



Supplement of

Aquatic metabolism influences temporal variations of water carbon and atmospheric carbon dioxide fluxes in a temperate salt marsh

Jérémy Mayen et al.

Correspondence to: Jérémy Mayen (jeremy.mayen@bordeaux-inp.fr)

The copyright of individual parts of the supplement might differ from the article licence.

Supplementary materials

Table S1. Contextualisation of meteorological parameters measured during the four seasonal 24-h cycles (in 2021) with regards to 3-year reference periods (from 2020 to 2022). Each meteorological parameter measured by the EC station during the 24-hour cycles was compared to a mean and standard deviation of the parameter measured continuously (i.e. every 10-min) over three full reference seasons (2020, 2021 and 2022). For all parameters, means and standard deviations were done in bold and ranges were done in brackets. Ta: air temperature (°C), PAR: photosynthetically active radiation ($\mu\text{mol photon m}^{-2} \text{s}^{-1}$), RH: relative humidity (%). n.a.: not available.

		Ta (°C)	Daytime PAR ($\mu\text{mol m}^{-2} \text{s}^{-1}$)	Wind speed (m s^{-1})	RH (%)
Winter	3-year reference period	9.3 ± 2.7 (-0.7 – 19.1)	454 ± 375 (10 – 1770)	4.59 ± 2.21 (0.05 – 14.01)	83.3 ± 10.2 (41.4 – 99.5)
	C1-winter 01/03-02/03/2021	11.4 ± 1.9 (8.7 – 15.3)	762 ± 465 (10 – 1335)	2.33 ± 1.19 (0.45 – 5.09)	75.2 ± 10.0 (54.8 – 89.5)
Spring	3-year reference period	14.8 ± 4.4 (2.5 – 35.7)	946 ± 668 (10 – 2539)	3.94 ± 1.96 (0.04 – 14.29)	72.8 ± 14.2 (24.5 – 99.4)
	C2-spring 27/04-28/04/2021	13.8 ± 2.9 (9.4 – 20.1)	1134 ± 668 (10 – 1964)	3.80 ± 1.29 (0.38 – 6.27)	65.6 ± 14.4 (31.5 – 84.1)
Summer	3-year reference period	19.9 ± 3.1 (12.2 – 36.3)	970 ± 662 (10 – 2428)	3.56 ± 1.54 (0.03 – 10.49)	74.0 ± 13.9 (16.6 – 99.6)
	C3-summer 26/07-27/07/2021	19.6 ± 0.6 (18.5 – 20.8)	976 ± 728 (10 – 2216)	3.11 ± 0.83 (1.14 – 5.05)	78.6 ± 2.6 (73.2 – 88.9)
Fall	3-year reference period	12.7 ± 4.1 (-0.5 – 23.7)	476 ± 393 (10 – 2062)	n.a.	81.9 ± 9.5 (42.2 – 99.4)
	C4-fall 06/12-07/12/2021	10.3 ± 0.7 (7.9 – 11.3)	160 ± 93 (10 – 340)	n.a.	87.8 ± 6.5 (73.4 – 97.5)

Table S2. Seasonal comparisons of water pCO₂ measured every 10-min between the 5-day reference periods and the corresponding 24-h cycles (see section 2.2). Means and standard deviations are in bold and ranges are in brackets. n.a.: water pCO₂ could not be measured during low tide periods over the winter reference period (from 26/02 to 01/03/2021).

		Water pCO ₂ (ppmv)
Winter	Winter reference period 26/02-02/03/2021	n.a.
	C1-winter 01/03-02/03/2021	669 ± 327 (321 – 1461)
Spring	Spring reference period 23/04-28/04/2021	296 ± 113 (106 – 596)
	C2-spring 27/04-28/04/2021	239 ± 105 (106 – 416)
Summer	Summer reference period 23/07-27/07/2021	307 ± 178 (85 – 668)
	C3-summer 26/07-27/07/2021	271 ± 182 (89 – 597)
Fall	Fall reference period 03/12-07/12/2021	452 ± 88 (260 – 753)
	C4-fall 06/12-07/12/2021	422 ± 73 (311 – 541)

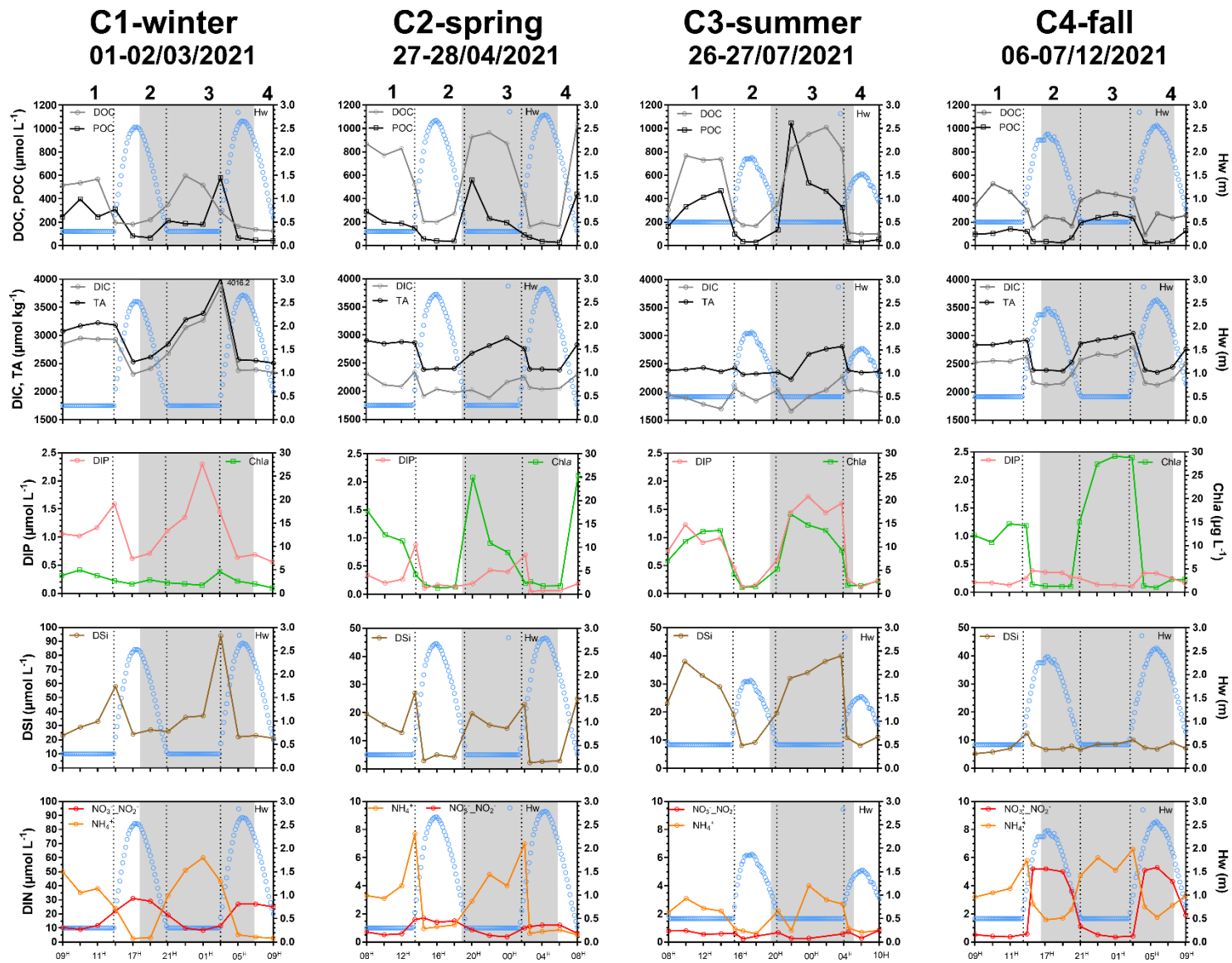


Fig. S1. Hourly variations of water biogeochemical parameters sampled during the seasonal 24-h cycle from March to December 2021: DOC and POC ($\mu\text{mol L}^{-1}$) as organic carbon parameters, DIC and TA ($\mu\text{mol kg}^{-1}$) as carbonate system parameters, Chl *a* ($\mu\text{g L}^{-1}$) as biological parameter, DSi, DIP and DIN as ecological parameters (nutrients, $\mu\text{mol L}^{-1}$). Simultaneously, water heights (Hw, m) were also measured every 10-min by the STPS probe (Fig. 1). Grey areas correspond to night-time periods. Each graduation of the x-axis corresponds to two hours. Graduations of DSi and DIN were not the same between C1-winter and other cycles to a better visualization of tidal variations. Vertical dotted lines allow to distinguish the periods of low tide day (LT/Day, **1**), high tide day (HT/Day, **2**), low tide night (LT/Night, **3**) and high tide night (HT/Night, **4**).

Table S3. Multiple factor variance analysis of biogeochemical parameters measured from hourly water samples during the four 24-h cycles (n = 59). Seasonal factor assesses variability between 24-h cycles (C1-winter, C2-spring, C3-summer and C4-fall); tidal factor assesses variability between high tide (Hw > 0.50 m) and low tide (Hw = 0.50 m); diurnal factor assesses variability between daytime (PAR > 10 $\mu\text{mol m}^{-2} \text{s}^{-1}$) and night-time (PAR < 10 $\mu\text{mol m}^{-2} \text{s}^{-1}$). Parameters that did not respect a normal distribution were transformed into $\log_{10}(x)$ or $\log_{10}(x+1)$ for variance analysis. The F values of the Fisher test were added. The higher the value of F, the greater the influence of the factor on the parameter.

	Seasonal factor	Tidal factor	Diurnal factor
$\log_{10}(\text{Chla})$	Yes F = 5.9 p < 0.001	Yes F = 30.2 p < 0.0001	No F = 0.1 p = 0.74
$\log_{10}(\text{DIC})$	Yes F = 47.9 p < 0.0001	Yes F = 18.1 p < 0.0001	No F = 0.3 p = 0.61
$\log_{10}(\text{TA})$	Yes F = 25.9 p < 0.0001	Yes F = 91.0 p < 0.0001	No F = 0.1 p = 0.79
$\log_{10}(\text{POC})$	No F = 2.2 p = 0.10	Yes F = 161.2 p < 0.0001	No F = 0.8 p = 0.37
$\log_{10}(\text{DOC})$	Yes F = 4.2 p < 0.05	Yes F = 188.5 p < 0.0001	No F = 0.8 p = 0.36
$\log_{10}(\text{PON})$	Yes F = 5.1 p < 0.05	Yes F = 174.3 p < 0.0001	No F = 0.7 p = 0.41
$\log_{10}(\text{NO}_3\text{-NO}_2 + 1)$	Yes F = 151.6 p < 0.0001	Yes F = 53.8 p < 0.0001	No F = 1.8 p = 0.19
$\log_{10}(\text{NH}_4 + 1)$	Yes F = 39.2 p < 0.0001	Yes F = 60.0 p < 0.0001	No F = 0.8 p = 0.39
$\log_{10}(\text{DIP} + 1)$	Yes F = 25.7 p < 0.0001	Yes F = 23.2 p < 0.0001	Yes F = 6.3 p < 0.05
$\log_{10}(\text{DSi} + 1)$	Yes F = 28.0 p < 0.0001	Yes F = 40.8 p < 0.0001	No F = 1.1 p = 0.31

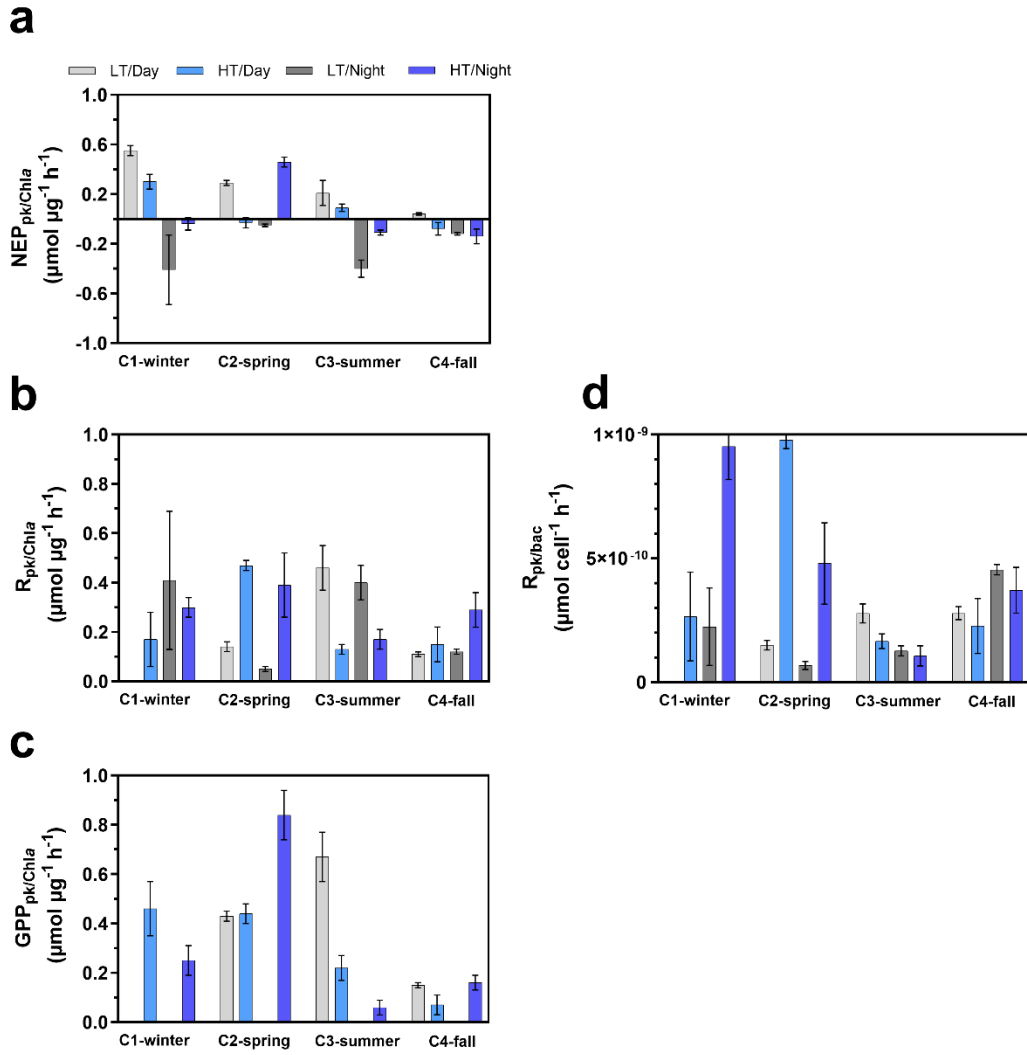


Fig. S2. Planktonic aquatic metabolism and associated standard errors at diurnal/tidal scale over the seasonal 24-h cycles: **(a)** NEP_{pk/Chla} **(b)** R_{pk/Chla} and **(c)** GPP_{pk/Chla} are planktonic metabolism rates standardized per unit of Chla biomass ($\mu\text{mol } \mu\text{g}^{-1} \text{h}^{-1}$). **(d)** R_{pk/bac} are planktonic respiration rates standardized per unit of bacteria abundance ($\mu\text{mol cell}^{-1} \text{h}^{-1}$). NEP_{pk/Chla} > 0 corresponds to an autotrophy (C sink in water) and NEP_{pk/Chla} < 0 corresponds to a heterotrophy (C source in water). LT/Day: low tide day; HT/Day: high tide day; LT/Night: low tide night; HT/Night: high tide night.

Table S4. Seasonal medians of DIN:DIP, DIN:DSi and DSI:DIP molar ratios (medians in bold and ranges in brackets) measured from water samplings at the Bossys perdus salt marsh.

	DIN:DIP	DIN:DSi	DSi:DIP
C1-winter	45.1 (29 – 57)	1.5 (0.6 – 2.6)	33.3 (16 – 65)
C2-spring	17.0 (6.0 – 34)	0.3 (0.0 – 0.9)	37.1 (26 – 132)
C3-summer	3.3 (0.2 – 8.4)	0.1 (0.0 – 0.2)	32.3 (20 – 67)
C4-fall	23.1 (19 – 64)	0.7 (0.5 – 1.0)	31.7 (19 – 92)