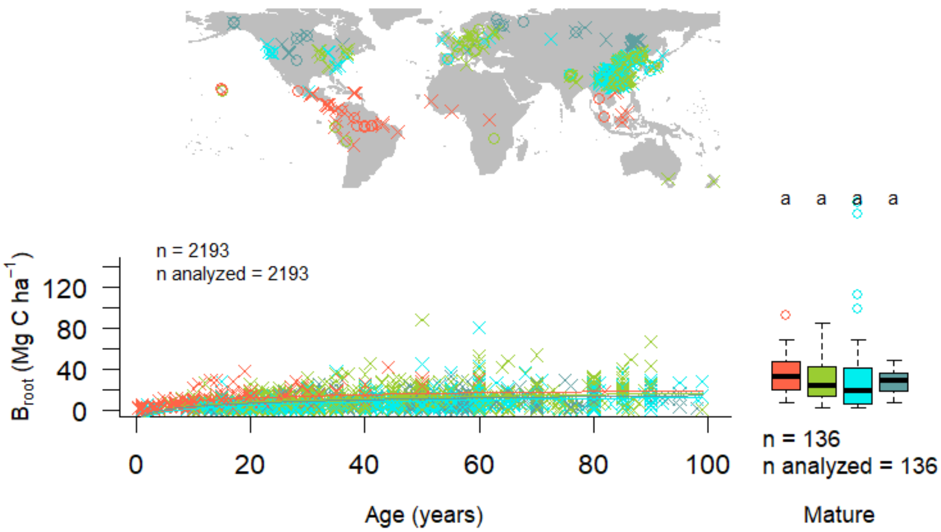
Age trends and biome differences for $B_{ag-wood}$. Map shows data sources (x and o indicate young and mature stands, respectively). In each panel, the left scatterplot shows age trends in forests up to 100 years old, as characterized by a linear mixed effects model with fixed effects of log10(age) and biome. The fitted line indicates the effect of age (solid lines: significant at p<0.05, dashed lines: non-significant), and non-parallel lines indicate a significant log10(age) x biome interaction. Boxplot illustrates distribution across mature forests, with different letters indicating significant differences between biomes. Data from biomes that did not meet the sample size criteria (see Methods) are plotted, but lack regression lines (young forests) or test of differences across biomes (mature forests).

Figure S23. Age trends and biome differences for $B_{foliage}$



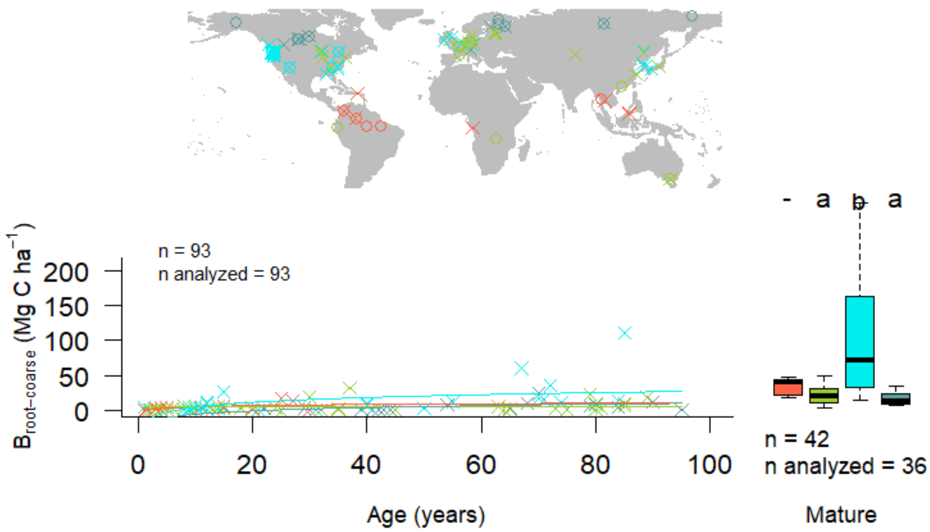
Age trends and biome differences for $B_{foliage}$. Map shows data sources (x and o indicate young and mature stands, respectively). In each panel, the left scatterplot shows age trends in forests up to 100 years old, as characterized by a linear mixed effects model with fixed effects of log10(age) and biome. The fitted line indicates the effect of age (solid lines: significant at p<0.05, dashed lines: non-significant), and non-parallel lines indicate a significant log10(age) x biome interaction. Boxplot illustrates distribution across mature forests, with different letters indicating significant differences between biomes. Data from biomes that did not meet the sample size criteria (see Methods) are plotted, but lack regression lines (young forests) or test of differences across biomes (mature forests).

Figure S24. Age trends and biome differences for B_{root}



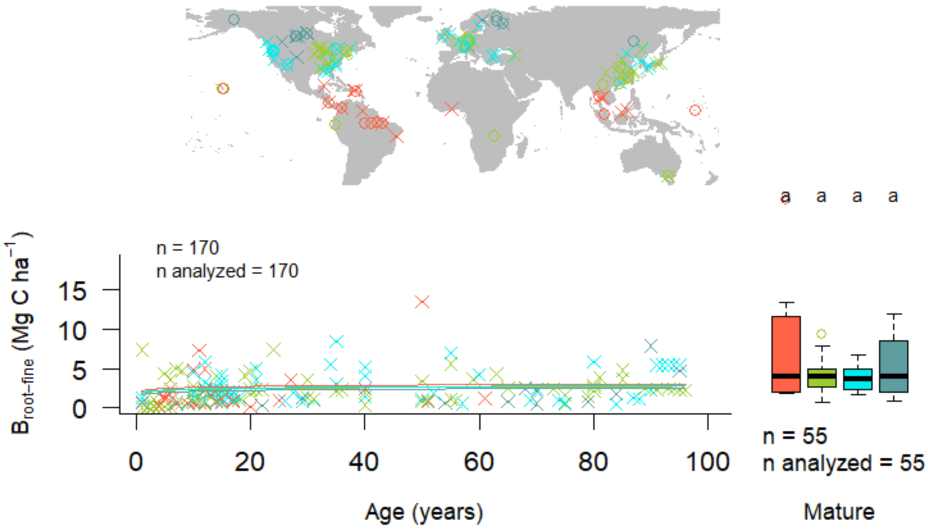
Age trends and biome differences for B_{root}. Map shows data sources (x and o indicate young and mature stands, respectively). In each panel, the left scatterplot shows age trends in forests up to 100 years old, as characterized by a linear mixed effects model with fixed effects of log10(age) and biome. The fitted line indicates the effect of age (solid lines: significant at $p<0.05$, dashed lines: non-significant), and non-parallel lines indicate a significant log10(age) x biome interaction. Boxplot illustrates distribution across mature forests, with different letters indicating significant differences between biomes. Data from biomes that did not meet the sample size criteria (see Methods) are plotted, but lack regression lines (young forests) or test of differences across biomes (mature forests).

Figure S25. Age trends and biome differences for $B_{root-coarse}$



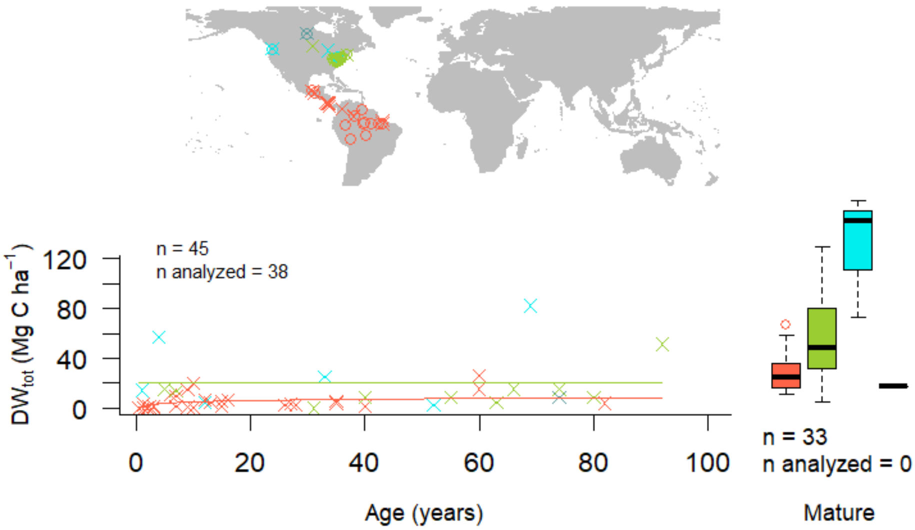
Age trends and biome differences for $B_{root-coarse}$. Map shows data sources (x and o indicate young and mature stands, respectively). In each panel, the left scatterplot shows age trends in forests up to 100 years old, as characterized by a linear mixed effects model with fixed effects of log10(age) and biome. The fitted line indicates the effect of age (solid lines: significant at p<0.05, dashed lines: non-significant), and non-parallel lines indicate a significant log10(age) x biome interaction. Boxplot illustrates distribution across mature forests, with different letters indicating significant differences between biomes. Data from biomes that did not meet the sample size criteria (see Methods) are plotted, but lack regression lines (young forests) or test of differences across biomes (mature forests).

Figure S26. Age trends and biome differences for $B_{root-fine}$



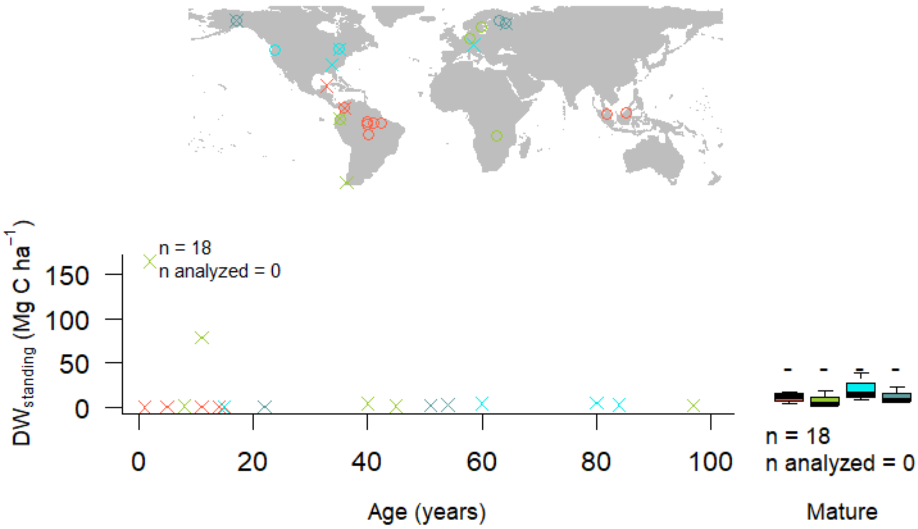
Age trends and biome differences for $B_{root-fine}$. Map shows data sources (x and o indicate young and mature stands, respectively). In each panel, the left scatterplot shows age trends in forests up to 100 years old, as characterized by a linear mixed effects model with fixed effects of log10(age) and biome. The fitted line indicates the effect of age (solid lines: significant at p<0.05, dashed lines: non-significant), and non-parallel lines indicate a significant log10(age) x biome interaction. Boxplot illustrates distribution across mature forests, with different letters indicating significant differences between biomes. Data from biomes that did not meet the sample size criteria (see Methods) are plotted, but lack regression lines (young forests) or test of differences across biomes (mature forests).

Figure S27. Age trends and biome differences for DW_{tot}



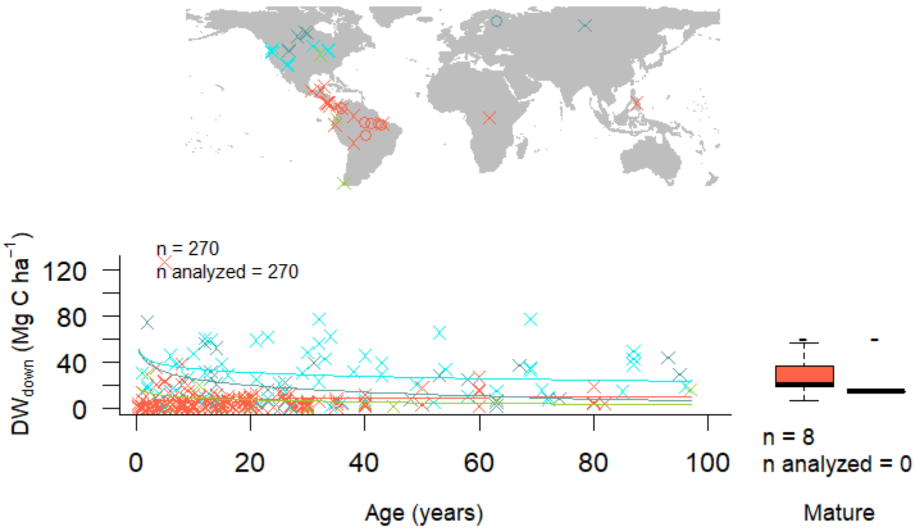
Age trends and biome differences for DW_{tot}. Map shows data sources (x and o indicate young and mature stands, respectively). In each panel, the left scatterplot shows age trends in forests up to 100 years old, as characterized by a linear mixed effects model with fixed effects of log10(age) and biome. The fitted line indicates the effect of age (solid lines: significant at $p<0.05$, dashed lines: non-significant), and non-parallel lines indicate a significant log10(age) x biome interaction. Boxplot illustrates distribution across mature forests, with different letters indicating significant differences between biomes. Data from biomes that did not meet the sample size criteria (see Methods) are plotted, but lack regression lines (young forests) or test of differences across biomes (mature forests).

Figure S28. Age trends and biome differences for $DW_{standing}$



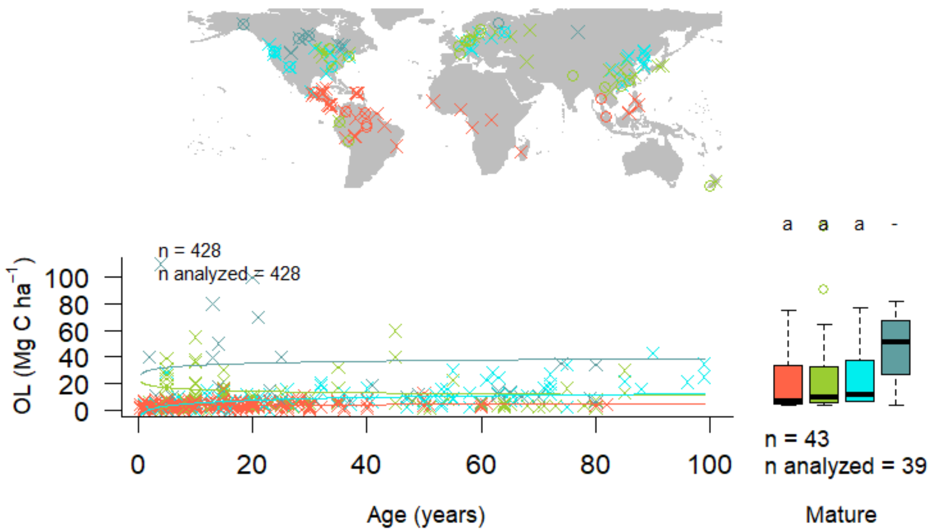
Age trends and biome differences for $DW_{standing}$. Map shows data sources (x and o indicate young and mature stands, respectively). In each panel, the left scatterplot shows age trends in forests up to 100 years old, as characterized by a linear mixed effects model with fixed effects of log10(age) and biome. The fitted line indicates the effect of age (solid lines: significant at $p<0.05$, dashed lines: non-significant), and non-parallel lines indicate a significant log10(age) x biome interaction. Boxplot illustrates distribution across mature forests, with different letters indicating significant differences between biomes. Data from biomes that did not meet the sample size criteria (see Methods) are plotted, but lack regression lines (young forests) or test of differences across biomes (mature forests).

Figure S29. Age trends and biome differences for DW_{down}



Age trends and biome differences for DW_{down}. Map shows data sources (x and o indicate young and mature stands, respectively). In each panel, the left scatterplot shows age trends in forests up to 100 years old, as characterized by a linear mixed effects model with fixed effects of log10(age) and biome. The fitted line indicates the effect of age (solid lines: significant at $p<0.05$, dashed lines: non-significant), and non-parallel lines indicate a significant log10(age) x biome interaction. Boxplot illustrates distribution across mature forests, with different letters indicating significant differences between biomes. Data from biomes that did not meet the sample size criteria (see Methods) are plotted, but lack regression lines (young forests) or test of differences across biomes (mature forests).

Figure S30. Age trends and biome differences for *OL*



Age trends and biome differences for *OL*. Map shows data sources (*x* and *o* indicate young and mature stands, respectively). In each panel, the left scatterplot shows age trends in forests up to 100 years old, as characterized by a linear mixed effects model with fixed effects of log10(age) and biome. The fitted line indicates the effect of age (solid lines: significant at $p<0.05$, dashed lines: non-significant), and non-parallel lines indicate a significant log10(age) x biome interaction. Boxplot illustrates distribution across mature forests, with different letters indicating significant differences between biomes. Data from biomes that did not meet the sample size criteria (see Methods) are plotted, but lack regression lines (young forests) or test of differences across biomes (mature forests).

Pastorello G, Trotta C, Canfora E, Chu H, Christianson D, Cheah Y-W, Poindexter C, Chen J, Elbashandy A, Humphrey M, Isaac P, Polidori D, Ribeca A, van Ingen C, Zhang L, Amiro B, Ammann C, Arain M A, Ardö J, Arkebauer T, Arndt S K, Arriga N, Aubinet M, Aurela M, Baldocchi D, Barr A, Beamesderfer E, Marchesini L B, Bergeron O, Beringer J, Bernhofer C, Berveiller D, Billesbach D, Black T A, Blanken P D, Bohrer G, Boike J, Bolstad P V, Bonal D, Bonnefond J-M, Bowling D R, Bracho R, Brodeur J, Brümmer C, Buchmann N, Burban B, Burns S P, Buysse P, Cale P, Cavagna M, Cellier P, Chen S, Chini I, Christensen T R, Cleverly J, Collalti A, Consalvo C, Cook B D, Cook D, Coursolle C, Cremonese E, Curtis P S, D'Andrea E, da Rocha H, Dai X, Davis K J, De Cinti B, de Grandcourt A, De Ligne A, De Oliveira R C, Delpierre N, Desai A R, Di Bella C M, di Tommasi P, Dolman H, Domingo F, Dong G, Dore S, Duce P, Dufrêne E, Dunn A, Dušek J, Eamus D, Eichelmann U, ElKhidir H A M, Eugster W, Ewenz C M, Ewers B, Famulari D, Fares S, Feigenwinter I, Feitz A, Fensholt R, Filippa G, Fischer M, Frank J, Galvagno M, Gharun M, et al 2020 The FLUXNET2015 dataset and the ONEFlux processing pipeline for eddy covariance data *Scientific Data* **7** 225