Supporting Information for

Eddy covariance data reveal that a small freshwater reservoir emits a substantial amount of carbon dioxide and methane

Alexandria G. Hounshell[1, †], Brenda M. D'Acunha[2], Adrienne Breef-Pilz[1], Mark S. Johnson[2,3], R. Quinn Thomas[1,4], Cayelan C. Carey[1]

[1] Department of Biological Sciences, Virginia Tech, Blacksburg, VA, USA, [2] Department of Earth, Ocean, and Atmospheric Sciences, University of British Columbia, Vancouver, BC, Canada, [3] Institute for Resources, Environment and Sustainability, University of British Columbia, Vancouver, BC, Canada, [4] Department of Forest Resources and Environmental Conservation, Virginia Tech, Blacksburg, VA, USA

Corresponding author: Alexandria G. Hounshell (alexgh@vt.edu)

[†] Current affiliation: National Centers for Coastal Ocean Science, National Oceanographic and Atmospheric Administration, Silver Spring, MD 20910, alexandria.hounshell@noaa.gov

Contents of this file

Introduction

The supplementary information additional figures (Figures S1-S11) and tables (Tables S1-S9) used as supporting information in the associated manuscript.

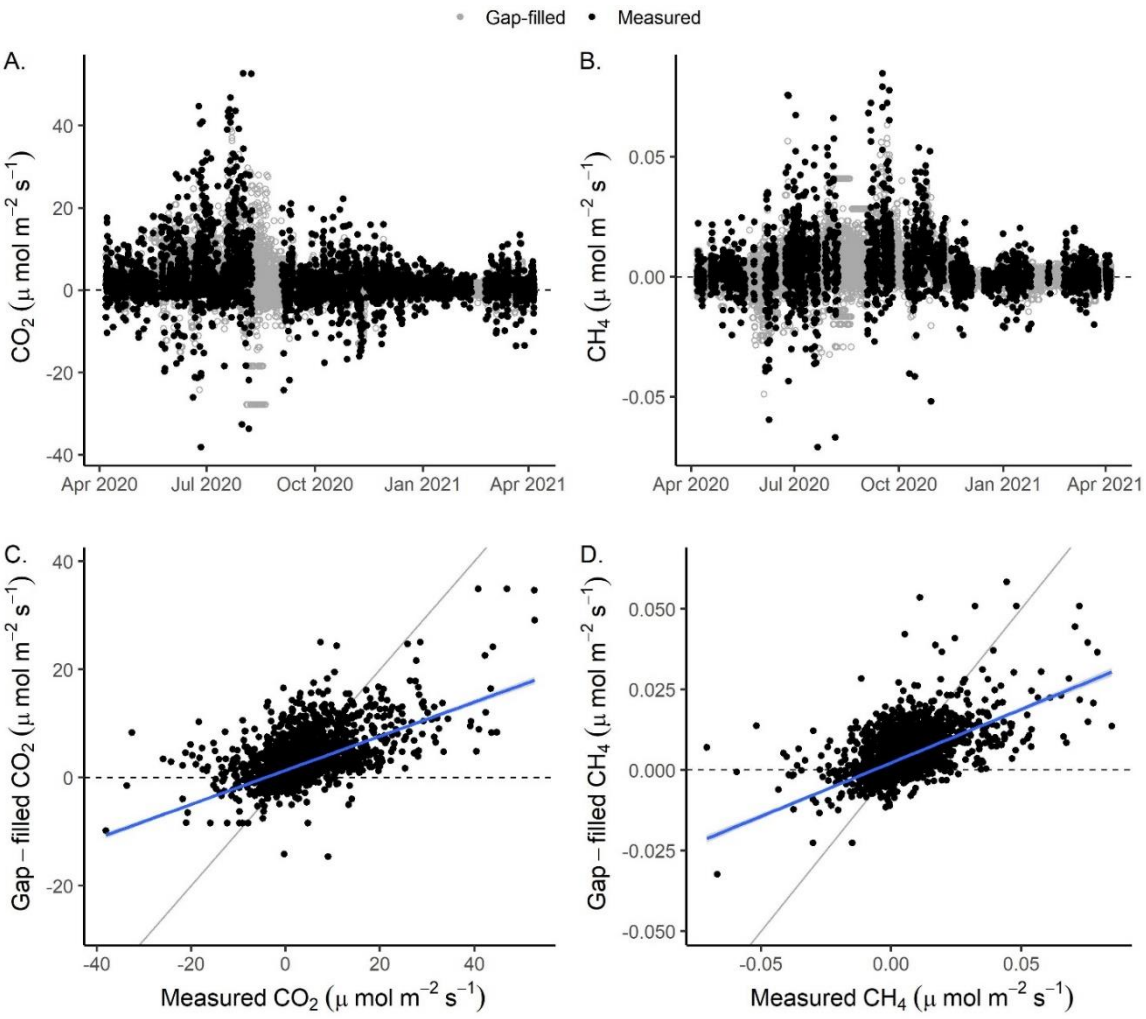

Figure S1. Comparison of measured eddy covariance (EC) fluxes and gap-filled, modeled fluxes. Half-hourly measured (black) and gap-filled fluxes (grey) for A) Carbon dioxide (CO_2 μmmol m^{-2} s^{-1}) and B) Methane (CH_4 μmmol m^{-2} s^{-1}) during the study period. Horizontal dashed line indicates zero. Linear regression of measured EC fluxes versus gap-filled, modeled fluxes for all tine periods with measured fluxes for C) CO_2 (μmmol m^{-2} s^{-1}) and D) CH_4 (μmmol m^{-2} s^{-1}). Horizontal dashed line indicates zero. The 1:1 line is represented as a solid grey line and the linear regression is the solid blue line.

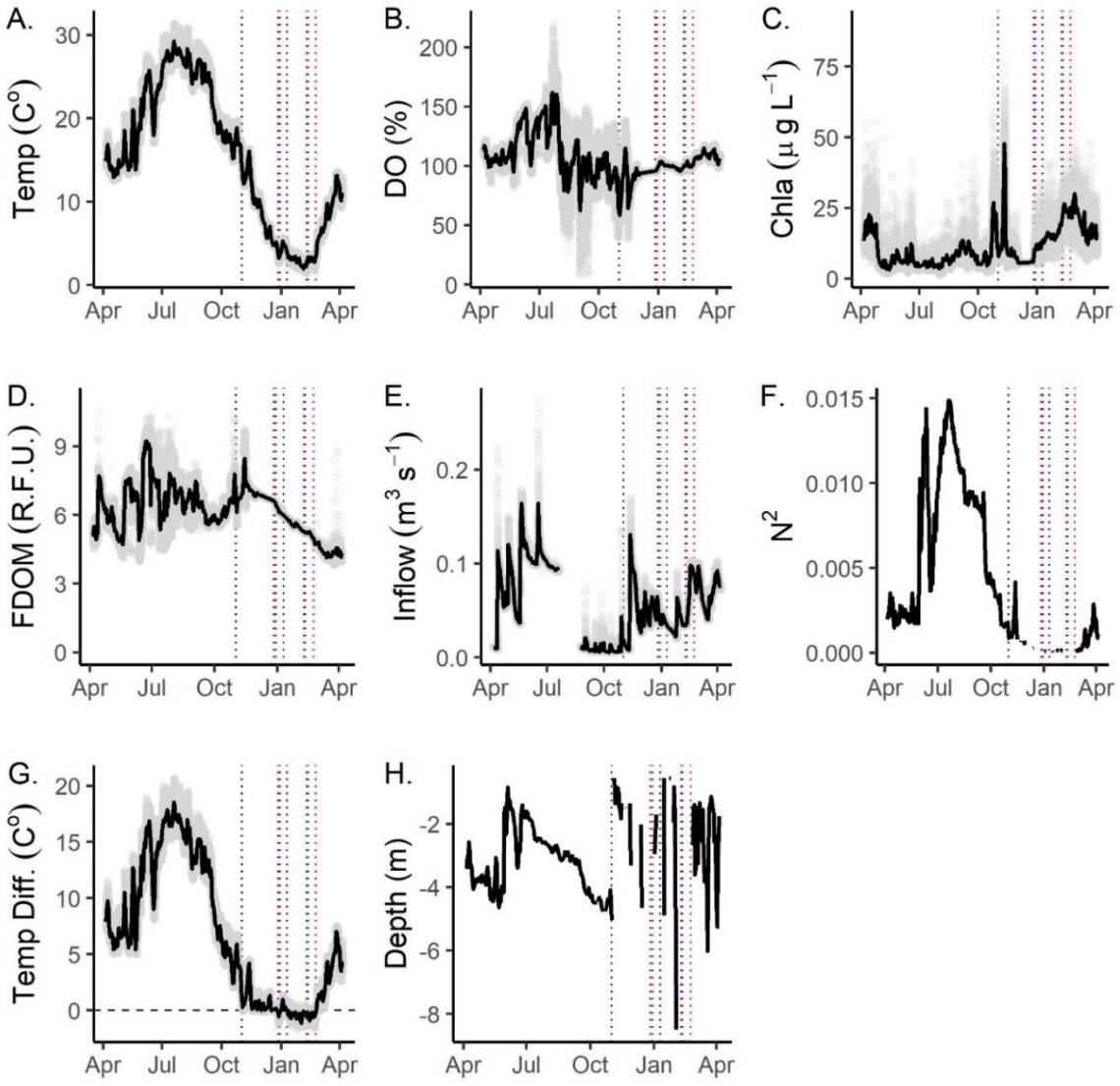

Figure S2. Environmental variables measured during the study period, including A. Surface Water Temperature (Temp, °C) measured at 0.1 m below the surface; B. Dissolved oxygen (DO, percent saturation, %) measured at 1.6 m; C. Chlorophyll-*a* (Chl-a, µg L^{-1}) measured at 1.6 m; D. fluorescent dissolved organic matter (fDOM, Relative Fluorescence Units, RFU) measured at 1.6 m; E. inflow (m^3 s^{-1}) measured at the primary inflow to Falling Creek Reservoir; F. buoyancy frequency (N^2) calculated from thermal profiles at the deepest point in the reservoir; G. the temperature difference (Temp Diff., °C) measured from the surface (0.1 m) and bottom (9 m) at the deepest point of the reservoir; and H. thermocline depth (Depth, m) calculated from thermal profiles deployed at the deepest point of the reservoir. Solid black lines represent the daily mean while the light grey points represent individual measurements made every 15 minutes for inflow and every 10 minutes for all other variables. The dashed vertical black line indicates

reservoir turnover; the blue dashed vertical lines indicate ice-on; and the red dashed vertical lines indicate ice-off.

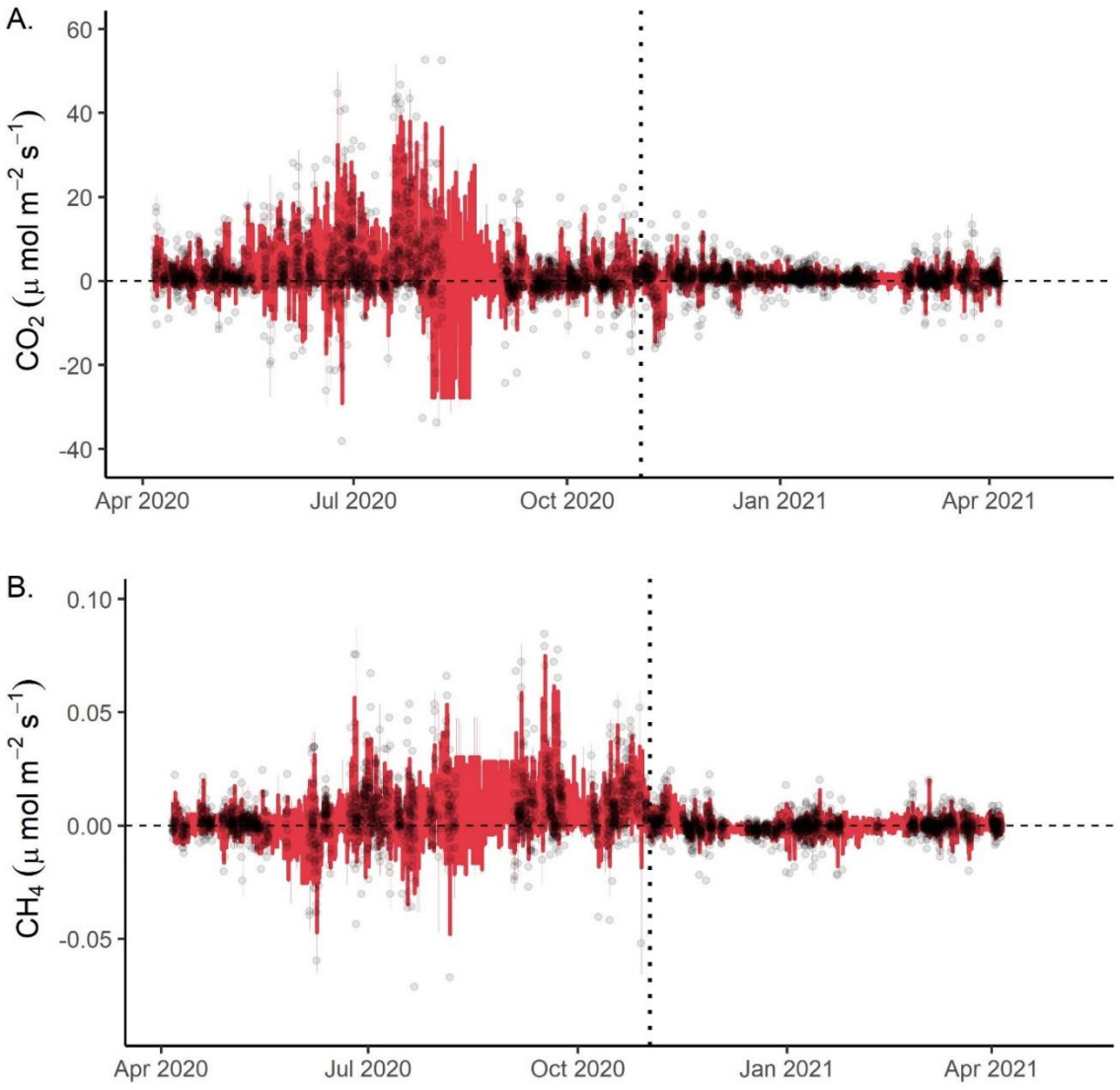

Figure S3. A. Mean hourly carbon dioxide fluxes (CO_2, μmol m^{-2} s^{-1}) and B. mean hourly methane fluxes (CH_4, μmol m^{-2} s^{-1}) aggregated from measured and gap-filled eddy covariance (EC) data from 5 April 2020 to 6 April 2021 in Falling Creek Reservoir. Black dots represent measured half-hourly fluxes. The vertical dashed line corresponds to reservoir turnover.

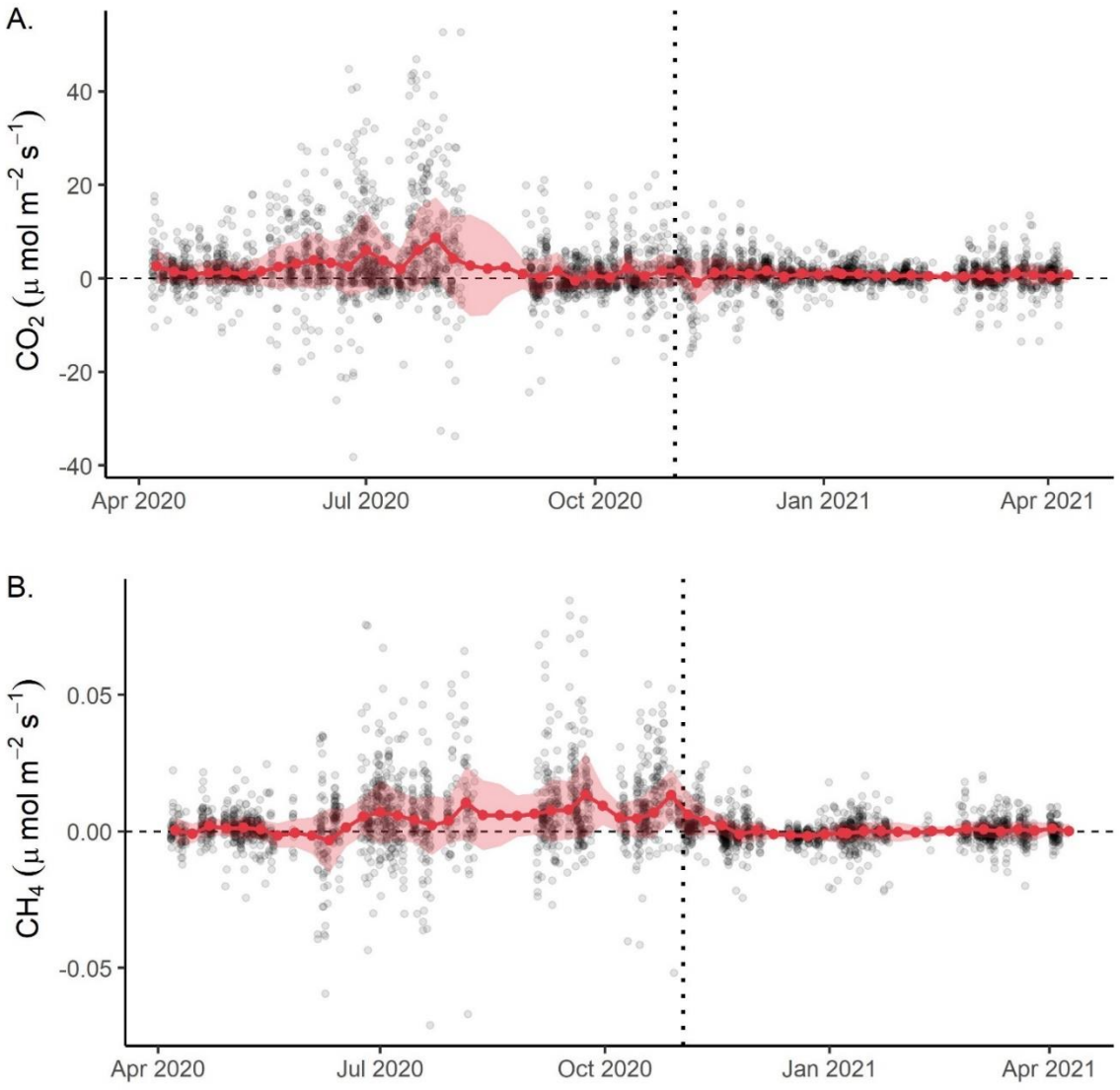

Figure S4. A. Mean weekly carbon dioxide fluxes (CO_2, μmol m^{-2} s^{-1}) and B. mean weekly methane fluxes (CH_4, μmol m^{-2} s^{-1}) aggregated from measured and gap-filled eddy covariance (EC) data from 5 April 2020 to 6 April 2021 in Falling Creek Reservoir. The red shaded area corresponds to the standard deviation (±1 S.D.) of aggregated fluxes for both measured and gap-filled values. Black dots represent measured half-hourly fluxes. The vertical dashed line corresponds to reservoir turnover.

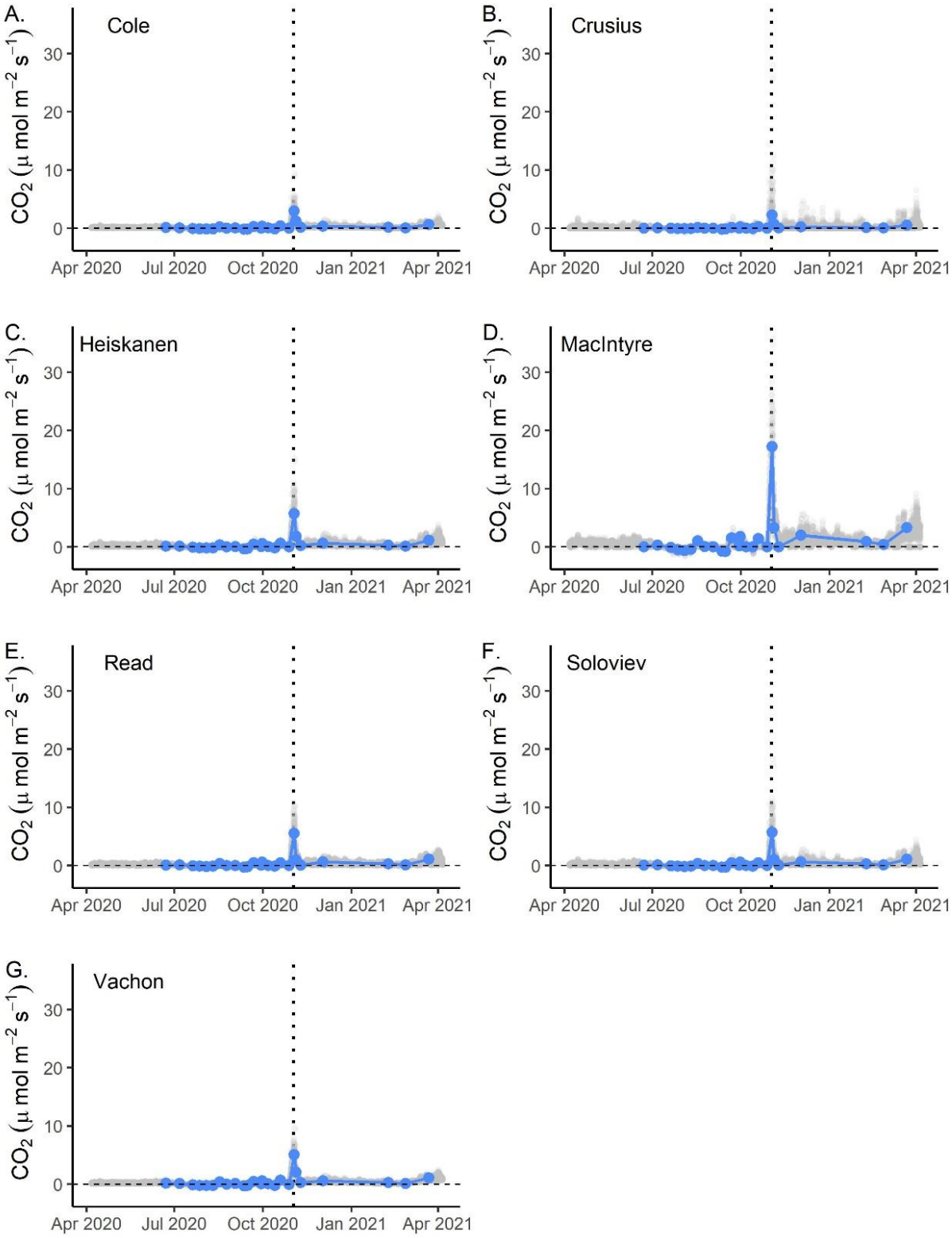

Figure S5. Discrete diffusive fluxes calculated for carbon dioxide (CO_2, μmol m^{-2} s^{-1}) during the study period (5 April 2020 to 6 April 2021) using multiple gas transfer coefficient models (k_{600};

Winslow et al. 2016; Cole and Caraco, 1998; Crusius and Wannikof, 2003; Vachon and Prairie, 2013; MacIntyre et al. 2010; Heiskanen et al. 2014; Read et al. 2012; Soloviev et al. 2007). Points represent the mean of two replicates calculated for each k_{600} method and the error bars are the standard deviation (±1 S.D.). Grey dots correspond to half-hourly diffusive flux calculations. The dashed horizontal line indicates zero fluxes and the dotted vertical line corresponds to fall turnover.

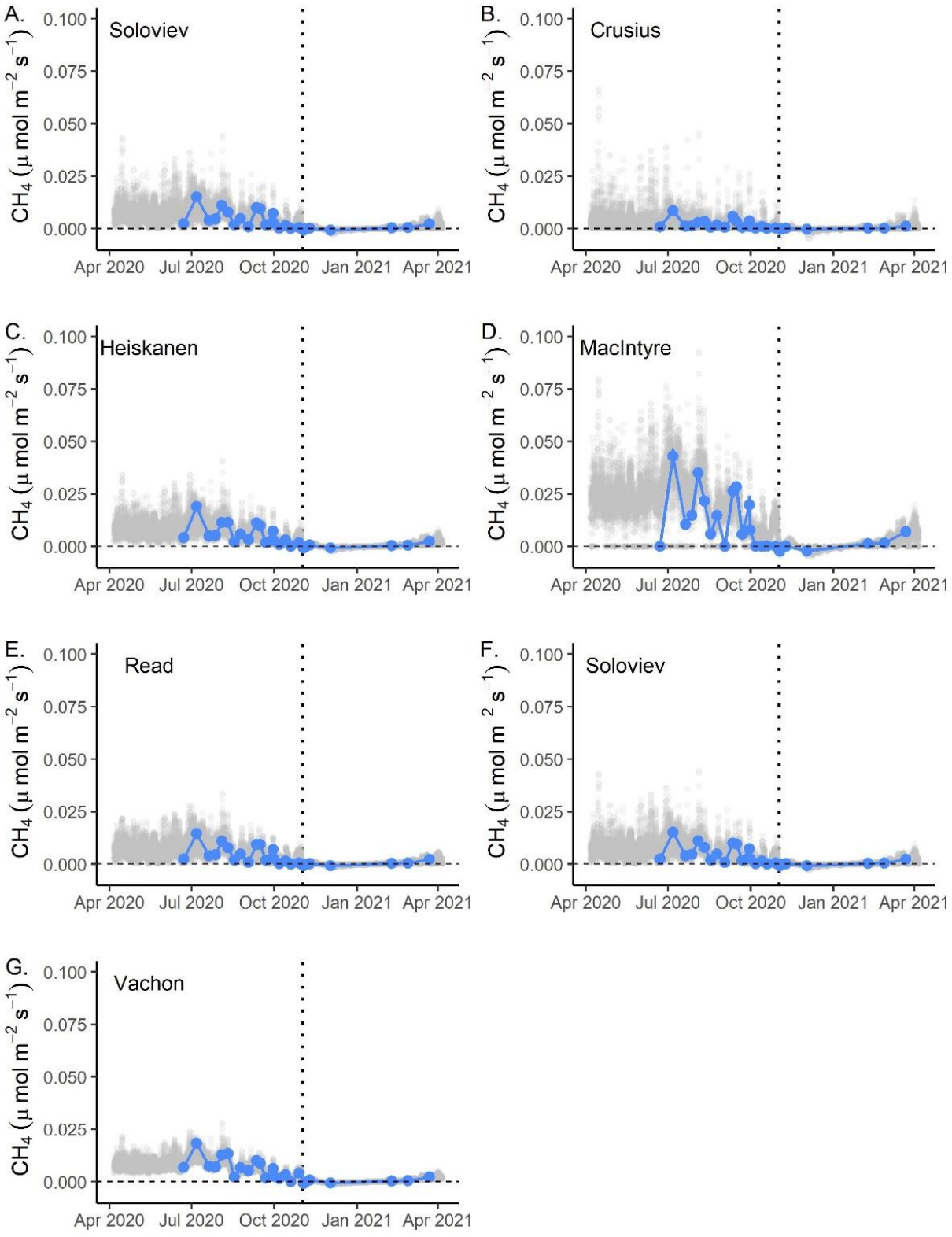

Figure S6. Discrete diffusive fluxes calculated for methane (CH_4, μmol m^{-2} s^{-1}) during the study period (5 April 2020 to 6 April 2021) using multiple gas transfer coefficient models (k_{600}; Winslow

et al. 2016; Cole and Caraco, 1998; Crusius and Wannikof, 2003; Vachon and Prairie, 2013; MacIntyre et al. 2010; Heiskanen et al. 2014; Read et al. 2012; Soloviev et al. 2007). Points represent the mean of two replicates calculated with multiple k_{600} methods and the error bars are the standard deviation (±1 S.D.). Grey dots correspond to half-hourly diffusive flux calculations. The dashed horizontal line indicates zero fluxes and the dotted vertical line corresponds to fall turnover.

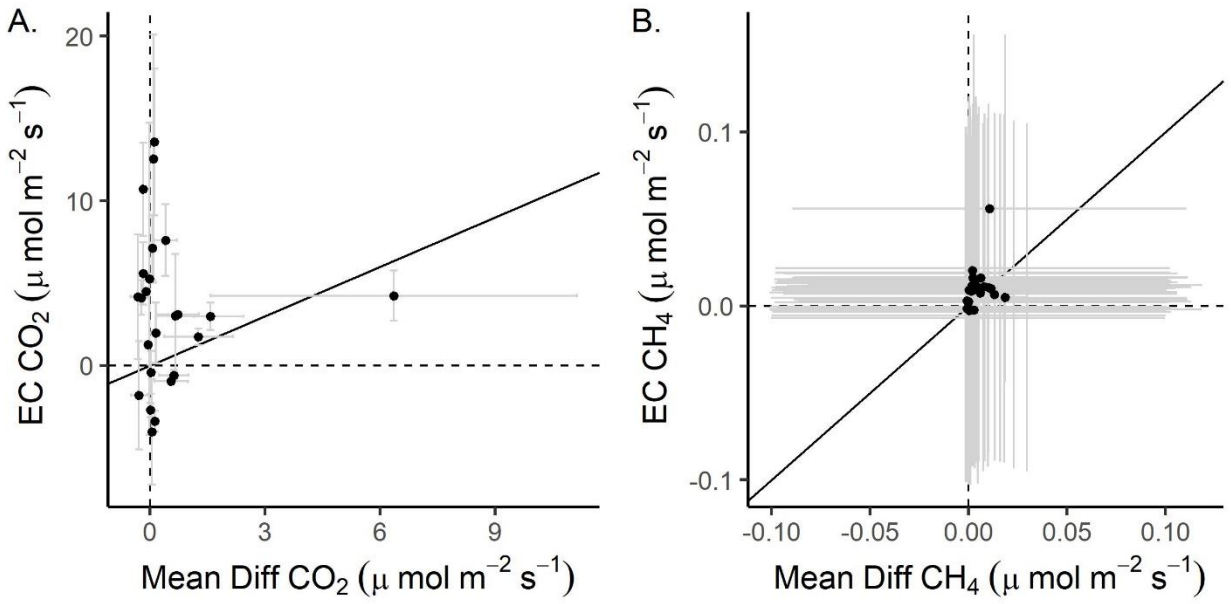

Figure S7. Instantaneous mean diffusive fluxes compared to mean hourly fluxes obtained using the eddy covariance (EC) system (n=24 observations) for A. carbon dioxide (CO_2, μmol m^{-2} s^{-1}) and B. methane (CH_4, μmol m^{-2} s^{-1}). Standard deviation is plotted as grey bars for both mean diffusive fluxes estimated for two replicates using all k_{600} methods (see main manuscript text) and for mean hourly fluxes obtained using the EC. Dashed vertical and horizontal lines correspond to zero fluxes; the one-to-one line is plotted as a solid black line.

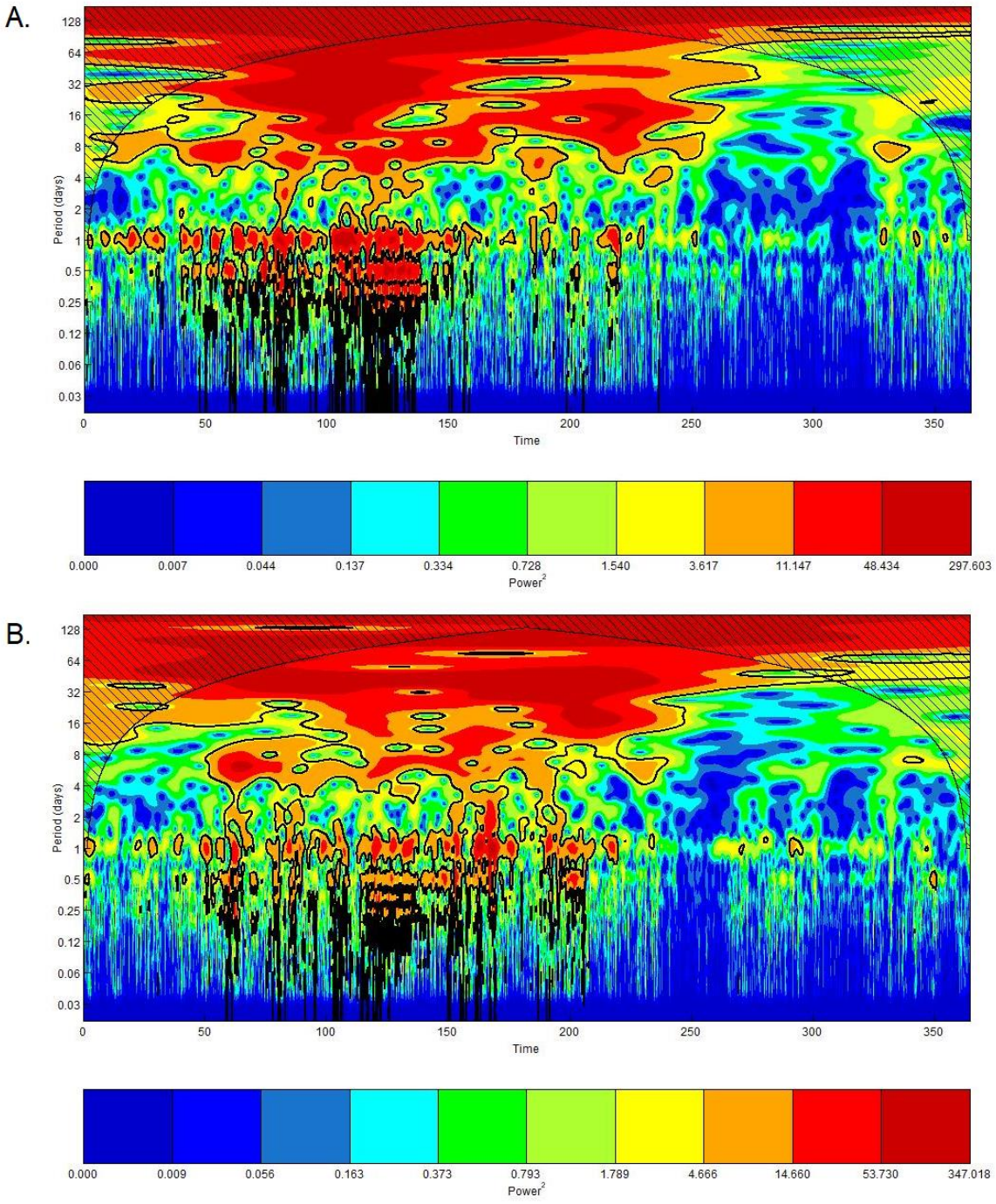

Figure S8. Results for the continuous wavelet transform (CWT) for A. carbon dioxide fluxes (CO_2, μmol m^{-2} s^{-1}) and B. methane fluxes (CH_4, μmol m^{-2} s^{-1}) throughout the yearlong study period (05 April 2020 to 04 April 2021). The color gradient represents the power of each time period from high power (dark red) to low power (blue). The black contour represents 95% significant levels while the black hatching represents the cone of influence (COI) where edge effects may distort results.

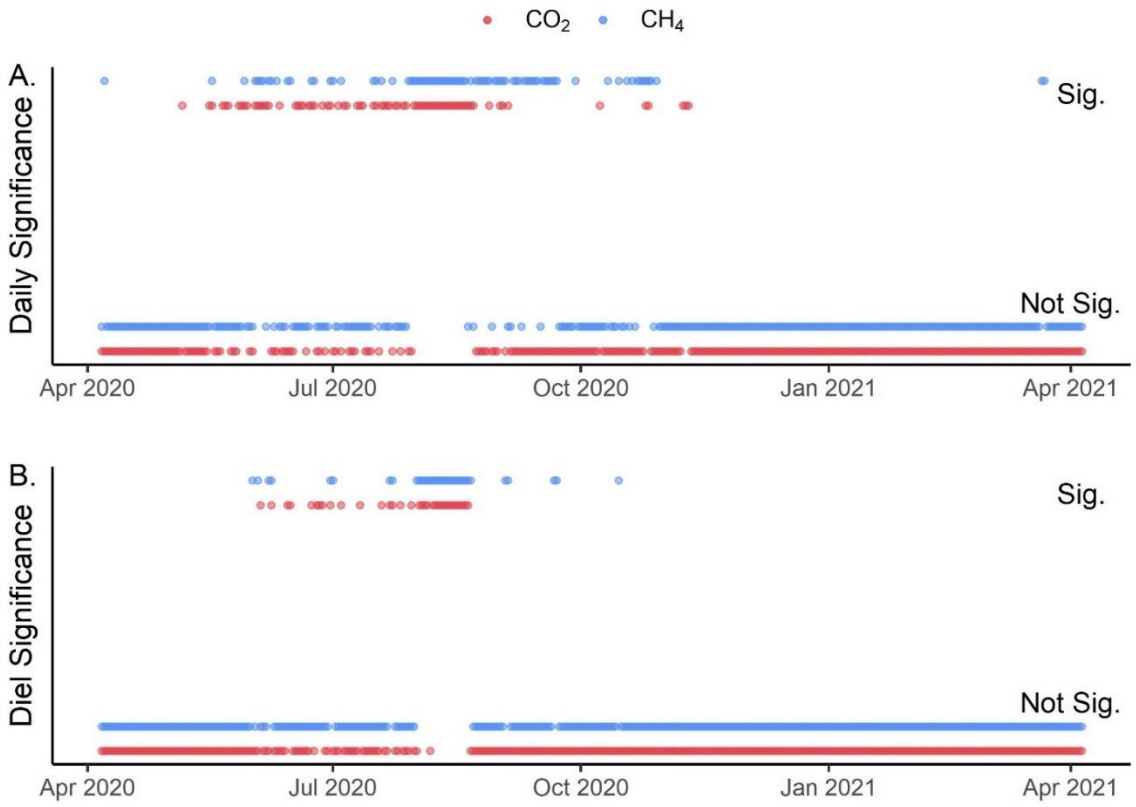

Figure S9. Visualization of days, defined as 12:00 for each day during the time period, when A. the daily time scale and B. the diel time scale was significantly important following continuous wavelet transform (CWT) analysis for carbon dioxide (CO_2, red) and methane (CH_4, blue). Days that were significant are plotted at the top (Sig.) and days that were not significant are plotted on the bottom (Not Sig.).

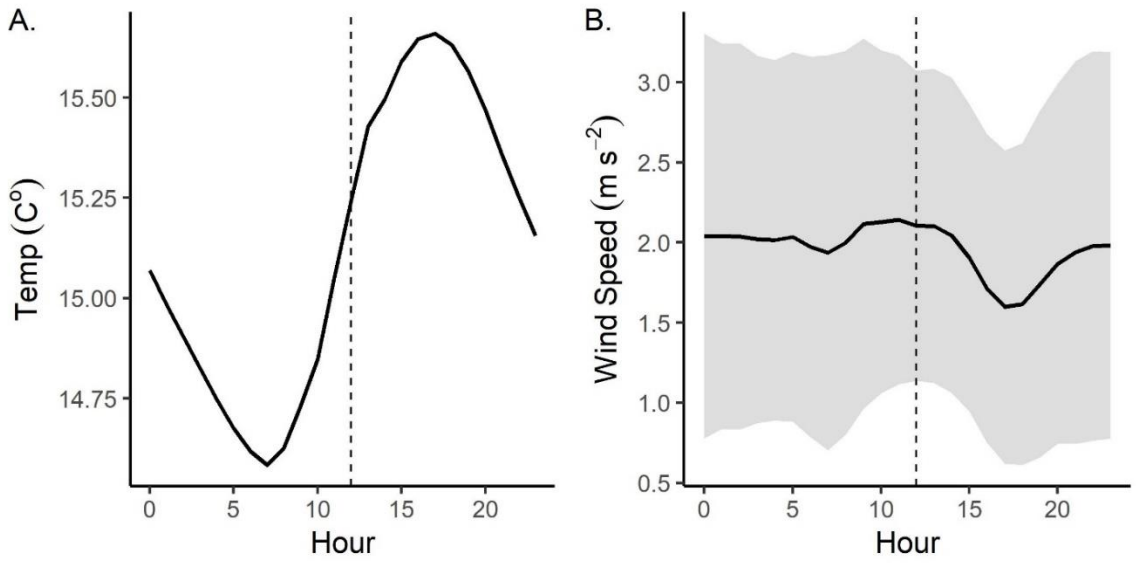

Figure S10. A. Surface water temperature (Temp, °C) and B. wind speed (m s^{-2}) averaged for each hour over the full study period. The vertical dashed line indicates 1200 (noon).

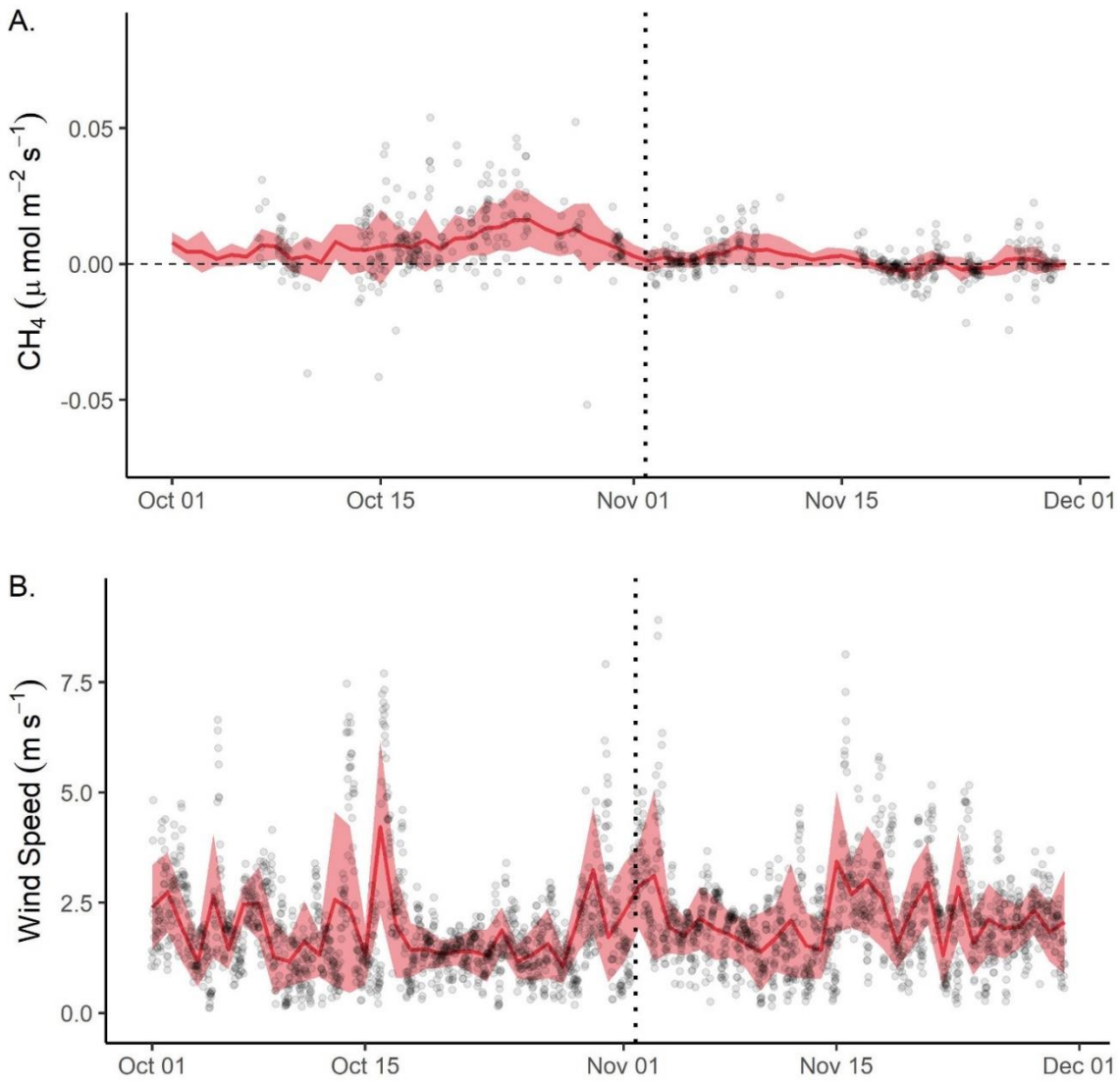

Figure S11. A. Mean daily methane fluxes (CH_4 µmol m^{-2} s^{-1}) and B. mean daily wind speed (m s^{-1}) plotted around reservoir turnover (01 November 2020). Grey dots represent measured half-hourly fluxes from the EC system (CH_4) and the meteorological station deployed at the dam of Falling Creek Reservoir (Wind speed). The dark red line represents daily mean fluxes, including gap-filled time points (for flux data). The shaded red area represents ±1 standard deviation of the daily 30-minute fluxes. The vertical dotted line indicates reservoir turnover.

Parameter	% Missing	R^2	rho	Linear equation
Wind speed	17	0.66	0.81	EC = Met*0.53 + 0.13
Air Temperature	42	0.97	0.98	EC = Met*0.93 - 0.58
Sonic Air Temperature	42	0.97	0.98	EC = Met*1.02 - 0.26
Relative Humidity	44	0.81	0.90	EC = Met*0.81 + 6.62

Table S1. Meteorological variables derived from the eddy covariance (EC) system which were estimated with meteorological data obtained from the meteorological (Met) station deployed on the dam of Falling Creek Reservoir. The percent of missing data (% Missing) represents the percent of data missing from the EC system over the one-year monitoring period that was estimated using the meteorological data. The R^2 is included for the linear relationship between the EC and Met data along with the linear equation used for estimation; rho denotes Spearman rho correlation. Parameters include: wind speed (m s^{-1}), air temperature (K), sonic air temperature (K), and relative humidity (%).

	Percent CO_2 fluxes (%)	Percent CH_4 fluxes (%)
Missing data pre-processing	79	60
Removing fluxes from behind dam (<80° and >250°)	56	42
QA/QC* of fluxes, LE**, and H***	37	28
Removing CH_4 due to rain	-	27
Removing fluxes outside of reservoir footprint	28	21

* QA/QC = Quality assurance/quality control
** Latent energy flux
*** Sensible heat flux

Table S2. Percent of measured carbon dioxide (CO_2) and methane (CH_4) fluxes retained for analysis following data post-processing and various steps of data post-processing. See main manuscript for description of each post-processing step; all code is available in (Carey et al. 2022a).

	Start Date	End Date
Ice off 1	19 December 2020	26 December 2020
Ice on 1	27 December 2020	29 December 2020
Ice off 2	30 December 2020	09 January 2021
Ice on 2	10 January 2021	09 February 2021

Table S3. Start and end dates used to define complete ice-off and intermittent ice-on periods during the winter for 2020-2021 in Falling Creek Reservoir (Carey et al. 2021).

	DO % Sat.	Chl-a ($\mu g\ L^{-1}$)	fDOM (RFU)	Inflow ($m^3\ s^{-1}$)	Temp Diff.	N^2	Thermo Depth (m)
Hourly							
Surface Temp. (°C)	0.42	-0.47	0.42	0.10	0.95	0.89	0.12
DO % Sat.		-0.13	0.17	0.43	0.56	0.51	-0.15
Chl-a ($\mu g\ L^{-1}$)			-0.35	-0.06	-0.45	-0.43	-0.09
fDOM (RFU)				0.20	0.36	0.33	-0.10
Inflow ($m^3\ s^{-1}$)					0.24	0.15	-0.15
Temp Diff.						0.92	0.04
N^2							-0.06
Daily							
Surface Temp. (°C)	0.46	-0.51	0.44	0.01	0.95	0.90	0.19
DO % Sat.		-0.19	0.16	0.48	0.62	0.57	-0.15
Chl-a ($\mu g\ L^{-1}$)			-0.40	-0.06	-0.48	-0.47	-0.12
fDOM (RFU)				0.21	0.38	0.36	-0.10
Inflow ($m^3\ s^{-1}$)					0.25	0.15	-0.19
Temp Diff.						0.93	0.10
N^2							-0.01
Weekly							
Surface Temp. (°C)	0.49	-0.57	0.45	0.09	0.95	0.91	0.34
DO % Sat.		-0.31	0.13	0.57	0.66	0.60	-0.14
Chl-a ($\mu g\ L^{-1}$)			-0.50	-0.06	-0.55	-0.54	-0.19
fDOM (RFU)				0.19	0.38	0.40	-0.10
Inflow ($m^3\ s^{-1}$)					0.24	0.15	-0.23
Temp Diff.						0.94	0.21
N^2							0.07
Monthly							
Surface Temp. (°C)	0.51	-0.68	0.56	0.07	0.95	0.93	0.19
DO % Sat.		-0.37	0.20	0.77	0.69	0.62	-0.20
Chl-a ($\mu g\ L^{-1}$)			-0.75	-0.12	-0.64	-0.63	-0.08
fDOM (RFU)				0.10	0.47	0.55	-0.19
Inflow ($m^3\ s^{-1}$)					0.25	0.14	-0.33
Temp Diff.						0.95	0.10
N^2							-0.05

Table S4. Correlations (Pearson's rho) among environmental parameters identified for the ARIMA analyses, including surface temperature (surface temp., °C), percent dissolved

oxygen saturation (DO % Sat.), chlorophyll-*a* (Chl-a, µg L^{-1}), fluorescent dissolved organic matter (fDOM, relative fluorescence units, RFU), inflow (m^3 s^{-1}), temperature difference (Temp Diff.) between the surface (0.1 m) and bottom (9 m), and buoyance frequency (N^2). Highlighted boxes indicate environmental variables which were removed due to collinearity (rho>|0.70|).

		Minimum (μmol m^{-2} s^{-1})	Maximum (μmol m^{-2} s^{-1})	Median (μmol m^{-2} s^{-1})	Mean (μmol m^{-2} s^{-1})	Standard Deviation (μmol m^{-2} s^{-1})	Coefficient of Variation (%)
CO_2	Hourly	-29.14	39.19	0.90	1.66	4.25	255.43
	Daily	-4.16	11.80	1.11	1.66	2.07	124.69
	Weekly	-0.94	8.76	1.14	1.66	1.70	102.14
	Monthly	0.53	5.17	1.03	1.59	1.42	89.11
	Diffusive (Cole)	-0.38	9.44	0.15	0.21	0.37	175.14
	Diffusive (Crusius)	-0.89	28.05	0.07	0.18	0.58	312.24
	Diffusive (Heiskanen)	-0.71	15.21	0.22	0.35	0.68	194.14
	Diffusive (MacIntyre)	-1.65	35.77	0.64	0.95	1.85	193.55
	Diffusive (Read)	-0.58	10.29	0.18	0.30	0.61	202.84
	Diffusive (Soloviev)	-0.77	18.39	0.19	0.32	0.68	214.42
	Diffusive (Vachon)	-0.49	9.67	0.24	0.34	0.56	165.81
	Diffusive (Mean)	-1.65	35.96	0.19	0.38	0.92	242.87

Table S5. Minimum, maximum, median, mean, standard deviation, and coefficient of variation for carbon dioxide (CO_2) fluxes for each time scale (hourly, daily, weekly, and monthly) for the study period (5 April 2020 to 6 April 2021) obtained from the eddy covariance (EC) system. Also included are the diffusive fluxes calculated from dissolved CO_2 concentrations measured in the surface water and multiple gas transfer coefficient methods (k_{600}; Winslow et al. 2016; Cole and Caraco, 1998; Crusius and Wannikof, 2003;

Vachon and Prairie, 2013; MacIntyre et al. 2010; Heiskanen et al. 2014; Read et al. 2012; Soloviev et al. 2007) as explained in the Methods. Mean diffusive fluxes represent the mean of all diffusive methods.

		Minimum ($\mu mol\ m^{-2}\ s^{-1}$)	Maximum ($\mu mol\ m^{-2}\ s^{-1}$)	Median ($\mu mol\ m^{-2}\ s^{-1}$)	Mean ($\mu mol\ m^{-2}\ s^{-1}$)	Standard Deviation ($\mu mol\ m^{-2}\ s^{-1}$)	Coefficient of Variation (%)
CH_4	Hourly	-0.0479	0.0750	0.0012	0.0027	0.0071	265.18
	Daily	-0.0078	0.0188	0.0011	0.0027	0.0043	157.87
	Weekly	-0.0033	0.0134	0.0010	0.0026	0.0039	148.99
	Monthly	-0.0012	0.0095	0.0008	0.0025	0.0034	135.86
	Diffusive (Cole)	-0.0016	0.0217	0.0018	0.0028	0.0029	103.70
	Diffusive (Crusius)	-0.0048	0.0666	0.0007	0.0018	0.0036	193.12
	Diffusive (Heiskanen)	-0.0024	0.0408	0.0027	0.0044	0.0051	114.93
	Diffusive (MacIntyre)	-0.0059	0.0928	0.0062	0.0121	0.0140	115.62
	Diffusive (Read)	-0.0018	0.0337	0.0021	0.0038	0.0045	118.43
	Diffusive (Soloviev)	-0.0030	0.0443	0.0022	0.0040	0.0049	123.28
	Diffusive (Vachon)	-0.0016	0.0282	0.0030	0.0045	0.0046	101.96
	Diffusive (Mean)	-0.0059	0.0928	0.0020	0.0048	0.0074	154.62

Table S6. Minimum, maximum, median, mean, standard deviation, and coefficient of variation for methane (CH_4) fluxes for each time scale (hourly, daily, weekly, and monthly) for the study period (5 April 2020 to 6 April 2021) obtained from the eddy covariance (EC) system. Also included are the diffusive fluxes calculated from dissolved CH_4 concentrations measured in the surface water and multiple gas transfer coefficient methods (k_{600}; Winslow et al. 2016; Cole and Caraco, 1998; Crusius and Wannikof, 2003; Vachon and

Prairie, 2013; MacIntyre et al. 2010; Heiskanen et al. 2014; Read et al. 2012; Soloviev et al. 2007) as explained in the Methods. Mean diffusive fluxes represent the mean of all diffusive methods.

	25th Percentile	Median	75th Percentile	*p*-value
	CO_2 (μmol m^{-2} s^{-1})			
Day	0.12	1.40	3.72	
Night	-0.51	1.01	2.84	0.02
Dawn	-0.01	1.31	3.32	
Dusk	-0.48	0.11	0.68	<0.001
	CH_4 (μmol m^{-2} s^{-1})			
Day	-0.0019	0.0010	0.0079	
Night	-0.0014	0.0009	0.0050	0.43
Dawn	-0.0022	0.0011	0.0064	
Dusk	-0.0010	0.0005	0.0034	0.20
	Wind (m s^{-1})			
Day	0.91	1.27	1.74	
Night	0.76	1.07	1.45	<0.001
Dawn	0.94	1.28	1.82	
Dusk	0.86	1.20	1.67	0.009

Table S7. Diel (day/night) and dawn/dusk comparisons for measured eddy covariance (EC) fluxes for carbon dioxide (CO_2, μmol m^{-2} s^{-1}) and methane (CH_4, μmol m^{-2} s^{-1}) along with wind (m s^{-1}). Day corresponds to measurements collected from 1100 to 1300 while night corresponds to 2300 to 0100 throughout the time period. Dawn corresponds to measurements collected from 0500 to 0700 and dusk corresponds to 1700 to 1900. Statistically significant differences ($p < 0.05$) based on paired Wilcoxon sign-rank tests are highlighted in grey.

		CO_2				CH_4			
Ice Period	**Diel**	**25th Percentile**	**Median**	**75th Percentile**	**p-value**	**25th Percentile**	**Median**	**75th Percentile**	**p-value**
Off_1	Day	-0.38	0.75	1.54		-0.0029	-0.0015	-0.0003	
Off_1	Night	-0.38	0.93	1.63	0.27	-0.0028	-0.0022	-0.0015	0.26
On_1	Day	0.39	0.91	1.56		-0.0029	-0.0015	0.0001	
On_1	Night	-0.89	0.85	1.62	0.91	-0.0008	0.0007	0.0033	0.05
Off_2	Day	0.24	0.68	1.05		-0.0008	0.0004	0.0022	
Off_2	Night	0.42	0.76	1.47	0.11	-0.0033	-0.0008	0.0009	0.002
On_2	Day	0.06	0.60	1.23		-0.0021	-0.0001	0.0022	
On_2	Night	0.18	0.87	1.48	0.01	-0.0017	0.0000	0.0017	0.76
Off_1	All	-0.44	0.90	1.54		-0.0029	-0.0017	-0.0004	
On_1	All	0.32	0.85	1.59	0.62	-0.0028	-0.0009	0.0006	0.13
Off_2	All	0.29	0.72	1.19		-0.0019	0.0001	0.0014	
On_2	All	0.10	0.69	1.38	0.50	-0.0019	-0.0001	0.0019	0.61
Off All	All	0.28	0.73	1.33		-0.0023	-0.0004	0.0009	
On All	All	0.11	0.70	1.43	0.62	-0.0021	-0.0002	0.0017	0.10

Table S8. 25th percentile, median, and 75th percentile reported measured eddy covariance (EC) data for carbon dioxide (CO_2, μmol m^{-2} s^{-1}) and methane (CH_4, μmol m^{-2} s^{-1}) fluxes during winter 2020-2021 under partial ice-on ('On') and complete ice-off ('Off') for two time periods (1 and 2). Diel indicates whether samples were measured during the day (0700 to 1900) or at night (1930 to 0630) during each time period. The Mann-Whitney-Wilcoxon test was used to identify medians which were statistically different including between day and night for each partial ice-on or complete ice-off period as well as between all ice-on versus ice-off periods. Statistically significant relationships are highlighted in grey.

GHG	Order	AR(1)	MA(1)	MA(2)	MA(3)	MA(4)	X Reg	Temp. Surf. (°C)	% DO Sat.	Chl-a (µg L^{-1})	fDOM (RFU)	Flow (m^3 s^{-1})	Thermo. (m)	AICc	RMSE
								Hourly							
CO_2	(0,1,4)		-0.35	-0.31	-0.21	-0.07		-0.72	-0.09		0.07			19659.77	0.74
S.E.			0.01	0.01	0.01	0.01		0.16	0.03		0.03				
CO_2	(0,1,4)		-0.35	-0.31	-0.21	-0.07		-0.72	-0.10	0.01	0.07			19661.67	0.74
S.E.			0.01	0.01	0.01	0.01		0.16	0.03	0.03	0.03				
CO_2	(0,1,4)		-0.35	-0.31	-0.21	-0.07		-0.72	-0.09		0.07		0.00	19661.76	0.74
S.E.			0.01	0.01	0.01	0.01		0.16	0.03		0.03		0.02		
CH_4	(1,1,3)	0.48	-0.95	-0.08	0.05		-0.35							19458.77	0.73
S.E.		0.05	0.05	0.03	0.02		0.12								
CH_4	(1,1,3)	0.48	-0.95	-0.08	0.05			-0.29	-0.04					19457.50	0.73
S.E.		0.05	0.05	0.03	0.02			0.13	0.02						
CH_4	(1,1,3)	0.48	-0.95	-0.08	0.05			-0.34			-0.04			19459.08	0.73
S.E.		0.05	0.05	0.03	0.02			0.12			0.03				
CH_4	(1,1,3)	0.48	-0.95	-0.08	0.05			-0.28	-0.05	0.02				19458.87	0.73
S.E.		0.05	0.05	0.03	0.02			0.13	0.02	0.03					
CH_4	(1,1,3)	0.48	-0.95	-0.08	0.05			-0.29	-0.04		-0.03			19458.46	0.73
S.E.		0.05	0.05	0.03	0.02			0.13	0.02		0.03				
CH_4	(1,1,3)	0.48	-0.95	-0.08	0.05			-0.30	-0.04			-0.02		19459.28	0.73
S.E.		0.05	0.05	0.03	0.02			0.13	0.02			0.05			
CH_4	(1,1,3)	0.48	-0.95	-0.08	0.05			-0.29	-0.04				0.00	19459.47	0.73
S.E.		0.05	0.05	0.03	0.02			0.13	0.02				0.02		
								Daily							
CO_2	(0,0,4)		0.87	0.68	0.39	0.12		0.30	0.17	-0.16	0.14	0.21		513.94	0.47
S.E.			0.05	0.07	0.06	0.06		0.09	0.06	0.07	0.07	0.07			

GHG	Order	AR(1)	MA(1)	MA(2)	MA(3)	MA(4)	X Reg	Temp. Surf. (°C)	% DO Sat.	Chl-a (µg L^{-1})	fDOM (RFU)	Flow (m^3 s^{-1})	Thermo. (m)	AICc	RMSE
								Daily							
CH_4	(1,0,3)	0.95	-0.26	-0.01	-0.22			0.48		0.14		0.00		470.64	0.45
SE		0.02	0.06	0.06	0.05			0.18		0.07		0.08			
								Weekly							
CO_2	(0,0,0)							0.21	0.59		0.30			97.08	0.55

S.E.			0.10	0.09		0.09					
CO_2	(0,0,0)		0.18	0.58	-0.09	0.28			98.73	0.54	
S.E.			0.10	0.09	0.10	0.09					
CO_2	(0,0,0)		0.25	0.54					98.97	0.55	
S.E.			0.11	0.11							
CH_4	(0,0,1)	0.70	0.56				-0.34		100.23	0.56	
S.E.		0.16	0.13				0.11				
CH_4	(0,0,1)	0.74	0.70		0.25		-0.31		98.41	0.54	
S.E.		0.16	0.14		0.12		0.11				
CH_4	(0,0,1)	0.76	0.49			0.19	-0.39		99.83	0.55	
S.E.		0.18	0.13			0.11	0.11				
CH_4	(0,0,1)	0.69	0.79	-0.16	0.27		-0.29		98.62	0.53	
S.E.		0.19	0.15	0.11	0.12		0.10				
CH_4	(0,0,1)	0.74	0.66		0.24		-0.32	0.08	99.72	0.53	
S.E.		0.17	0.14		0.12		0.10	0.07			
CH_4	(0,0,1)	0.70	0.70	-0.12	0.28	0.19	-0.35		98.48	0.51	
S.E.		0.25	0.15	0.11	0.11	0.11	0.11				
			Monthly								
CO_2	(0,0,0)		0.40	0.68		-	-		16.31	0.33	
S.E.			0.11	0.11		-	-				
CO_2	(0,0,0)			0.68	-0.42	-	-		14.49	0.30	
S.E.				0.10	0.10	-	-				
CO_2	(0,0,0)		0.23	0.63	-0.29	-	-		15.47	0.26	
S.E.			0.11	0.09	0.11	-	-				
CH_4	(0,0,0)		0.97	-0.54					26.77	0.51	
S.E.			0.18	0.18							
CH_4	(0,0,0)		1.04		0.41			0.27	26.69	0.40	
S.E.			0.26		0.14			0.09			

Table S9. Best-fit results from Autoregressive Integrated Moving Average (ARIMA) showing the top selected model (lowest corrected Akaike Information Criterion, AICc < 2). Models are separated by greenhouse gas (GHG) flux as carbon dioxide fluxes (CO_2) and methane fluxes (CH_4) as well as by timescale (hourly, daily, weekly, monthly). Environmental predictors included: Surface temperature (Surface Temp, °C), dissolved oxygen saturation (DO Sat, %), Chlorophyll-*a* (Chl-a, μg L^{-1}), fluorescent dissolved organic matter (fDOM, RFU), inflow discharge (Inflow, m^3 s^{-1}), and

thermocline depth (Thermo. depth, m). Model order is specified as (p,d,q) where p is the order of the AR term, d is the order of the integration term, and q is the order of the MA term. Results for all models with 2 AICc of the best fitting model are included. Grey shading indicates the environmental variables which were removed prior to modeling due to collinearity (Pearson's rho>|0.70|). The root mean square error (RMSE) is also reported for each model. Shaded model results are included in the main manuscript (Table 1). S.E. is the standard error.