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*Supplement of*

## **The importance of radiation for semiempirical water-use efficiency models**

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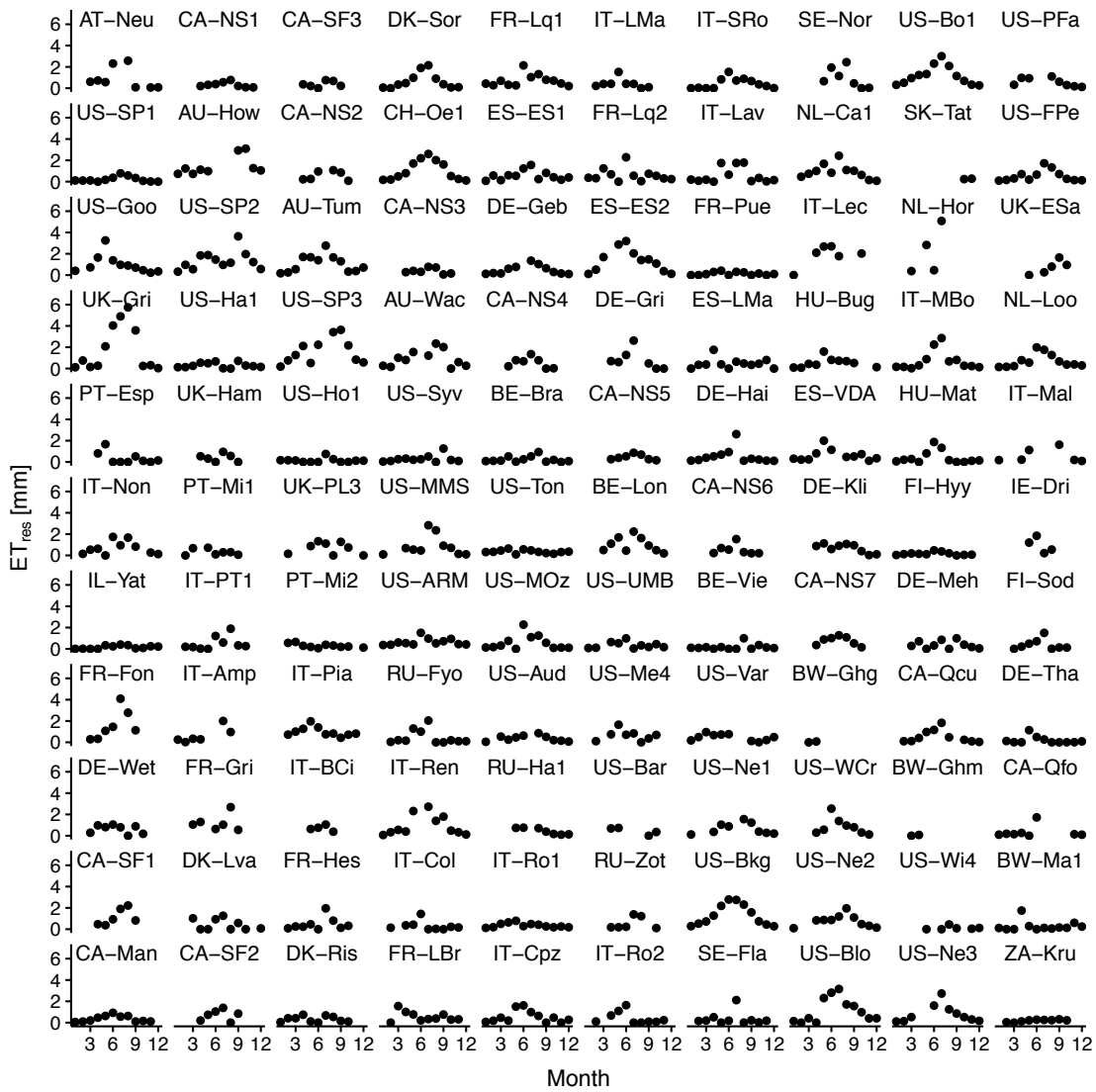
# Supplement

## S1 Mean differences of RMSE between sites

5 **Table S1.** Mean differences of the root mean squared error (RMSE) for the different model variants. Entries indicate the mean of the comparison  $RMSE(row\ model) - RMSE(column\ model)$  for all 110 sites.

	Zhou	+ETres	+VPD	+Rg	+VPD+Rg
Zhou	–	0.06	0.08	0.15	0.15
+ETres	-0.06	–	0.02	0.09	0.09
+VPD	-0.08	-0.02	–	0.07	0.07
+Rg	-0.15	-0.09	-0.07	–	0
+VPD+Rg	-0.15	-0.09	-0.07	0	–

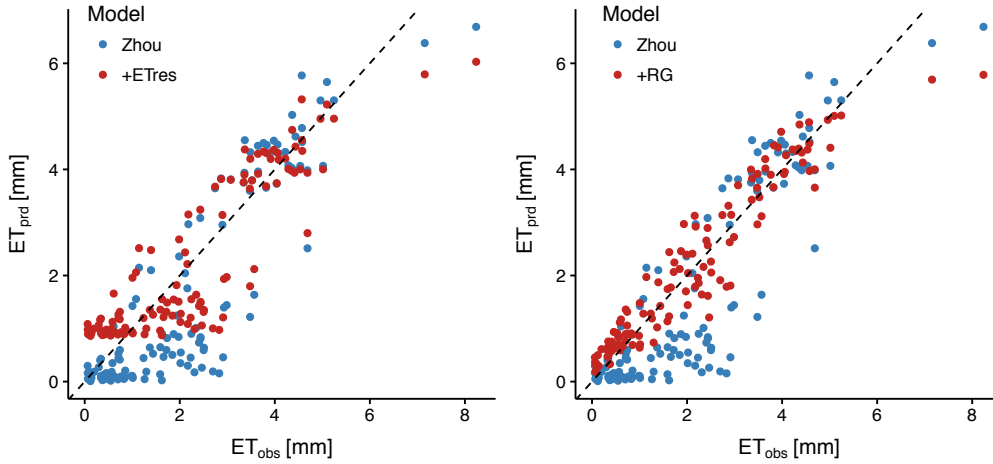
S2 Monthly patterns of ETres



5 Fig. S1. Monthly means of  $ET_{res}$  for the 110 sites included in our analysis. Missing points indicate that the respective month had less than 10 valid observations for all site-years combined.

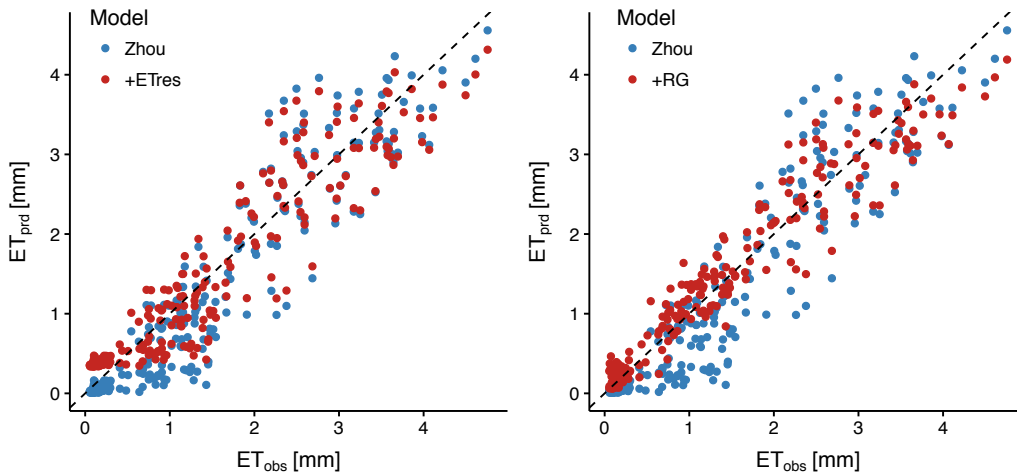
### S3 Site-specific improvement in model predictions

To illustrate the improvements made with the +ET<sub>res</sub> and +Rg variants, we selected two sites in which we compared the new models to the Zhou variant (Fig. S2, Fig. S3). In both sites, the Zhou model showed a systematic underestimation of ET for lower observed values. This deviation was remedied when using the +ET<sub>res</sub> variant with an additional intercept term (Fig. S2(a), Fig. S3(a)). However, substantial unexplained ET variation remained for all flux magnitudes. This was visibly reduced when we used the +Rg variant that included an additional linear term with radiation (Fig. S2(b), Fig. S3(b)).



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Fig. S2. Predicted compared to observed daily ET fluxes for the FLUXNET site BE-Lon. The Zhou model was compared to the +ET<sub>res</sub> variant (a) and the +Rg variant (b).



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Fig. S3. Predicted compared to observed daily ET fluxes for the FLUXNET site HU-Bug. The Zhou model was compared to the +ET<sub>res</sub> variant (a) and the +Rg variant (b).

#### S4 Overview over all FLUXNET sites used

Table S2 contains an overview of all FLUXNET sites used in our analysis. A full description of all FLUXNET sites can be found at <http://fluxnet.fluxdata.org/sites/site-list-and-pages/>

**Table S2. Overview of all FLUXNET sites used in our analysis.**

Site	Site-Years	Biome (IGBP)	Climate (K.-Geiger)
AT-Neu	2002-2004	GRA	Cfb
AU-How	2001-2006	WSA	Aw
AU-Tum	2001-2006	EBF	Cfb
AU-Wac	2005-2007	EBF	Cfb
BE-Bra	1997-2006 <sup>1</sup>	MF	Cfb
BE-Lon	2004-2006	CRO	Cfb
BE-Vie	1996-2006	MF	Cfb
BW-Ghg	2003	SAV	BSh
BW-Ghm	2003	WSA	BSh
BW-Ma1	1999-2001	WSA	BSh
CA-Man	1994-2003	ENF	Dfc
CA-NS1	2002-2005	ENF	Dfc
CA-NS2	2001-2005	ENF	Dfc
CA-NS3	2001-2005	ENF	Dfc
CA-NS4	2002-2004	ENF	Dfc
CA-NS5	2001-2005	ENF	Dfc
CA-NS6	2001-2005	OSH	Dfc
CA-NS7	2002-2005	OSH	Dfc
CA-Qcu	2001-2006	ENF	Dfc
CA-Qfo	2003-2006	ENF	Dfc
CA-SF1	2003-2005	ENF	Dfc
CA-SF2	2003-2005	ENF	Dfc
CA-SF3	2003-2005	ENF	Dfc
CH-Oe1	2002-2006	GRA	Cfb
DE-Geb	2004-2006	CRO	Cfb
DE-Gri	2005-2006	GRA	Cfb
DE-Hai	2000-2006	DBF	Cfb
DE-Kli	2004-2006	CRO	Cfb
DE-Meh	2003-2006	GRA	Cfb
DE-Tha	1996-2006	ENF	Cfb
DE-Wet	2002-2006	ENF	Cfb

<sup>1</sup> No observations in the years 1999 and 2003.

DK-Lva	2005-2006	GRA	Cfb
DK-Ris	2004-2005	CRO	Cfb
DK-Sor	1996-2006	DBF	Cfb
ES-ES1	1999-2006	ENF	Csa
ES-ES2	2004-2006	CRO	Csa
ES-LMa	2004-2006	SAV	Csa
ES-VDA	2004-2006	GRA	Cfb
FI-Hyy	1996-2006	ENF	Dfc
FI-Sod	2000-2006	ENF	Dfc
FR-Fon	2005-2006	DBF	Cfb
FR-Gri	2005-2006	CRO	Cfb
FR-Hes	1997-2006	DBF	Cfb
FR-LBr	1996-2006	ENF	Cfb
FR-Lq1	2004-2006	GRA	Cfb
FR-Lq2	2004-2006	GRA	Cfb
FR-Pue	2000-2006	EBF	Csa
HU-Bug	2002-2006	GRA	Cfb
HU-Mat	2004-2006	GRA	Cfb
IE-Dri	2003-2005	GRA	Cfb
IL-Yat	2001-2006	ENF	BSh
IT-Amp	2002-2006	GRA	Cfa
IT-BCi	2004-2006	CRO	Csa
IT-Col	1996-2006	DBF	Cfa
IT-Cpz	1997-2006	EBF	Csa
IT-Lav	2000-2006	ENF	Cfb
IT-Lec	2005-2006	EBF	Cfa
IT-LMa	2003-2006	GRA	Cfb
IT-Mal	2003-2006	GRA	Cfb
IT-MBo	2003-2006	GRA	Cfb
IT-Non	2001-2006	DBF	Cfa
IT-Pia	2002-2005	OSH	Csa
IT-PT1	2002-2004	DBF	Cfa
IT-Ren	1999-2006	ENF	Dfb
IT-Ro1	2000-2006	DBF	Csa
IT-Ro2	2002-2006	DBF	Csa
IT-SRo	1999-2006	ENF	Csa
NL-Cal	2003-2006	GRA	Cfb
NL-Hor	2004-2006	GRA	Cfb
NL-Loo	1996-2006	ENF	Cfb
PT-Esp	2002-2006	EBF	Csa
PT-Mi1	2003-2005	EBF	Csa
PT-Mi2	2004-2006	GRA	Csa

RU-Fyo	1998-2004	ENF	Dfb
RU-Ha1	2002-2004	GRA	Dfc
RU-Zot	2002-2004	ENF	Dfc
SE-Fla	1996-2002	ENF	Dfc
SE-Nor	1996-2005	ENF	Dfb
SK-Tat	2005	ENF	Dfb
UK-ESa	2003-2005	CRO	Cfb
UK-Gri	1997-2006	ENF	Cfc
UK-Ham	2004-2005	DBF	Cfb
UK-PL3	2005-2006	DBF	Cfb
US-ARM	2003-2006	CRO	Cfa
US-Aud	2002-2006	GRA	BSk
US-Bar	2004-2005	DBF	Dfb
US-Bkg	2004-2006	GRA	Dfa
US-Blo	1997-2006	ENF	Csa
US-Bo1	1996-2007	CRO	Dfa
US-FPe	2000-2006	GRA	BSk
US-Goo	2002-2006	GRA	Cfa
US-Ha1	1991-2006	DBF	Dfb
US-Ho1	1996-2004	ENF	Dfb
US-Me4	1996-2000	ENF	Csb
US-MMS	1999-2005	DBF	Cfa
US-MOz	2004-2006	DBF	Cfa
US-Ne1	2001-2005	CRO	Dfa
US-Ne2	2001-2005	CRO	Dfa
US-Ne3	2001-2005	CRO	Dfa
US-PFa	1996-2003	MF	Dfb
US-SP1	2000-2005	ENF	Cfa
US-SP2	1998-2004	ENF	Cfa
US-SP3	1999-2004	ENF	Cfa
US-Syv	2002-2006	MF	Dfb
US-Ton	2001-2006	WSA	Csa
US-UMB	1999-2003	DBF	Dfb
US-Var	2001-2006	GRA	Csa
US-WCr	1999-2006	DBF	Dfb
US-Wi4	2002-2005	ENF	Dfb
ZA-Kru	2001-2003	SAV	Cwa