RC3: 'Comment on egusphere-2025-335', Anonymous Referee #3, 17 Mar 2025

We thank the Referee#3 for his/her work and for the time he/she spent in reviewing our manuscript. We have considered all your remarks to ameliorate the methodology, the precision, the limitations and the implications of our research. A new table was added in the revised MS to regroup similar articles studying inorganic carbon dynamics and water-air CO_2 emissions in temperate salt marsh systems to contextualize our findings and enhance the manuscript's scientific significance (see table 5 below). In that respect, we noticed that the referee ranked the scientific significance of our MS as "poor", unlike the two other referees that ranked it as "excellent" and "good". However, Referee 3 did not provide any reference of previous works that report same findings as ours. Consequently, we based our revisions on our own knowledge of the literature, hoping that we did not miss any key paper on the topic. Finally, to further discuss our finding in a broader context, we propose in the revised MS a conceptual model to better organize and delimit the contribution of terrestrial and aquatic compartments to net ecosystem CO_2 exchanges (sink/source) according to the various measurements done at our study site (see Fig. 8 below).

The main goal of this paper is to show that tidal floodwater when over the marsh alters CO_2 gas flux between the tidal marsh and the atmosphere, that the biogeochemistry of the tidal water is altered when it floods and drains from the marsh, and that the CO_2 flux magnitude and direction from flood water when it totally inundates all marsh vegetation is controlled by CO_2 levels somewhat controlled by pelagic metabolism. The approach appears to be designed primarily just to prove these points – not to quantify the seasonal/annual pattern of any of the processes that can contribute to these patterns. I say this because water chemistry was only sampled on 4 days during an entire year (seasonally) and with the exception of pCO_2, which was measured by continuous probe, other parameters (nutrients OC, IC, etc) were sampled only twice on either side of high tide and low tide. The interval between samplings at high and low tide were not mentioned, best I can tell.

Salt marshes play a major role in the global carbon (C) cycle allowing atmospheric CO_2 uptake and blue C sequestration due to intense plant primary production. This present study was built to better understand the influence of marsh aquatic metabolism on water pCO_2 and net ecosystem CO_2 exchanges (NEE) at short timescales (diurnal/tidal rhythms). In a salt marsh, we performed bi-hourly water samplings over each 24-hour cycle ($n = 13$) to measure continuously water biogeochemical parameters (organic carbon, inorganic carbon, phytoplankton abundances and nutrients) at the diurnal/tidal scales (see figure S1 in the Supplements). Moreover, for planktonic metabolism, water samples were collected every six hours during each 24-h cycle ($n = 4$) successively at low tide and high tide. Finally, these water samplings were performed simultaneously with NEE fluxes measured by atmospheric Eddy Covariance inside the footprint. To our best knowledge, this is the first time so many parameters are quantified simultaneously at a same study site to better study the marsh carbon cycle. In the literature, very few studies have looked for the aquatic metabolism influence in water carbon dynamics and atmospheric carbon exchanges from an integrative manner, using *in situ* carbon original samplings (through intense seasonal 24-h cycles) and innovative methods (autonomous water pCO_2 probe and atmospheric Eddy Covariance). In this way, our original results provide a better understanding of biotic and abiotic factors controlling water pCO_2 and atmospheric CO_2 fluxes in salt marshes where diurnal/tidal data are scarce. The novelty of this study and the original findings were fully highlighted in the revised MS.

In our study, water pCO_2 were mainly controlled by biological activity inducing water CO_2 oversaturation at low tide in winter due to heterotrophic processes (DIC, TA, NH_4^+ and PO_4^{3-} increases). In a new way in the literature, we recorded large water CO_2 undersaturation coupled with DOC production in spring/summer at low tide due to autochthonous/allochthonous autotrophic processes from phytoplankton, benthic microalgae and macroalgae. Contrary to global findings on the marsh carbon cycle (large DIC and DOC outwelling; Santos et al., 2021), our study highlighted CO_2-depleted and DOC-concentrated water exportations from high to low tide in spring and summer confirming the major role of marsh primary production within all compartments (terrestrial and aquatic) in the coastal carbon cycle. It could indicate lower aquatic heterotrophy and higher aquatic autotrophy at our studied marsh, especially in spring and summer, allowing simultaneously large CO_2 uptake and DOC production.

Santos, I. R., Burdige, D. J., Jennerjahn, T. C., Bouillon, S., Cabral, A., Serrano, O., Wernberg, T., Filbee-Dexter, K., Guimond, J. A., and Tamborski, J. J.: The renaissance of Odum's outwelling hypothesis in "Blue Carbon" science, Estuarine, Coastal and Shelf Science, 255, 107361, https://doi.org/10.1016/j.ecss.2021.107361, 2021.

The sampling conducted here was done in a tidal creek that connects a marsh to open bay water and the ocean. The creek and sampling point were within the footprint of an ongoing eddy covariance tower study. However, the footprint of the tidal creek and its flooding watershed were never indicated. Indeed, when I look at a google earth image of the study site, it seems to be an extremely human altered marsh/estuary, with ponds, ditches, spoil banks, etc all over the place. The flooding pattern seems impossible to describe by looking at an aerial image.

Referee#3 is right, the Bossys perdus salt marsh is located on the intertidal area of the Fier d'Ars tidal estuary at the interface between the upstream salt ponds and the downstream continental shelf (Fig. 1). As fully described in Mayen et al. (2024), the Bossys perdus salt marsh experienced successive periods of intensive land use (salt harvesting and oyster farming) and returned to natural conditions before becoming a permanent part of the national natural reserve since 1981 for the biodiversity protection without major restoration work. It is currently managed to restore its natural hydrodynamics while conserving the site's specific typology due to past human activities (channel networks, humps and dykes; Fig. 1). Past human activities and water management practices for salt farming have shaped the marsh typology (channel network, humps and dykes), producing a time-delayed immersion of plants and muds between high and low marsh areas during spring tides. Thus, due to this emersion/immersion heterogeneity, mud flats and *S. maritima* were quickly immersed by coastal waters, whereas the whole immersion of marsh habitats only occurred during the highest tidal amplitudes favouring a higher atmospheric CO_2 uptake by *H. portulacoides* and *S. vera* (Mayen et al., 2024). We have now added in the description of the study the following to make clear that the Bossys Perdus hydrology is the results of natural and anthropogenic conditions (as in many coastal wetlands worldwide):

Section 2.1. Study sites (these sentences were completed in the revised MS)

p3-4, L101-109: "The Bossys perdus salt marsh is a vegetated intertidal wetland (52.5 ha) located along the French Atlantic coast on Ré Island (Fig. 1-a). The salt marsh is located within the Fier d'Ars tidal estuary which receives coastal waters from the Breton Sound continental shelf during high tide periods (Fig. 1-a). This intercommunication enables (1) the immersion of the estuarine intertidal zone (including the studied salt marsh) and (2) the water supply for artificial salt marshes (i.e. salt ponds) upstream of the dyke. Water residence times in the salt ponds vary from a few hours to a fortnight depending on seasonal management practice. Generally, macroalgae blooms (*Ulva spp.*) colonize salt ponds from April to October each year (Mayen et al., 2023). *After an intensive land-use (salt harvesting and oyster farming), the Bossys perdus salt marsh is now protected within a National Natural Reserve to restore its natural hydrodynamics and vegetation while conserving the site's specific typology due to past human activities (channel networks, humps and dykes; Fig. 1-b) (Mayen et al., 2024)"*

The Bossys perdus salt marsh, located upstream of the estuary, is subjected to semi-diurnal tides from the Breton Sound continental shelf (Fig. 1) allowing the marsh immersion by two main channels differently in space, time and frequency according to the tidal periods. At high tide, coastal waters advected from the continental shelf can completely fill channels and immerse the marsh through variable water heights depending on tidal amplitudes and meteorological conditions as described in Mayen et al. (2023, 2024). The Breton Sound continental shelf exchanges salt waters with the Atlantic Ocean to the west at each semi-diurnal tidal cycle and receives continental inputs through the Aiguillon Bay discharges to the east depending on hydrodynamic and meteorological conditions (Fig. 1). The residence time of coastal waters in the Breton Sound continental shelf is long, generally above 85 days (Polsenaere et al., 2017). In contrast, at low tide, the marsh vegetation at the benthic interface is emerged into the atmosphere without any coastal water input. During this time, Bossys perdus channels allow drainage of upstream salt pond waters to the downstream estuary with low water heights. In the revised MS, the flooding pattern by downstream coastal waters at high tide and by upstream pond waters at low tide was fully described in the section 2.1 (see below). This present study was conducted following on 1) from Mayen et al (2023) who studied the water pCO_2 dynamics in the two contrasted end-members (i.e. in upstream artificial salt ponds and downstream tidal estuary and continental shelf) and 2) from Mayen et al. (2024) who detailed temporal dynamics and controlling factors of NEE fluxes at the Bossys perdus salt marsh.

Section 2.1. Study sites (these sentences were modified in the revised MS)

p4, L114-121: "At high tide (HT), imported coastal waters gradually fill the sampling channel (Fig. 1-b) and immerse the salt marsh at variable water heights depending on tidal amplitudes and meteorological conditions. *Due to the site's specific typology, lowest marsh levels (mudflats and S. maritima) were quickly immersed (south), whereas the whole marsh immersion (all muds and plants) only occurred 0.75 h later at the highest water heights (Mayen et al., 2024). At low tide (LT), the channel empties and the salt marsh is emerged and exposed to the atmosphere. During this time, water remaining at the bottom of the channel come from (i) the Bossys perdus marsh-drainage process by tidal pumping and (ii) the waterflow from the upstream salt ponds to the downstream estuary (Fig. 1-b) at low water height situations (0.50 m maximum depth;*

see Fig. S1 in Mayen et al., 2024) fluctuating seasonally according to meteorological conditions and pond managements (Mayen et al., 2023).”

As in most estuaries there seems to be strong spatial gradients in water chemistry (and metabolism) with two end-members – way into the marsh and the ocean/bay. The authors took 2 samples at low tide, after water had drained from the marsh surface and apparently sat around still in a tidal creek until the next tide came in. why the water level never drained completely such that water level went to zero was never mentioned. The water at low tide was sampled presumably about ½ way before the current went slack and then picked up again. Water was sampled again at high tide – presumably, the water was in the bay only minutes before and therefore showing little to no immediate effect of being on the marsh (of course the estuarine water at high tide presumably had been influenced by previous flood tides – but we don’t know what the water residence time was and what its time course trajectory was.

In this study, strong water mixing processes occurred in the channel due to contrasted shelf and marsh endmembers (see above). At low tide, the trickle of water flow occurring continuously at the bottom of the channel come from (i) the marsh-drainage processes by tidal forcing and (ii) the flow from the upstream salt ponds to the downstream estuary (Fig. 1-b). At high tide, coastal waters advected from the continental shelf can completely fill the channels and immerse the marsh through variable water heights depending on tidal amplitudes and meteorological conditions. Emersion and immersion periods at the studied salt marsh was fully described in Mayen et al. (2024). For instance, on average in 2020, the daily immersion durations ranged between 5.7 h d^{-1} (winter) and 6.5 h d^{-1} (fall). Moreover, as the water residence time in the Breton Sound continental shelf was above 85 days (Polsenaere et al., 2017), imported coastal waters to the salt marsh could be similar from one high tide to another.

Over the 24-hour periods, we intensively and continuously sampled every hour or two hours all carbon forms and nutrients in surface waters (with water filtrations and other sample work in between) taking into account all marsh tidal phases with different water depths (from 0.50 m at the bottom of the channel at low tide up to 2.50 m at high tide with all intermediate tidal situations in between). Thus, at low tide, at least eight samples were collected in channel waters over each 24-h cycle (see figure S1 in the Supplements). Moreover, we sampled and incubated surface water in Winkler bottles every six hours during each 24-h cycle (n = 4) successively at low tide and high tide to measure planktonic aquatic metabolism simultaneously with all other biogeochemical parameters. This sampling strategy allows to measure multiples parameters simultaneously for a typical full tidal cycle, representing all the water heights founding in the salt marsh. When repeated across seasons, it allows to sample the full tidal range, and hence the heterogeneity of the tidal height, residence time and water mixing. We have amended the section 2.2 as follow:

Section 2.2. Sampling strategy and field samplings (these sentences were modified in the revised MS)

p5, L134-L142: “*At a single point in the main channel of the salt marsh (Fig. 1-b*), four seasonal 24-h cycles were performed from March to December 2021 (Fig. 2). For each 24-h cycle, our sampling strategy consisted of simultaneously measuring water biogeochemical parameters, planktonic metabolism and water-air CO_2 fluxes at diurnal (daytime and night-time) and tidal (from high to low tides and all tidal phases in between) scales through discrete samplings and continuous real-time measurements. At this station, samplings of sub-surface waters were performed continuously every one or two hours over the four 24-h cycles (n = 13 over C1-winter, n = 15 over C2-spring and C3-summer and n = 16 over C4-fall) encompassing a large variation in water heights (Hw): from the channel bottom at low tide (Hw = 0.5 m) to the full marsh immersion at high tide (Hw > 2.5 m) with all tidal intermediate situations in between (Fig. 2 and Fig. S1). *When repeated across seasons, it allows to sample the full tidal range, and hence the heterogeneity of the tidal height, residence time and water mixing.”*

We also don’t know how deep the water was when it flooded the marsh during the different times samples were collected.

At low tide, all water samplings were performed in the studied channel with 0.50 m of depth (see figure S1 in the Supplements). At that time, water remaining at the bottom of the channel results from (i) the marsh-drainage processes by tidal pumping and (ii) the flow from the upstream salt ponds to the downstream estuary through low water heights. At high tide, water samplings were performed with depths ranging between 0.60 m and 2.50 m from the beginning of the rising tide until the full marsh immersion to take into account all marsh tidal phases (the water depth associated to each sample was done in Fig. S1 in the Supplement). See above responses.

We don’t know if the vegetation was completely flooded or not.

Over our 24-h cycles, the marsh vegetation was completely emerged during low tide periods, partially immersed in coastal waters during all tidal intermediate situations between high and low tide (0.50 < Hw < 2.00 m; Fig. 2 and Fig. S1) and fully immersed at the highest water depths (Hw > 2.00 m; Fig. 2 and Fig. S1). The Bossys perdus salt marsh is subject to semi-diurnal tides allowing its immersion through channels differently in space, time and frequency depending on tidal periods. Mayen et al. (2024) fully described the immersion/emersion marsh heterogeneity. At incoming tide, when coastal waters begin to fill the channel and then overflow over the marsh (from 0.5 h in spring tides to 2.5 h in neap tides; data not shown), the SSW sector was first immersed. However, although some marsh sectors were simultaneously immersed, others were still emerged. Indeed, lowest marsh levels (56% of the footprint area), mainly composed of mudflats and *S. maritima*, were quickly immersed (south), whereas the whole marsh immersion (muds and plants) only occurred 0.75 h later at high tide during spring tide. Thus, the highest marsh levels (44% of the footprint area), mainly composed of *H. portulacoides* and *S. vera*, were still emerged during the beginning of the tidal immersion. Conversely, at neap tide, this footprint immersion *versus* emersion marsh heterogeneity could still be present even at high tide due to insufficient water levels (Mayen et al., 2024). We completed our revised MS in the section 2.1. to better understand the plant flooding during high tide periods (see below).

Section 2.1. Study sites (these sentences were modified in the revised MS)

p4, L112-117: "The salt marsh is subject to semi-diurnal tides originating on the continental shelf allowing its immersion through channels differently in space, time and frequency depending on tidal periods. At high tide (HT), imported coastal waters gradually fill the sampling channel (Fig. 1-b) and immerse the salt marsh at variable water heights depending on tidal amplitudes and meteorological conditions. *Due to the site's specific typology, lowest marsh levels (mudflats and S. maritima) were quickly immersed (south), whereas the whole marsh immersion (all muds and plants) only occurred 0.75 h later at the highest water heights (Mayen et al., 2024).*"

We don't know if the tidal creek was influenced by the many ponds on the marsh which apparently had dense macroalgae. We do know that there was extensive salt accumulation in the summer, presumably reflecting evaporation in the many ponds, which may or may not have flooded and drained on a regular basis.

At low tide, water remaining at the bottom of the channel come from (i) the marsh-drainage processes by tidal pumping and (ii) the flow from the upstream salt ponds with low water heights (see section 2.1 Study site). Generally, macroalgae blooms (*Ulva* spp.) colonize these upstream salt ponds from April to October each year and can influence the sampling channel according to the seasonal marsh water managements (Mayen et al., 2023). Moreover, in these upstream salt ponds supplying the studied salt marsh during low tide, large seasonal variations of salinity can occur due to different meteorological conditions with low salinity in winter/fall due to dilution of salt waters by the rain and high salinity in spring/summer due to evaporation of salt waters by the hot (Mayen et al., 2023). In this study, the influence of the upstream marsh end-member (i.e. artificial salt ponds) on our findings were more discussed in the revised MS.

We learned – that the flux of CO_2 from the tidal marsh to/from the marsh surface and its plants was shut off at high tide. We also know this from just about every flux tower study that's been conducted that I'm aware. So nothing new was learned here.

Indeed, tidal immersion strongly affected NEE fluxes measured by atmospheric Eddy Covariance by decreasing daytime CO_2 uptake and night-time CO_2 emissions at the ecosystem scale from a certain water height level as deeply explained in Mayen et al. (2024). We don't know what study the referee is aware of. However, to our best knowledge, such tidal pattern on marsh CO_2 exchanges was reported in salt marshes (Mayen et al., 2024; Moffett et al., 2010; Forbrich and Giblin, 2015, Weiss et al., 2020), in brackish marshes (Knox et al., 2018) and in a vegetated (seagrass) tidal flat lagoon (Polsenaere et al., 2012). However, in our study, water-air CO_2 fluxes estimated from water pCO_2 could be compared for the first time with NEE measured simultaneously by Eddy Covariance to go further into the contribution of aquatic metabolism on uptake/emission fluxes at the ecosystem scale (Table 2). Thanks to these original data in the literature, we highlighted that at high tide during the day, water column CO_2 oversaturation due to heterotrophic metabolism was able to significantly reduce marsh atmospheric CO_2 uptake during the highest immersion levels only when all marsh plants were immersed by coastal waters. For the first time, we showed that NEE at high tide remained strongly controlled by marsh vegetation, since emerged plants located on the highest levels can maintain daytime and night-time atmospheric CO_2 uptake or emission, respectively, in the presence of coastal water oversaturated or undersaturated in CO_2 (see section 4.4., p28-29). This novelty and these original findings were fully detailed in the section 4.4. of the submitted MS.

We learned that the remaining CO_2 flux from the marsh surface when it was completely covered by water reflected not processes occurring in/on the salt marsh, but metabolism of the water itself. This means that the pCO_2 levels were entirely due to the metabolism – planktonic and benthic, which were not completely separated. Light-dark bottles were used to simulate the pelagic metab and everything else plus plankton were measured by the time course change near high tide or low tide. However, the water at high tide wasn't over the marsh – it was in the tidal creek. So it doesn't reflect the marsh surface sediment fluxes, as they authors didn't say they sampled water out in the middle of the marsh after it had traversed the marsh surface flooding away from the tidal creek.

For planktonic metabolism measurements, water samples were collected every six hours during each 24-h cycle (n = 4) successively at low tide and high tide. At low tide, planktonic communities were sampled in light and dark bottles at the bottom of the studied channel when water is drained from upstream salt ponds with a low flow. On the contrary, at high tide, planktonic communities were sampled after the studied channel was fully filled by imported coastal water and the marsh surface was mostly flooded by water. At high tide, when the marsh is fully flooded, horizontal homogenization of water masses occurs, due to surface water flows induced by complex tidal circulation and wind action. So, light-dark bottles sampled at high tide reflected the marsh surface sediment fluxes and all the sediment organic matter put back into suspension in water by the tide. The revised MS was completed to take into account this precision (see below).

During high tide (marsh immersion), total aquatic metabolism was heterotroph ($NEP_{tot} < 0$) both during day and night (except in winter at daytime), inducing net DIC and pCO_2 increases in water (Table 2). At the same time, the low contribution of planktonic aquatic metabolism (NEP_{pk}) to total aquatic metabolism (NEP_{tot}) suggested a major influence of immersed plant respiration and/or benthic processes on the water inorganic carbon pool and air-water CO_2 fluxes. Previous studies in intertidal wetlands showed that benthic respiration produces strong sediment-to-water DIC fluxes through diffusion during immersion inducing water CO_2 oversaturation (see section 4.3, p27, L635-640).

Section 2.2. Sampling strategy and field samplings (this sentence was completed in the revised MS)

p5, L147-L150: "*For planktonic metabolism measurements, water samples were collected every six hours during each 24-h cycle (n = 4) successively at low tide (LT; water remaining at the channel bottom) and high tide (HT; water flooding mostly marsh surface).*"

While light-dark bottles can give some measure of pelagic metabolism, were they suspended at multiple light levels – I don't think so.

For planktonic metabolism measurements, the light-dark Winkler bottles were incubated for six hours in surface waters of the sampling channel under *in situ* water temperature and aquatic PAR and at the same depth of sampling. So, the light-dark Winkler bottles were incubated in close environmental conditions as all the planktonic communities in surface waters. However, the bottles have not been suspended at multiple light levels as suggested by Referee#3. As planktonic aquatic metabolism (NEP_{pk}) played a minor role in the total aquatic metabolism (NEP_{tot}) during marsh immersion (Table 2), the absence of multiple light levels in the planktonic metabolism measurements is, in our opinion, not crucial. Again, this is the first attempt to account for planktonic metabolism in a marsh carbon budget, probably because the light-dark bottles technique is time-consuming and difficult. We acknowledge that methodological can further be improved.

Was shading from marsh plants imitated – I don't think so. There was some metabolism as the authors documented it. The level of pCO_2 in the floodwater was related to the direction of flux seen by the flux tower. When floodwater at high tide was supersaturated – there was an escape of CO_2 to the atmosphere and vice versa.

For planktonic metabolism measurements, the shading from marsh plants was not tested as suggested by Referee#3. So, our measurements of planktonic metabolism might overestimate autotrophy *versus* heterotrophy. Nevertheless, NEP_{pk} played a minor role in the total aquatic metabolism during marsh immersion (Table 2), and thus the absence of shading from marsh plants in the planktonic metabolism measurements is unlikely to alter significantly our results.

We learned therefore that flux direction and magnitude from a marsh can change when the marsh is flooded. But we don't know whether the magnitude calculated bears any semblance to reality and how it really compared to what the flux tower saw. Actually it could have been interesting to see what k value should be used to calculate flux from the water surface when it is over the marsh, as the flux tower doesn't rely on a k. Presumably the k value at a particular wind speed differs when the marsh vegetation sticks above the surface or alters water turbulence. This is a big unknown, but unfortunately the authors didn't measure this.

Referee#3 is right, the gas transfer velocity (k) could have been calculated from water pCO_2 and NEE fluxes measured at the same time in the EC footprint during marsh immersion periods. However, this approach and calculation would have significantly increased the quantity of results and the length of the manuscript. In this study, we have chosen to use the k parameterization of Van Dam et al. (2019) as a function of wind speed, that was determined from concomitant pCO_2 and FCO_2 eddy covariance data in an estuarine system with characteristics very similar with our study site. Currently, there is no consensus on the k value parameterization in shallow coastal systems, such as salt marshes, mainly because k depends on several drivers acting at the same time: wind, current, water depth, friction at the bottom, heating and cooling. In the revised MS, the k values obtained the parameterization of Van Dam et al. (2019) were recorded in the table 2 for each high tide period (from 4.44 to 7.74 cm h^{-1} in winter, from 5.89 to 9.93 cm h^{-1} in spring, from 9.25 to 10.85 cm h^{-1} in summer and from 4.81 to 10.85 cm h^{-1} in fall).

I don't think we really learned by comparing light-dark incubations with whole water DIC changes the true contribution of pelagic vs all other processes that control DO or DIC concentrations in a water column in contact with sediments, plants, the air, etc.

We could not find which factual basis supports this referee's comment and what was the exact concern of the reviewer here. In original way in the literature, at each high tide, total aquatic metabolism (NEP_{tot}) was estimated by changes in DIC concentrations between two discrete samplings and was compared at the same time to planktonic aquatic metabolism (NEP_{pk}) and water-air CO_2 fluxes (FCO_2) to better understand the aquatic metabolism contribution on CO_2 emissions during marsh immersion.

During daytime high tides, total aquatic metabolism was weakly autotrophic ($NEP_{tot} > 0$) in winter and strongly heterotrophic ($NEP_{tot} < 0$) in spring, summer and fall indicating a weak photosynthesis of immersed plants and a low biological use of marine DIC (Table 2) (see section 4.2, p24, L562-564). Total aquatic metabolism was heterotroph ($NEP_{tot} < 0$) both during day and night (except in winter at daytime), inducing net DIC and pCO_2 increases in water (Table 2). At the same time, the low contribution of planktonic aquatic metabolism (NEP_{pk}) to total aquatic metabolism (NEP_{tot}) suggested a major influence of immersed plant respiration and/or benthic processes on the water inorganic carbon pool. Previous studies in intertidal wetlands showed that benthic respiration produces strong sediment-to-water DIC fluxes through diffusion during immersion inducing water CO_2 oversaturation (Gong et al., 2023; Song et al., 2023) (see section 4.3, p27, L635-640).

We also learned that aquatic metabolism isn't always greatest in the hot summer, as this study showed the highest and greatest range in DOC during the winter – the coldest month. But of course this result wasn't strictly a function of temperature.

In the submitted MS, we showed that the highest DOC concentrations were recorded over the summer 24-h cycle (Table 1), especially at low tide (Fig. 7) probably due to intense autochthonous and allochthonous aquatic primary production (benthic microalgae, phytoplankton, and macroalgae). Moreover, at our salt marsh, the strong primary production of emerged plants, especially in spring and summer ($-14.3 <$ daytime $GPP_{marsh} < -2.6$ µmol CO_2 m^{-2} s^{-1} over C3-summer; Fig. 2) and confirmed by Mayen et al. (2024), could also induce DOC production through above-ground and belowground litter loss and root exudations (Kristensen and Alongi, 2006; Schiebel et al., 2018), then exported to surface waters of the sampling channel. DOC can also come from the heterotrophic degradation of organic matter in the sediments and be transferred to channel waters by tidal pumping during ebbing tide. The high spring/summer DOC concentrations in channel water could have different various sources in our studied site and were fully described in the section 4.2. of the revised MS.

An extensive set of observations was presented here. The authors justified many flux trajectories by mentioning one of many processes previously studied in marshes. For example, they showed that through a particular DIC-DIN flux ratio and NH4:NO3 ratios that there may have been DNRA. They also showed via the slope of the DIC/TA change could have been explained by sulfate reduction. But they showed it being greatest in winter, when there is often less sulfate reduction and more pyrite reoxidation – changing the O_2 to DIC flux ratio of metabolism.

Referee#3 is right, the highest DIC outwelling from overall salt marshes was generally observed in summer since the highest temperature values promote intense heterotrophic respiration in sediments (Wang et al., 2016, 2018). In our case, the highest increases of DIC (from 2354 to 3963 µmol kg^{-1}), TA (from 2508 to 4016 µmol kg^{-1}) and DIN (from 27.7 to 68.4 µM) were measured in winter at low tide night probably due to intense anaerobic respiration processes in channel waters and/or sediments resulting in the highest water pCO_2 (up to 1461 ppmv). This large winter DIC production by the studied salt marsh could be explained by dominant detrital organic matter in the channel (see high POC:PON and POC:Chl*a* ratios; Fig. 7) coupled with large river-derived nutrient inputs during high tide periods (see high NO_3^-_NO_2^- concentrations in coastal waters; Fig. 7) supplying anaerobic respiration in sediments (see below).

Section 4.3. Marsh aquatic respiration as DIC source (this paragraph was modified in the revised MS)

p27, L641-659: "*During low tide (marsh emersion), the largest DIC and TA increases were measured in channel waters, especially in winter, highlighting a strong control of tidal forcing on water carbonate chemistry (Fig. 8). In similar salt marsh systems, the same tidal DIC pattern was recorded over all seasons with highest concentrations at low tide and lowest ones at high tide (Table 5).* In most intertidal systems, such as salt marshes and mangroves, intense respiration processes occur in sediments inducing high DIC and TA concentrations in surface waters, especially at low tide through porewater exports driven by the tide (Nakamura et al., 2024; Reithmaier et al., 2023). In winter, during low biological activity of *S. maritima* (Mayen et al., 2024), the highest POC:PON and POC:Chla ratios measured at low tide (Fig. 7) suggested predominant detrital organic matter from decaying vegetation (Savoye et al., 2003). The highest POC-δ^{13}C values measured in winter at low tide (-14.6 ± 0.9‰; unpublished data) could confirm the presence of terrestrial C4 plants in channel waters, like S. maritima (Amann et al., 2024). This could constitute an energy source for microbial activity in sediments inducing, in turn, the largest increase of DIC and pCO_2 measured at low tide night (up to 3963 µmol kg^{-1} and 1461 ppmv, respectively; Fig. 6) due to a strong winter tidal forcing. *During this period, DIC increased faster than TA until reaching very close concentrations (Table 1). This could indicate that most of carbonate ions (CO_3^{2-}) in channel waters were converted into bicarbonate ions (HCO_3-) by the large addition of CO_2 and H^+ from marsh respiration processes, such that carbonate species in the exported channel waters mostly consisted of HCO_3^- and dissolved CO_2.* In mangroves, Cabral et al. (2024) confirmed a strong control of tidal forcing in water pCO_2 dynamics with highest values recorded a low tide during the highest tidal amplitudes. In addition, in our case, the strong DIP and NH_4^+ increases from high to low tide could confirm microbial respiration of organic matter in marsh sediments and, in turn, lateral export of DIC from porewaters to channel waters by tidal pumping (Fig. 8) as observed in other tidal systems (Cabral et al., 2024; Deborde et al., 2008; Santos et al., 2019)."

While there is a lot of data presented here – I see little that's new. It's from an extensively altered salt marsh so extrapolation of results to anywhere else is dubious – except for saying some of the same marsh processes occur there as everywhere else. I don't see that we are any closer to understanding the magnitude and direction of DIC flux to/from a regularly flooded marsh. Nor are we any closer to quantifying the CO_2 sequestration rate of this salt marsh system.

In the literature, very few studies have looked for the aquatic metabolism influence in water carbon dynamics and atmospheric carbon exchanges from an integrative manner, using *in situ* carbon original samplings (through intense seasonal 24-h cycles) and innovative methods (autonomous water pCO_2 probe and atmospheric Eddy Covariance). In this way, our original results provide a better understanding of biotic and abiotic factors controlling water pCO_2 and atmospheric CO_2 fluxes in salt marshes where diurnal/tidal data are scarce. In our study, water pCO_2 were mainly controlled by biological activity inducing water CO_2 oversaturation at low tide in winter due to heterotrophic processes (DIC, TA, NH_4^+ and PO_4^{3-} increases). In a new way in the literature, we recorded large water CO_2 undersaturation coupled with DOC production in spring/summer at low tide due to autotrophic processes from phytoplankton, benthic microalgae and macroalgae. Contrary to global findings on the marsh carbon cycle (large DIC and DOC outwelling; Santos et al., 2021), our study highlighted CO_2-depleted and DOC-concentrated water exportations from high to low tide in spring and summer confirming the major role of autochthonous/allochthonous primary production within all marsh compartments (terrestrial and aquatic) in the coastal carbon cycle. It could indicate lower aquatic heterotrophy and higher aquatic autotrophy at our studied marsh, especially in spring and summer, allowing simultaneously large CO_2 uptake and DOC production. The novelty of this study and the original findings were fully highlighted in the revised MS.

A new table was added in the revised MS to regroup similar articles studying inorganic carbon dynamics and water-air CO_2 emissions in temperate salt marsh systems to contextualize our findings and enhance the manuscript's scientific significance (see table 5). Moreover, to further discuss our finding in a broader context, we propose in the revised MS a conceptual model to organize the contribution of terrestrial and aquatic compartments to net ecosystem CO_2 exchanges (see figure 8). Although we think we made a literature survey as complete as possible, we would be very happy to learn about additional literature we could refer to in our MS.

Table 5. Seasonal/annual comparison of water inorganic carbon dynamics (pCO_2 in ppmv, DIC and TA in µmol kg^{-1}), total aquatic metabolism (NEP_{tot} in mmol m^{-2} h^{-1}) and water-air CO_2 fluxes (FCO_2 in mmol m^{-2} h^{-1}) between the Bossys perdus salt marsh (this study, France) and other similar temperate salt marsh systems in the literature. Median values were done in bold and range values were done in brackets (min – max).

Reference		Winter	Spring	Summer	Fall	Annual
This study	Water pCO_2 (ppmv)	**525** (321 – 1461)	**221** (106 – 416)	**158** (89 – 597)	**411** (311 – 541)	**382** (89 – 1461)
	DIC (µmol kg^{-1})	**2799** (2354 – 3963)	**2173** (2053 – 2530)	**2056** (1587 – 2175)	**2584** (2206 – 2762)	**2238** (1587 – 3963)
	TA (µmol kg^{-1})	**3076** (2508 – 4016)	**2757** (2379 – 2947)	**2385** (2228 – 2812)	**2804** (2351 – 3047)	**2617** (2228 – 4016)
	NEP_{tot} (mmol m^{-2} h^{-1})	**-2.35** (-7.72 – 3.02)	**-15.80** (-16.61 – -14.98)	**-16.43** (-19.36 – -13.50)	**-5.45** (-7.81 – -3.08)	**-10.01** (-19.36 – 3.02)
	Water-air FCO_2 (mmol m^{-2} h^{-1})	**0.24** (0.05 – 0.46)	**-0.25** (-0.52 – -0.03)	**0.28** (0.05 – 0.53)	**0.36** (0.03 – 0.62)	**0.15** (-0.52 – 0.62)
Wang et al. (2018)	Water pCO_2 (ppmv)	n.a. (500 – 4000)	n.a.	n.a. (1600 – 12000)	n.a.	n.a. (500 – 12000)
	DIC (µmol kg^{-1})	n.a. (1500 – 2500)	n.a.	n.a. (2250 – 4300)	n.a.	n.a. (1500 – 4300)
	$NEP_{aquatic}$ (mmol m^{-2} h^{-1})	-0.83	n.a.	-2.50	n.a.	-1.60
	Water-air FCO_2 (mmol m^{-2} h^{-1})	0.60	n.a.	3.90	n.a.	2.05
Reithmaier et al. (2023)	DIC (µmol kg^{-1})	**2158** (1610 – 3080)	**1941** (1452 – 7895)	**2052** (1450 – 4200)	**2210** (1367 – 3740)	**2065** (1367 – 7895)
	TA (µmol kg^{-1})	**2262** (1634 – 3296)	**1977** (1376 – 8045)	**2083** (1578 – 4191)	**2269** (1330 – 3765)	**2104** (1330 – 8040)
Song et al. (2023)	Water-air FCO_2 (mmol m^{-2} h^{-1})	n.a.	n.a.	**1.03**	**0.20**	n.a.
Gong et al. (2023)	Water-air FCO_2 (mmol m^{-2} h^{-1})	n.a.	**0.53**	**0.65**	**1.10**	**0.76**
Alongi (2020)	Water-air FCO_2 (mmol m^{-2} h^{-1})	n.a.	n.a.	n.a.	n.a.	**1.49**

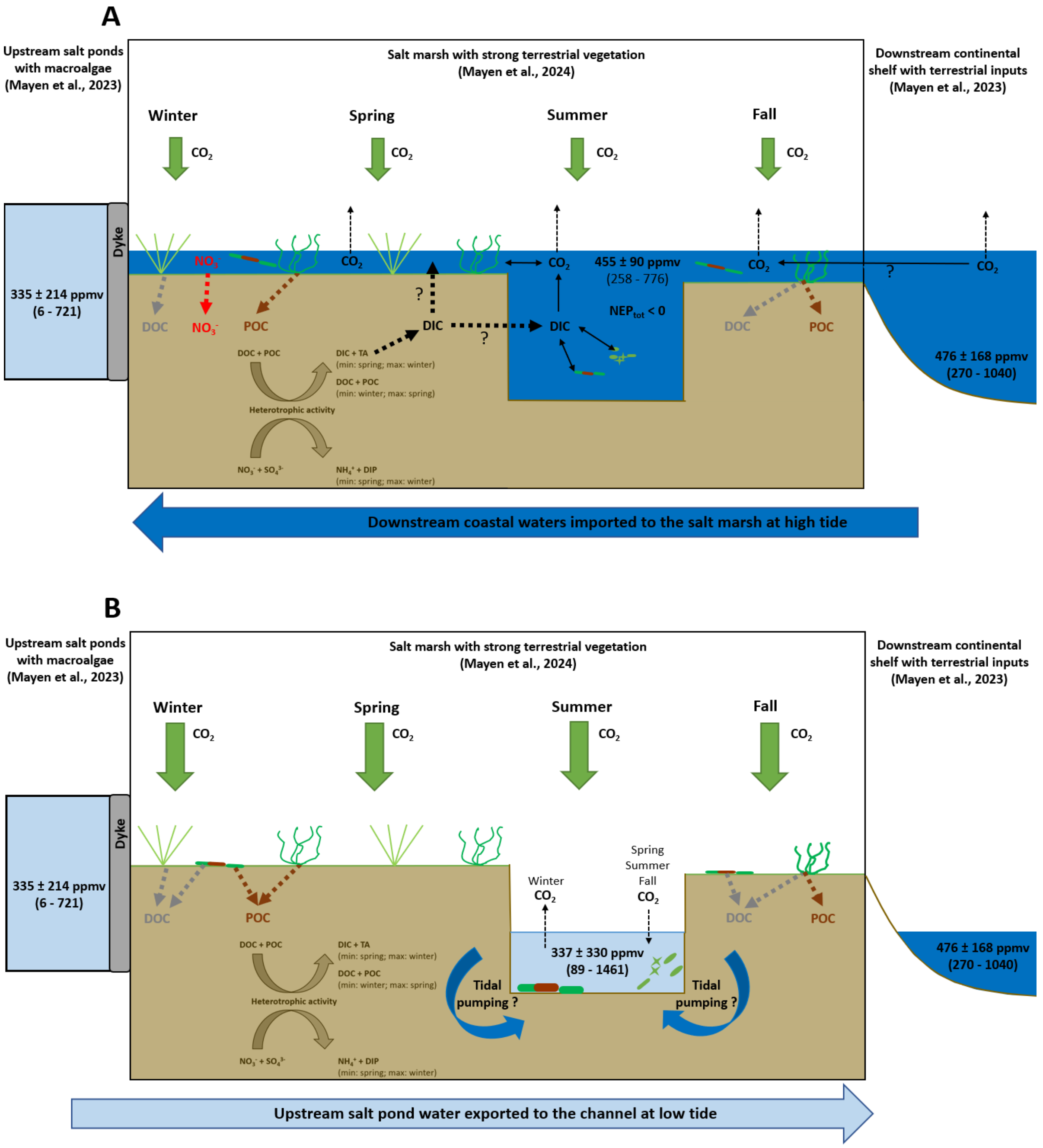

Fig. 8. Water carbon dynamics and atmospheric CO_2 fluxes at the Bossys perdus salt marsh over our 24-h cycles at two contrasted tidal periods: (A) high (flooding) tide (marsh immersion by downstream coastal waters) and (B) low (ebbing) tide (marsh emersion and channel water come from the marsh-drainage process by tidal forcing and the waterflow **from the upstream salt ponds). Green arrows represent net atmospheric CO_2 sink measured at the ecosystem scale by eddy covariance. Negative NEP_{tot} in the water column at high tide corresponds to aquatic heterotrophy (net carbon source for water).**