*Supplement of*

## Improved global estimation of seasonal variations in C3 photosynthetic capacity based on eco-evolutionary optimality hypotheses and remote sensing

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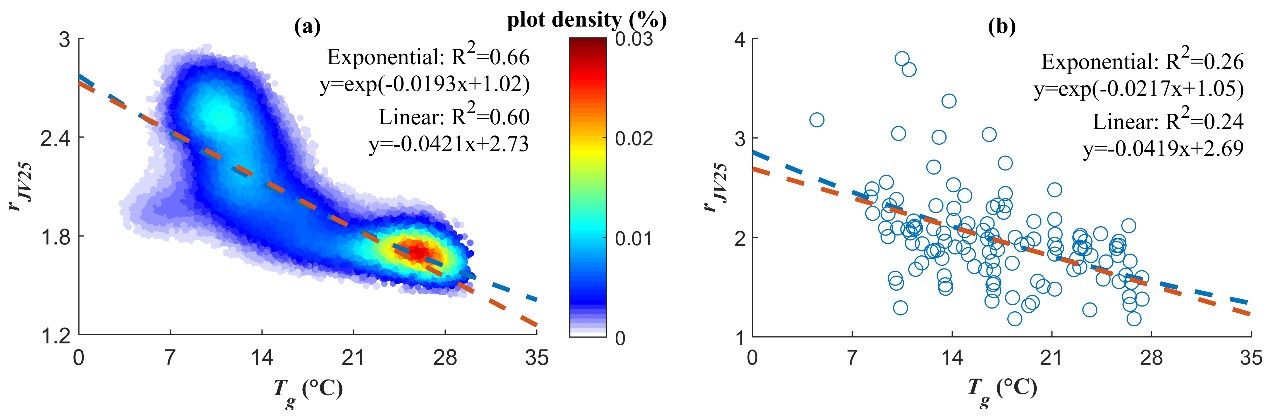
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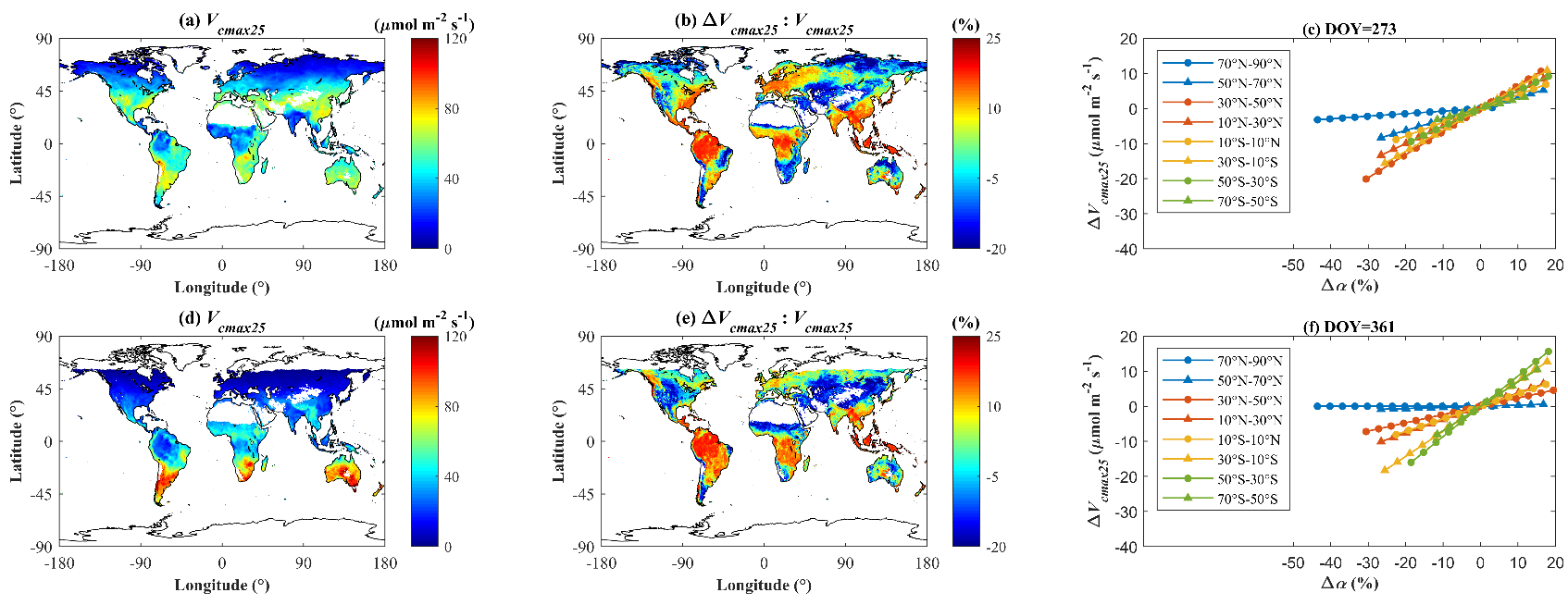
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**Table S1** Leaf parameters used in the PROSPECT model for each PFT. *N* refers to structure parameter, *Car* refers to carotenoid content, *Cb* refers to brown pigment, *Cm* refers dry matter, and *Cw* refers equivalent water thickness. ENF = Evergreen needleleaf forest, EBF = Evergreen broadleaf forest, DBF = Deciduous broadleaf forest, MF = Mixed broadleaf forest, SHR = Shrubland, SAV = savanna; GRS = Grassland, CRO = Cropland

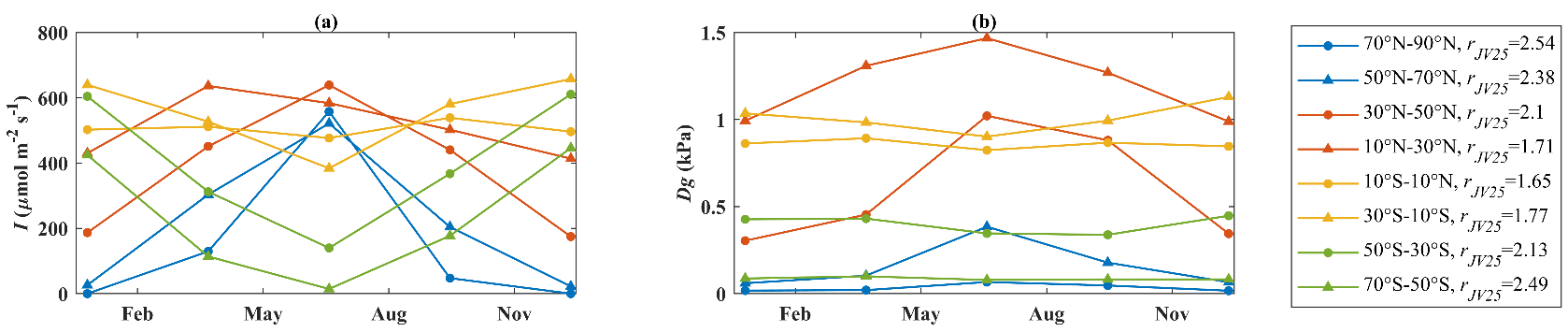
|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **PFT** | ***N*** | ***Car* (μg·cm-2)** | ***Cb*** | ***Cm* (g·cm-2)** | ***Cw* (g·cm-2)** | **Reference** |
| ENF | 2.8 | LCC/7 | 0 | 0.05 | 0.01 | De Santis et al. (2009) & Kötz et al. (2004) |
| EBF | 1.8 | LCC/7 | 0 | 0.005 | 0.01 | Arellano et al., 2017a, 2017b |
| DBF | 1.2 | LCC/7 | 0 | 0.005 | 0.01 | Féret et al. (2011) |
| MF | 1.2 | LCC/7 | 0 | 0.005 | 0.01 | Féret et al. (2011) |
| SHR | 1.8 | LCC/7 | 0 | 0.005 | 0.01 | Enrique et al. (2016) & Sow et al. (2013) |
| SAV | 1.2 | LCC/7 | 0 | 0.005 | 0.01 | Féret et al. (2011) |
| GRA | 1.2 | LCC/7 | 0 | 0.005 | 0.01 | Darvishzadeh et al. (2008) |
| CRO | 1.4 | LCC/7 | 0 | 0.015 | 0.01 | Jacquemoud et al. (2000) |

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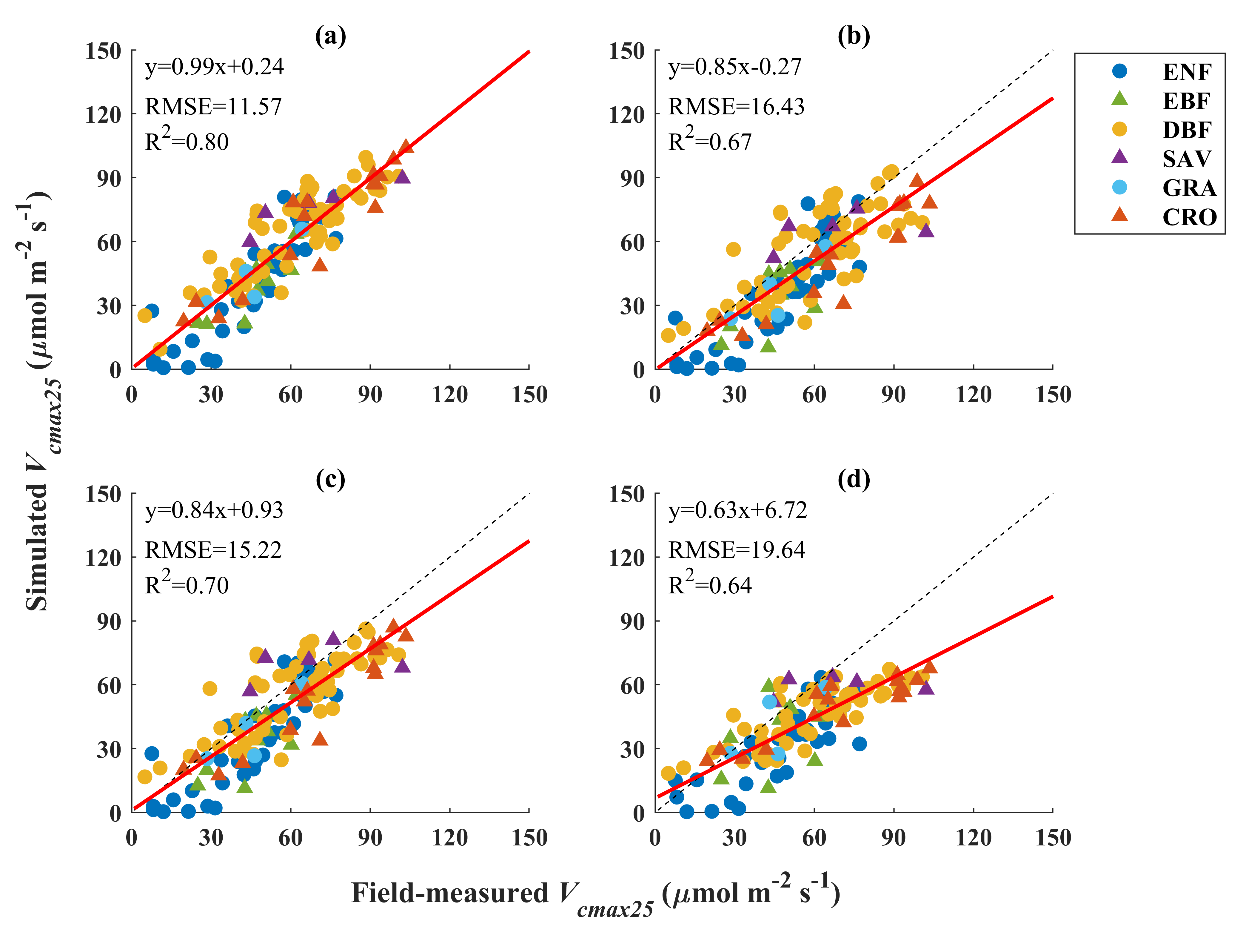
**Fig. S1.** Relationships between (**a**) RS-*rJV25* and *Tg* and between (**b**) *rJV25* from the global observation dataset and *Tg*. The blue dashed lines are the exponential empirical relationships, and the red dashed lines are the linear ones.



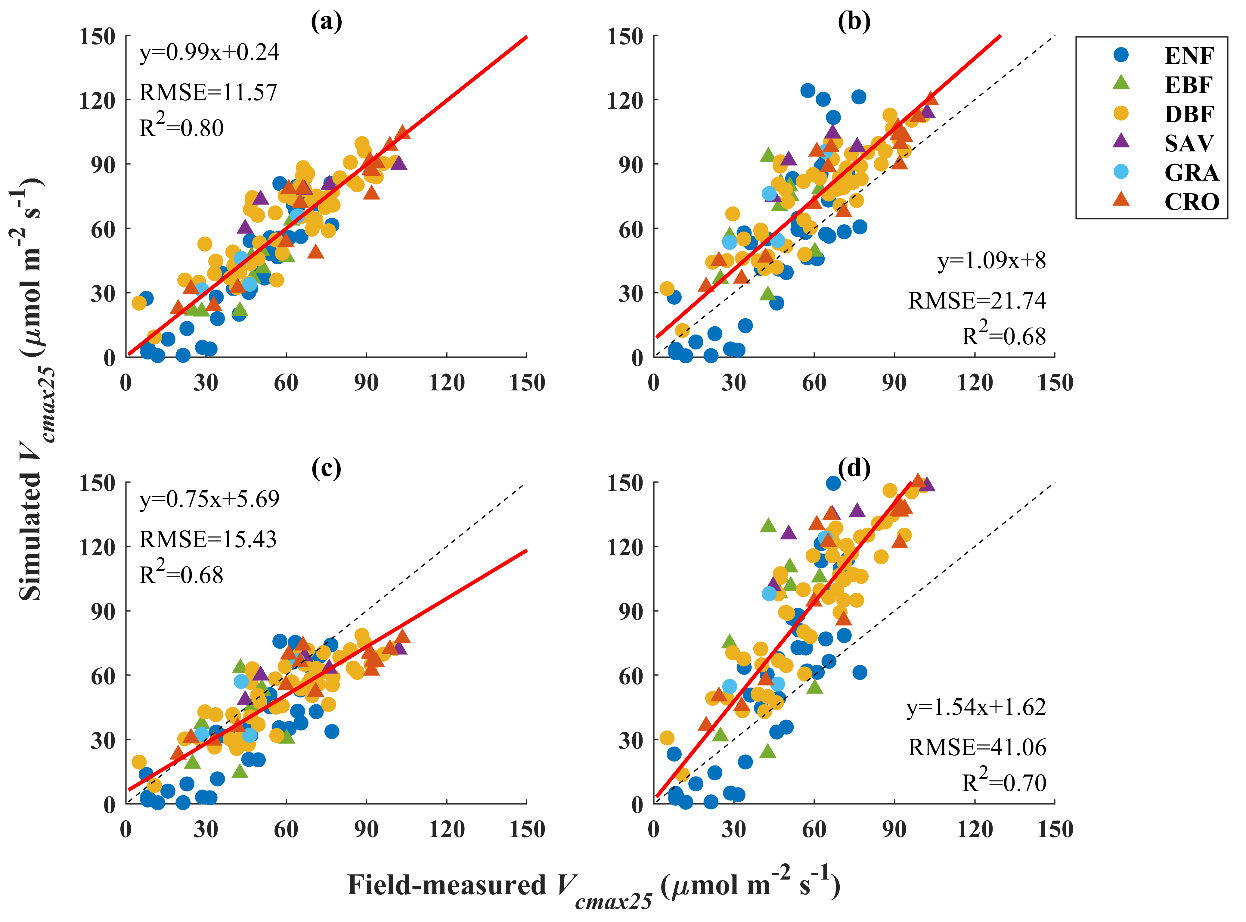
**Fig. S2. (a)** and **(d)** Global distributions of simulated *Vcmax25* of Scheme 4 at DOY 273 and 361, respectively; **(b)** and **(e)** Global distributions of Δ*Vcmax25* relative to Scheme 4 at DOY 273 and 361, respectively; **(c)** and **(f)** Sensitivity of Δ*Vcmax25* to variations in in different regions at DOY 273 and 361, respectively. The global mapsonly show areas with positive estimates, while the other areas are in blank.



**Fig. S3.** Averaged **(a)** *I* and **(b)** *Dg*for different latitudinal regions used in the sensitivity test in Figs. 5 and S1.



**Fig. S4.** Comparisons between all field measurements at 18 sites and **(a)** the top-leaf *Vcmax25* simulated using Eq. 14 with leaf absorptance (Scheme 1), **(b)** the canopy-average leaf-level *Vcmax25* simulated using Eq. 14 with canopy absorptance, **(c)** the top-leaf *Vcmax25* converted from **(b)** based on the empirical nitrogen vertical distribution coefficient, and **(d)** the top-leaf *Vcmax25* simulated using the model version in Jiang et al. (2020) with canopy absorptance and the empirical nitrogen vertical distribution coefficient. Canopy absorptance and the empirical nitrogen vertical distribution coefficient were estimated using the method in Jiang et al. (2020). Field-measured *rJV25* was adopted in **(a)** - **(c)**. The red lines are the regression lines, and the black dash lines are the 1:1 lines.



**Fig. S5.** Comparisons between all field measurements at 18 sites and **(a)** *Vcmax25* simulated using Eq. 14 (Scheme 1), **(b)** *Vcmax25* simulated using the model version in Smith et al. (2019), **(c)** *Vcmax25* simulated using the model version in Jiang et al. (2020), and **(d)** *Vcmax25* simulated using the model version in Peng et al. (2021). All inputs for the four simulations were the same, except that Scheme 1 adopted field-measured *rJV25*. The red lines are the regression lines, and the black dash lines are the 1:1 lines.

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