# Supporting Information

## **Appendix S1** Description of the water budget model.

The monthly potential evapotranspiration ($PET_m$) was computed using the Turc equation (Turc, 1961) (see eqn S1).

$PET_m = n \times 0.0133333 \times (Rg_m + 50) \times (t_m/(t_m+15))$ eqn S1

with n = number of days of the month, $t_m$ = the monthly temperature and $Rg_m$ = the monthly potential radiation.

The water budget computed monthly soil water content (SWCm) for each plot over the period 1980-2001, with initial condition for January 1980 SWCm set as SWCmax (the maximum soil water content). Then monthly soil water content was iteratively computed using eqn S2.

$SWC_{m+1} = \min(SWC_m + Precip_{s\ m} - AET_m, SWC_{max})$ eqn S2

With $Precip_{s\ m}$ = the infiltrating precipitation, $AET_m$ = the monthly actual evapotranspiration computed by eqn S3.

$AET_m = \min(D_m, S_m)$ eqn S3

with $D_m = PET_m – Precip_{i\ m}$ where $Precip_{i\ m}$ is the the intercepted precipitation. and $S_m = c_w * SWC_m/SWC_{max}$ where $c_w$ is a parameter denoting the maximum evapotranspiration from a saturated soil under conditions of high demand (as in Bugmann & Cramer 1998 we assume that $c_w$ = 12 cm/month).

$Precip_{i\ m}$ and $Precip_{s\ m}$ are computed with eqns S4 and S5

$Precip_{i\ m} = \min(f_i * P_m , PET_m)$ eqn S4

with $f_i$ = a parameter denoting the fraction of precipitation that is intercepted and is set at a value of 0.3 following Bugmann & Cramer (1998), and $P_m$ = the monthly precipitation.

$Precip_{s\ m} = P_m - Precip_{i\ m}$ eqn S5

**References**

Bugmann, H. & Cramer, W. (1998) Improving the behaviour of forest gap models along drought gradients. *Forest Ecology and Management*,**103**, 247-263.

Turc, L. (1961) Evaluation des besoins en eau d’irrigation, évapotranspiration potentielle. *Annales Agronomiques*, **12**, 13-49.

**Appendix S2** Likelihood of the model and prior description.

The likelihood of the observed five years radial growth ($y_{pi}$) based on a log-normal distribution of mean $G_{pi}$ (see eqn 1) and variance $\sigma^2$ is given by eqn S6.

$$L(Y \mid X, \sigma^2) = \prod_{p=1}^{P} \prod_{i=1}^{N_p} \mathrm{LN}(y_{pi} \mid G_{pi}, \sigma^2) \qquad \text{eqn S6}$$

We used flat conjugate prior with inverse-gamma distribution for variance $\sigma^2$ and conjugate log-normal prior for $\alpha_p$, $\beta_1$, $\beta_2$, and $\beta_3$ and non informative unconjugate prior for $\gamma$ and $\delta$. The first level priors were log-normal prior for $\beta$ $p(\log(\beta_k)) = N(mean = 0, \text{precision} = 0.000001)$, inverse-gamma for $\sigma^2$ $p(\sigma^2) = IG(1, 0.1)$, a uniform prior for $\gamma$, a normal prior for $\delta$ $p(\delta) = N(\text{mean} = 0, \text{precision} = 0.000001)$. $\alpha_p$ was modelled as a random log-normal variable accounting for plot effect, with mean $\alpha$ and variance $V_p$ ($p(\alpha_p) = \mathrm{LN}(\alpha, V_p)$). The second level priors were a flat inverse-gamma prior $p(V_p) = IG(1, 0.1)$ and non informative log-normal prior $p(\log(\alpha)) = N(\text{mean} = 0, \text{precision} = 0.000001)$.

To keep the parameters within a biologically meaningful range and to help MCMC convergence we bounded prior within a plausible range of values. Studies have generally concluded that there is a positive effect of degree-day sum (*DD*), and a negative effect of drought, on tree growth (see Rickebusch *et al.* 2007). We therefore decided to constrain our estimation to have a positive effect of both *DD* and *WB* by setting a positive boundary to the prior.

**References**

Rickebusch, S., Lischke, H., Bugmann, H., Guisan, A. & Zimmermann, N.E. (2007) Understanding the low-temperature limitations to forest growth through calibration of forest dynamics models with tree-ring data. *Forest Ecology and Management*, **246**, 251-263.

**Table S1:** Year of data collection and area for each *Département.*

| Département | Year of data collection | Area (km²) |
|---|---|---|
| 1 | 1995 | 5762 |
| 4 | 1999 | 6925 |
| 5 | 1997 | 5549 |
| 6 | 2002 | 4299 |
| 25 | 1994 | 5234 |
| 26 | 1996 | 6530 |
| 38 | 1997 | 7431 |
| 39 | 1992 | 4999 |
| 73 | 2000 | 6028 |
| 74 | 1998 | 4388 |
| 83 | 1999 | 5973 |
| 84 | 2001 | 3567 |

**Table S2.** Parameter estimates of the growth model (see eqn 1 for details): mean posterior values (and 95% posterior credible intervals) for the fixed-effects of the best model (see Table 2). ‡ indicates that the parameter was not estimated for this species. For species acronyms, see Table 1.

| Species | α | β1 | β2 | β3 | γ | δ | δ1 | δ2 |
|---|---|---|---|---|---|---|---|---|
| **ABIALB** | 2.56 (2.01 - 3.47) | 0.42 (0.41 - 0.44) | 0.15 (0.11 - 0.19) | 0.14 (0.11 - 0.17) | 0.17 (0.09 - 0.25) | 1.05 (0.86 - 1.27) | 0.1 (0.02 - 0.19) | ‡ |
| **FAGSIL** | 0.96 (0.87 - 1.09) | 0.43 (0.42 - 0.44) | 0.07 (0.03 - 0.1) | 0.08 (0.06 - 0.1) | 0.34 (0.26 - 0.4) | 1.04 (0.87 - 1.23) | -0.29 (-0.38 - -0.2) | 0.15 (0.06 - 0.26) |
| **PICABI** | 3.08 (2.5 - 3.95) | 0.44 (0.43 - 0.45) | 0.3 (0.24 - 0.35) | 0.13 (0.1 - 0.16) | 0.09 (0.05 - 0.14) | 0.91 (0.8 - 1.02) | 0.16 (0.11 - 0.21) | 0 (-0.03 - 0.04) |
| **PINSYL** | 1.07 (0.94 - 1.24) | 0.1 (0.09 - 0.11) | 0 (0 - 0.01) | 0.01 (0 - 0.03) | 0.18 (0.12 - 0.25) | 0.85 (0.72 - 0.99) | ‡ | ‡ |
| **LARDEC** | 1.67 (1.14 - 2.6) | 0.26 (0.24 - 0.27) | 0.15 (0.08 - 0.25) | 0.06 (0.03 - 0.09) | 0.1 (0.02 - 0.25) | 0.6 (0.45 - 0.8) | 0.12 (0.04 - 0.23) | ‡ |
| **QUEPET** | 1.62 (1.16 - 2.22) | 0.44 (0.42 - 0.46) | 0.12 (0.09 - 0.15) | 0.07 (0.03 - 0.12) | 0.05 (0.02 - 0.13) | 0.59 (0.48 - 0.73) | ‡ | -0.02 (-0.07 - 0.02) |
| **QUEPUB** | 0.5 (0.46 - 0.54) | 0.19 (0.18 - 0.2) | 0.1 (0.08 - 0.11) | 0.04 (0.02 - 0.07) | 0.34 (0.27 - 0.42) | 0.72 (0.6 - 0.86) | ‡ | 0.2 (0.1 - 0.31) |
| **QUEROB** | 1.86 (1.22 - 3.43) | 0.33 (0.29 - 0.36) | 0.17 (0.09 - 0.26) | 0.03 (0 - 0.07) | 0.13 (0.01 - 0.34) | 0.59 (0.42 - 0.82) | 0.02 (-0.09 - 0.14) | ‡ |
| **QUEILE** | 0.46 (0.42 - 0.51) | 0.15 (0.14 - 0.16) | 0.14 (0.11 - 0.17) | 0.09 (0.06 - 0.11) | 0.18 (0.03 - 0.46) | 0.13 (0.06 - 0.19) | ‡ | ‡ |
| **PINCEM** | 1.4 (0.64 - 3.19) | 0.01 (-0.08 - 0.09) | 0.04 (0 - 0.11) | 0.13 (0.02 - 0.26) | 0.17 (0.01 - 0.58) | 0.8 (0.46 - 1.3) | ‡ | ‡ |
| **PINUNC** | 0.86 (0.58 - 1.45) | 0.1 (0.07 - 0.14) | 0.03 (0 - 0.08) | 0.09 (0.04 - 0.15) | 0.22 (0.05 - 0.43) | 1 (0.66 - 1.46) | ‡ | ‡ |
| **POPTRE** | 1.84 (1.24 - 3.38) | 0.28 (0.24 - 0.32) | 0.09 (0.03 - 0.15) | 0.08 (0.02 - 0.13) | 0.17 (0.02 - 0.35) | 0.81 (0.54 - 1.13) | ‡ | ‡ |
| **ACEg** | 1.56 (1.09 - 2.37) | 0.26 (0.23 - 0.29) | 0.05 (0.01 - 0.11) | 0.12 (0.08 - 0.16) | 0.19 (0.05 - 0.38) | 0.85 (0.61 - 1.18) | 0.03 (-0.1 - 0.17) | |
| **BETPUB** | 1.65 (1.11 - 2.64) | 0.1 (0.05 - 0.15) | 0.03 (0 - 0.08) | 0.1 (0.02 - 0.19) | 0.15 (0.03 - 0.33) | 0.77 (0.54 - 1.04) | ‡ | 0.08 (-0.07 - 0.27) |
| **CARBET** | 1.16 (0.87 - 1.68) | 0.3 (0.29 - 0.31) | 0.1 (0.07 - 0.13) | 0.08 (0.04 - 0.13) | 0.15 (0.05 - 0.26) | 0.9 (0.69 - 1.13) | ‡ | -0.01 (-0.12 - 0.07) |
| **FRA** | 1.66 (1.23 - 2.41) | 0.36 (0.34 - 0.38) | 0.07 (0.04 - 0.1) | 0.11 (0.08 - 0.15) | 0.14 (0.04 - 0.25) | 0.77 (0.57 - 1) | ‡ | ‡ |

**Fig. S1.** Effect of neighbourhood crowding on potential growth for three hypothetical species. Species A exhibits a very strong decrease of potential growth at high crowding index (*δ*=1.5 and *γ*=0.15), whereas Species B exhibits a much smaller reduction of potential growth (*δ*=0.5 and *γ*=0.15). Finally, Species C exhibits a positive crowding effect (i.e. facilitation) (*δ*=-2 and *γ*=0.15). The crowding reduction function and crowding index range between 0 and 1. See text for more details on the crowding function.

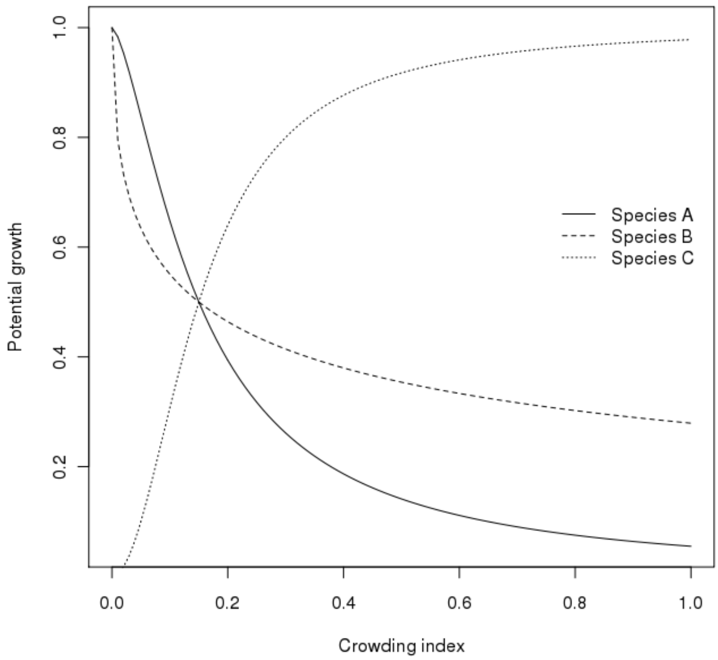

**Fig S2.** Growth response curves. For each of the 16 studies species, growth parameters α (and 95% credible intervals) (a), and growth curves showing the effect of (b) diameter (*D*), (c) degree-day sum (*DD*), (d) water budget (*WB*) and (e) crowding index (*CI*), for the 16 studied species. See Table 1 for species acronyms.

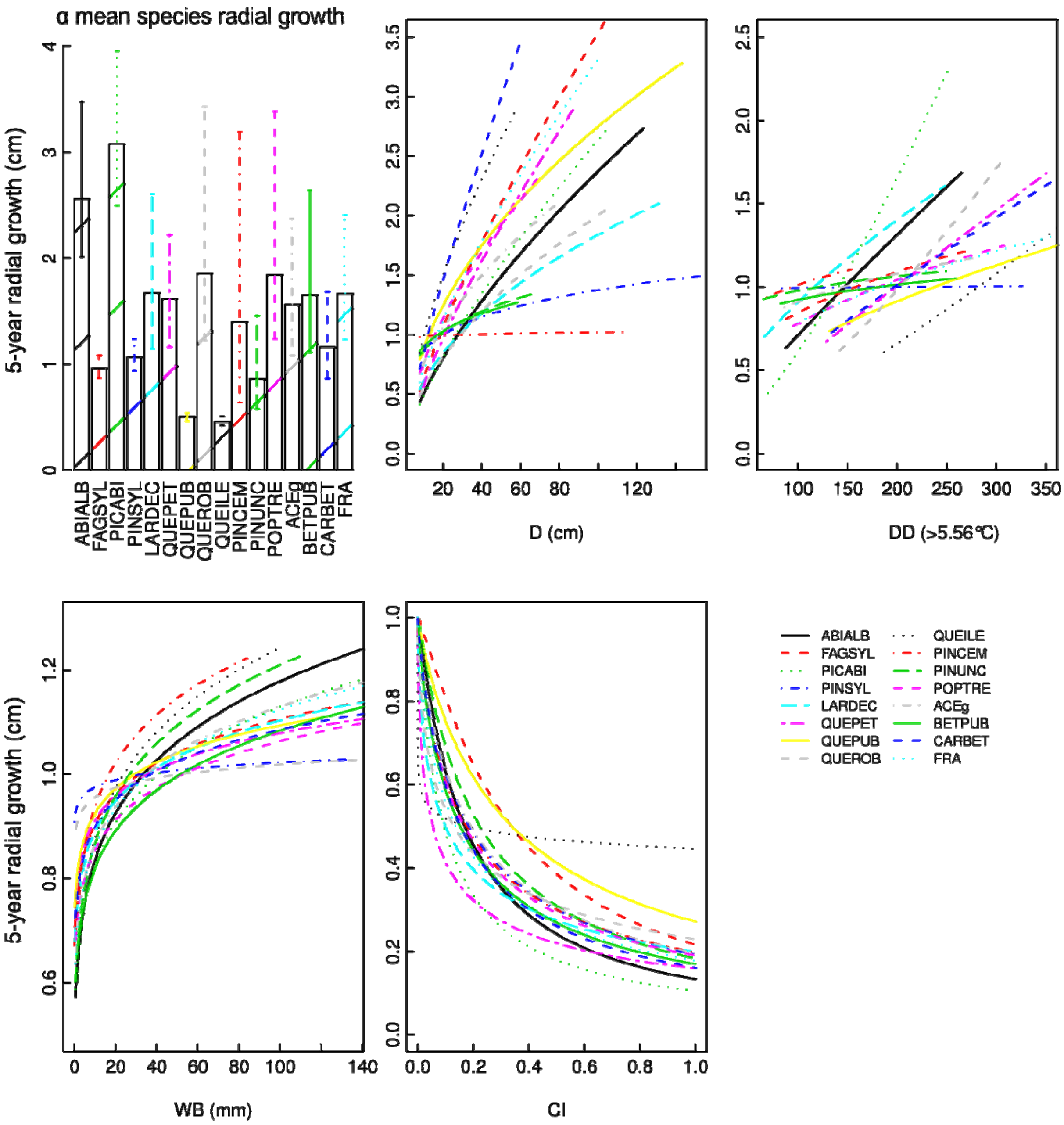

**Fig. S3.** Variation in competition importance with crowding index at low values of degree-day sum (*DD*) (high stress) (a) and low value of water budget (*WB*) (high stress) (b). Vertical dotted lines represents positions of low and high crowding conditions (*CI* of 0.02 and 0.7 respectively) used in Figs. 6 and 7 in the main text.