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Atmospheric CO_2 exchanges measured by eddy covariance over a temperate salt marsh and influence of environmental controlling factors

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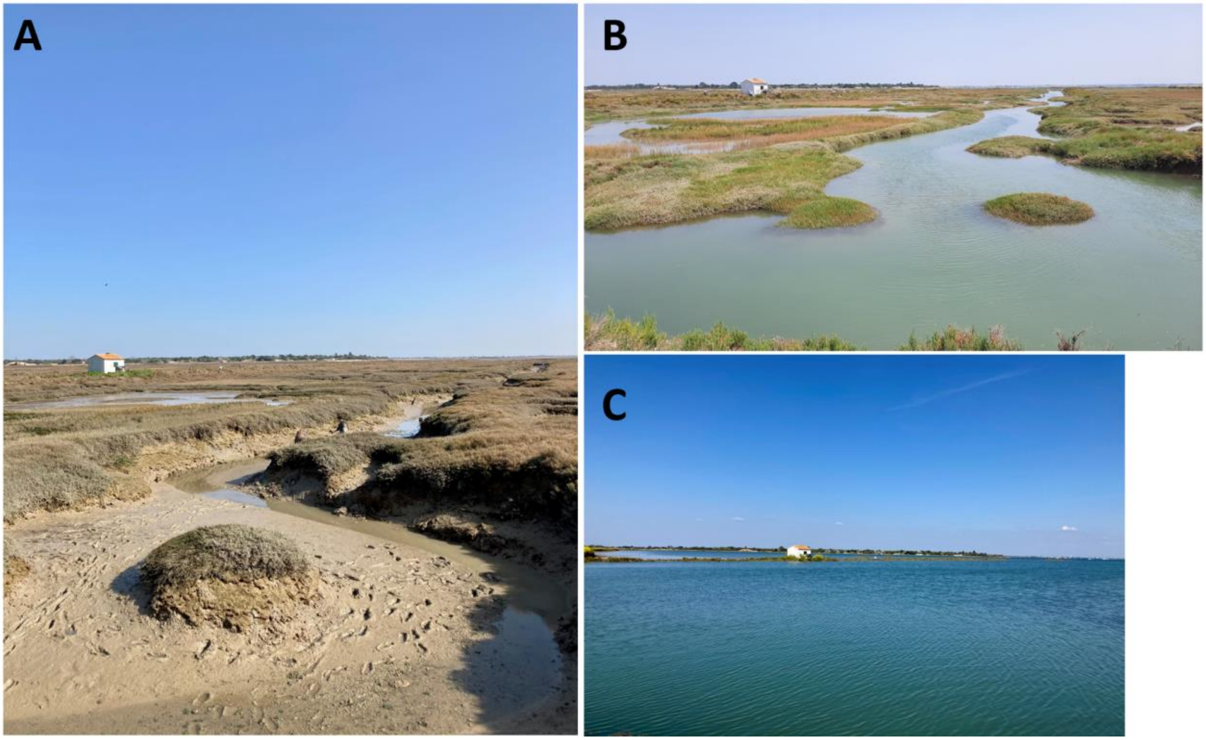

Fig. S1. Pictures of the Bossys perdus salt marsh during emersion (A; 01/03/2021 15:00, Hw = 0 m) and immersion (B, 22/07/2021 13:00, Hw = 0.3 m; C, 27/04/2021 16:00, Hw = 1.8 m). Picture A was taken at low tide when all the marsh plants were emerged into the atmosphere. During this time, the channel drains the upstream marsh waters to the estuary. Picture B was taken during incoming tide when advected coastal waters completely fill the channel and immerse the marsh. Picture C was taken at high tide during the highest tidal amplitude when all the marsh plants were immersed by coastal waters. Water heights (Hw) were measured from the STPS sensor located on the salt marsh and not in the channel (see M&M section and Fig. 2). © P. Polsenaere.

Table S1. Performance indicators for each model (RF: Random Forest, ANN: Artificial Neural Network) tested to gap fill the CO_2 fluxes. Predictor variables are PAR (Photosynthetically active radiation, µmol m^{-2} s^{-1}), Ta (air temperature, °C), Hw (water height, m), RH (Relative Humidity, %) and Vd (wind direction, m s^{-1}). The performance indicators are the coefficient of linear determination Pearson which shows the level of variability captured by the model (R^2), the racine of the error quadratic average which gives an overview of the uncertainty of the result (RMSE: Root Mean Square Error), as well as the bias of the model.

Models	**Predictor variable**	**RMSE**	**Bias**	**R^2**
RF1	PAR, Ta, Hw	1.42	0.0039	0.85
RF2	PAR, Ta, Hw, RH	1.27	0.0024	0.88
RF3	PAR, Ta, Hw, Vd	1.19	0.0029	0.90
ANN1	PAR, Ta, Hw	1.95	-0.0003	0.71
ANN2	PAR, Ta, Hw, RH	1.89	0.0021	0.73
ANN3	PAR, Ta, Hw, Vd	1.81	0.0041	0.75

Table S2. Estimation of the parameters used for NEE flux partitioning (a_1, a_2, R_0 and *b*) during emersion at the monthly scale. The a_1 coefficient is directly linked to the phenology of the ecosystem.

	a_1	a_2	R_0	*b*
January	-7.82	370	0.34	0.04
February	-9.89	435	0.64	-0.03
March	-9.38	506	0.17	0.15
April	-12.51	787	0.24	0.12
May	-13.41	812	0.35	0.10
June	-14.68	846	0.68	0.06
July	-14.98	934	0.84	0.05
August	-17.91	1397	0.56	0.07
September	-16.86	1419	0.32	0.09
October	-13.08	766	0.58	0.06
November	-14.37	783	0.19	0.14
December	-7.60	360	0.31	0.09

Table S3. Monthly mean (µmol CO_2 m^{-2} s^{-1}) and monthly cumulative (g C m^{-2} $month^{-1}$) fluxes of the measured NEE and estimated NEE_{marsh} during marsh emersion periods (Hw = 0 m). These comparisons between measured NEE and estimated NEE_{marsh} only during marsh emersion allowed to confirm the correct NEE flux partitioning (see M&M section).

	Mean NEE (µmol CO_2 m^{-2} s^{-1})	Mean NEE_{marsh} (µmol CO_2 m^{-2} s^{-1})	Cumulative NEE (g C m^{-2})	Cumulative NEE_{marsh} (g C m^{-2})
January	-0.75	-0.77	-18.2	-18.7
February	-1.55	-1.56	-34.8	-35.0
March	-1.53	-1.53	-37.3	-37.3
April	-1.95	-1.93	-45.2	-44.9
May	-2.16	-2.16	-53.0	-53.2
June	-2.29	-2.30	-50.6	-50.9
July	-2.34	-2.33	-57.7	-57.6
August	-1.24	-1.27	-29.9	-30.6
September	-1.14	-1.13	-27.2	-26.9
October	-0.80	-0.80	-18.4	-18.4
November	-0.63	-0.61	-14.8	-14.4
December	-0.40	-0.40	-6.3	-6.2

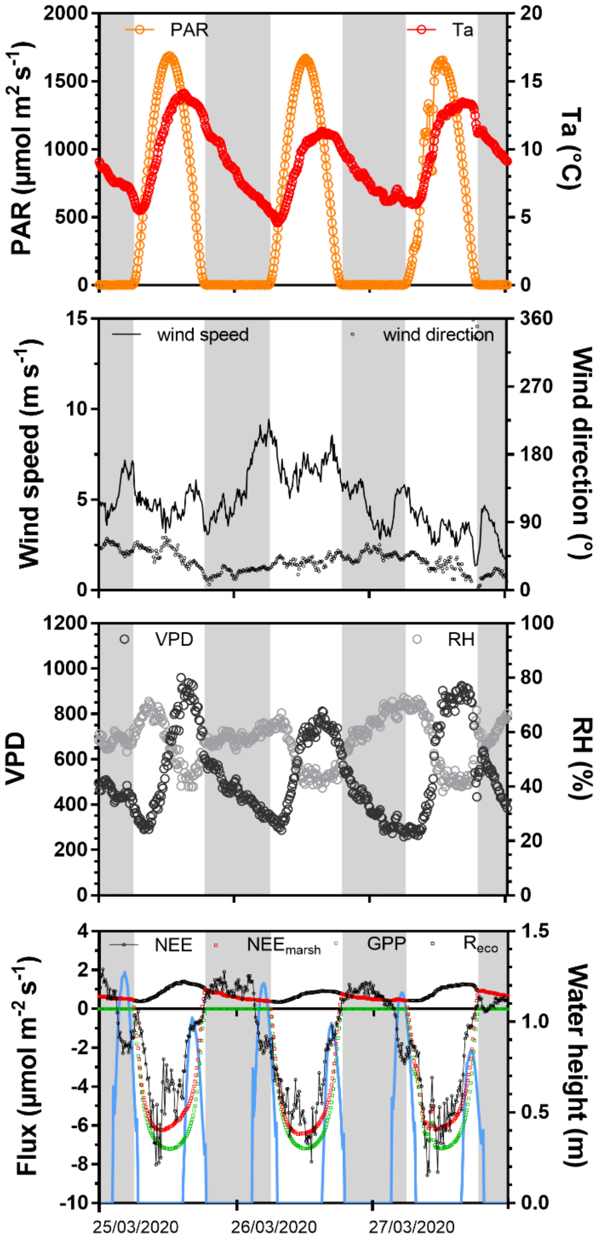

Fig. S2. Temporal variations of PAR (µmol m^{-2} s^{-1}), Ta (°C), wind speed (m s^{-1}), wind direction (°), VPD (Pa), RH (%), measured NEE, estimated NEE$_{marsh}$, estimated GPP and estimated R$_{eco}$ (µmol CO_2 m^{-2} s^{-1}) and water height (Hw, m) values measured at a 10-minute frequency in early spring 2020 from 25/03/2020 (00:00 am) to 27/03/2020 (23:50 pm). Grey areas correspond to night-time periods (PAR ≤ 10 µmol m^{-2} s^{-1}). This temporal window in March 2020 was chosen to highligh the marsh CO_2 sink during night-time immersion, the rapid decrease of CO_2 uptake during daytime immersion and the negative correlation between NEE and PAR.

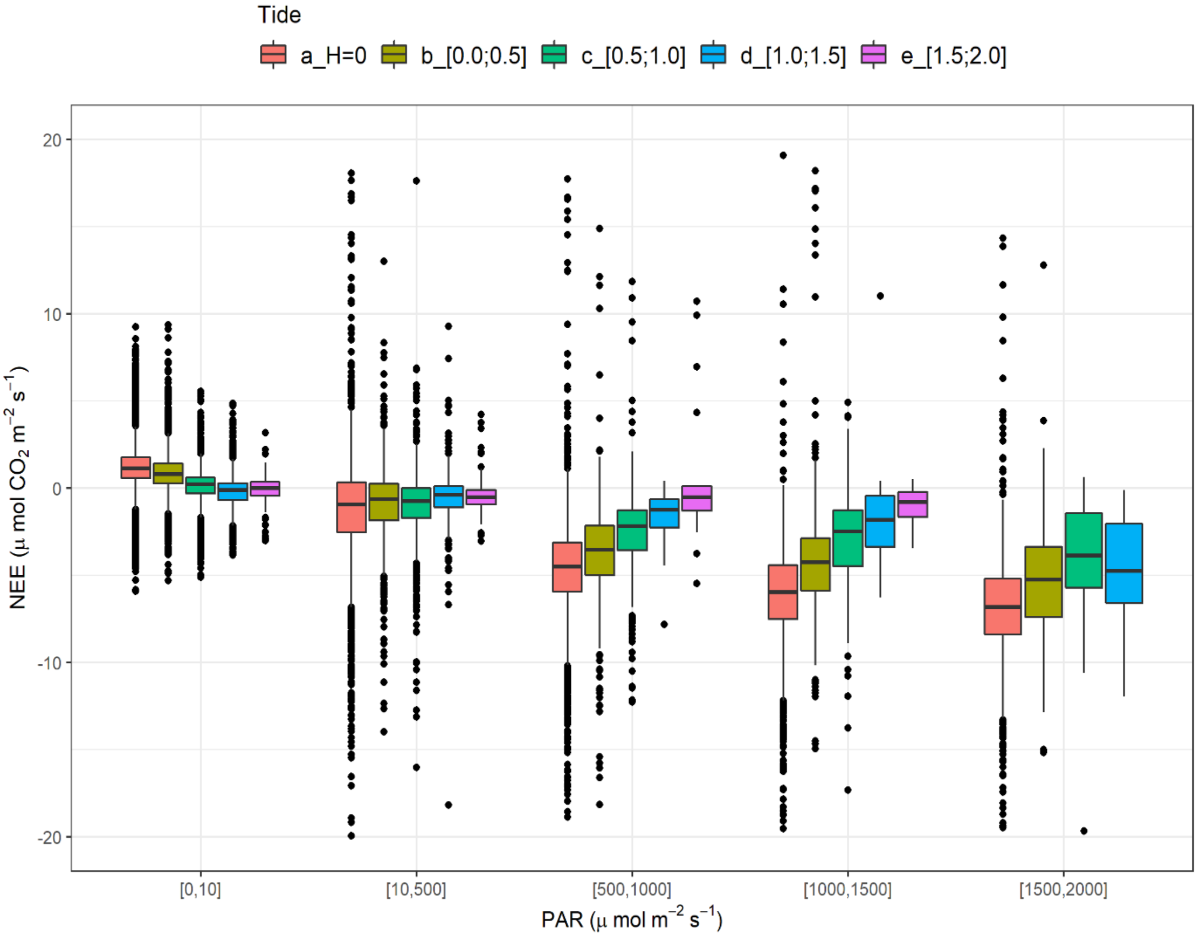

Fig. S3. Diurnal/tidal variations (boxplots) of NEE fluxes (µmol CO_2 m^{-2} s^{-1}) during marsh emersion (Hw = 0 m) and at four water level ranges of 0.5 m within five PAR groups. The five PAR groups are 0 < PAR ≤ 10 (night), 10 < PAR ≤ 500, 500 < PAR ≤ 1000, 1000 < PAR ≤ 1500, 1500 < PAR ≤ 2000 µmol m^{-2} s^{-1}.