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Supplement of

Regulation of carbon dioxide and methane in small agricultural reservoirs: optimizing potential for greenhouse gas uptake

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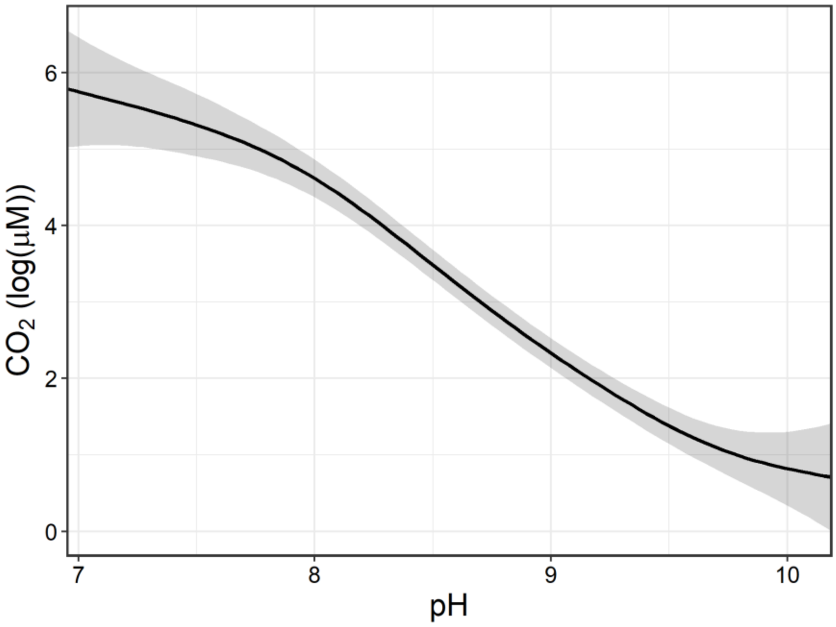

Figure S1: Correlation between measured log-transformed CO_2 concentrations (µM) and surface water pH using a generalised additive model. Model deviance explained was 86.3%. The response pattern shown is the partial effect splines from the GAM and shaded area indicated 95% credible intervals.

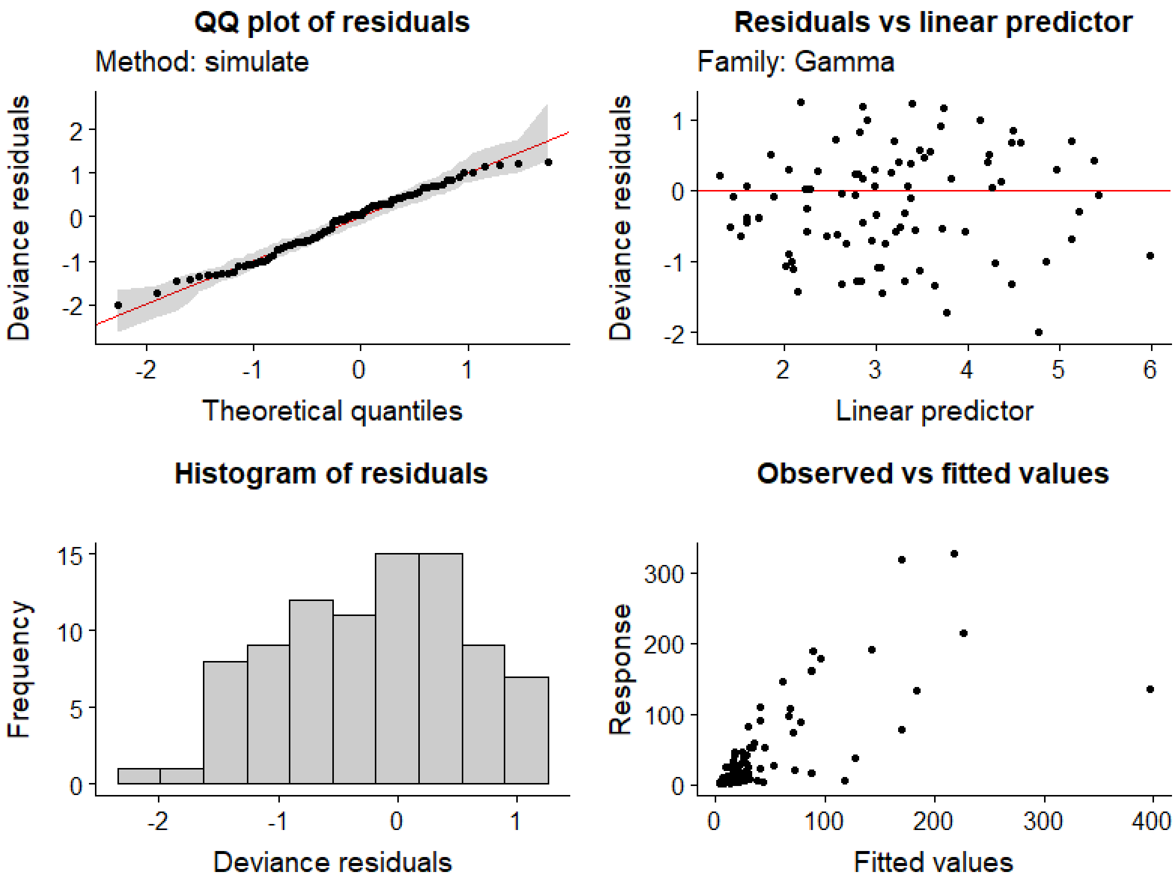

Fig. S2: R output of diagnostic plots for carbon dioxide model

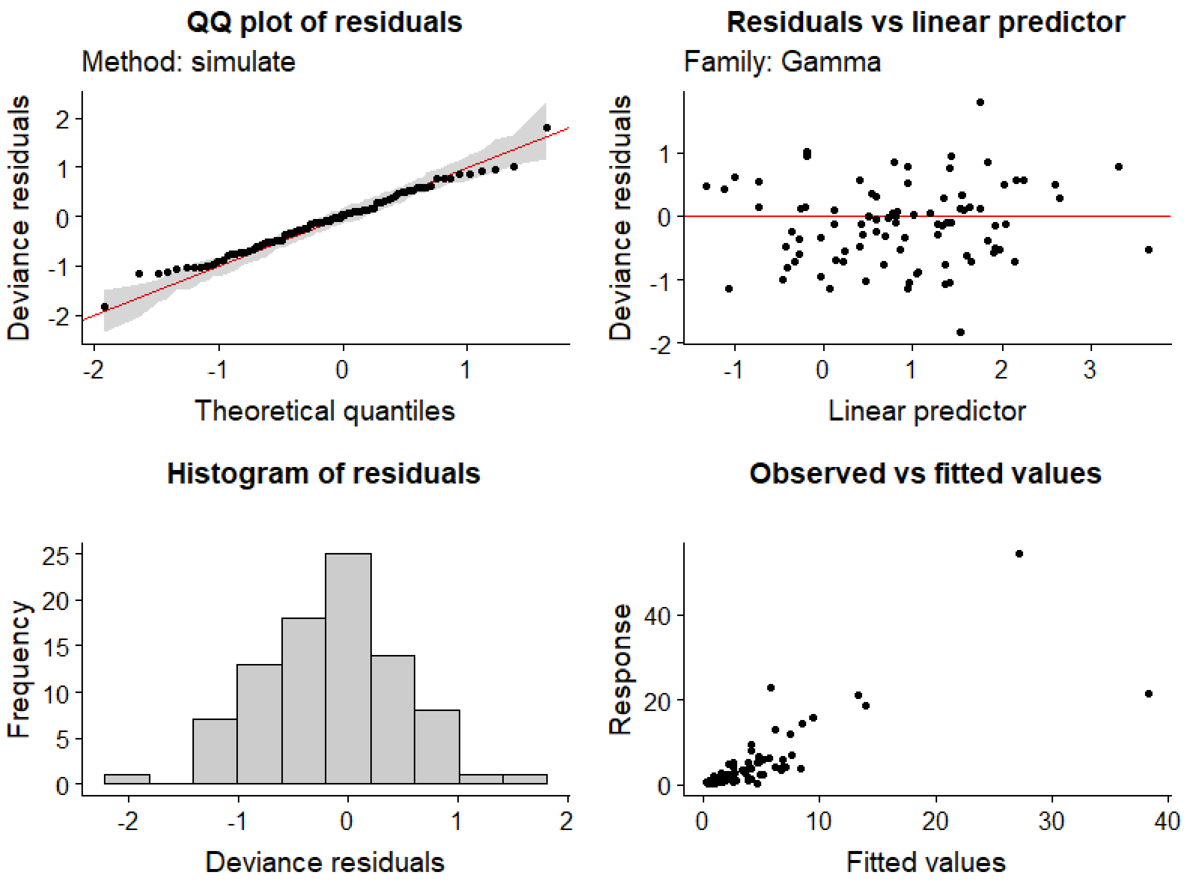

Fig. S3: R output of diagnostic plots for methane model

Fig. S4: Scatterplot matrices of covariate data used in the CO$_2$ model showing distribution and correlation pairs

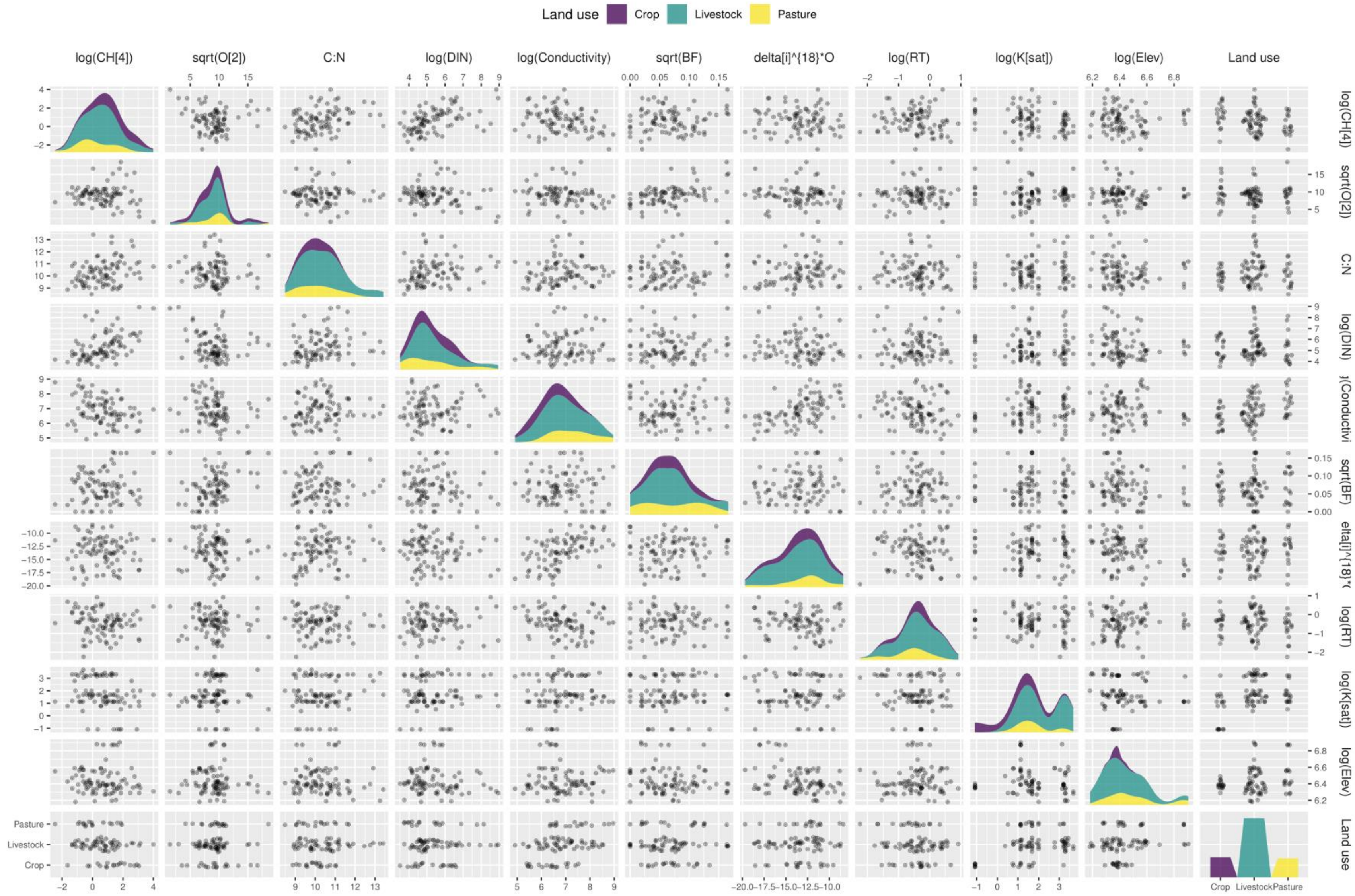

Fig S5. Scatterplot matrices of covariate data used in the CH_4 model showing distribution and correlation pairs.

Table S1: Spearman correlation matrix of biotic and abiotic factors with log-transformed CO_2 and CH_4 concentrations. Variables included total nitrogen (*TN*), chlorophyll *a* (*Chla*), alkalinity (*Alk*), sediment C/N ratio (*SedCNorg*), total phosphorus (*TP*), dissolved organic carbon (*DOC*), Nitrate-nitrite (*NOx*), conductivity (*Cond*), and dissolved oxygen (*DO*).

Row	*logCO2*	*logCH4*	*logTN*	*logChla*	*logAlk*	*SedCNorg*	*logTP*	*logDOC*	*logNOx*	*logCond*	*sqrtDO*
logCO2											
logCH4	0.21*										
logTN	0.20*	0.31**									
logChla	-0.15	0.36***	0.20								
logAlk	0.41****	-0.03	0.53****	-0.10							
SedCNorg	0.19	0.25*	0.30**	0.14	0.23*						
logTP	0.29**	0.30**	0.62****	0.16	0.29**	0.18					
logDOC	0.13	0.10	0.84****	0.19	0.59****	0.30**	0.52****				
logNOx	0.30**	0.48****	0.47****	0.14	0.12	0.21*	0.42****	0.12			
logCond	0.17	-0.29**	0.42****	-0.10	0.66****	0.06	0.16	0.52****	-0.10		
sqrtDO	-0.46****	-0.21*	-0.10	0.21*	-0.16	0.01	-0.13	-0.04	-0.15	-0.06	
logDIN	0.28**	0.51****	0.72****	0.14	0.21*	0.19	0.53****	0.33***	0.85****	0.07	-0.18

$p < .0001$ ****; $p < .001$ ***, $p < .01$ **, $p < .05$ *

Table S2: Spearman correlation matrix of hydromorphological factors with log-transformed CO_2 and CH_4 concentrations. Variables included reservoir surface area (*Area*), index of basin permanence (*IBP*), evaporation to inflow ratio (*EtoI*), residence time (*RT*), inflow volume (*Inflow*), deuterium excess (*d_excess*), and $\delta^{18}O$ of inflow (*delI18O*).

Row	*logCO2*	*logCH4*	*logArea*	*logIBP*	*logEtoI*	*logRT*	*logInflow*	*d_excess*	*delI18O*
logCO2									
logCH4	0.18								
logArea	-0.22*	-0.20*							
logIBP	-0.19	-0.20*	0.76****						
logEtoI	-0.09	0.07	0.10	-0.10					
logRT	-0.19	-0.04	0.28**	0.39****	0.78****				
logInflow	-0.21*	-0.11	0.78****	0.48****	0.69****	0.66****			
d_excess	0.09	-0.03	-0.12	0.08	-0.96****	-0.72****	-0.70****		
delI18O	-0.07	-0.07	0.04	-0.03	0.03	-0.02	0.03	0.05	
sqrtBF	-0.06	0.12	-0.18	-0.06	-0.12	-0.01	-0.20*	0.16	0.15

$p < .0001$ ****; $p < .001$ ***, $p < .01$ **, $p < .05$ *

Table S3: Spearman correlation matrix of landscape factors with log-transformed CO_2 and CH_4 concentrations. Variables include landscape elevation (*Elevation*), total soil sand (*TSAND*), total soil silt (*TSILT*), total soil clay (*TCLAY*), soil organic carbon (*ORGCARB*), soil pH (*PH2*), and soil cation exchange capacity (*CEC*).

Row	*logCO2*	*logCH4*	*logElevation*	*TSAND*	*TSILT*	*TCLAY*	*logORGCARB*	*PH2*	*logCEC*
logCO2									
logCH4	0.17								
logElevation	-0.10	-0.03							
TSAND	-0.10	-0.24*	-0.03						
TSILT	0.00	0.16	0.13	-0.65****					
TCLAY	0.00	0.20	0.08	-0.77****	0.45****				
logORGCARB	0.12	0.17	-0.34***	-0.42****	0.19	-0.12			
PH2	0.02	0.23*	-0.10	-0.34***	0.11	0.48****	0.06		
logCEC	0.13	0.26*	-0.09	-0.91****	0.39****	0.59****	0.64****	0.32**	
logKSAT	-0.04	-0.23*	-0.08	0.90****	-0.67****	-0.94****	-0.08	-0.44****	-0.71****

$p < .0001$ ****; $p < .001$ ***, $p < .01$ **, $p < .05$ *

Output tables

Table S4: Summary of GAM output used to assess multivariate drivers of CO_2 concentrations. Predictor variables included DO saturation (*DO*), alkalinity (*Alk*), NO_x (NO_x), buoyancy frequency (*BF*), δ_I ($\delta_I^{18}O$), water residence time (RT), soil cation exchange capacity (*CEC*), elevation (*Elevation*), soil salinity and land use (parametric coefficients).

Smooth terms	**Ref edf**	**edf**	**F statistic**	***p*-value**
$f(sqrt(DO_i))$	6	2.66	10.7	<0.001
$f(log(Alk_i))$	6	1.80	3.2	<0.001
$f(log(NOx_i))$	6	1.49	1.0	<0.05
$f(sqrt(BF_i))$	6	1.22	0.6	<0.05
$f(log(RT_i), \delta_I^{18}O_i)$	24	2.58	0.9	<0.001
$f(log(CECi))$	6	0.80	0.7	<0.05
$f(log(Elevation_i))$	6	0.82	0.8	<0.05
Parametric coefficients	**Estimate**	**Std. Error**		***p*-value**
Non-saline (N)	3.04	0.26		
Weakly saline (W)	3.35	0.16		0.30
Moderately saline (M)	3.21	0.14		0.56
Strongly saline (S)	2.88	0.55		0.77
Pasture	3.04	0.26		
Livestock	3.34	0.34		0.19
Crop	3.19	0.37		0.38
Intercept coefficient: 3.04 ± 0.25				
Deviance explained: 66.5%				

Table S5: Summary of GAM output showing significance of predictor variables for CH$_4$ concentrations. Predictor variables included DO saturation (*DO*), sediment C/N (*SedC/N*), DIN (*DIN*), conductivity (Cond), buoyancy frequency (*BF*), δ_I ($\delta_I{}^{18}O$), water residence time (RT), soil K$_{sat}$ (*KSAT*), elevation (*Elevation*), and land use (parametric coefficients).

Smooth terms	**Ref edf**	**Edf**	**F statistic**	***p*-value**
$f(sqrt(DO_i))$	6	2.10	1.42	<0.01
$f(SedC/N_i)$	6	1.87	2.07	<0.001
$f(log(DIN_i))$	6	0.98	6.73	<0.001
$f(log(Cond_i))$	6	1.80	5.27	<0.001
$f(sqrt(BF_i))$	6	7.4E-6	0.00	0.71
$f(log(RT_i), \delta_I{}^{18}O_i)$	32	5.10	0.95	<0.001
$f(log(KSATi))$	6	0.47	0.09	0.32
$f(log(Elevation_i))$	6	0.21	0.04	0.24
Parametric coefficients	**Estimate**	**Std. Error**		***p*-value**
Pasture	0.59	0.22		
Livestock	0.82	0.10		*0.27*
Crop	1.23	0.21		*<0.05*
Intercept coefficient: 0.59 ± 0.19				
Deviance explained: 74.1%				

Table S6: Reference information for Figure 4 and 5 in the main article

Study	Reference
Alaska ponds	Sepulveda-Jauregui, A., Walter Anthony, K. M., Martinez-Cruz, K., Greene, S., and Thalasso, F.: Methane and carbon dioxide emissions from 40 lakes along a north–south latitudinal transect in Alaska, Biogeosciences, 12, 3197-3223, 10.5194/bg-12-3197-2015, 2015.
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