New Phytologist Supporting Information

Article title: Temperature responses of photosynthesis and respiration in evergreen trees from boreal to tropical latitudes

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The following Supporting Information is available for this article:

Fig. S1. Boxplots and relationship between biome, mean annual temperature and mean temperature of the warmest quarter in the ESWE dataset**.**

Fig. S2. Partial residuals with 95% confidence intervals (grey area) of the ANCOVA as a function of mean temperature of the warmest quarter (meanTWQ) to represent the effect of biome.

Fig. S3. Linear regression relationships with 95% confidence intervals (grey area) between several variables against experimental control growth temperatures across biomes.

Fig. S4. Partial residuals with 95% confidence intervals (grey area) from the ANCOVA as a function of mean annual temperature (mat) to represent the effect of biome.

Fig. S5. Linear relationships with 95% confidence intervals (grey area) against experimental control growth temperature for the response ratio (RR) of (a) net photosynthesis at 25°C, A_{net25} and (b) respiration rates a prevailing growth temperatures, R_{growth}.

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Table S1. Species list per biome and plant functional type, including latitude and longitude, the reference where the data originated and whether the study used controlled conditions or not.

Table S2. ANCOVA results with mean annual temperature as a covariate for both (a) control values and (b) the response ratios.

Table S3. Table with sample sizes for each variable in each category (warming amount, biome and leaf form).

Fig. S1. Boxplots of mean annual temperature, MAT (a) and mean temperature of the warmest quarter, Mean TWQ (b) per biome category indicated in the reference study. The boxplots consist of a central box representing the interquartile data range with the median shown as the bold line. Whiskers extend 1.5 times beyond the interquartile range or to the most extreme value, whichever is smaller. The small open circles are individual data points within a given biome outside the range of the whiskers. Both MAT and mean TWQ were good proxies for biome. There was a strong, positive relationship between mean annual temperature and mean temperature of the warmest quarter in the ESWE dataset (MAT = 1.30x – 11.96, $R^2 = 0.71$, $p < 0.0001$) (c). Colours indicate biome (Bor = boreal in skyblue, Temp = temperate in green and Trop = tropical in black). Leaf form is represented with different symbols with triangles for needleleaf and circles for broadleaf species.

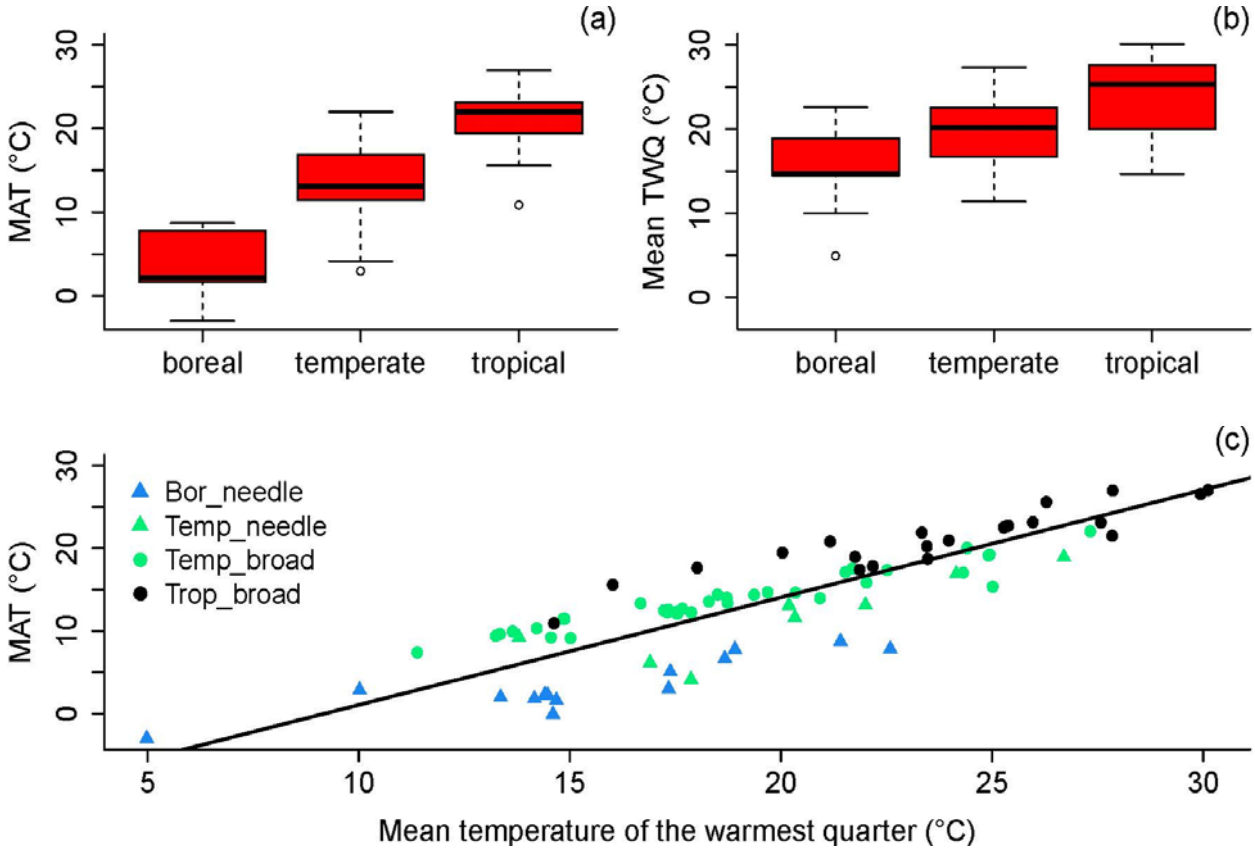

Fig. S2. Partial residuals with 95% confidence intervals (grey area) of the ANCOVA as a function of mean temperature of the warmest quarter (meanTWQ) from the *visreg* R package to represent the effect of biome for (a) maximum carboxylation rate at 25 °C, V_{cmax25} (slope of V_{cmax25} = exp(-0.0345x)), (b) maximum electron transport rates at 25 °C (slope of J_{max25} = exp (-0.0613x)), (c) the ratio of J_{max25} to V_{cmax25} (slope of $J{:}V_{25}$ = exp(-0.0281x)), (d) net photosynthesis measured at 25 °C, A_{net25} (slope of A_{net25} = exp(-0.367x)), (e) respiration measured at 25 °C, R_{25} (slope of R_{25} = exp(-0.0312x)) and (f) area-based nitrogen, N_a (slope of N_a = exp(-0.0798x)). Colours indicate biome (Bor = boreal in skyblue, Temp = temperate in green and Trop = tropical in black). Leaf form is represented with different symbols with triangles for needleleaf and circles for broadleaf species). Corresponding statistics using mean annual temperature as a covariate are shown in Table S2.

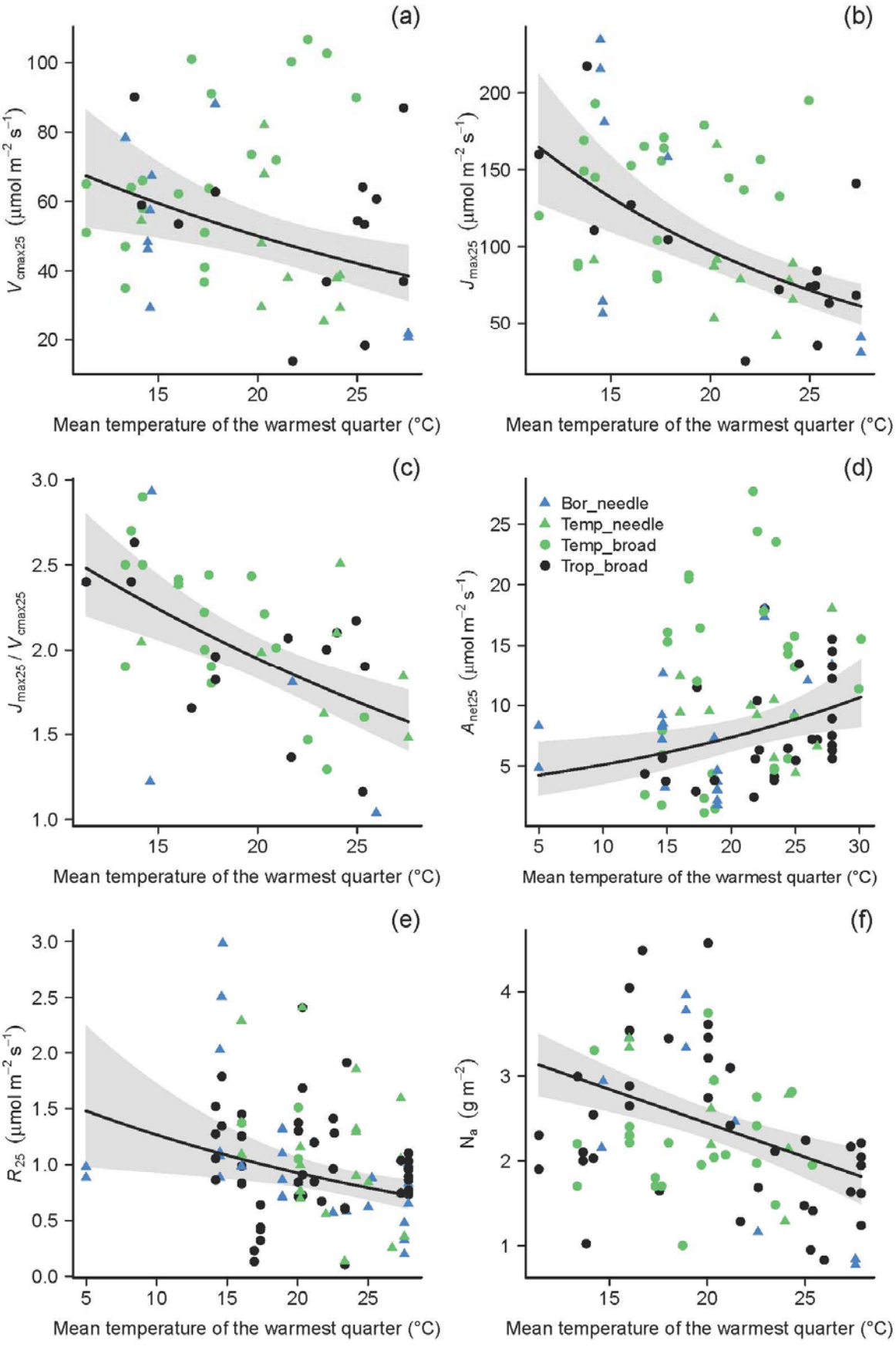
(a)
(b)
(c)
(d)
(e)
(f)
V_{cmax25} (µmol m^{-2} s^{-1})
J_{max25} (µmol m^{-2} s^{-1})
J_{max25} / V_{cmax25}
A_{net25} (µmol m^{-2} s^{-1})
R_{25} (µmol m^{-2} s^{-1})
N_a (g m^{-2})
Mean temperature of the warmest quarter (°C)
Bor_needle
Temp_needle
Temp_broad
Trop_broad

Fig. S3. Linear regression relationships with 95% confidence intervals (grey area) between several variables against experimental control growth temperatures across biomes (Bor = boreal in skyblue, Temp = temperate in green and Trop = tropical in black) in control conditions for (a) maximum carboxylation rate at 25 °C, V_{cmax25}, (b) maximum electron transport rates at 25 °C (J_{max25} = -4.14x + 176.89, R^2 = 0.15, p = 0.0008), (c) the ratio of J_{max25} to V_{cmax25} (J_{max25}/V_{cmax25} = -0.042 + 2.73, R^2 = 0.20, p = 0.001), (d) net photosynthesis measured at a common temperature of 25 °C, A_{net25}, (e) nitrogen content (N_a = -0.0797x + 4.035, R^2 = 0.14, p < 0.0001) and (f) the temperature optimum of photosynthesis (T_{optA} = 0.477x + 12.855, R^2 = 0.24, p = 0.0004). Leaf form is represented with different symbols with triangles for needleleaf and circles for broadleaf species.

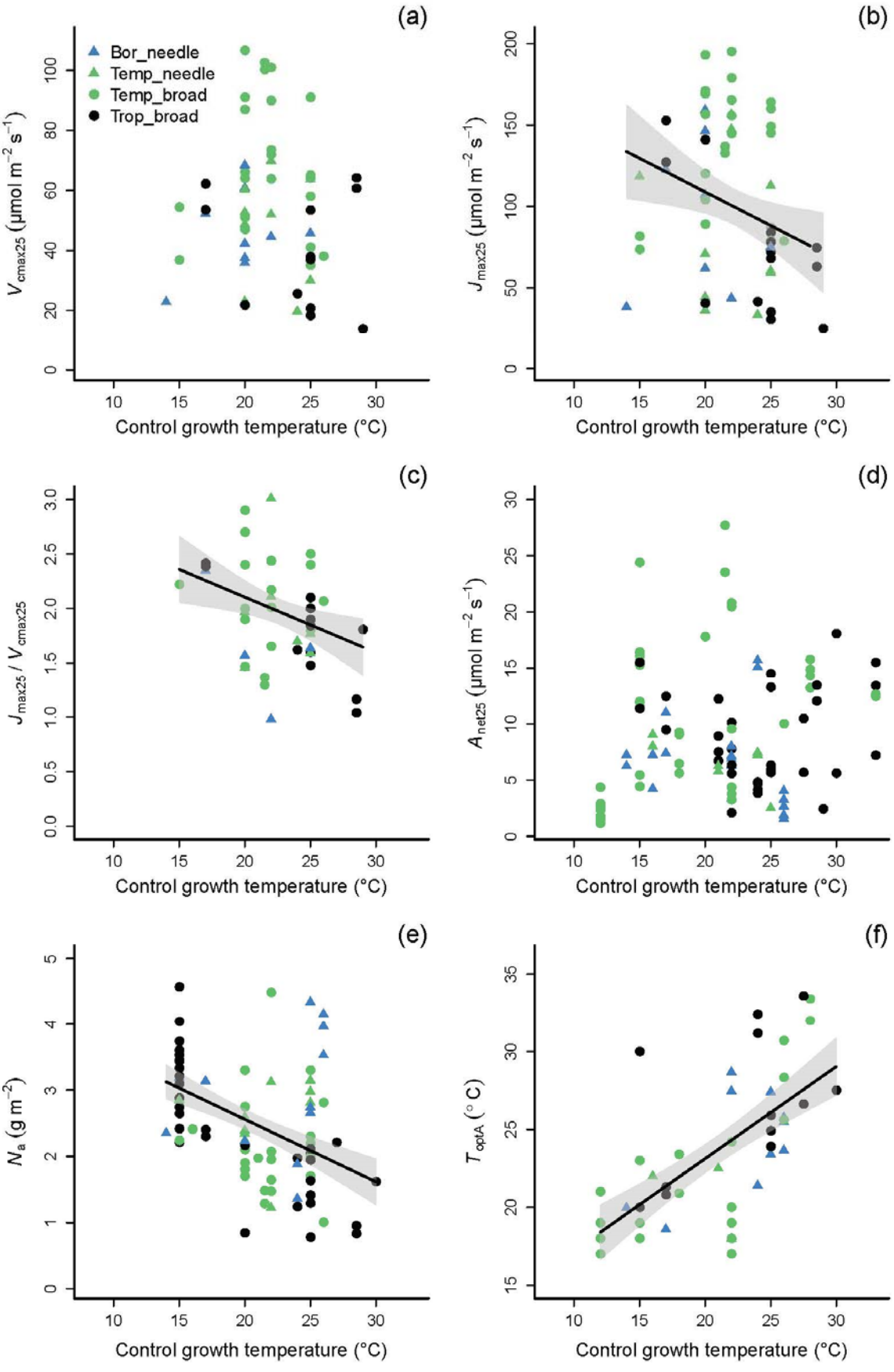
(a)
Bor_needle
Temp_needle
Temp_broad
Trop_broad
V_{cmax25} (µmol m^{-2} s^{-1})
Control growth temperature (°C)
(b)
J_{max25} (µmol m^{-2} s^{-1})
Control growth temperature (°C)
(c)
J_{max25} / V_{cmax25}
Control growth temperature (°C)
(d)
A_{net25} (µmol m^{-2} s^{-1})
Control growth temperature (°C)
(e)
N_a (g m^{-2})
Control growth temperature (°C)
(f)
T_{optA} (° C)
Control growth temperature (°C)

Fig. S4. Partial residuals with 95% confidence intervals (grey area) from the ANCOVA as a function of mean annual temperature (mat) from the *visreg* R package to represent the effect of biome for (a) the maximum carboxylation rate at 25 °C (slope of V_{cmax25} = exp(-0.031x)), (b) the maximum electron transport rate at 25 °C (slope of J_{cmax25} = exp(-0.049x)), (c) the J_{max}/V_{cmax} ratio measured at 25 °C (slope of $J{:}V_{25}$ = exp(-0.019x)), (d) net photosynthesis at 25 °C, A_{net25} (slope of A_{net25} = exp(0.025x)), (e) the temperature optimum of photosynthesis, T_{optA} (slope of T_{optA} = exp(0.018x)) and (f) area-based nitrogen, N_a (slope of N_a = exp(-0.032x)). Colours indicate biome (Bor = boreal in skyblue, Temp = temperate in green and Trop = tropical in black). Leaf form is represented with different symbols with triangles for needleleaf and circles for broadleaf species). Corresponding statistics using mean annual temperature as a covariate are shown in Table S2.

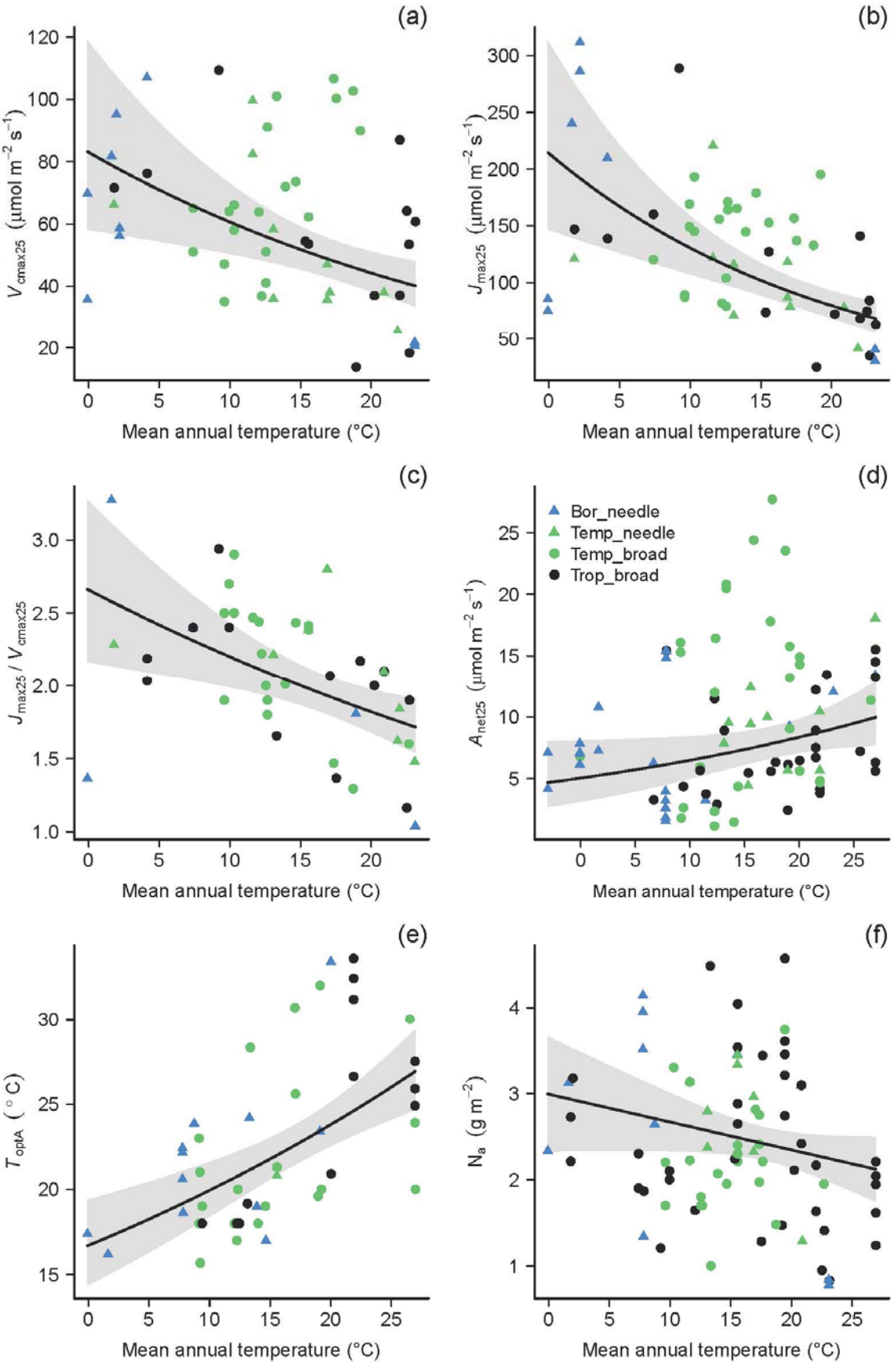
(a)
V_{cmax25} (µmol m^{-2} s^{-1})
Mean annual temperature (°C)
(b)
J_{max25} (µmol m^{-2} s^{-1})
Mean annual temperature (°C)
(c)
J_{max25} / V_{cmax25}
Mean annual temperature (°C)
(d)
Bor_needle
Temp_needle
Temp_broad
Trop_broad
A_{net25} (µmol m^{-2} s^{-1})
Mean annual temperature (°C)
(e)
T_{optA} (°C)
Mean annual temperature (°C)
(f)
N_a (g m^{-2})
Mean annual temperature (°C)

Fig. S5. Linear relationships with 95% confidence intervals (grey area) against experimental control growth temperature for the response ratio (RR) of (a) A_{net25} (RR_A_{net25} = -0.0219x + 1.432, R^2 = 0.13, p = 0.0001) and (b) R_{growth} (RR_R_{growth} = 0.0257x + 0.64, R^2 = 0.07, p = 0.002). Colours indicate biome (Bor = boreal in skyblue, Temp = temperate in green and Trop = tropical in black). Leaf form is represented with different symbols with triangles for needleleaf and circles for broadleaf species. A response ratio > 1 indicate an increased value in warming compared to control conditions, whereas a response ratio < 1 indicate a decreased value in warming compared to control conditions.

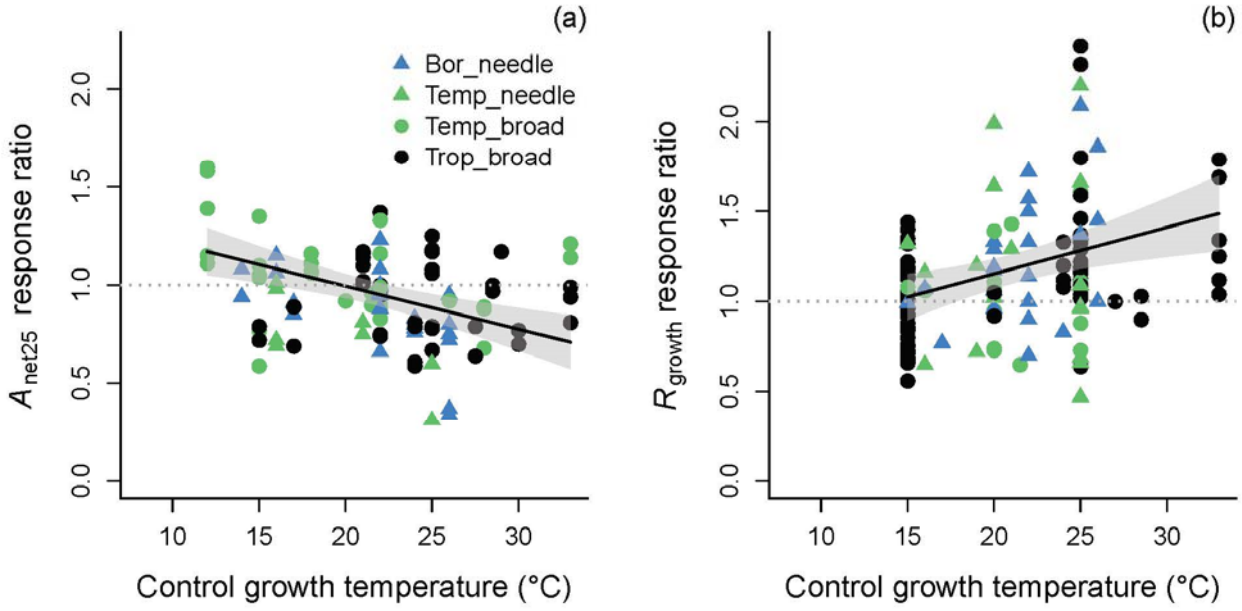

Table S1. Species list, including the plant functional type (PFT), biome where the species is found (Latitude, Longitude) based on information in the reference. The last column indicates whether the study was conducted in the field or in a controlled environment, albeit some field studies included controlled conditions such as open top chambers (OTC), whole tree chambers (WTC) or potted plant (POT).

Biome	Species	PFT	Latitude	Longitude	Reference	Field? Controlled Env?
Boreal	*Abies balsamea*	needleleaf	47.92	-92.5	Reich *et al*., 2016	Controlled
Boreal	*Abies faxoniana*	needleleaf	31.59	102.58	Yin *et al*., 2008	Controlled
Boreal	*Picea abies*	needleleaf	64.12	19.45	Lamba *et al*., 2018	Field
Boreal	*Picea abies*	needleleaf	44.02	-78.53	Kroner & Way 2016	Controlled
Boreal	*Picea aspertata*	needleleaf	31.59	102.58	Yin *et al*., 2008	Controlled
Boreal	*Picea crassifolia*	needleleaf	34.05	128.25	Zhang *et al*., 2018	Controlled
Boreal	*Picea glauca* (Deville/Wendover)	needleleaf	48.62 ,	-65.75	Benomar *et al*., 2018	Field
Boreal	*Picea glauca*	needleleaf	47.92	-92.5	Reich *et al*., 2016	Controlled
Boreal	*Picea koraiensis*	needleleaf	35.94	104.15	Zhang *et al*., 2015	Controlled
Boreal	*Picea likiangensis*	needleleaf	35.94	104.15	Zhang *et al*., 2015	Controlled
Boreal	*Picea mariana*	needleleaf	49.11	-74.61	Way & Sage 2008	Controlled
Boreal	*Picea mariana*	needleleaf	49.11	-74.61	Dusenge *et al*., 2020	Controlled
Boreal	*Picea meyeri*	needleleaf	35.94	104.15	Zhang *et al*., 2015	Controlled
Boreal	*Picea wilsonii*	needleleaf	37.5	109	Zhang *et al*., 2018	Controlled
Boreal	*Pinus banksiana*	needleleaf	47.92	-92.5	Reich *et al*., 2016	Controlled
Boreal	*Pinus banksiana*	needleleaf	47.92	-92.5	Bermudez *et al*., 2020	Field
Boreal	*Pinus sylvestris*	needleleaf	62.79	30.97	Wang *et al*., 1996	Field
Boreal	*Pinus sylvestris*	needleleaf	-		Kurepin *et al*., 2018	Controlled
Boreal	*Pinus sylvestris*	needleleaf	62.79	30.97	Kellomaki &Wang 1996	Field, OTC

Boreal	*Pinus sylverstris*	needleleaf	62.24	33.07	Smith & Dukes 2017	Controlled
Temperate	*Acmena smithii*	broadleaf	-37.42	149.82	Cunningham & Read 2002	Controlled
Temperate	*Anoperus glandulosus*	broadleaf	-42.43	146.54	Scafaro *et al*., 2017	Controlled
Temperate	*Antherosperma moschatum*	broadleaf	-41.29	145.89	Scafaro *et al*., 2017	Controlled
Temperate	*Antherosperma moschatum*	broadleaf	-37.7	145.68	Hill *et al*., 1998	Controlled
Temperate	*Ceratopetalum apetalum*	broadleaf	-31.17	152.4	Hill *et al*., 1998	Controlled
Temperate	*Doryphora sassafras*	broadleaf	-31.83	151.45	Hill *et al*., 1998	Controlled
Temperate	*Eucalyptus camadulensis* VIC	broadleaf	-37.22	143.27	Ferrar *et al*., 1989	Controlled
Temperate	*Eucalyptus incrassata*	broadleaf	-35.75	141.97	Ferrar *et al*., 1989	Controlled
Temperate	*Eucalyptus paciflora* PS	broadleaf	-36.5	148.5	Ferrar *et al*., 1989	Controlled
Temperate	*Eucalyptus paciflora* WP	broadleaf	-36.5	148.5	Ferrar *et al*., 1989	Controlled
Temperate	*Eucalyptus argophloia*	broadleaf	-26.33	150.33	Ngugi *et al*. 2003	Controlled
Temperate	*Eucalyptus argophloia*	broadleaf	-27.03	150.95	Oparah thesis, 2012	Controlled
Temperate	*Eucalyptus boistoana*	broadleaf	-35.57	149.7	Oparah thesis, 2012	Controlled
Temperate	*Eucalyptus cloeziana*	broadleaf	-26.05	152.7	Ngugi *et al.,* 2003	Controlled
Temperate	*Eucalyptus fastigata*	broadleaf	-33.49	150.56	Oparah thesis, 2012	Controlled
Temperate	*Eucalyptus globoidea*	broadleaf	-34.57	148.72	Oparah thesis, 2012	Controlled
Temperate	*Eucalyptus globolus*	broadleaf	-38.8	143.62	Crous *et al*., 2013	Field, WTC
Temperate	*Eucalyptus grandis*	broadleaf	-30.1	153.08	Crous *et al*., 2018	Controlled
Temperate	*Eucalyptus regnans*	broadleaf	-37.46	147.46	Warren *et al*., 2008	Controlled
Temperate	*Eucalyptus regnans*	broadleaf	-37.75	145.57	Scafaro *et al*., 2017	Controlled
Temperate	*Eucalyptus saligma*	broadleaf	-30.57	152.15	Ghannoum *et al*., 2010	Controlled
Temperate	*Eucalyptus saligna*	broadleaf	-33.6	150.73	Crous *et al*., 2011	Field, WTC
Temperate	*Eucalyptus sideroxylon*	broadleaf	-32.99	147.89	Ghannoum *et al*., 2010	Controlled
Temperate	*Eucalyptus tereticornis*	broadleaf	-29.1	152.58	Crous *et al*., 2018	Controlled
Temperate	*Eucalyptus tereticornis*	broadleaf	-33.6	150.73	Aspinwall *et al*., 2016	Field, WTC
Temperate	*Eucryphia lucida*	broadleaf	-42.68	146.67	Hill *et al*., 1998	Controlled
Temperate	*Eucryphia lucida*	broadleaf	-41.17	144.95	Cunningham & Read 2002	Controlled
Temperate	*Eucryphia lucida*	broadleaf	-42.44	145.98	Scafaro *et al*., 2017	Controlled
Temperate	*Eucryphia moorei*	broadleaf	-35.6	149.95	Hill *et al*., 1998	Controlled
Temperate	*Hedycarya angustifolia*	broadleaf	-37.85	145.37	Scafaro *et al*., 2017	Controlled
Temperate	*Juniperus monosperma*	needleleaf	35.84	-106.29	Collins *et al*., 2021	Field, OTC

Temperate	*Nothofagus cunninghamii*	broadleaf	-42.68	146.67	Hill *et al*., 1998	Controlled
Temperate	*Nothofagus cunninghamii*	broadleaf	-41.15	145.02	Cunningham & Read 2002	Controlled
Temperate	*Nothofagus moorei*	broadleaf	-31.83	151.45	Hill *et al*., 1998	Controlled
Temperate	*Pinus densiflora*	needleleaf	35.75	-138.83	Han *et al*., 2004	Field
Temperate	*Pinus edulis*	needleleaf	35.84	-106.29	Collins *et al*., 2021	Field, OTC
Temperate	*Pinus nigra*	needleleaf	40.18	-0.84	Smith & Dukes 2017	Controlled
Temperate	*Pinus pinaster*	needleleaf	41.08	-6.73	Smith & Dukes 2017	Controlled
Temperate	*Pinus pinea*	needleleaf	37.53	-6.68	Smith & Dukes 2017	Controlled
Temperate	*Pinus radiata*	needleleaf	-43.42	172.97	Ow *et al*., 2008	Controlled
Temperate	*Pinus strobus*	needleleaf	47.92	-92.5	Reich *et al*., 2016	Controlled
Temperate	*Pinus strobus*	needleleaf	46.66	-92.52	Bermudez *et al*., 2020	Field
Temperate	*Pinus taeda*	needleleaf	-		Teskey & Will 1999	Controlled
Temperate	*Pinus taeda*	needleleaf	34.95	-83.98	Wertin *et al*., 2012	Field, WTC
Temperate	*Quercus myrsinaefolia*	broadleaf	35.68	139.6	Hikosaka *et al*, 1999	Controlled
Temperate	*Sequioa sempervirens*	needleleaf	-38.76	175.57	Oparah thesis, 2012	Controlled
Temperate	*Simmondsia chinensis*	broadleaf	29.48	-115.81	Wardlaw *et al*., 1983	Controlled
Temperate	*Tasmannia lanceolata*	broadleaf	-41.58	145.95	Scafaro *et al*., 2017	Controlled
Temperate	*Telopea specissiosima*	broadleaf	-33.53	151.28	Huang *et al*.,2015	Controlled
Temperate	*Tristaniopsis laurina*	broadleaf	-37.7	147.37	Cunningham & Read 2002	Controlled
Tropical	Tropical species combined	broadleaf	-3.02	-54.97	Doughty *et al*., 2011	Field
Tropical	*Alchornea glandulosa*	broadleaf	-23.56	-46.73	Fauset *et al*., 2019	Field, OTC
Tropical	*Alstonia scholaris*	broadleaf	-16.22	145.87	Cunningham & Read 2002	Controlled
Tropical	*Anacardium excelsum*	broadleaf	8.98	-79.55	Slot *et al*., 2014	Field
Tropical	*Bonamia trichantra*	broadleaf	8.98	-79.55	Slot *et al*., 2014	Field
Tropical	*Bridelia brideliifolia*	broadleaf	-2.5	29.38	Mujawamariya *et al*., 2020	Field, POT
Tropical	*Bridelia micrantha*	broadleaf	-2.1	30.85	Mujawamariya *et al*., 2020	Field, POT
Tropical	*Calophyllum longifolium*	broadleaf	8.99	-79.55	Slot & Winter 2017	Controlled
Tropical	*Carapa grandiflora*	broadleaf	-2.5	29.05	Mujawamariya *et al*., 2020	Field, POT
Tropical	*Castanospermum australe*	broadleaf	-26.63	153.63	Cunningham & Read 2002	Controlled
Tropical	*Castanospermum australe*	broadleaf	-16.86	145.64	Scafaro *et al*., 2017	Controlled
Tropical	*Castilla slastica*	broadleaf	8.98	-79.55	Slot *et al*., 2014	Field
Tropical	*Cecropia insignis*	broadleaf	8.98	-79.55	Slot & Winter 2018	Controlled

Tropical	*Chrysophyllum gorungosanum*	broadleaf	-2.47	29.77	Mujawamariya *et al*., 2020	Field, POT
Tropical	*Croton megalocarpus*	broadleaf	-2.47	29.77	Mujawamariya *et al*., 2020	Field, POT
Tropical	*Cryptocarya mackinnoniana*	broadleaf	-16.8	145.64	Scafaro *et al*., 2017	Controlled
Tropical	*Dombeya rotundifolia*	broadleaf	-2.47	29.77	Mujawamariya *et al*., 2020	Field, POT
Tropical	*Eucalyptus camadulensis* QLD	broadleaf	-17.47	141.17	Ferrar *et al*., 1989	Controlled
Tropical	*Eucalyptus miniata*	broadleaf	-16.7	137.25	Ferrar *et al*., 1989	Controlled
Tropical	*Entandrophragma excelsum*	broadleaf	-2.47	29.77	Mujawamariya *et al*., 2020	Field, POT
Tropical	*Eucalyptus grandis*	broadleaf	-16.58	145.4	Crous *et al*., 2018	Controlled
Tropical	*Eucalyptus tereticornis*	broadleaf	-16.73	145.33	Crous *et al*., 2018	Controlled
Tropical	*Ficus insipida*	broadleaf	8.99	-79.55	Cheesman & Winter 2013	Controlled
Tropical	*Ficus insipida*	broadleaf	-		Krause *et al*., 2013	Controlled
Tropical	*Ficus insipida*	broadleaf	8.99	-79.55	Slot & Winter, 2017	Controlled
Tropical	*Ficus thonninghii*	broadleaf	-2.47	29.77	Mujawamariya *et al*., 2020	Field, POT
Tropical	*Guarea guidonia*	broadleaf	18.3	-65.83	Carter *et al*., 2021	Field
Tropical	*Harungana madagascariensis*	broadleaf	-2.47	29.77	Mujawamariya *et al*., 2020	Field, POT
Tropical	*Harungana montana*	broadleaf	-2.5	29.38	Mujawamariya *et al*., 2020, Dusenge *et al*. 2021	Field, POT
Tropical	*Heritiera trifoliolata*	broadleaf	-28.6	152.72	Cunningham & Read 2002	Field, POT
Tropical	*Itea chinensis*	broadleaf	23.17	112.17	Li *et al*., 2020	Field
Tropical	*Luehea seemannii*	broadleaf	8.99	-79.55	Slot *et al*., 2014	Field
Tropical	*Macaranga kilimandscharica*	broadleaf	-2.5	29.38	Mujawamariya *et al*., 2020	Field, POT
Tropical	*Machilus breviflora*	broadleaf	23.17	112.17	Li *et al*., 2020	Field
Tropical	*Maesa lanceolata*	broadleaf	-2.5	29.38	Mujawamariya *et al*., 2020	Field, POT
Tropical	*Markhamia lutea*	broadleaf	-2.1	30.85	Mujawamariya *et al*., 2020	Field, POT
Tropical	*Ochroma pyramidale*	broadleaf	8.99	-79.55	Cheesman & Winter 2013	Controlled
Tropical	*Ochroma pyramidale*	broadleaf	8.99	-79.55	Slot & Winter 2017	Controlled
Tropical	*Ocotea sintenisii*	broadleaf	18.3	-65.83	Carter *et al*., 2021	Field
Tropical	*Ormosia macrocalyx*	broadleaf	8.99	-79.55	Cheesman & Winter 2013	Controlled
Tropical	*Piper glabrescens*	broadleaf	18.3	-65.83	Carter *et al*., 2020	Field
Tropical	*Polyscias fulva*	broadleaf	-2.5	29.38	Mujawamariya *et al*., 2020	Field, POT
Tropical	*Prunus africana*	broadleaf	-2.5	29.38	Mujawamariya *et al*., 2020	Field, POT
Tropical	*Psychotria brachiata*	broadleaf	-18.3	-65.83	Carter *et al*., 2020	Field

Tropical	*Quercus virginiana*	broadleaf	28.28	-82.23	Smith & Dukes 2017	Controlled
Tropical	*Schima superba*	broadleaf	23.88	121.14	Sheu & Lin 1999	Controlled
Tropical	*Schima superba*	broadleaf	23.17	112.17	Li *et al*., 2020	Field
Tropical	*Sloanea woollsii*	broadleaf	-30.72	152.72	Cunningham & Read 2002	Controlled
Tropical	*Stigmaphyllon lindenianum*	broadleaf	8.98	-79.55	Slot *et al*., 2014	Field
Tropical	*Synima cordierorum*	broadleaf	-17.38	145.51	Scafaro *et al*., 2017	Controlled
Tropical	*Syzygium guineense*	broadleaf	-2.5	29.38	Mujawamariya *et al*., 2020, Dusenge *et al*. 2021	Field, POT
Tropical	*Syzygium rehderianum*	broadleaf	23.17	112.17	Li *et al*., 2020	Field
Tropical	*Syzygium sayeri*	broadleaf	-17.23	145.47	Scafaro *et al*., 2017	Controlled
Tropical	*Tabebuia rosea*	broadleaf	8.98	-79.55	Slot & Winter 2018, Slot *et al*. 2021	Controlled
Tropical	*Tamarindus indica*	broadleaf	26.63	-81.44	Smith & Dukes 2017	Controlled
Tropical	*Virola surinamensis*	broadleaf	8.98	-79.55	Slot & Winter 2018	Controlled

Table S2. (a) ANCOVA results (F-statistic and p-value) with leaf form as categorical variable and mean annual temperature (mat) as the covariate using absolute values of the control treatments only, transformed where necessary. (b) ANCOVA results (F-statistic and p-value) with warming amount, biome and leaf form as categorical variables and mean annual temperature as covariate on the response ratios to warming (RR) to test the effects of warming, except for T_{optA} where the absolute shift and the shift per °C warming was evaluated. Sources of the model are the columns and variables form the rows, df are the degrees of freedom for each source and the sample size for each variable is found in the second column (Total Obs.). P-values are indicated in bold when significant < 0.05.

(a) Control conditions	Total Obs.	Leaf form df = 1		mat (cov) df = 1	
Variable		F	p	F	p
V_{cmax25}	69	8.93	**0.004**	9.67	**0.003**
J_{max25}	68	18.14	**<0.0001**	21.78	**<0.0001**
J:V_{25}	53	11.33	**0.0015**	9.45	**0.0036**
A_{net25}	106	0.007	0.93	4.26	**0.042**
T_{optA}	56	4.11	**0.048**	19.54	**<0.0001**
A_{growth}	54	5.81	**0.020**	0.21	0.64
R_{growth}	126	0.52	0.47	1.04	0.31
R_{25}	129	0.61	0.44	2.29	0.13
N_a	109	0.0035	0.95	3.17	0.078

(b) Response ratios	Total Obs.	Warming amount (binned), df = 2		Mat (cov) df = 1		Leaf form df = 1		Amount*leaf form df = 2	
Variable		F	p	F	p	F	p	F	p
T_{optA}_abs shift	56	6.09	**0.0047**	1.49	0.23	0.12	0.73	1.32	0.28
T_{optA}_shift per °C	56	0.077	0.93	0.22	0.64	1.41	0.24	0.55	0.58
RR_V_{cmax25}	69	0.043	0.96	4.82	**0.03**	0.22	0.64	2.60	0.08
RR_J_{max25}	68	0.52	0.60	0.98	0.33	0.027	0.87	1.70	0.19
RR_$J:V_{25}$	53	0.026	0.97	7.87	**0.008**	4.66	**0.037**	0.13	0.88
RR_A_{net25}	106	0.19	0.83	7.91	**0.006**	17.27	**<0.0001**	5.69	**0.0047**
RR_A_{growth}	54	0.035	0.25	0.01	0.90	9.24	**0.004**	1.95	0.17
RR_R_{growth}	126	2.64	0.076	3.04	0.084	4.45	**0.037**	0.41	0.67
RR_R_{25}	129	1.15	0.32	2.36	0.13	1.92	0.17	5.30	**0.0063**
RR_Q_{10}	27	4.18	**0.032**	0.06	0.81	0.49	0.49	0.20	0.82
RR_N_a	109	3.05	0.052	0.85	0.36	0.31	0.58	0.77	0.47

Variables are: The absolute shift in temperature optimum of photosynthesis (T_{optA}_abs shift), the relative shift in T_{optA} per °C warming (T_{optA}_shift per °C), the maximum carboxylation rate, V_{cmax25}, the maximum electron transport rate, J_{max25}, the ratio of J_{max25} over V_{cmax25}, $J:V_{25}$ and net photosynthesis, A_{net25}. all measured at a common temperature of 25 °C, Photosynthesis and respiration measured at their growth temperatures (A_{growth} and R_{growth} respectively), mitochondrial dark respiration measured at 25 °C, R_{25} , the temperature sensitivity of respiration, Q_{10}, and area-based leaf nitrogen content, N_a. The response ratios of these variables are indicated with RR and are all log-transformed to meet normality assumptions.

Table S3. Sample sizes in each category (warming amount, biome and leaf form) for each variable: Maximum carboxylation rate at 25 °C (V_{cmax25}), Maximum electron transport rate at 25 °C (J_{max25}), the ratio of V_{cmax}/J_{max} at 25 °C ($J{:}V_{25}$), net photosynthesis at 25 °C (A_{net25}) and net photosynthesis at prevailing growth temperatures (A_{growth}), the temperature optimum of photosynthesis (T_{optA}), mitochondrial respiration at 25 °C (R_{25}), and dark respiration at growth temperatures (R_{growth}) and area-based nitrogen content (N_a).

Variable	Warming amount	Biome	Leaf form
V_{cmax25}	< 5°C - 19 5-10°C - 38 >10°C - 12	Boreal - 10 Temperate – 38 Tropical - 21	Broad - 45 Needles - 24
J_{max25}	< 5°C - 18 5-10°C - 38 >10°C - 12	Boreal - 9 Temperate - 37 Tropical - 22	Broad - 45 Needles - 23
$J{:}V_{25}$	< 5°C - 17 5-10°C - 28 >10°C - 8	Boreal - 5 Temperate - 30 Tropical - 18	Broad - 40 Needles - 13
A_{net25}	< 5°C - 37 5-10°C - 41 >10°C - 28	Boreal - 24 Temperate - 45 Tropical - 37	Broad - 72 Needles - 34
A_{growth}	< 5°C - 9 5-10°C - 33 >10°C - 12	Boreal - 9 Temperate - 26 Tropical - 19	Broad - 43 Needles - 11
T_{optA}	< 5°C - 17 5-10°C - 18 >10°C - 21	Boreal - 13 Temperate - 26 Tropical - 17	Broad - 40 Needles - 16
R_{25}	< 5°C - 49 5-10°C - 57 >10°C - 23	Boreal - 31 Temperate - 32 Tropical - 66	Broad - 73 Needles - 56
R_{growth}	< 5°C - 47 5-10°C - 62 >10°C - 17	Boreal - 24 Temperate - 36 Tropical - 66	Broad - 84 Needles - 42
N_a	< 5°C - 36 5-10°C - 57 >10°C - 16	Boreal - 13 Temperate - 38 Tropical - 58	Broad - 83 Needles - 26

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