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Supplement of

Climate-based prediction of carbon fluxes from deadwood in Australia

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Supporting Figures and Tables

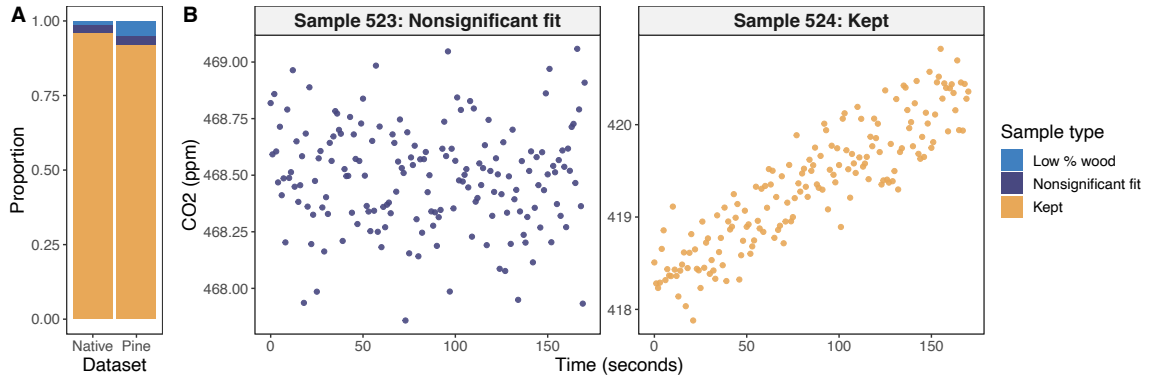

Figure S1. Flux measurement cleaning. Panel A shows the proportions of samples designated as less than 50% wood and nonsignificant linear fits from gas analyzer measurements, which were removed from analysis. 18/366 pine blocks and 8/617 native stems (5%, 1%) were removed for low wood percentage and 11/366 pine blocks and 16/617 native stems (3%) were removed for nonsignificant fits ($p>0.05$). Panel B shows example gas analyzer measurements that were removed (523) and kept (524). Both samples were from the species *Cardwelia sublimis*.

Table S1. Summary of the model fit results
model = brm(CO_2_resp_rate ~ FMC_nor * T_nor + (1|site),data = pine_flux,iter = 5000,family ="beta", control = list(adapt_delta = 0.98),seed=123)

	mean	se_mean	sd	2.5%	25%	50%	75%	97.5%	n_eff	Rhat	p-value
b_Intercept	2.3	0.08	5.1	-7.5	-1.1	2.4	5.8	12.4	4456	1	0.9
b_FMC_nor	-56.3	0.2	14.6	-84.2	-66.2	-56.4	-46.6	-27.1	4040	1	<0.001
b_T_nor	-8.2	0.08	5.7	-19.4	-12.0	-8.3	-4.3	2.8	4465	1	0.367
b_FMC_nor:T_nor	65.4	0.3	16.4	32.5	54.5	65.5	76.6	96.8	4045	1	<0.001
sd_site__Intercept	0.8	0.01	0.5	0.3	0.5	0.7	0.9	2.0	1808	1	
phi	108.7	0.1	10.8	88.5	101.3	108.4	115.8	131.0	6561	1	
r_site[wet rainforest,Intercept]	0.4	0.01	0.4	-0.6	0.2	0.4	0.7	1.2	2039	1	
r_site[sclerophyll,Intercept]	0.3	0.01	0.4	-0.7	0.1	0.3	0.5	1.1	1988	1	
r_site[dry rainforest,Intercept]	0.2	0.01	0.4	-0.8	-0.03	0.2	0.4	0.95	1991	1	
r_site[dry savanna,Intercept]	-0.8	0.01	0.5	-1.8	-0.96	-0.7	-0.5	0.0	2068	1	
r_site[wet savanna,Intercept]	-0.5	0.01	0.5	-1.5	-0.7	-0.5	-0.2	0.3	2022	1	
lprior	-15.1	0.01	0.3	-15.8	-15.3	-15.1	-14.9	-14.6	3705	1	
lp__	1029.3	0.06	2.9	1022.6	1027.6	1029.6	1031.3	1033.8	2335	1	

Samples were drawn using NUTS(diag_e) at Thu Apr 11 18:09:40 2024. For each parameter, n_eff is a crude measure of effective sample size, and Rhat is the potential scale reduction factor on split chains (at convergence, Rhat=1).

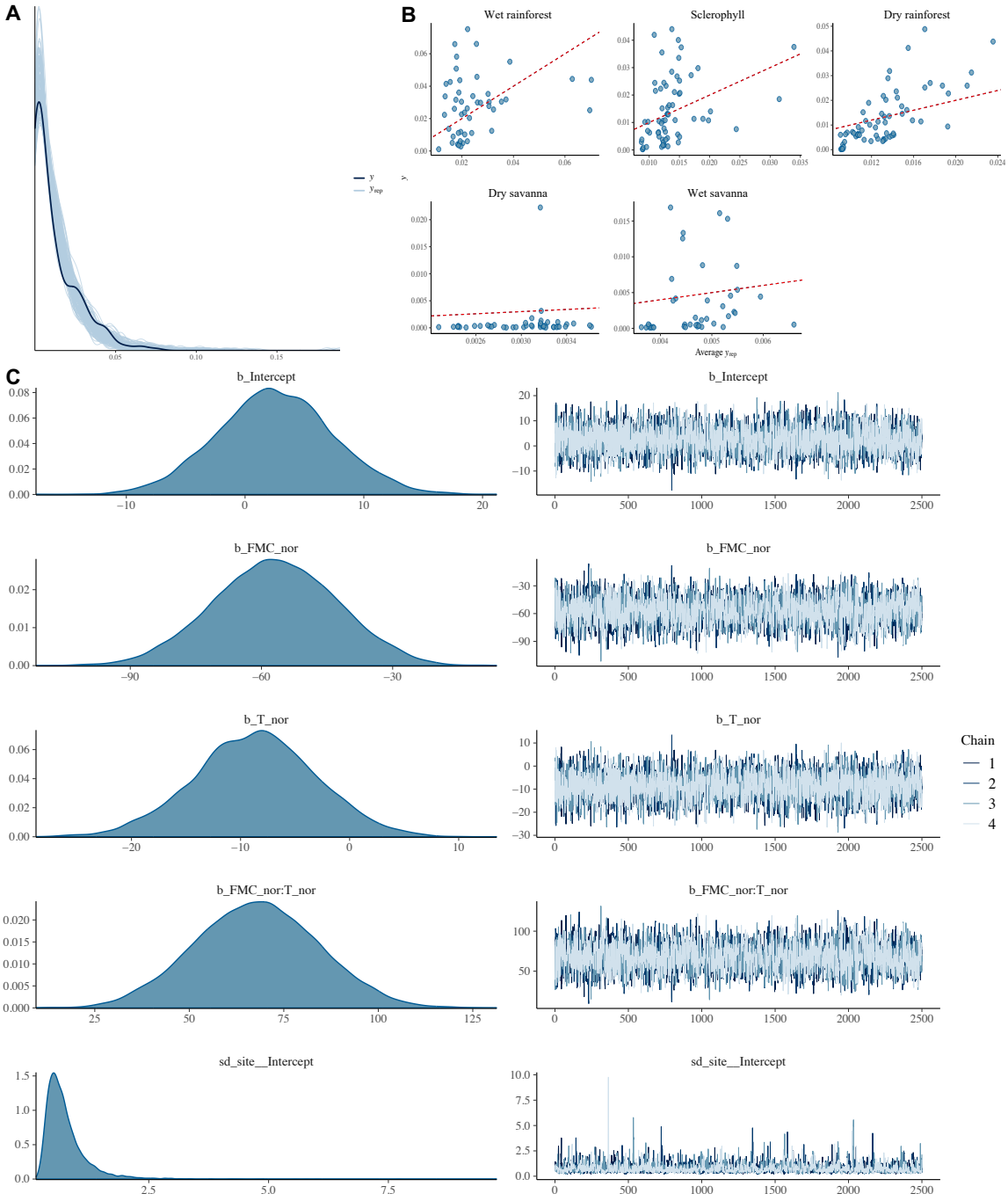

Figure S2. Posterior predictive check of the total data (A) in each site (B), as well as tracer plots and posterior distribution of the model parameters (C).

Table S2. Fitted model parameters for FMC sticks and pine blocks across the precipitation gradient (wettest to driest: wet rainforest, dry rainforest, sclerophyll, wet savanna, dry savanna).

	Wet rainforest		Dry rainforest		Sclerophyll		Wet savanna		Dry savanna	
Best fit	sensor	wood	sensor	wood	sensor	wood	sensor	wood	sensor	wood
f	0.9	0.1	0.9	0.1	0.8	0.1	0.8	0.1	0.6	0.1
A	4.2	4.2	4.2	5.5	4.3	4.3	3.8	3.8	4.2	2.7
B	-12.6	-12.6	-12.6	-12.6	-15.3	-15.3	-16.6	-16.6	-14.1	-14.1
d_s	$1.1 \cdot 10^{-6}$	$1.1 \cdot 10^{-6}$	$1.1 \cdot 10^{-6}$	$1.1 \cdot 10^{-6}$	$1.1 \cdot 10^{-6}$	$1.1 \cdot 10^{-6}$	$1.1 \cdot 10^{-6}$	$1.1 \cdot 10^{-6}$	$1.1 \cdot 10^{-6}$	$1.1 \cdot 10^{-6}$
m_{max}	1.65	2.5	1.65	2.0	1.5	2.5	1.5	1.8	1.7	0.5
svf	0.1	0.1	0.1	0.1	0.3	0.2	0.9	0.7	1	0.9
$RMSE/NSE$	28.2	**0.1**	43.8	**0.04**	25.6	**0.4**	22.6	**0.2**	16.1	-2.8

Table S3. Fixed parameters for FMC sticks and pine blocks.

Parameters	Description	Unit	Stick	Wood
ρ_s	Stick density	$\mathrm{kg\,m^{-3}}$	400	480
L	Length	m	0.41	0.1
r	Radius	m	0.0065	0.035
ϵ_s	Stick emissivity	-	0.85	
σ	Stephan-Boltzmann constant	$\mathrm{J\,h^{-1}\,m^{-2}\,K^{-4}}$	0.00020412	
ϵ_g	Emissivity of the ground	-	0.95	
ϵ_v	Emissivity of the vegetation	-	0.965	
a_1	Fit parameter 1	-	1.2	
a_2	Fit parameter 2	-	3	
a_3	Fit parameter 3	-	0.5	
Ce	Climatological value	$\mathrm{cm\,K\,hPa^{-1}}$	46.5	
β	Constant based on cloud type	-	0.26	
α_s	Stick Albedo	-	0.65	
α_g	Ground albedo	-	0.185	
ρ_A	Density of air	$\mathrm{kg\,m^{-3}}$	1.093	
c_a	Specific heat of air	$\mathrm{J\,kg^{-1}\,K^{-1}}$	1005	
k	Thermal diffusivity of the air	$\mathrm{m^2\,h^{-1}}$	0.0684	
v	Kinematic viscosity of air	$\mathrm{m^2\,h^{-1}}$	0.0000151	
M	Molecular mass of water	$\mathrm{kg\,mol^{-1}}$	0.018	
R	Gas constant	$\mathrm{m^3\,kPa^{-1}\,mol^{-1}}$	0.008314	
g	Specific gravity of the stick	-	0.42	0.41
c_{water}	Specific heat of water	$\mathrm{J\,K^{-1}\,kg^{-1}}$	4200	
cv	Vegetation contribution coefficient	-	0.5	
dv	Density of water	$\mathrm{kg\,m^{-3}}$	1000	

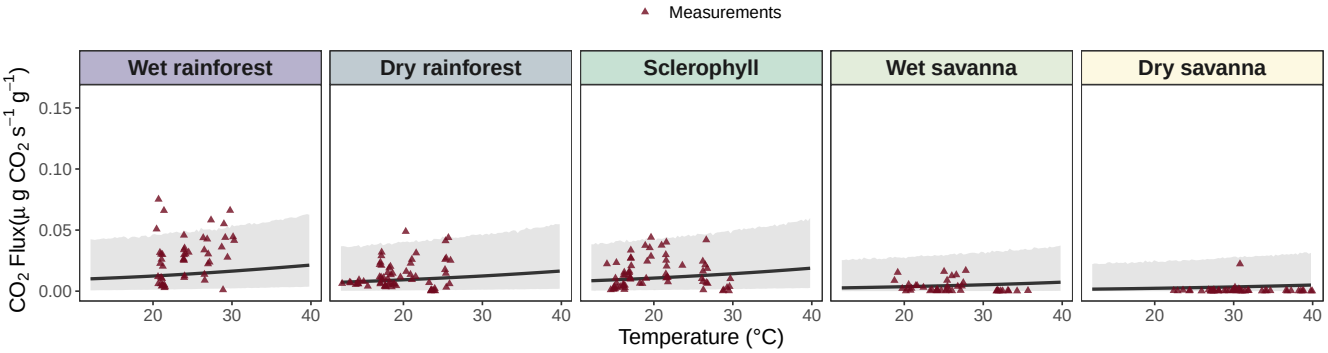

Figure S3. Mixed model of CO_2 fluxes ($\mu g\, CO_2\, s^{-1}\, g^{-1}$) from decaying wood, with wood moisture content and temperature as fixed effects and site as a random effect. The figure shows flux predictions against ambient temperature. Different colors represent different sites and the red triangles represent pine block measurements used to construct the models. An outlier in the dry savanna was kept, as there was no indication that there was an error in measurement.

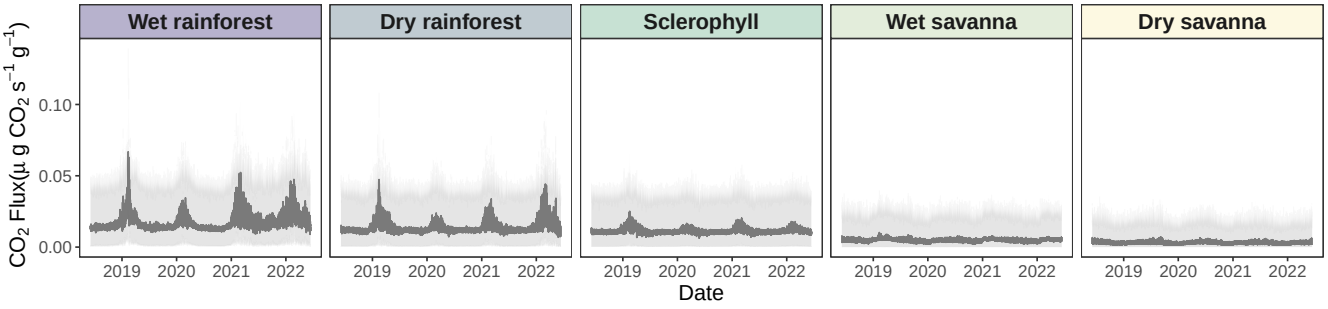

Figure S4. Time-resolved flux predictions with uncertainty.

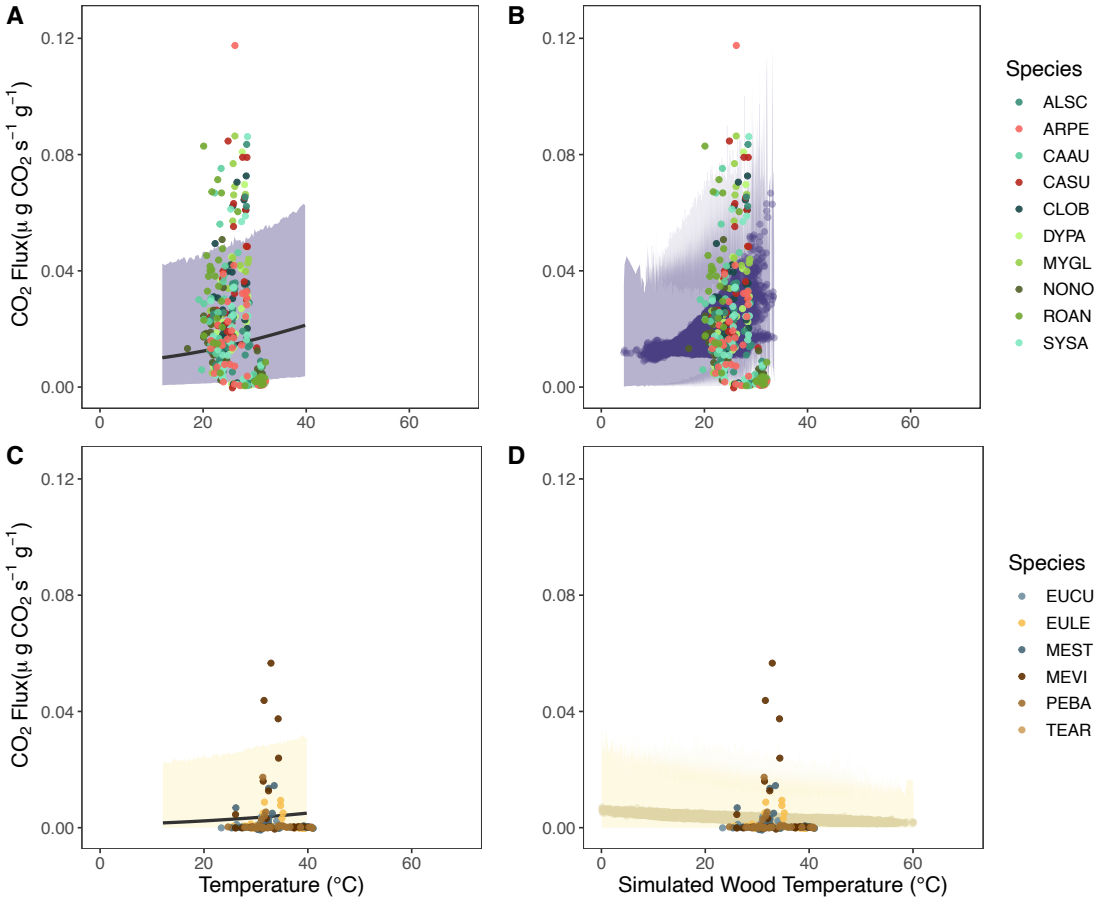

Figure S5. Measured native stem ambient temperature and CO_2 fluxes plotted with estimates from the statistical model (A, C) and time-resolved simulations (B, D) Panels A and B show native species found at the wet rainforest panels C and D from the dry savanna. The species name for each code given in Figure 6 is described in Table S3.

Table S4. Code and species description of native tree species deployed at the wet rainforest and dry savanna.

Code	Wood species	Location
Alstonia scholaris	ALSC	Rainforest
Argyrodendron peralatum	ARPE	Rainforest
Castanospermum australe	CAAU	Rainforest
Cardwelia sublimis	CASU	Rainforest
Cleistanthus oblongifoloius	CLOB	Rainforest
Dysoxylum papuanum	DYPA	Rainforest
Myristica globosa	MYGL	Rainforest
Normanbya normanbyi	NONO	Rainforest
Rockinghamia angustifolia	ROAN	Rainforest
Syzygium sayeri	SYSA	Rainforest
Eucalyptus cullenii	EUCU	Savanna
Eucalyptus chlorophylla	EULE	Savanna
Melaleuca stenostachya	MEST	Savanna
Melaleuca viridiflora	MEVI	Savanna
Petalostigma banksii	PEBA	Savanna
Terminalia aridicola	TEAR	Savanna

Table S5. C loss model
model = Carbon Flux ~ Carbon Loss * Site * Termite Discovery

Characteristic	Beta	95% CI	p-value
Carbon Loss	1.1	0.75, 1.4	**0.001**
Site			
Dry rainforest	—	—	
Dry savanna	-0.13	-0.27, -0.01	0.07
Sclerophyll	-0.05	-0.21, 0.10	0.5
Wet rainforest	0.05	-0.09, 0.20	0.5
Wet savanna	-0.06	-0.17, 0.06	0.3
Termite Discovery			
No	—	—	
Yes	0.06	-0.12, 0.24	0.5
Carbon Loss * Site			
Carbon Loss * Dry savanna	-0.28	-1.4, 0.86	0.6
Carbon Loss * Sclerophyll	0.06	-0.4, 0.48	0.8
Carbon Loss * Wet rainforest	0.07	-0.35, 0.48	0.8
Carbon Loss * Wet savanna	-0.64	-1.2, -0.12	**0.018**
Carbon Loss * Termite Discovery			
Carbon Loss * Yes	-0.43	-0.88, 0.03	0.064
Site * Termite Discovery			
Dry savanna * Yes	-0.08	-0.33, 0.18	0.5
Sclerophyll * Yes	0.15	-0.15, 0.45	0.3
Wet rainforest * Yes	3.3	1.7, 4.8	**0.001**
Wet savanna * Yes	-0.07	-0.33, 0.18	0.6
Carbon Loss * Site * Termite Discovery			
Carbon Loss * Dry savanna * Yes	-0.01	-1.3, 1.3	>0.9
Carbon Loss * Sclerophyll * Yes	-0.27	-0.9, 0.36	0.4
Carbon Loss * Wet rainforest * Yes	-4.5	-6.6, -2.4	**0.001**
Carbon Loss * Wet savanna * Yes	0.28	-0.47, 1.0	0.5

[1] CI = Confidence Interval

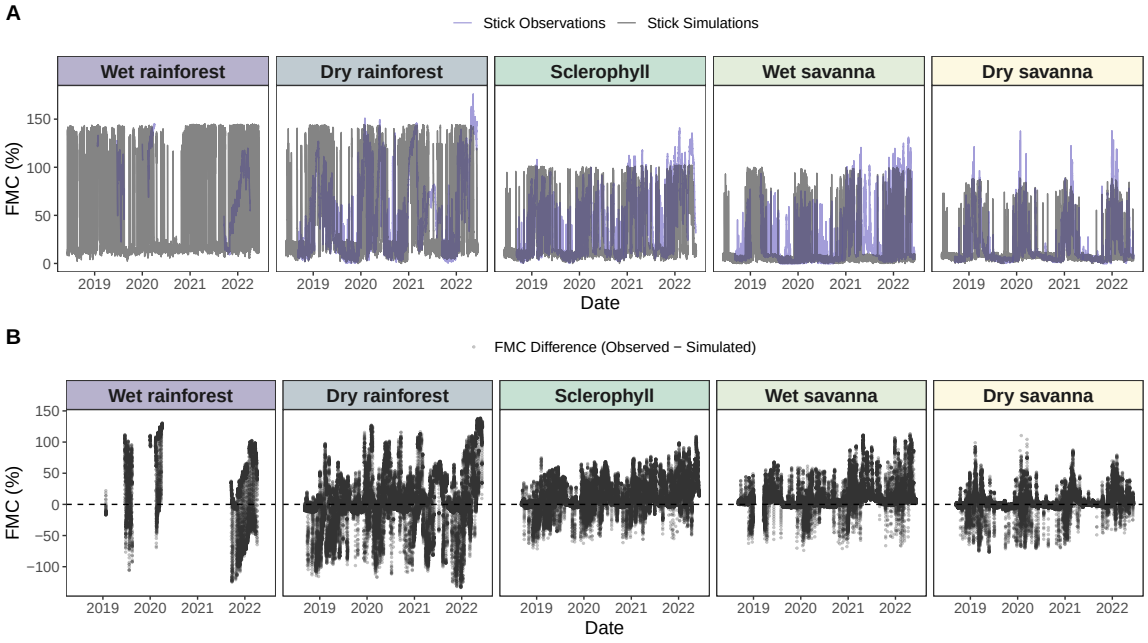

Figure S6. Original calibration results on sensor dowel moisture per site (A) and residuals (B).