

# Supplemental Information



muddy site / soil flux chamber C2



sandy site / soil flux chamber C1



vegetated site / soil flux chamber C3

Figure S1: Photographs of automatic flux chambers in dry habitat types.



Figure S2: Location of the terrestrial sampling sites. CH1, CH2, and CH3 indicate the location of the automatic chambers.

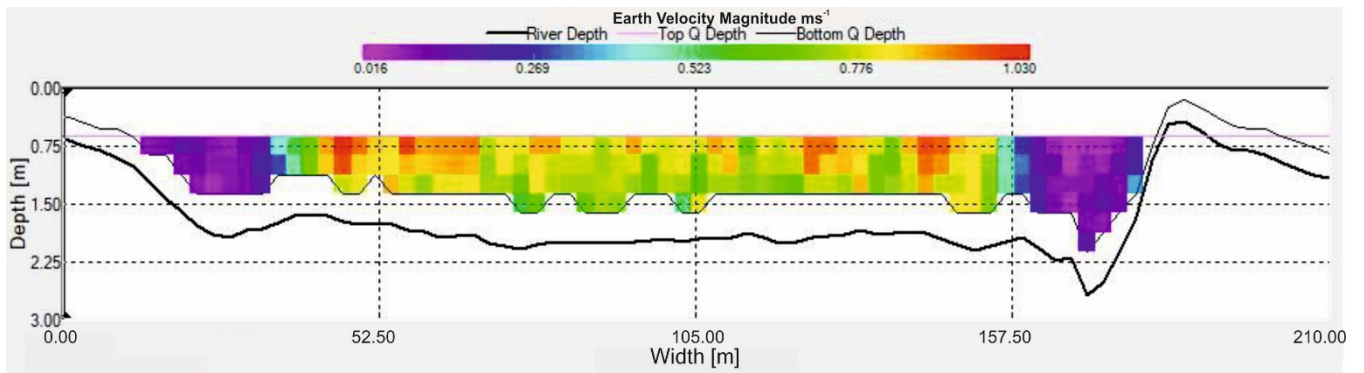


Figure S3: Example of ADCP contour map of flow velocity in a river cross section of the study reach.

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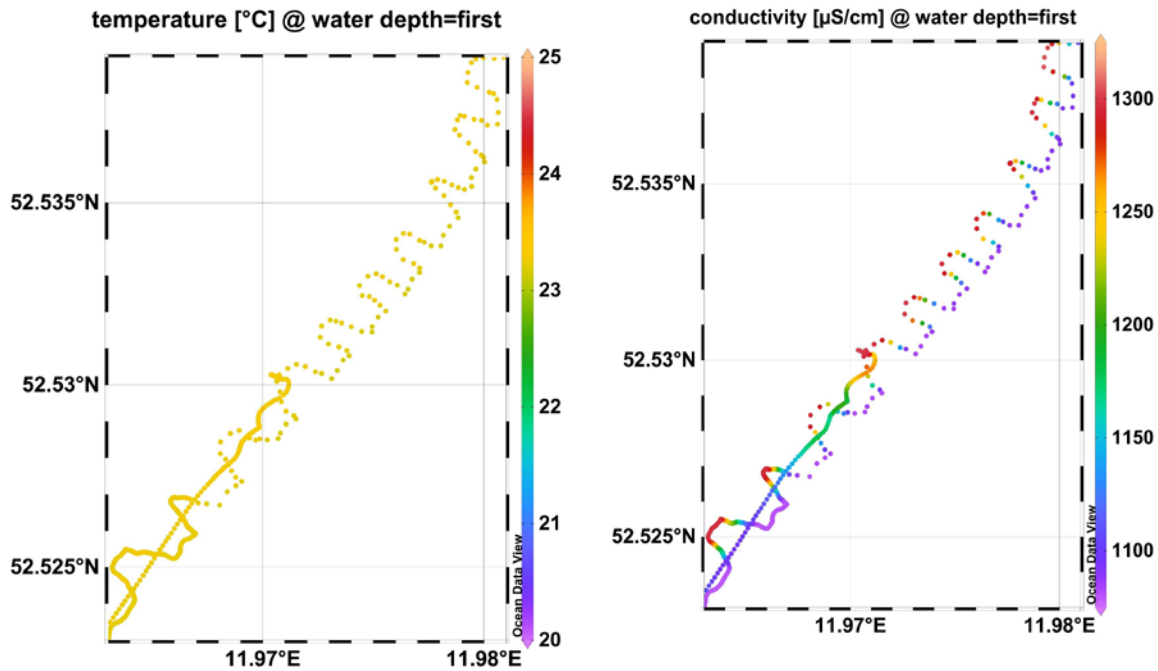


Figure S4: Water temperature and conductivity along the Elbe, on 19.8.2022 in the same area as shown in Figure 1b. Data were measured by a CTD probe on RV Albis and cover the middle and side section of the river. The boat did not enter the groyne fields.

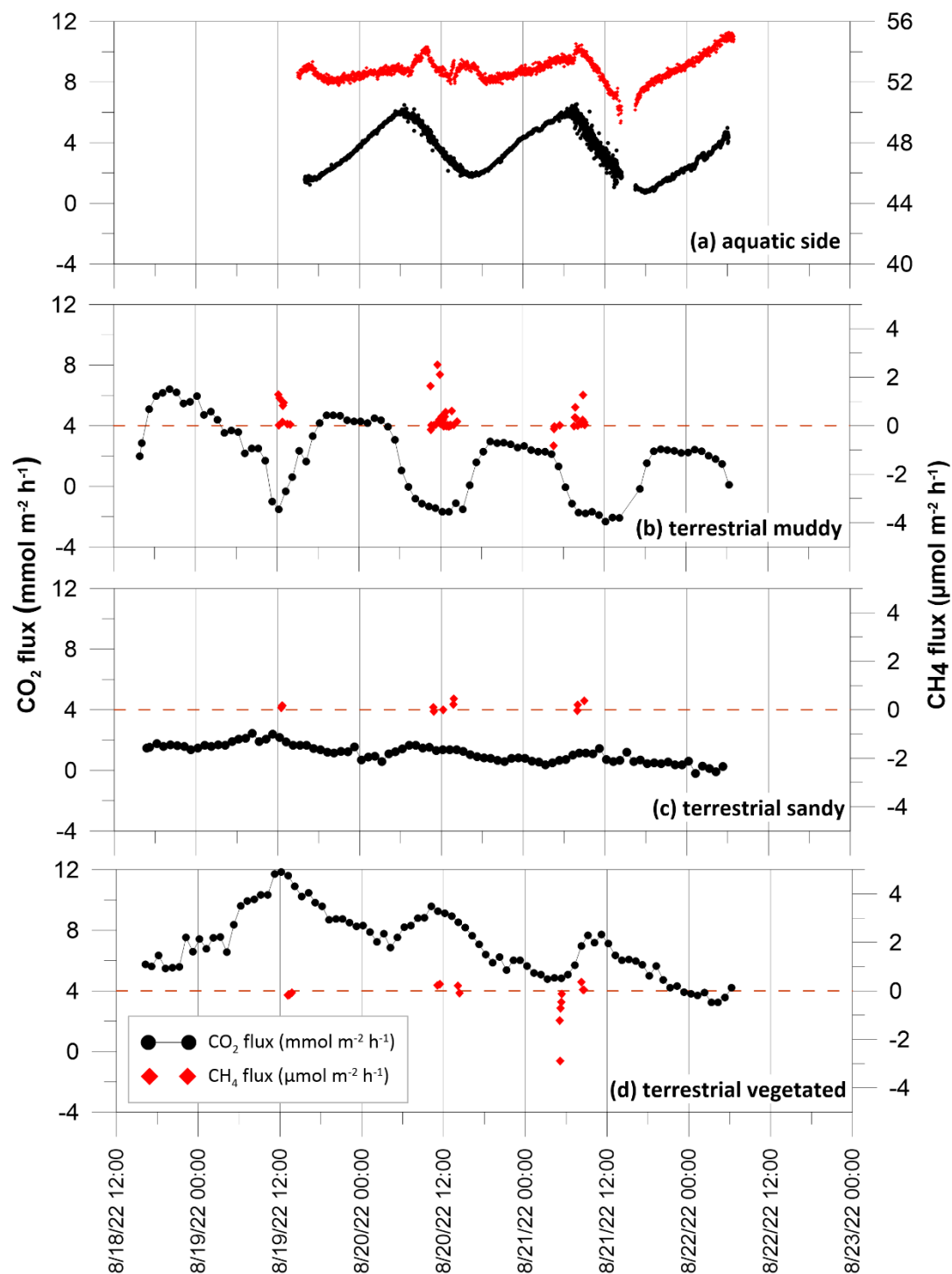
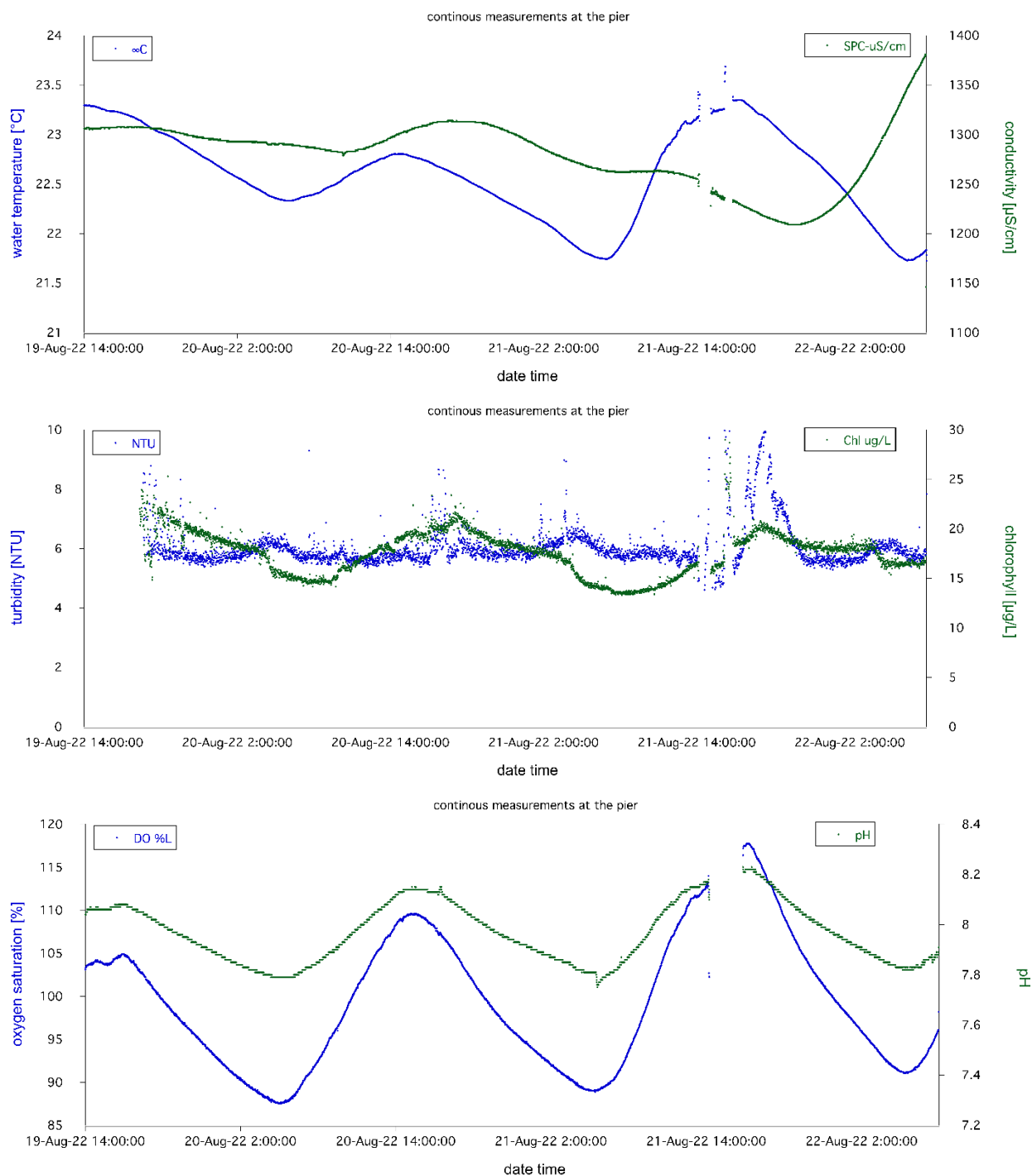


Figure S5: Time series of CO<sub>2</sub> flux (black) and CH<sub>4</sub> flux (red) in different habitats: (a) aquatic side (b) terrestrial muddy (c) terrestrial sandy (d) terrestrial vegetated. Aquatic fluxes calculated from concentration data, terrestrial fluxes directly measured with chambers. Note different scale for aquatic data. All data are shown.



20 **Figure S6: Time series of water temperature (blue) and electrical conductivity (green) (upper figure), turbidity and chlorophyll (middle figure), and oxygen and pH (lower figure) measured at RV Albis.**

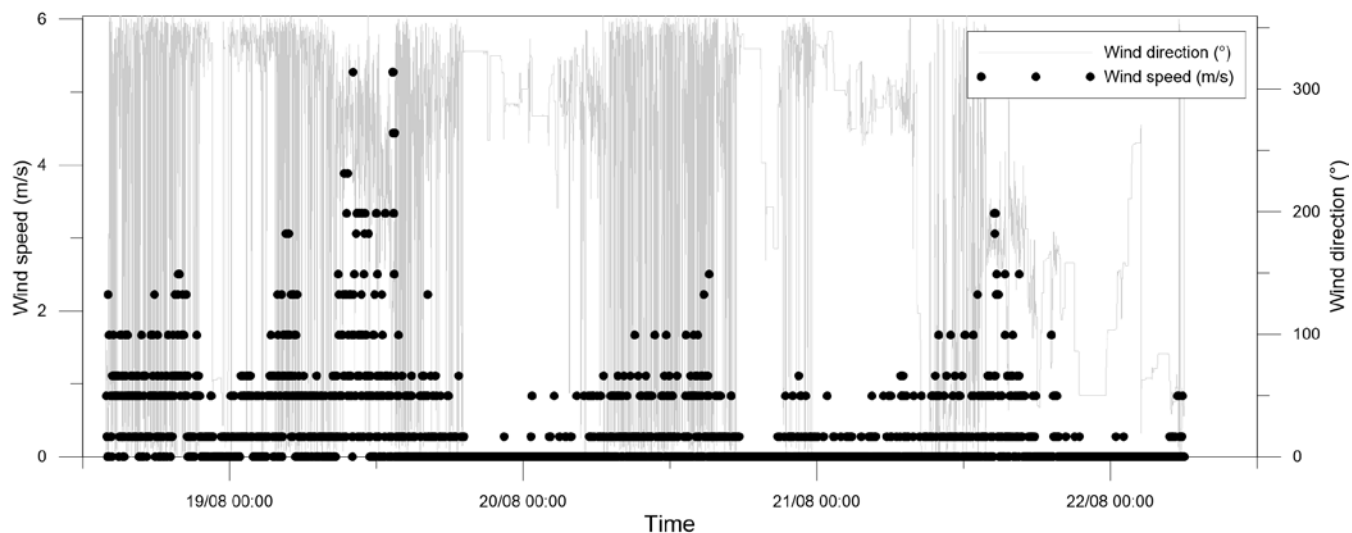


Figure S7: Wind speed (dots) and wind direction (line) during the study period measured with a weather station on board of RV Albis.

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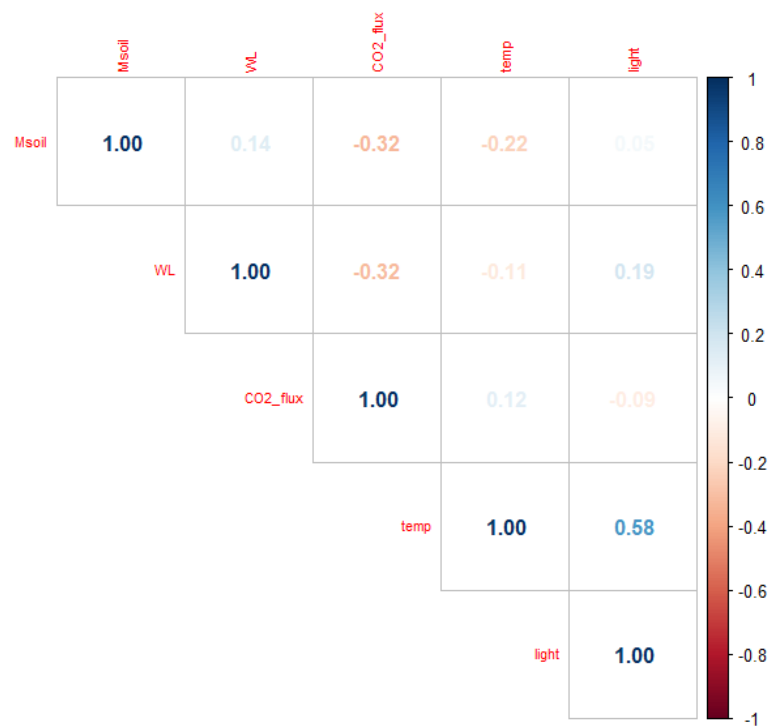
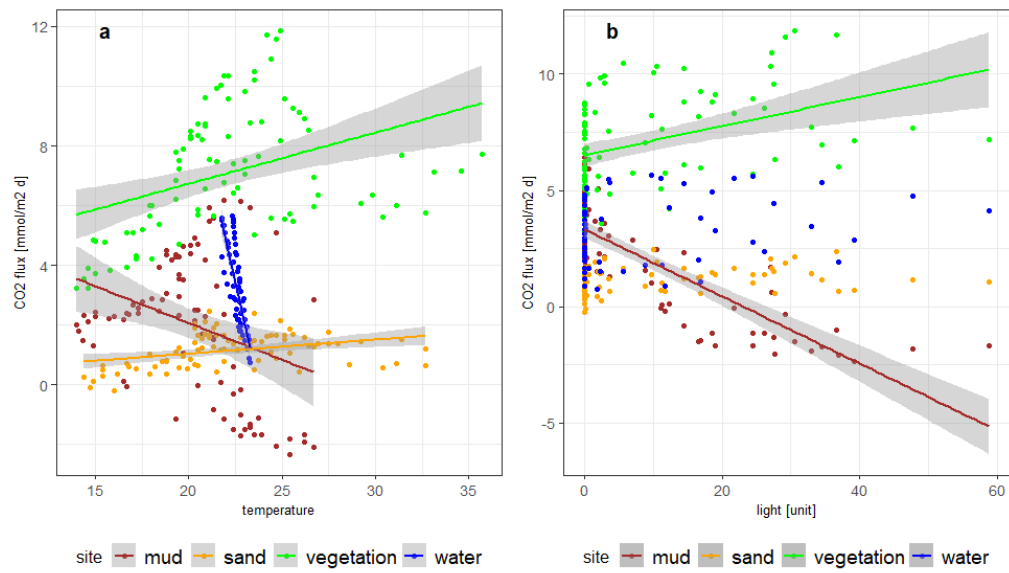
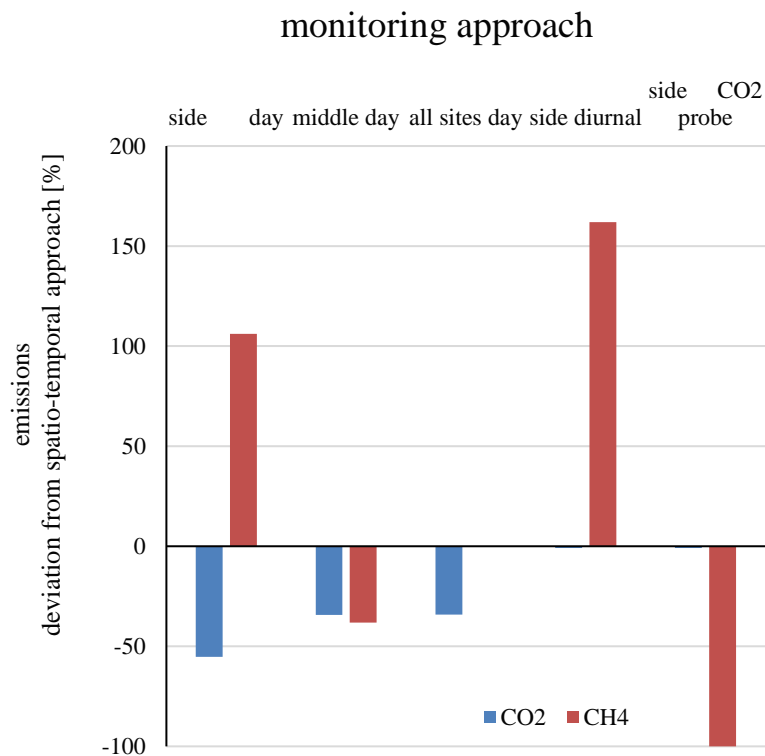


Fig. S8: Correlation matrix including temporal terrestrial CO<sub>2</sub> flux data and potential regulators. Temporal variability of terrestrial CH<sub>4</sub> fluxes was not measured. Msoil=sediment moisture, WL=water level, temp=sediment temperature, light= light intensity. Numbers show R<sup>2</sup> of linear correlations.

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**Figure S9: Linear correlation of CO<sub>2</sub> fluxes with temperature (a) and light (b). Lines show linear fit if significant ( $p < 0.05$ ), shaded areas are confidence intervals. Results of Pearson correlation in Table S1.**



**Figure S10:** Deviation of total CO<sub>2</sub> (blue) and CH<sub>4</sub> (red) emissions obtained by different monitoring approaches from the optimal approach (both spatial and diurnal variability considered).

45 **Table S1: Data pairs of CH<sub>4</sub> concentration results from discrete GC samples and continuous analysis with the greenhouse gas analyser (GGA) used to calculate a conversion factor. That conversion factor was then used to convert all GGA data to concentrations.**

date	conc. from GC [nmol/l]	from GGA [ppm]	conversion factor	mean ± SD
19.08. 9:14	216	1.70	127.67	88.7 ± 23.1
19.08. 9:49	183	2.37	77.18	
19.08. 11:04	178	2.10	84.88	
20.08. 7:37	258	3.83	67.29	
20.08. 11:22	214	3.23	66.17	
21.08. 7:20	191	2.24	85.19	
21.08. 9:06	243	2.16	112.19	

50 **Table S2: Linear correlation (Pearson) of the CO<sub>2</sub> flux at different habitats with temperature or light. Data shown in Figure S9. Negative R indicates negative correlation.**

Habitat	Temperature		light	
	R	p	R	p
Aquatic	-0.80	3.6E-14	0.22	0.09
Terrestrial mud	-0.32	0.003	-0.81	1.24E-20
Terrestrial sand	0.35	0.001	0.26	0.018
Terrestrial vegetation	0.39	0.0002	0.39	0.0002



55 **Table S3: Comparison of linear mixed effect models with CO<sub>2</sub> flux as response variable and site as random factor. Msoil = sediment moisture, AIC = Akaike Information Criterion. Numbers in the first 4 columns show coefficient estimates for predictors. Df = degrees of freedom. All data log transformed.**

light	Msoil	temperature	water level	df	R <sup>2</sup>	AIC
			-0.2597	4	0.75	986
	-0.03268		-0.2455	5	0.75	992
		0.0177	-0.2575	5	0.75	993.1
-0.009366			-0.2539	5	0.75	994.4
-0.02149		0.06155	-0.2388	6	0.76	997.6
	-0.03333	0.01825	-0.243	6	0.75	999.1
-0.008765	-0.02859		-0.2419	6	0.75	1000.6
-0.02074	-0.02513	0.06044	-0.2285	7	0.76	1003.9
	-0.1891			4	0.68	1048.4
-0.03772	-0.1553	0.1155		6	0.70	1050
	-0.1869	0.04131		5	0.68	1053.4
-0.01555	-0.1777			5	0.68	1054.7
-0.04989		0.1445		5	0.67	1063
				3	0.64	1071
-0.02339				4	0.65	1073.5
		0.04778		4	0.65	1075.5

### Method sediment incubation experiment

60 Experiments for CH<sub>4</sub> production rates were set up with surface sediments and water samples from our main groyne field. Sediment cores were manually obtained by wading into the river. Sediment from the main groyne field (where the chambers were set up, Figure 1c) were taken with plastic cores (60 mm diameter) at a water depth of approx. 50 cm. Ten ml of surface sediment were diluted with 50 ml of anoxic water into 120 ml glass bottles which were closed with crimped butyls stoppers. Anoxic water was prepared by filtering 1 L water from the study site through (0.2 µm) into a nitrogen purged bottle. After  
65 filtering the water was again purged with nitrogen for 10 minutes.

Water samples (60 ml) were taken from the overlaying water of the sediment cores, transferred to 120 ml glass bottles and closed with crimped butyl stoppers, without further modifications of the head space.

All glass bottles (3 replicates for sediment and water) were incubated in a net at 1 m water depth in the river. Measurement for CH<sub>4</sub> concentrations in the headspace were performed according to Wilkinson et al (2018) from 19.08 – 22.08.2022, once a day  
70 for 68 hours. Rates were calculated from the linear decrease of methane over time (68 hours for sediment incubations and 31 hours for water incubations).