

Appendix

A.1 Creating and sampling PLS

In order to create the hypervolume that contains all the possible combinations of functional traits and, hence, the PLSs, each trait owns a range of values that determines the minimum and the maximum value that will be sampled (Table A3). From this initial range of values, for allocation traits, XXXX. For the residence time traits the values are randomly and uniformly sampled. the sampled traits are combined to create the potential functional space that contains all the possible combination of values. From this potential space some combinations are excluded following a viability standard: first, the combination of values for allocation functional traits, necessarily, must sum 100%, otherwise this combination is excluded from the functional space. After that, all the combinations are submitted to a spinup simulation in order to verify if it presents carbon content on fine roots and on leaves that are higher than 0.001. Then, from the combinations that respect this premise 3000 PLSs (see A.2 for the sensitivity number test) are sampled and seeded in each grid-cell

Grasses and herbs percentage

A.2 Sensitivity for the sampled number of PLS

After creating the potential functional space with more than 10^5 a problem emerges: how many PLSs are enough to be sampled in order to make meaningful representation of all? To answer this question a set of 6 ensembles with different numbers of sampled PLSs (number of PLSs = 50, 100, 200, 500, 1000, 3000) was ran to test the model sensitivity. Each ensemble contains 10 runs, this is required because of the random nature of the initial sampling process. The only difference between the ensembles is the number of initialized PLS.

To explore the sensitivity of the model for the number of sampled PLSs we assessed the mean values and the variance in each of the 10 runs for the 6 ensembles for total plant carbon storage and for all the six functional traits (Figure A.1). With this strategy we sought to understand how the mean and the variances change between the runs for each ensemble of PLS number. Our idea is that since the sampling of functional trait values is random, we expect that the higher the number of PLSs the lower the difference in mean and variance between the runs. It would ensure that the results that emerge from the model, both for biogeochemical and functional diversity variables, are not a product of a “false” diversity derived from the simple difference between the runs.

As expected, it is notable that the number of PLSs sampled from all the possible combinations presents a meaningful influence on estimating the mean value and variance between the runs, both for the total plant carbon stock and the functional traits. We observed that as more PLSs are sampled, the greater the convergence in the mean values (orange ticks on Figure A.1) and in the variance between the 10 runs. These results emerge from the fact that the increase in the number of sampled PLSs turns better the ability in representing the total traits combinations in the potential functional space.

A.3 CAETÊ formulation description

The symbols used for each variable, its description and unit can be found in Table A.4. The constants with its respective values are shown in Table A.5.

A.3.1 Gridcell occupation and survivorship

The model CAETÊ is an area-based model, thus, the abundance of a strategy (a PLS or a PFT) is the fraction of the grid cell that it occupies based on the biomass contribution of this strategy in

47 relation to the total grid cell biomass. This procedure has support in the biomass-ratio hypothesis
 48 (Grime, 1998) that predicts that the immediate effects of a species is proportional to its relative
 49 contribution to the total biomass of the community. Then, from the relative abundances it is
 50 possible to aggregate the biogeochemical variables to the grid cell scale. This approach is also
 51 necessary because the competition scheme in CAETÉ model is still not mechanistic. However,
 52 the differential capture of carbon, water and light through the differential combination of
 53 functional traits is capable of leading to difference of abundances (Grime, 1998) between the
 54 PLSs (for the trait-based modeling approach) and between the PFTs (for the PFT modeling
 55 approach) in a grid cell. In that sense, the competition is indirectly considered by deriving the
 56 relative abundances (Grime, 1998). A PLS/PFT is considered as a survivor if it presents a
 57 positive carbon balance and also if it presents, concomitantly, at least 100 g of carbon in fine
 58 roots and in leaves.

59 In the subsequent formulas i means that the values is specific for a PFT or PLS in a grid cell
 60 y . The allocation traits α_z (Table A1 and A2) seeks to represent the percentage of the net
 61 primary productivity ($A_{r,y} NPP_i$; Eq. A15) distributed to each compartment z ; the carbon
 62 residence time traits τ_z (Table A1 and A2) seeks to represent how long the carbon stays in
 63 each of these compartments. Together, these functional traits ultimately define the amount of
 64 carbon (B_{z_i} ; Eq. A1) in each compartment of a PLS or PFT i in a certain time t , and then,
 65 the total plant carbon of that PLS or PFT (B_i ; Eq. A2).

$$\partial B_{z_i} / \partial t = \alpha_{z_i} NPP_i - B_{z_i} / \tau_{z_i} \quad (A1)$$

$$B_i = \sum B_{Z_i} \quad (A2)$$

66

67 The abundance of a strategy is the fraction of the grid cell that it occupies based on the biomass
 68 contribution of a strategy in relation to the total grid cell biomass. Therefore, the relative
 69 abundance ($A_{r_{i,y}}$; Eq. A3) of a PLS/PFT i in a grid cell y is assumed to be proportional to its
 70 relative contribution to the total grid cell biomass (B_{T_y} ; Eq. A4), in its turn determined by the
 71 sum of biomass of all the survival PLS/PFT (S) in that grid cell:

$$A_{r_{i,y}} = B_{i,y} / B_{T_y} \quad (A3)$$

$$B_{T_y} = \sum_{i=1}^S B_{i,y} \quad (A4)$$

72

73 From the relative abundance is possible to aggregate the biogeochemical variables from a PFTs/
 74 PLSs to the grid cell scale. For example, the net primary production (NPP_{grid_y} ; Eq. A5) of a
 75 grid cell y is equal to the sum of the NPP_i of all PFT/PLS i that survived (S) in that
 76 grid cell, weighted by their respective relative abundance ($A_{r_{i,y}}$):

$$NPP_{grid_y} = \sum_{i=1}^S (NPP_{i,y} A_{r_{i,y}}) \quad (A5)$$

77

78 *A.3.2 Functional traits trade-offs and associated ecophysiological processes*

79 Hereafter we describe the ecophysiological processes linked to the traits trade-offs. The first
 80 trade-off of CAETÉ's traits linked to allocation emerges from the fact that the carbon allocated to

one function or organ becomes unavailable to others. As a consequence, some capabilities are, necessarily, prioritized at the expense of others (Weiner, 2004). In order to include the limitation of photosynthesis by water availability and to include a trade-off for the fine roots traits investment, we added to the photosynthesis (GPP_i ; Eq. A14) equation a water stress factor (f_{5_i} ; Eq. A6). This factor is calculated in function of the ratio between the potential water supply for transpiration (L_i ; Eq. A7) and the atmospheric demand for transpiration (D_i ; Eq. A32). This approach is based on Pavlick et al. (2013).

$$f_{5_i} = 1 - \exp(-L_i/D_i) \quad (A6)$$

The potential water supply for transpiration (L_i) is a function of the carbon stock on fine roots compartment (B_{root_i} ; Eq. A1) multiplied by a constant water uptake capacity (C_{sru}) with a value of $0.0005 \text{ mmH}_2\text{O kgC}^{-1}\text{day}^{-1}$, and of the degree of water soil saturation in the grid cell (w_y ; Eq. A39). It is important to highlight that the value for w_y is correspondent to that of the previous day calculated by the water balance sub-model (see section *Water balance submodel*).

$$L_i = C_{sru} B_{root_i} w_{y_{t-1}} \quad (A7)$$

Following Pavlick et al. (2013), the leaf area index (LAI_i ; Eq. A8) takes into account the carbon content on leaves (B_{leaves_i} ; Eq. A1) and its specific leaf area (SLA_i ; Eq. A9). In order to consider the part of the canopy that receives direct light and the other that receive only

diffused light, LAI_i (Eq. A8) is partitioned in LAI_{sun_i} (Eq. A30) and LAI_{shade_i} (Eq. A31; see section *General ecophysiological formulations*).

$$LAI_i = B_{leaves_i} SLA_i \quad (A8)$$

$$SLA_i = 30(4380 / \tau_{leaves_i}) \exp(-0.46) \quad (A9)$$

101

where τ_{L_i} is the carbon residence time on leaves. This equation uses an empirical relationship derived from Reich et al. (1997) and aims to compute the so-called leaf economic spectrum (Wright et al., 2004).

The carbon stored on aboveground wood tissues are highly correlated to light competition (Reich, 2014). However, the model CAETÊ is still not able to represent the competition ecological process mechanistically, since there is no representation of shading of PFTs/PLSs that resemble understory plants by the ones that resemble trees with higher height and higher canopy area, for example. The majority of models represents the plants competitive ability for light associated to woody tissues through variables that describe height, wood density and canopy ratio [e.g. aDGVM (Scheiter, Langan, & Higgins, 2013) and LPJ (Sitch et al., 2003). These variables are estimated via allometric relationships that were not used by CAETÊ in this study. So in order to implement a trade-off for the traits (allocation and residence time) that determines the carbon content on ABGW (B_{abgw_i} ; Eq. A1), we used a simplified approach for the sake of representing the differential light capture between the different PFTs/PLSs in a grid cell. We considered that 5% of the PFTs/PLSs that present the higher relative carbon content on ABGW in a grid cell can capture 100% of the incident photosynthetically active radiation ($IPAR$; Eq.

118 A10), while the other ones can capture 80% of the $IPAR$. Here $IPAR$ represents 50% of the
 119 shortwave radiation (PAR ; input) that reaches the surface:

$$IPAR=0.5 PAR \quad (A10)$$

120

121 Lastly, all the plant compartments and, consequently, all the traits are associated to respiratory
 122 costs for maintenance and growth that, ultimately, imposes restrictions to investment in each of
 123 the compartments. The autotrophic respiration (R_{a_i} ; Eq. A11) is splitted in growth respiration
 124 (R_{g_i} ; Eq. A12) and maintenance respiration (R_{m_i} ; Eq. A13) following Ryan (1991a;
 125 1991b).

$$R_{a_i} = R_{g_i} + R_{m_i} \quad (A11)$$

126

127 The R_{g_i} formulation is based on Ryan et al. (1991a; 1991b), which postulates that a reasonable
 128 growth respiration estimate can be done assuming that its metabolics costs in each tissue
 129 consumes an amount of carbon equal to a quarter of the carbon incorporated in the new tissue
 130 (i.e. the difference between the carbon content in a compartment in a time t ($B_{Z_{i,t}}$) and the
 131 carbon content in the same compartment in a time $t-1$ ($B_{Z_{t-1}}$).

$$R_{g_i} = 1.25 (B_{Z_{i,t}} - B_{Z_{i,t-1}}) \quad (A12)$$

132

133 The maintenance respiration is calculated according to the nitrogen and carbon content in each
 134 compartment. The nitrogen content on plant tissues is intimately connected to the maintenance

135 respiration since about 60% of it is used to protein repair and substitution (Ryan, 1991a, 1991b).
 136 Yet, the nitrogen supriment is not considered as a limiting factor.

$$R_{m_i} = \sum [nc_Z B_{Z_i}^{27} \exp(0.07 T)] \quad (A13)$$

137

138 where nc_Z represents the N:C ratio for each plant compartment Z and T (°C) is the mean
 139 annual temperature. A considerable amount of the woody tissues do not respire (the so called
 140 heartwood; (Ryan, 1991b), and then we consider only 5% of the aboveground woody tissues
 141 carbon content on the maintenance respiration for this compartment. This 5% aims to represent
 142 the sapwood (Pavlick, Drewry, Bohn, Reu, & Kleidon, 2013). The N:C ratio is equal to 0.034,
 143 0.003 and 0.034 for leaves, sapwood and fine roots, respectively (Levis, Bonan, Vertenstein, &
 144 Oleson, 2004; Sitch et al., 2003). The parameter 0.07 is a sensibility factor of the maintenance
 145 respiration to temperature. Because in tropical forests the soil temperature is lower than the air
 146 temperature, then for calculating the fine roots maintenance respiration we used the soil
 147 temperature (T_{soil} ; see Oyama & Nobre, 2004).

148 *General ecophysiological formulations*

149 The photosynthesis equation (GPP_i) and the ones associated to it are based on Farquhar et al.
 150 (1980) formulation, which takes into account three limiting factors: rubisco carboxylation (J_C
 151 ; Eq. A18), light (J_{L_i} ; Eq. A19) and electron transport (J_E ; Eq. A20). We also included
 152 water stress limitation (f_{5_i}) as above described.

$$GPP_i = 0.012 * 31557600 * f_{1_i} f_{4_i} f_{5_i} \quad (A14)$$

153

154 where f_{1_i} (Eq. A16) is the leaf level gross photosynthesis and f_{4_i} is a function for
 155 upscaling the leaf level photosynthesis to the canopy level.

156 The net primary productivity (NPP_i ; Eq. A15) is the carbon available from photosynthesis (GPP_i) discounting the respiratory costs (R_{a_i}).

$$NPP_i = GPP_i - R_{a_i} \quad (A15)$$

158

159 In the following equations k_n are constants summarized in Table A5. The f_{1_i} is calculated as
 160 the smallest root between the three limiting rates: J_C (Eq. A18), J_{L_i} (Eq. A19) and J_E (Eq.
 161 A20):

$$f_{1_i} = \text{smallest root of: } k_1 J^2 - J(J_{P_i} + J_E) + J_{P_i} J_E = 0 \quad (A16)$$

162

163 where J_{P_i} (Eq. A17) is the minimum between J_C and J_{L_i} :

$$J_{P_i} = k_2 J_{P_i}^2 - J_{P_i}(J_C + J_{L_i}) + J_C J_{L_i} = 0 \quad (A17)$$

164

165 J_C is the photosynthesis rate limited by the Rubisco carboxylation capacity:

$$J_C = V_m \left(C_{press} - \Gamma / C_{press} + f_2 \left(1 + \left(k_3 / f_3 \right) \right) \right) \quad (A18)$$

166

167 where V_m (Eq. A21) is the rate of Rubisco carboxylation, C_{press} (Eq. A22) is the partial
 168 CO₂ pressure at leaf interior, Γ (Eq. A23) is the photorespiration compensation point, f_2
 169 (Eq. A24) is the Michaelis-Menten constant for CO₂ and f_3 (Eq. A25) the Michaelis-Menten
 170 constant for O₂.

171 J_{L_i} is the photosynthetic rate limited by light as a function of $IPAR_i$:

$$J_{L_i} = k_4 (1 - k_5) IPAR_i (C_{press} - \Gamma / C_{press} + k_6 \Gamma) \quad (A19)$$

172

173 The photosynthetic rate limited by the electron transport J_E is given by:

$$J_E = k_7 V_m \quad (A20)$$

$$V_m = V_{cmax} \left(\frac{k_{10} (T - k_{11})}{k_{18}} \right) / 1 + \exp(k_{19} (T - k_{20})) \quad (A21)$$

174

175 where V_{cmax} (Table A5) is the maximum rate of Rubisco carboxylation and T (input) is

176 temperature.

$$C_{press} = k_{16} \left(1 - (r / k_{17}) \right) (C_a - \Gamma) + \Gamma \quad (A22)$$

177

178 where r is the leaf level moisture deficit and C_a is the atmospheric CO₂ concentration.

$$\Gamma = k_3 / k_8 k_9^{k_{10} (T - k_{11})} \quad (A23)$$

$$f_2 = k_{12} (k_{13})^{k_{10} (T - k_{11})} \quad (A24)$$

$$f_3 = k_{14} (k_{15})^{k_{10} (T - K_{11})} \quad (A25)$$

179

180 The leaf level moisture deficit (r ; Eq. A26) is obtained by the actual mixing ratio on leaf level

181 and the saturated mixing ratio (r_{max} ; Eq. A27):

$$r = -0.315 r_{max} \quad (A26)$$

182

183 r_{max} is a function of partial pressure of water vapor (w_{press} ; Eq. A28) and the surface

184 pressure (P_{surf} ; input):

$$r_{max} = 0.622 (w_{press} / P_{surf} - w_{press}) \quad (A27)$$

$$w_{press} = 6.1121 \exp((18.678 - (T/234.5)) * (T/257.14 + T)) \quad (A28)$$

The function f_{4_i} is used in the canopy scaling of photosynthesis. Since we assume a canopy division in sun and shade parts the function f_{4_i} is subdivided in $f_{4_i}^{sun}$ (Eq. A29) and $f_{4_i}^{shade}$ (Eq. A30). The sun part aims to represent the canopy portion in which solar radiation reaches it directly in a 90° angle, while the shade part receives diffuse radiation in a 20° angle.

$$f_{4_i}^{sun} = (1 - e^{-k_{21} LAI_{sun_i}}) / k_{21} \quad (A29)$$

$$f_{4_i}^{shade} = (1 - e^{-k_{22} LAI_{shade_i}}) / k_{22} \quad (A30)$$

where LAI_i is the leaf area index also splitted in LAI_{sun_i} (Eq. A31) and LAI_{shade_i} (Eq. A32) in order to follow the canopy subdivision. Then, following Beer-Lambert's Law (see De Pury & Farquhar, 1997):

$$LAI_{sun_i} = 1 - \exp(-k_{21} LAI_i) / k_{21} \quad (A31)$$

$$LAI_{shade_i} = LAI_i - LAI_{sun_i} \quad (A32)$$

Following Gerten et al. (2004), the atmospheric demand for transpiration (D ; Eq. A33) used to calculate the water stress factor (f_{5_i}) represents the condition of a “unstressed transpiration” which occurs when stomatal opening is not limited by reduced water potential in the plant:

$$D=(1-w_{sat})E_{pot}\gamma_m/1+(g_m/g_{pot}) \quad (A33)$$

200

201 where w_{sat} (Eq. A39) is the degree of water soil saturation, E_{pot} the potential
 202 evapotranspiration, γ_m is a maximum Priestley-Taylor coefficient equal to 1.391 and g_m is
 203 the upscaling of stomatal conductance to canopy with value equal to 3.26 mms⁻¹ (Gerten,
 204 Schaphoff, Haberlandt, Lucht, & Sitch, 2004). Lastly, g_{pot} (Eq. A34) is the canopy potential
 205 conductance when there is no water limitation and is calculated through the minimum stomatal
 206 resistance (rc_{min}) that is equal to 100:

$$g_{pot}=1/rc_{min} \quad (A34)$$

207

208 The productivity (GPP_i) is coupled to the water balance sub-model (see section *Water*
 209 *balance submodel*) through the calculation of canopy resistance (Cr_i ; Eq. A35) and the
 210 stomatal conductance (gs_i ; Eq. A36):

$$Cr_i=1/gs_i \quad (A35)$$

211

$$gs_i=g_0+1.6\left(1+(g_1/\sqrt{VPD})\right)GPP_iC_a \quad (A36)$$

212

213 g_0 is the minimal stomatal conductance with a fix value of 0.001, g_1 is the conductance
 214 sensibility to the carbon assimilation (Medlyn et al., 2011) and has a constant value of 3.77.
 215 Lastly, VPD (Eq. A37) is the the deficit of vapor pressure on the leaf surface:

$$VPD=(E_{vap}*h)/10 \quad A37)$$

216

217 where h (input) is the relative humidity and E_{vap} is the evapotranspiration (see *Water*
218 *balance sub-model*)

219 A.3.3 Water balance sub-model

220 The CAETÊ uses a sub-model to calculate the water balance in a grid cell scale. This sub-model
221 is based on Oyama & Nobre (2004) and is evaluated over an homogeneous soil layer with a
222 unique water maximum holding capacity (H_{max}) equal to 500 mm. In the present study
223 different types of soil are not considered. Developments on CAETÊ have being done in order to
224 increase the amount of soil layers and to implement different soil types with different water
225 holding capacity and different nutrients availability.

226 The model here employed calculates soil water and snow budgets separately, however given the
227 climatic conditions of the study area we do not present here the soil snow budget formulation [see
228 Oyama & Nobre (2004) for accessing it]. The actual soil water content (H_y ; Eq. A38) in a
229 grid cell y in a time t depends on the precipitation (P_{rec} , input) , the evapotranspiration
230 (E_{vap} ; see Oyama & Nobre, 2004) and the runoff (R_{off} ; see Oyama & Nobre, 2004) on
231 this grid cell:

$$\partial H_y / \partial t = P_{rec_y} - E_{vap_y} - R_{off_y} \quad (A38)$$

232
233

234 Then, the degree of water soil saturation in the grid cell (w_{sat_y} ; Eq. A39) can be calculated:

$$w_{sat_y} = H_y / H_{max} \quad (A39)$$

235

236 For more in-depth information about the water balance submodel access Oyama e Nobre (2004).

A.3.4 Spinup simulation

Before the model initialization a spinup simulation was performed to determine the initial carbon content on plant compartments. This spinup was run until the stability attainment of the total biomass (i.e. the sum of carbon in all plant compartments) in all the grid cells, with a sensibility of 10% of difference between t_x and t_{x-1} . Thus, the initial amount of carbon (

$C_{init_{i,z}}$; Eq. A40) in each plant compartment z in an specific PFT or PLS i in a given time t_x :

$$\partial C_{init_{i,z}} / \partial t_x = \alpha_{i,z} NPP_{pot} - C_{init_{i,z}} / \tau_{i,z} \quad (A40)$$

where $\alpha_{i,z}$ (Table A1 and A2) is the fraction of NPP allocated to a plant compartment in each PFT/PLS i and $\tau_{i,j}$ (Table A1 and A2) represents the carbon residence time in a compartment. Here, NPP is potential (NPP_{pot}) calculated from the model CPTEC Potential Vegetation Model 2 (CPTEC-PVM2; Lapola, Oyama, & Nobre, 2009), a precursor model for CAETÊ. The potential NPP was calculated using the same climatology applied to CAETÊ.

References

- De Pury, D. G. G., & Farquhar, G. D. (1997). Simple scaling of photosynthesis from leaves to canopies without the errors of big-leaf models. *Plant, Cell and Environment*, 20(5), 537–557. <https://doi.org/10.1111/j.1365-3040.1997.00094.x>
- Farquhar, G. D., Caemmerer, S. Von, & Berry, J. a. (1980). A biochemical model of photosynthetic CO₂ assimilation in leaves of C₃ species. *Planta*, 90, 78–90. <https://doi.org/10.1007/BF00386231>
- Gerten, D., Schaphoff, S., Haberlandt, U., Lucht, W., & Sitch, S. (2004). Terrestrial vegetation and water balance - Hydrological evaluation of a dynamic global vegetation model. *Journal of Hydrology*, 286(1–4), 249–270. <https://doi.org/10.1016/j.jhydrol.2003.09.029>

260 Grime, J. P. (1998). Benefits of plant diversity to ecosystems: Immediate, filter and founder
 261 effects. *Journal of Ecology*, 86(6), 902–910. [https://doi.org/10.1046/j.1365-](https://doi.org/10.1046/j.1365-2745.1998.00306.x)
 262 2745.1998.00306.x

263 Lapola, D. M., Oyama, M. D., & Nobre, C. A. (2009). Exploring the range of climate biome
 264 projections for tropical South America: The role of CO₂ fertilization and seasonality. *Global*
 265 *Biogeochemical Cycles*, 23(3), 1–22. <https://doi.org/10.1029/2008GB003357>

266 Levis, S., Bonan, G. B., Vertenstein, M., & Oleson, K. W. (2004). The Community Land Model's
 267 Dynamic Global Vegetation Model (CLM-DGVM). *Ncar/Tn-459+Ia*, 50.
 268 <https://doi.org/10.5065/D6P26W36> CN - 03559 LA - en

269 Medlyn, B. E., Duursma, R. A., Eamus, D., Ellsworth, D. S., Prentice, I. C., Barton, C. V. M., ...
 270 Wingate, L. (2011). Reconciling the optimal and empirical approaches to modelling stomatal
 271 conductance. *Global Change Biology*, 17(6), 2134–2144. [https://doi.org/10.1111/j.1365-](https://doi.org/10.1111/j.1365-2486.2010.02375.x)
 272 2486.2010.02375.x

273 Oyama, M. D., & Nobre, C. a. (2004). A simple potential vegetation model for coupling with the
 274 Simple Biosphere Model (SiB). *Rev. Bras. Meteorol.*, 19, 203–216.

275 Pavlick, R., Drewry, D. T., Bohn, K., Reu, B., & Kleidon, A. (2013). The Jena Diversity-Dynamic
 276 Global Vegetation Model (JeDi-DGVM): a diverse approach to representing terrestrial
 277 biogeography and biogeochemistry based on plant functional trade-offs. *Biogeosciences*,
 278 10(6), 4137–4177. <https://doi.org/10.5194/bg-10-4137-2013>

279 Reich, P B, Walters, M. B., & Ellsworth, D. S. (1997). From tropics to tundra: global
 280 convergence in plant functioning. *Proceedings of the National Academy of Sciences of the*
 281 *United States of America*, 94(25), 13730–13734. <https://doi.org/10.1073/pnas.94.25.13730>

282 Reich, Peter B. (2014). The world-wide “fast-slow” plant economics spectrum: A traits
 283 manifesto. *Journal of Ecology*, 102(2), 275–301. <https://doi.org/10.1111/1365-2745.12211>

284 Ryan, M. G. (1991a). A simple method for estimating gross carbon budgets for vegetation in
 285 forest ecosystems. *Tree Physiology*, 9(1_2), 255–266. [https://doi.org/10.1093/treephys/9.1-](https://doi.org/10.1093/treephys/9.1-2.255)
 286 2.255

287 Ryan, M. G. (1991b). Effects of Climate Change on Plant Respiration, 1(2), 157–167.

288 Scheiter, S., Langan, L., & Higgins, S. I. (2013). Next-generation dynamic global vegetation
 289 models: learning from community ecology. *The New Phytologist*, 198(3), 957–969.
 290 <https://doi.org/10.1111/nph.12210>

291 Sitch, S, Smith, B., Prentice, I. C., Arneth, A., Bondeau, A., Cramer, W., ... Venevsky, S. (2003).
 292 Evaluation of ecosystem dynamics, plant geography and terrestrial carbon cycling in the LPJ

dynamic global vegetation model. *Global Change Biology*. <https://doi.org/10.1046/j.1365-2486.2003.00569.x>

Sitch, Stephan, Huntingford, C., Gedney, N., Levy, P. E., Lomas, M., Piao, S. L., ... Woodward, F. I. (2008). Evaluation of the terrestrial carbon cycle, future plant geography and climate-carbon cycle feedbacks using five Dynamic Global Vegetation Models (DGVMs). *Global Change Biology*, 14(9), 2015–2039. <https://doi.org/10.1111/j.1365-2486.2008.01626.x>

Weiner, J. (2004). Allocation, plasticity and allometry in plants. *Perspectives in Plant Ecology, Evolution and Systematics*, 6(4), 207–215. <https://doi.org/10.1078/1433-8319-00083>

Wright, I. J., Reich, P. B., Westoby, M., Ackerly, D. D., Baruch, Z., Bongers, F., ... Gulias, J. (2004). The worldwide leaf economics spectrum. *Nature*, 428, 821–827.