Supplement of

Changing sources and processes sustaining surface CO₂ and CH₄ fluxes along a tropical river to reservoir system

Cynthia Soued and Yves T. Prairie

Correspondence to: Cynthia Soued (cynthia.soued@gmail.com)

The copyright of individual parts of the supplement might differ from the CC BY 4.0 License.
Supplementary information content

- **Table S1**: non-parametric Kendall correlation (cor) and their p-value between reservoir surface CO₂ and CH₄ concentrations with physical and chemical variables.

- **Figure S1**: Linear regressions of the natural logarithm of surface CO₂ and CH₄ concentrations with water temperature (a, p-value < 0.001, \( R^2_{adj} = 0.22 \)) and TN (b, p-value < 0.001, \( R^2_{adj} = 0.14 \)) respectively in the reservoir (branches and main basin).

- **Figure S2**: Linear regressions of the natural logarithm of surface concentrations of CO₂ versus CH₄ in the reservoir inflows (brown, p-value = 0.006 and \( R^2_{adj} = 0.54 \)), branches (green, p-value = 0.005 and \( R^2_{adj} = 0.17 \)), and main basin (blue, p-value = 0.11 and \( R^2_{adj} = 0.01 \)).

- **Table S2**: Estimated averages (± SE) of rates of CO₂ inputs to the epilimnion from horizontal flow (H), sediments (S), vertical transport (V), and internal metabolism (M_inc and M_mod when derived from incubations and inverse O₂ modeling respectively), their sum (T, considering an average of M_inc and M_mod) and surface flux to the atmosphere (F) in the branches and main basin for each sampling campaign and their mean. Units are mmol m⁻² d⁻¹ of water surface area.
  *Represents missing value, assumed to be equal to the mean of other campaigns.

- **Table S3**: Estimated averages (± SE) of rates of CH₄ inputs to the epilimnion from horizontal flow (H), sediments (S), vertical transport (V), and internal metabolism (M_inc), their sum (T) and surface flux to the atmosphere (F) in the branches and main basin for each sampling campaign and their mean. Units are mmol m⁻² d⁻¹ of water surface area.
  *Represents missing value, assumed to be equal to the mean of other campaigns.

- **Figure S3**: Boxplots of the buoyancy frequency N² (a), dissipation rate ϵ (b), and CH₄ and CO₂ concentration gradients at the epilimnion-metalimnion interface (c, d) in the reservoir branches and main basin. Boxes bounds, whiskers, solid lines, and open circles represent the 25th and 75th percentiles, the 10th and 90th percentiles, the median, and single data points respectively.

- **Figure S4**: Example of a vertical profile (main reservoir, Aug 2018) of CO₂ (light gray points) and CH₄ (dark gray points) concentrations, as well as \( δ^{13} \)CH₄ (dark grey triangles) as a function of depth. The dotted line represents the top of the metalimnion.

- **Figure S5**: Boxplot of sediment CO₂ (a) and CH₄ (b) flux rates (per sediment area) across sampled sites in the reservoir branches and main basin. Boxes bounds, whiskers, solid lines, and open circles represent the 25th and 75th percentiles, the 10th and 90th percentiles, the median, and single data points respectively.
Table S1: non-parametric Kendall correlation (cor) and their p-value between reservoir surface CO₂ and CH₄ concentrations with physical and chemical variables.

| Variables       | [CO₂]  |        | [CH₄]  |        | n   |
|-----------------|--------|--------|--------|--------|-----|
|                 | cor    | p-value| cor    | p-value|     |
| Water temperature| -0.36  | < 0.001| 0.07   | 0.223  | 131 |
| % O₂            | -0.01  | 0.933  | 0.15   | 0.013  | 130 |
| Chla            | 0.12   | 0.056  | 0.18   | 0.005  | 110 |
| DOC             | 0.01   | 0.939  | 0.17   | 0.008  | 113 |
| TP              | 0.14   | 0.031  | 0.13   | 0.049  | 112 |
| TN              | 0.1    | 0.112  | 0.27   | < 0.001| 113 |

Figure S1: Linear regressions of the natural logarithm of surface CO₂ and CH₄ concentrations with water temperature (a, p-value < 0.001, R²_adj = 0.22) and TN (b, p-value < 0.001, R²_adj = 0.14) respectively in the reservoir (branches and main basin).
**Figure S2:** Linear regressions of the natural logarithm of surface concentrations of CO$_2$ versus CH$_4$ in the reservoir inflows (brown, p-value = 0.006 and R$^2_{\text{adj}} = 0.54$), branches (green, p-value = 0.005 and R$^2_{\text{adj}} = 0.17$), and main basin (blue, p-value = 0.11 and R$^2_{\text{adj}} = 0.01$).
Table S2: Estimated averages (± SE) of rates of CO₂ inputs to the epilimnion from horizontal flow (H), sediments (S), vertical transport (V), and internal metabolism (M_inc and M_mod when derived from incubations and inverse O₂ modeling respectively), their sum (T, considering an average of M_inc and M_mod) and surface flux to the atmosphere (F) in the branches and main basin for each sampling campaign and their mean. Units are mmol m⁻² d⁻¹ of water surface area. *Represents missing value, assumed to be equal to the mean of other campaigns.

|       | H       | S       | V       | M_inc   | M_mod   | T       | F       |
|-------|---------|---------|---------|---------|---------|---------|---------|
| Branches | Nov-Dec 2016 | 5.7 (± 2.6) | 0.6 (± 0)* | -1.8 (± NA) | 1.4 (± 1.9) | -63.2 (± NA) | -26.5 (± 36.1) | 2.8 |
|       | Apr-May 2017 | 2.7 (± 0.2) | 0.6 (± 0)* | 3.6 (± 2.3) | 1.4 (± 1.9)* | -32.4 (± 20) | -8.6 (± 19.4) | 15.2 |
|       | Feb-Mar 2018 | 3.2 (± 1.1) | 0.6 (± 0)* | 0.9 (± 0.5) | 1.4 (± 1.9)* | -47.8 (± 20)* | -18.6 (± 26.2) | 4.1 |
|       | Aug 2018    | 5.5 (± 3.3) | 0.6 (± 0)* | 0.1 (± 0.5) | 1.4 (± 1.9)* | -47.8 (± 20)* | -17.1 (± 28.4) | 15.2 |
| Mean  |         | 4.3 (± 0.8) | 0.6 (± 0) | 0.7 (± 1.1) | 1.4 (± 1.9) | -47.8 (± 15.4) | -17.7 (± 26.5) | 4.7 |

|       | H       | S       | V       | M_inc   | M_mod   | T       | F       |
|-------|---------|---------|---------|---------|---------|---------|---------|
| Main basin | Nov-Dec 2016 | 0.2 (± NA) | 0.5 (± 0.1)* | 6 (± 2.2) | -2.6 (± 6.2) | -21.4 (± 5.6) | -5.3 (± 11.7) | 11.3 |
|       | Apr-May 2017 | 0.4 (± NA) | 0.5 (± 0.1)* | 3.1 (± 1.3) | 7.2 (± NA) | -49 (± 37.3) | -16.9 (± 29.5) | 15.1 |
|       | Feb-Mar 2018 | 0.5 (± NA) | 0.5 (± 0.1)* | 4.7 (± 1) | 2.3 (± 6.2)* | -17 (± 4.5) | -1.6 (± 10.8) | 3.3 |
|       | Aug 2018    | 0.1 (± NA) | 0.5 (± 0.1)* | 4.3 (± 3.3) | 2.3 (± 6.2)* | -16.2 (± 20.9) | -2 (± 12.6) | 0.3 |
| Mean  |         | 0.3 (± 0.1) | 0.5 (± 0.1) | 4.5 (± 0.6) | 2.3 (± 4.9) | -25.9 (± 7.8) | -6.5 (± 14.9) | 7.5 |

Table S3: Estimated averages (± SE) of rates of CH₄ inputs to the epilimnion from horizontal flow (H), sediments (S), vertical transport (V), and internal metabolism (M_inc), their sum (T) and surface flux to the atmosphere (F) in the branches and main basin for each sampling campaign and their mean. Units are mmol m⁻² d⁻¹ of water surface area. *Represents missing value, assumed to be equal to the mean of other campaigns.

|       | H       | S       | V       | M_inc   | T       | F       |
|-------|---------|---------|---------|---------|---------|---------|
| Branches | Nov-Dec 2016 | 0.94 (± 0.67) | 0.04 (± 0.02)* | -0.001 (± NA) | 0.04 (± 0.05) | 1.03 (± 0.74) | 1.28 |
|       | Apr-May 2017 | 0.58 (± 0.08) | 0.04 (± 0.02)* | 0.001 (± 0.008) | 0.04 (± 0.05)* | 0.67 (± 0.16) | 0.71 |
|       | Feb-Mar 2018 | 0.16 (± 0.08) | 0.04 (± 0.02)* | 0.025 (± 0.016) | 0.04 (± 0.05)* | 0.27 (± 0.17) | 0.84 |
|       | Aug 2018    | 1.97 (± 1.39) | 0.04 (± 0.02)* | 0.034 (± 0.029) | 0.04 (± 0.05)* | 2.09 (± 1.49) | 1.13 |
| Mean  |         | 0.91 (± 0.39) | 0.04 (± 0.02) | 0.015 (± 0.009) | 0.04 (± 0.05) | 1.01 (± 0.46) | 0.99 (± 0.13) |

|       | H       | S       | V       | M_inc   | T       | F       |
|-------|---------|---------|---------|---------|---------|---------|
| Main basin | Nov-Dec 2016 | 0.005 (± NA) | 0.1 (± 0.06)* | 0.001 (± 0.004) | -0.35 (± 0.32) | -0.24 (± 0.38) | 0.36 |
|       | Apr-May 2017 | 0.003 (± NA) | 0.1 (± 0.06)* | 0.013 (± 0.008) | 0.03 (± NA) | 0.14 (± 0.39) | 0.39 |
|       | Feb-Mar 2018 | 0.003 (± NA) | 0.1 (± 0.06)* | 0.001 (± 0.003) | -0.16 (± 0.32)* | -0.06 (± 0.38) | 0.45 |
|       | Aug 2018    | 0.003 (± NA) | 0.1 (± 0.06)* | 0.018 (± 0.008) | -0.16 (± 0.32)* | -0.04 (± 0.39) | 0.58 |
| Mean  |         | 0.004 (± 0.001) | 0.1 (± 0.06) | 0.008 (± 0.004) | -0.16 (± 0.19) | -0.05 (± 0.25) | 0.44 (± 0.05) |
Figure S3: boxplots of the buoyancy frequency $N^2$ (a), dissipation rate $\epsilon$ (b), and CH$_4$ and CO$_2$ concentration gradients at the epilimnion-metalimnion interface (c, d) in the reservoir branches and main basin. Boxes bounds, whiskers, solid lines, and open circles represent the 25th and 75th percentiles, the 10th and 90th percentiles, the median, and single data points respectively.
Figure S4: Example of a vertical profile (main reservoir, Aug 2018) of CO₂ (light gray points) and CH₄ (dark gray points) concentrations, as well as δ¹³CH₄ (dark grey triangles) as a function of depth. The dotted line represents the top of the metalimnion.
**Figure S5**: Boxplot of sediment CO$_2$ (a) and CH$_4$ (b) flux rates (per sediment area) across sampled sites in the reservoir branches and main basin. Boxes bounds, whiskers, solid lines, and open circles represent the 25th and 75th percentiles, the 10th and 90th percentiles, the median, and single data points respectively.