Supporting Information for "Canopy height and climate dryness parsimoniously explain spatial variations of unstressed stomatal conductance"

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Table S1. Accuracies and selected variables of the top ten scaled models based on AIC. The coefficients in front of the selected variables are the regression coefficients (β in Eq. 4 of the main text) of the normalized variables (z-scores), representing the sensitivities of $g_{s,\mathrm{ref}}$ to the selected variables. $g_{s,\mathrm{ref}}$ of each site is the 90th percentile of stomatal conductance derived using $g_s = (G_s - G_0)/\min(\mathrm{LAI}, 6)$.

			Selected variables		
Model	R^2	AIC	Canopy height	Dryness index	Mean climate
1	0.45	−328.52	$+0.046/H_c$	−0.198(PET − ET)	
2	0.44	−328.50		−0.201(PET − ET)	
3	0.44	−326.72		−0.212(PET − ET)	−0.016MAP
4	0.45	−326.63	$+0.047/H_c$	−0.208(PET − ET)	−0.007MAT
5	0.43	−326.62		−0.229(PET − ET)	+0.026MAT
6	0.45	−326.47	$+0.043/H_c$	−0.209(PET − ET)	−0.015MAP
7	0.40	−320.53		−0.155PET/ET	−0.071MAT
8	0.41	−319.56	$+0.063/H_c$	−0.139PET/ET	−0.053MAT
9	0.39	−316.12		−0.155PET/ET	−0.039MAP
10	0.40	−315.69	$+0.051/H_c$	−0.149PET/ET	−0.030MAP

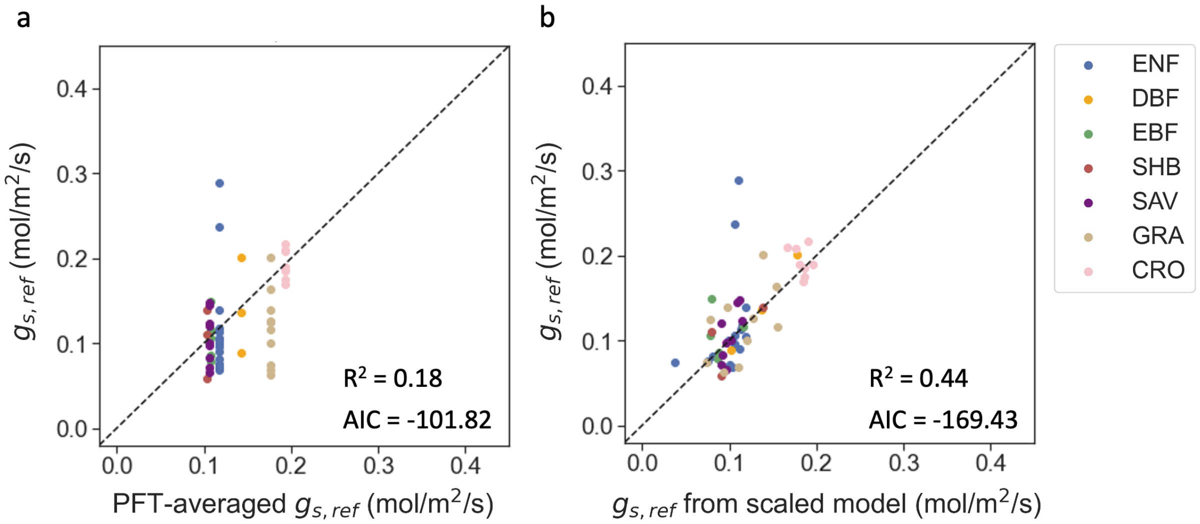

Figure S1. Comparison between gs,ref derived from observations (y-axis) and those estimated using (a) the baseline model (PFT-averages) and (b) the best scaled model, color coded by PFTs. Here, gs,ref is derived as described in the main text, but using only data when the energy closure error is below a threshold of 18%, which is the average across time and sites. The energy closure error is calculated as the difference between net radiation and the summation of latent, sensible, and ground heat fluxes, normalized by the net radiation. Only sites with available downward and upward longwave and shortwave radiation and ground heat flux observations and with at least 100 observations satisfying all quality-control filters are analyzed. The $\beta^T X$ in Eq. (4) of the best scaled model is $0.64 - 0.108\,(\mathrm{PET} - \mathrm{ET}) - 0.062\,\mathrm{MAT}$, followed by $0.63 + 0.050/H_c - 0.088\,(\mathrm{PET} - \mathrm{ET}) - 0.057\,\mathrm{MAT}$, where $1/H_c$, $\mathrm{PET} - \mathrm{ET}$, and MAT are z-scores of the corresponding variables.

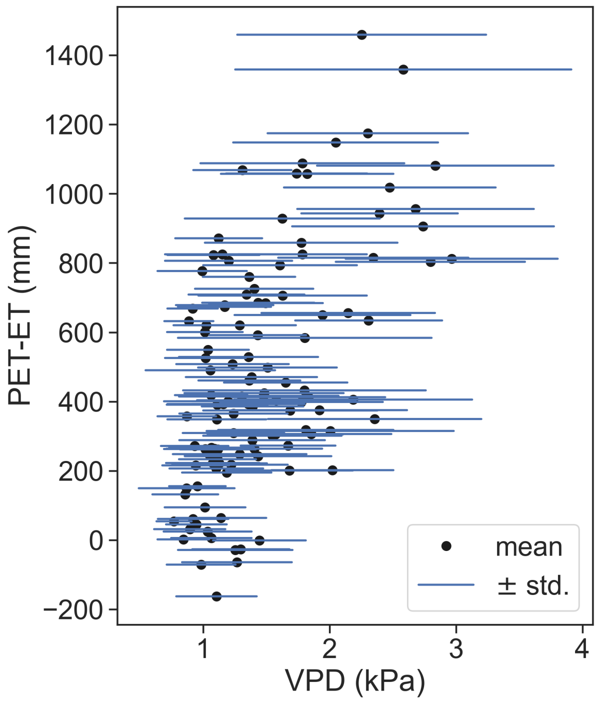

Figure S2. Relation between dryness index (long-term averaged annual PET-ET) and vapor pressure deficit (VPD) when the stomatal conductance g_s is close to $g_{s,\mathrm{ref}}$, i.e., within the range of 85th and 95th percentiles. Each black dot shows the mean and each horizontal blue line shows the standard deviation of VPD when g_s is close to $g_{s,\mathrm{ref}}$ at each site.

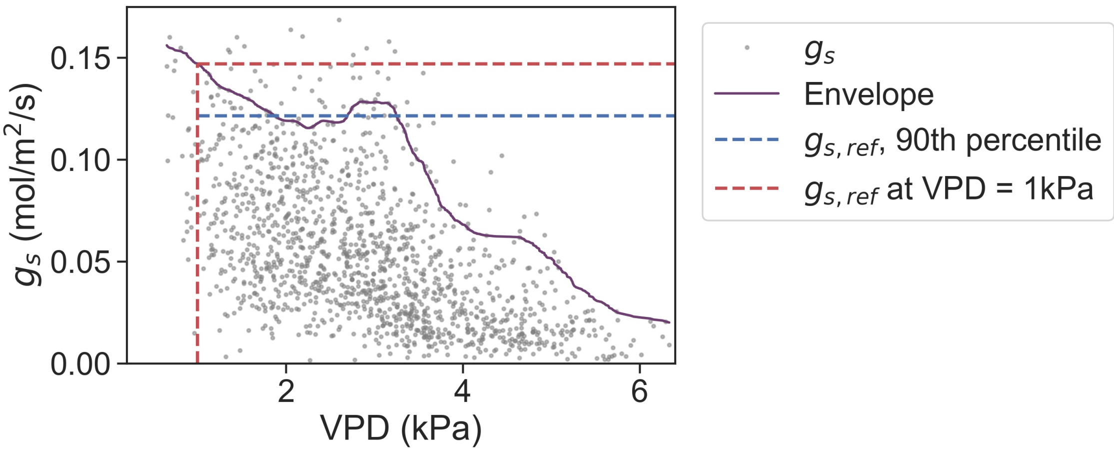

Figure S3. An example of deriving unstressed stomatal conductance ($g_{s,\mathrm{ref}}$) as the 90th percentile of stomatal conductance (g_s) at all times and as the envelope at VPD of 1 kPa, respectively, at the AR-Vir site. Grey dots are g_s derived from half-hourly observations satisfying the filters (described in Section 2.2.) across the entire record. The purple line shows the upper envelope of g_s, calculated using a quantile regression (Koenker, 2005) that estimates the 90th quantile of g_s in response to VPD using the *cvxpy* software in Python. The blue and red dashed lines denote the 90th percentile of g_s and the envelope at VPD of 1kPa, respectively.

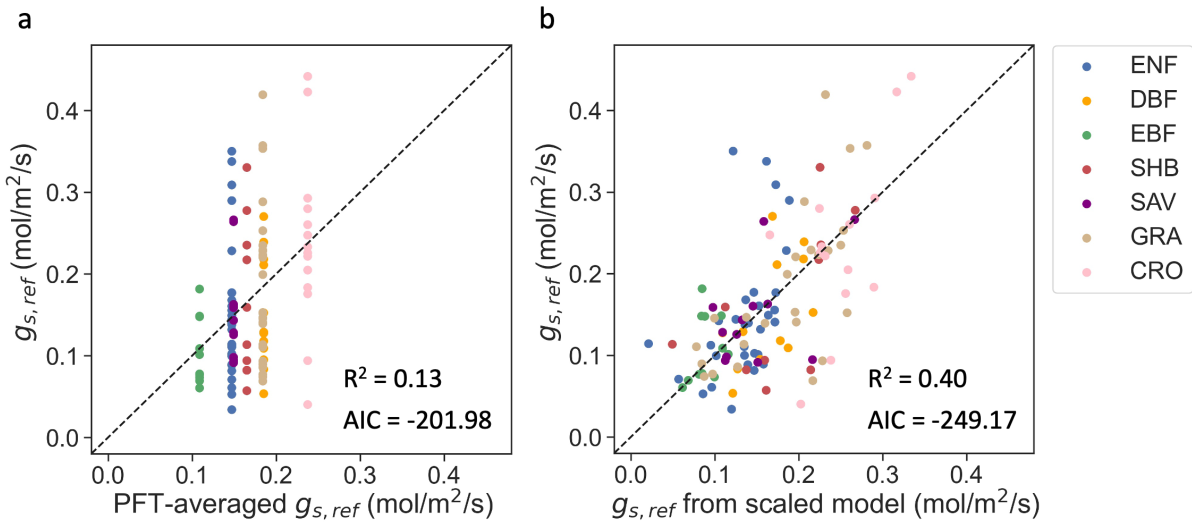

Figure S4. Comparison between $g_{s,\mathrm{ref}}$ derived from observations (y-axis) and those estimated using (a) the baseline model (PFT-averages) and (b) the best scaled model, color coded by PFTs. Here, $g_{s,\mathrm{ref}}$ is the 90th percentile of stomatal conductance (g_s) at all times, which was derived assuming ecosystem conductance G_s represents canopy conductance, i.e., replacing Eq. (2) in the main text with $g_s = G_s/\min(\mathrm{LAI}, 6)$. The $\beta^T X$ in Eq. (4) of the best scaled model is $0.76 + 0.075/H_c - 0.221(\mathrm{PET} - \mathrm{ET}) - 0.053\mathrm{MAP}$, where $1/H_c$, $\mathrm{PET} - \mathrm{ET}$, and MAP are z-scores of the corresponding variables.

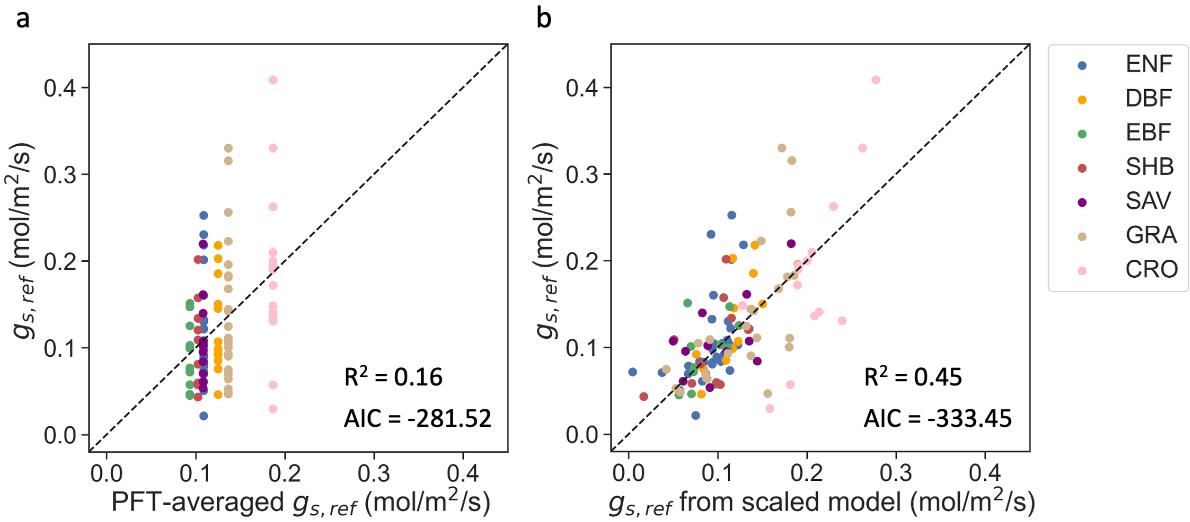

Figure S5. Comparison between $g_{s,\mathrm{ref}}$ derived from observations (y-axis) and those estimated using (a) the baseline model (PFT-averages) and (b) the best scaled model, color coded by PFTs. Here, $g_{s,\mathrm{ref}}$ is the 90th percentile of stomatal conductance (g_s) at all times, which was derived using a LAI cut-off of 4, i.e., $g_s = (G_s - G_0)/\min(\mathrm{LAI}, 4)$. The $\beta^T X$ in Eq. (4) of the best scaled model is $0.66 + 0.038/H_c - 0.223(\mathrm{PET} - \mathrm{ET}) + 0.036\mathrm{MAT}$, where $1/H_c$, $\mathrm{PET} - \mathrm{ET}$, and MAT are z-scores of the corresponding variables.

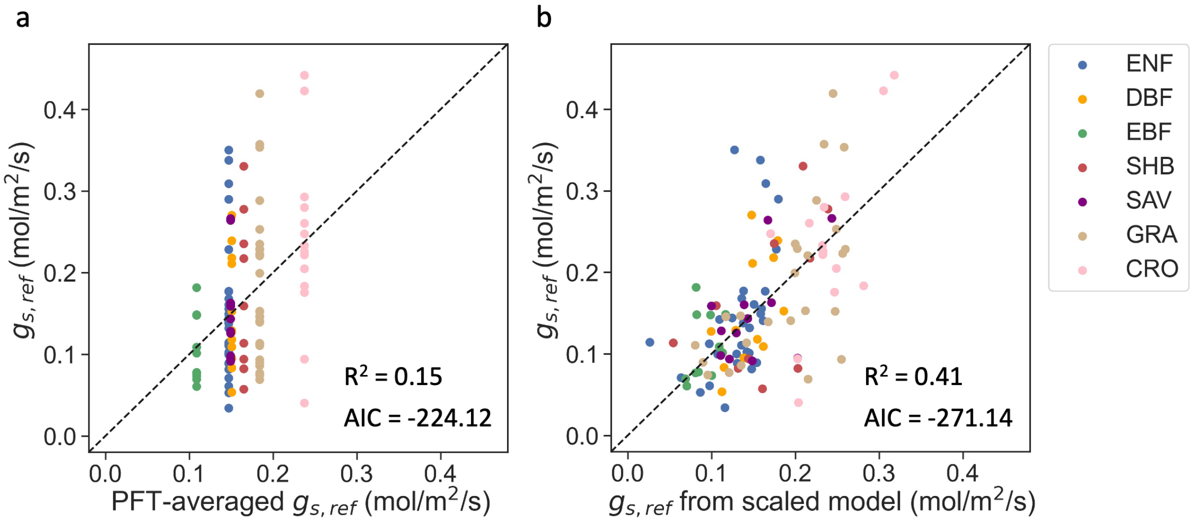

Figure S6. Same as Fig. S4 except that a LAI cut-off of 8 was used, i.e., $g_s = (G_s - G_0)/\min(\mathrm{LAI}, 8)$. The $\beta^T X$ in Eq. (4) of the best scaled model is $0.81 - 0.230(\mathrm{PET} - \mathrm{ET}) - 0.033\mathrm{MAP}$. The $\beta^T X$ of the second best (AIC = -270.93, $R^2 = 0.42$) scaled model is $0.75 + 0.077/H_c - 0.213(\mathrm{PET} - \mathrm{ET}) - 0.028\mathrm{MAP}$, where $1/H_c$, $\mathrm{PET} - \mathrm{ET}$, and MAP are z-scores of the corresponding variables.

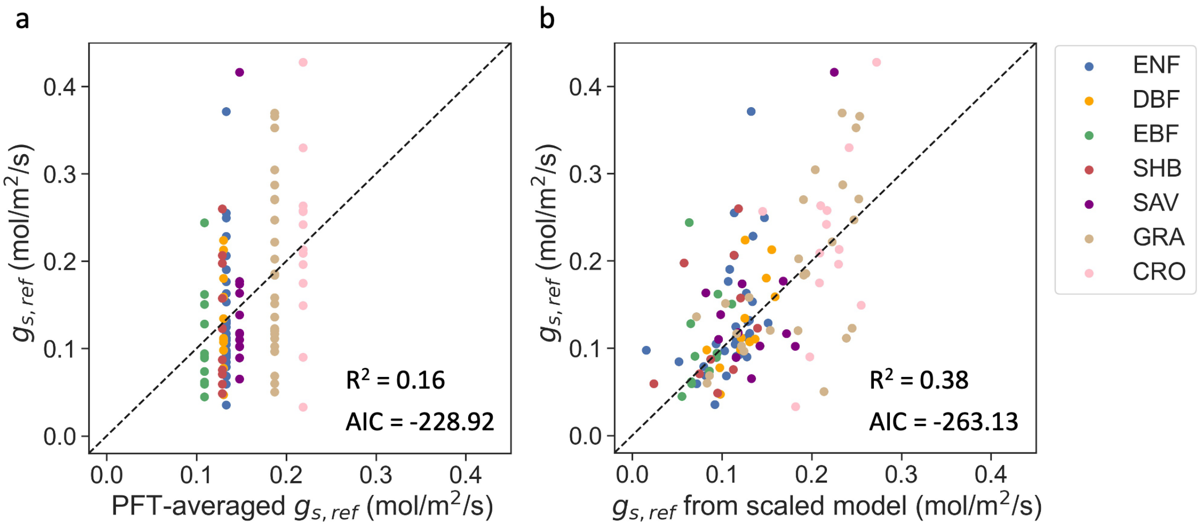

Figure S7. Comparison between $g_{s,\text{ref}}$ derived from observations (y-axis) and those estimated using (a) the baseline model (PFT-averages) and (b) the best scaled model, color coded by PFTs. Here, $g_{s,\text{ref}}$ is the envelope of stomatal conductance when VPD $= 1$ kPa, estimated using quantile regression as illustrated in Fig. S2. The stomatal conductance was derived using Eq.(2) in the main text. The $\beta^T X$ in Eq. (4) of the best scaled model is $0.71 + 0.041/H_c - 0.197(\text{PET} - \text{ET})$, where $1/H_c$ and $\text{PET} - \text{ET}$ are z-scores of the corresponding variables.