remote sensing

Supporting Information for

Disentangling the Key Drivers of Ecosystem Water-Use Efficiency in China's Subtropical Forests Using an Improved Remote Sensing Driven Analytical Model

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Table S1. Model parameters and equations. $\mathbf{T_a}$ is the air temperature (°C); $\mathbf{T_{opt}}$ is optimum temperature for plant growth (°C), and we used the equation proposed by [1], which was also used in the CASA model. $\mathbf{R_n}$ is the net radiation (W/m²). RH and VPD are relative humidity (%) and vapor pressure deficit (kPa). $\mathbf{f_{APAR\_max}}$ is the maximum $\mathbf{f_{APAR}}$; β (1.28) is the sensitivity of the soil moisture constraint to VPD (kPa); k_{Rn} (0.6) is the extinction coefficient (unitless) [2]. b1 = 0.95, b2 = 0.9355, k1 = 0.57, and k2 = 0.81.

Parameter	Description	Equation	Reference
f_{wet}	Relative surface wetness	$f_{wet} = RH^4$	[3]
f_g	Green canopy fraction	$f_g = f_{APAR}/f_{IPAR}$	[3]
f_t	Plant temperature constraint	$f_t = \exp\left[-(\frac{T_a - T_{opt}}{T_{opt}})^2\right]$	[4]
f_m	Plant moisture constraint	$f_m = \frac{f_{APAR}}{f_{APAR\_max}}$	[3]
f_{sm}	Soil moisture constraint	$f_{wet} = RH^{VPD/\beta}$	[3]
R_{nc}	Net radiation to the canopy	$R_n = R_{nc} - R_{ns}$	[3]
R_{ns}	Net radiation to the soil	$R_{ns} = R_n \times \exp(-k_{Rn}LAI)$	[3]
f_{APAR}	Fraction of PAR absorbed by the canopy	$f_{APAR} = b1(1 - \exp(-k_1 LAI))$	[5,6]
f_{IPAR}	Fraction of PAR intercepted by the canopy	$f_{APAR} = b2(1 - \exp(-k_2 LAI))$	[6,7]

Table S2. Information description of four flux tower sites (ChinaFLUX) used in this study. EBF: Subtropical evergreen broad-leaved forest; ENF: Subtropical evergreen needle-leaved forest.

Site name	Vegetation type	Longitude	Latitude	Elements	Time range	Reference
Ailaoshan (ALS)	EBF	101.029°E	24.538°N	WUE and ET	2009–2013	[8,9]
Dinghushan (DHS)	EBF	112.534°E	23.174°N	WUE and ET	2003-2010	[9]
Qianyanzhou (QYZ)	ENF	115.067°E	26.733°N	WUE and ET	2003-2010	[9]
Xishuangbanna (XSBN)	EBF	101.267°E	21.900°N	WUE and ET	2003–2010	[9]

Table S3. Descreption of the characteristics and measured forest ecosystem water-use efficiency (WUE) (gC kg^{-1} H_2O) that reported in the published literature.

Ecosystem type	Name	Longitude	Latitude	Measured WUE	Period	References
Forest	Yueyang (YY)	112.51°E	29.31°N	2.26	2006	[10]
	Huitong (HT)	109.75°E	26.83°N	2.36	2009	[11,12]
	Lin'an (LA)	119.34°E	30.18°N	1.84	2011	[13,14]
	Hunang (HN)	117.00°E	33.00°N	1.85	2005	[15]

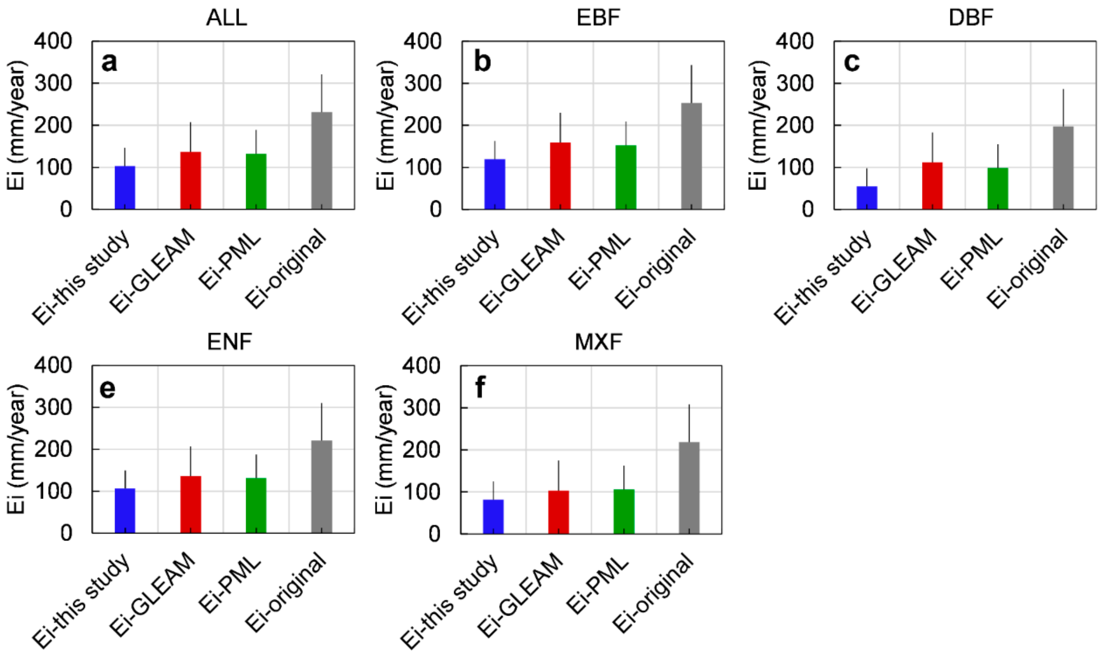

Figure S1. Comparison of annual mean (2001–2018) E_i between this study, GLEAM, PML_V2, and the original PT-JPL model for the whole forests (**a**) and different forests (**b**–**f**).

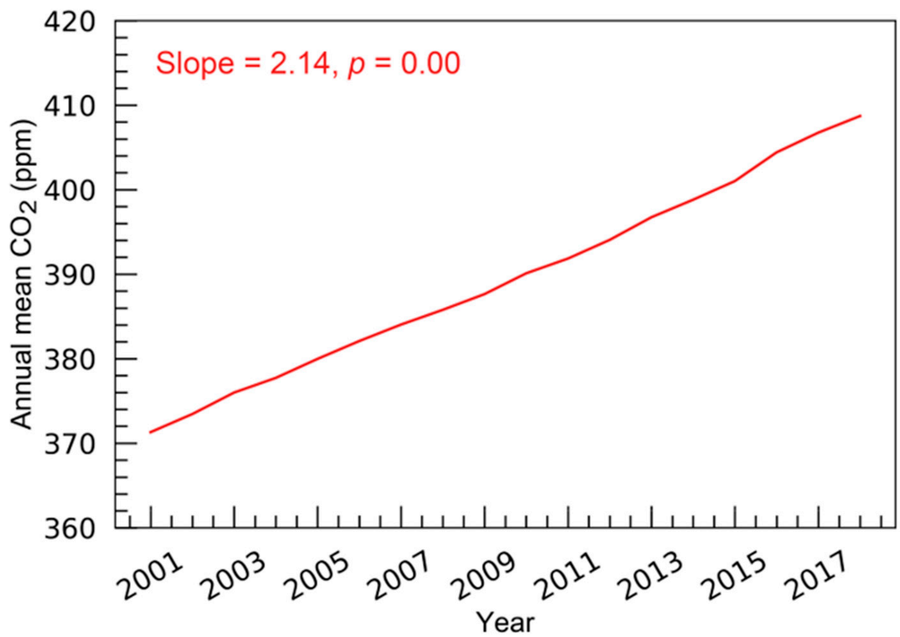

Figure S2. Temporal changes of annual mean CO_2 concentration from 2001 to 2018.

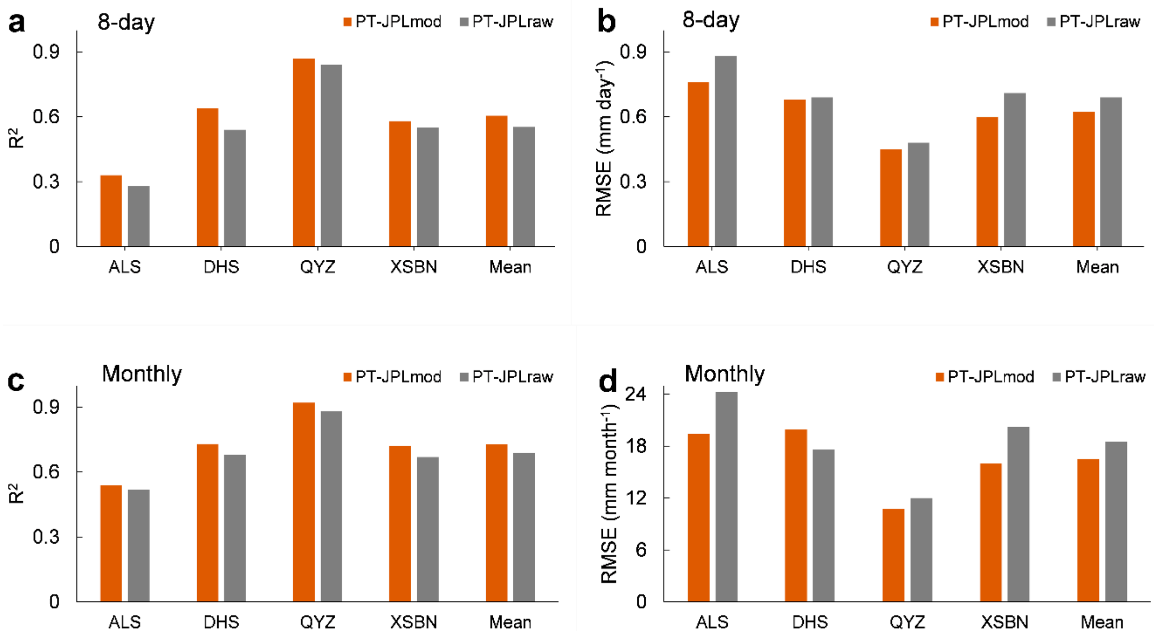

Figure S3. The bar chart compares the performance of the improved and original PT-JPL models on simulated ET using the two metrics of R^2 and RMSE. (**a**,**b**) compare the performance of the improved and original PT-JPL models on simulated ET at the 8-day scale, respectively; (**c**,**d**) compare the performance of the improved and raw PT-JPL models on simulated ET at the monthly scale, respectively. Mean indicates the average of R^2 or RMSE for the four flux stations.

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