General comments:

In a world dealing with climate change, there is a need to better understand all ecosystems. Studies like this one, investigating GHG exchange in understudied ecosystems like non-tidal salt marches are relevant and important. The combination of in-situ CO_2 – CH_4 soil fluxes with CO_2 vegetation fluxes in the different habitats results in interesting insights and a valuable addition to the laboratory studies with controlled conditions previously carried out. The study highlights the seasonal variability and the differences between species well.

The Materials and Methods sections could be more detailed. Many elements are not mentioned here such as soil information, salinity, more specific climate data, the amount of data points taken and details about calculations are also left out. Possible additions and suggestions are mentioned in the attached file.

The Carbon mineralization quotient is not entirely clearly explained for me in the method section and not much explanation is given in the result and conclusion section. I think more explanation is needed around the mineralization quotient calculation and some discussion is needed around the carbon sequestration potential of the habitats as this result is interesting but not well supported.

The authors mention large discrepancies between measurement methods (GC, soda lime) and between in situ and laboratory experiments, therefore this information should be added when comparing to literature. Especially for the soil fluxes it should be mentioned which method and closure time is used in the literature you compare to. In this study, the closure time of the chamber for the GC method is very long, with only 2 data points (before and at the end of the closure time), so this will seriously influence the fluxes.

Data presentation can be improved by the inclusion of a table with soil parameters, a table with the main results, a map of the study region and graph of climate data (either in supplementary or in the main text).

More comments and also some technical corrections and suggestions for readability are included in the attached document.

Specific comments:

Introduction

Line 68: How extensive are the salt marshes worldwide/in this region and what is the proportion of tital vs non-tidal in this region?

Materials and Methods

Line 79: Authors could add a map of the region

Line 92: Authors could add some climate data of the region both in numbers and a graph. Annually average rainfall, mean temperatures, … also add some soil data if this is available. How many months is the soil flooded on average? Is this different between the different habitats? Be sure to add the bulk density, SOC, C and N from the three habitats as these are important in the discussion

Section 2.2: Is the NER measured in situ with the leaves and tissues attached to the plants? How many leaves and tissues were measured per plant and how many plants were measured per species per session and in total?

Section 2.3: I'm don't know the soda lime method very well, but was the amount of soda lime needed for the chambers tested to be sure of complete absorption of the efflux or was this based this on previous literature?

I also think the statement starting in line 137 should be more nuanced or better supported, as in the same reference (Lou and Zhou, 2006), there is also indicated "The method (soda lime) tends to overestimate soil CO2 efflux in its low range and underestimate it in its high range compared-with dynamic methods (Yim *et al.* 2002). The technique can potentially underestimate soil surface CO2 effluxes by 10 to 100% (Norman *et al.* 1992, rochette *et al.* 1992, Haynes and Gower 1995, Nay *et al.* 1994)."

The sentence used in this article is based on the sentence from (Lou and Zhou, 2006) "The GC method can potentially underestimate the rate of soil CO2 fluxes in comparison with other methods by up to 45% (Knoepp and Vose 2002)." But if you continue to Knoepp and Vose 2002, it seems to me that the SODA method used in this study is not that good either compared to the other methods and underestimates the CO2 emissions even more than the GC method.

In this study serious underestimation is however a possible issue as the closure time is 24h. This is a long time in which saturation in the headspace can occur. The accumulation of the gas inside the chamber can limit the further emission. However this underestimation is not linked to the GC method but rather to the closure time of the chamber.

Mention how many measurements were taken in flooded state and how many in non-flooded state and how this is different for different habitats.

Wf and *Wi* were estimated from volumetric concentration (%) considering the air volume inside the chamber in each sampling date.

- ➔ Is it meant here inclusion of temperature and pressure measurement from the chamber on the sampling date to transform the ppm/ppb measurements from the GC to g CO2/CH4?
- ➔ If yes, which temperature and pressure is used?

Line146: very small comment but the unit of SMF is g CH4 m-2 d-1 here but later on the unit mg CH4 m-2 d-1 is consistently used.

Line 164: The bulk density of soil is never mentioned before, so authors could add the values. Also mention the SOC values used (see also previous comment on line 92).

I'm not familiar with the carbon mineralization quotient. How were the C_CO2 and C_CH4 values calculated? How was the transformation from the unit of "g CH4 m-2 d-1" and "g CO2 m-2 d-1" to "mg C g soil-1 d-1"?

Results

Concerning the correlation between SR and SOC and TN found in July: there is one value of SOC and TN for each habitat, so three in total? Or is there a value for each plot?

Discussion

The authors could add a table (maybe in supplementary) with mean/min/max values of water use efficiency, photosynthetic rates, …

Section 5.2.2.

The soil C and N content is put forward as possible explanation in line 372 and 377 for the higher SR in HS and SM than in GS, so it think the values of SOC and TN should be added in the paper (maybe in supplementary).

Line 375-378: Accordingly, a positive correlation was found between July SR and SOC or TN content at the halophilous scrub and the salt meadow of La Pletera salt marsh, since these two habitats had higher content of SOC and TN than the glasswort sward (Carrasco-Barea et al., 2023).

- ➔ Was there only a positive correlation found between SR and SOC and TN for HS and SW because in the results this is not specified (see my one remark in the section Results above). Also if you have one value of SOC or TN per habitat, then how is a correlation per habitat found, which brings me back to my previous question in Result section?

  Maybe this needs to be rephrased, framing that the positive correlation found between July SR and SOC or TN content across the habitats together with the fact that HS and SM have higher SOC an TN underpin the statement that the differences in SR might be related to the soil C and/or N content.

Line 394: can the "occasional tide" be more specific. Are we talking about flooding during several weeks in specific months or also small occasional floods once every week?

Line 406-413: The way this section is written makes it seem like there is mainly absorption of methane and then some sudden high emission peaks, while it is actually mainly emissions that are measured. Maybe a percentage of negative fluxes to total fluxes can be given.

Line 411-413: "In the glasswort sward, peaks in CH4 emissions were observed both when the soil was not flooded (110± 59 mg CH4 m-2 d-1) and when it was flooded (131 ± 45 mg CH4 m-2 d-1), highlighting that methane oxidation in the overlying water column would not be happening."

I'm not sure that emissions during both non flooded and flooded states prove that there is no oxidation in the overlying water column. It states that the methane oxidation is rather limited or actually that the methane oxidation is not a big factor as the net emission is still large.

Line 439-442: Not much is said about this mineralization quotient. Is there an explanation for the higher sequestration potential of the HS and SM or the lower sequestration potential of GS? I assume that the SOC amount of GS is very low compared to the SOC amount of HS and SM (be sure to put these values in).

Table1. The authors mention large discrepancies between measurement methods and between in situ or laboratory experiments, therefore this information can maybe be added in the table. I would

suggest to move this table to supplementary material and instead incorporate some tables with the data gathered from this study. For readers who want to quickly scan the paper, a table with the mean results of the study would be handy.

Technical corrections:

Abstract

Line 19-21: Regarding the studied habitats, the halophilous scrub and the salt meadow showed higher soil CO_2 emissions than the glasswort sward, ~~being these values, in general~~, <u>and the overall emissions were</u> higher than those <u>previously</u> reported for tidal salt marshes.

Introduction

Line 29: ~~in relation~~ <u>compared</u> to the atmospheric concentration

Line 30-32: In this context of continuous global warming, ecosystems play an important role in global climate regulation~~, being thus~~ <u>Therefore, it is</u> essential to determine net emissions of greenhouse gases of ecosystems to estimate their effects on global warming.

Line 34: (Laffoley & Grimsditch, 2009) is not present in the references.

Line 35-39: ~~Regarding net primary productivity, p~~<u>P</u>revious studies on the photosynthetic capacity of salt marsh halophytic species have mainly focused on the effect of salinity on photosynthetic rates, ~~being~~ <u>and most of</u> these studies ~~mostly~~ <u>were</u> performed under controlled conditions (Davy et al., 2006; Duarte et al., 2014; Kuramoto and Brest, 1979; Nieva et al., 1999; Pearcy and Ustin, 1984; Redondo-Gómez et al., 2007) and less frequently under field conditions (Drake, 1989; Maricle and Maricle, 2018; Warren and Brockelman, 1989).

Line 45-47: Photosynthetic rates also depend on abiotic factors, such as light, temperature, flooding regime, salinity or nutrient availability (Drake, 1989; Huckle et al., 2000). ~~being i~~<u>I</u>n general <u>it is</u> assumed that the highest plant photosynthetic activity occurs during the hours of the day with the highest solar radiation (midday).

Line 55-56: In salt marshes, flooding also has a major effect on CO_2 and CH_4 emissions, since <u>it</u> determines which process, aerobic respiration or anaerobic metabolism, prevails.

Line 60-62: Nevertheless, ~~in general,~~ <u>generally</u> soil CH_4 emissions are negatively affected by salinity (Bartlett and Harriss, 1993; Livesley and Andrusiak, 2012; Poffenbarger et al., 2011), since in saline environments sulphate-reducing bacteria ~~use to~~ compete with methanogens for energy sources, and consequently disfavor and even inhibit methane production.

Line 65-68: ~~However, d~~<u>D</u>espite the importance ~~that~~ <u>of</u> soil carbon fluxes ~~can potentially have~~ in climate regulation, few studies have characterized these fluxes in Mediterranean salt marshes (Wang, 2018), and, to our knowledge, no<u>t</u> one <u>study</u> has been performed in non-tidal salt marshes (tides range from 0.1 to 1 m, in contrast to 1-10 m of tidal salt marshes) of the Mediterranean Basin.

Materials and Methods

Line 79-80: The study was performed at La Pletera, a coastal Mediterranean non-tidal salt marsh located in the north of the river <u>mouth of the</u> Ter ~~mouth~~ in the municipality of Torroella de Montgrí.

Line 86-87: being all these species C3 -> , all these species being C3

Line 136: the air volume inside the chamber ~~in~~ on each sampling date.

Line 151: air volume inside the chamber ~~in~~ on each sampling date.

Line 157 : stored in the soil (SOC) ~~for~~ at/above a certain depth

Results

Line 203: Differences among species in instantaneous ~~net CO_2 exchange rates (~~NER~~)~~ from green tissues

Line 205: after sunrise ~~(~~with no significant differences with *S. fruticosa* in April (Fig. 1a),

Line 232: During most of the year, *E. atherica* showed the highest values of ~~stomatal conductance (gs)~~ at midday

Line 272: ~~Daily soil respiration (~~SR~~)~~ for non-flooded soils of the three

Line 273-274: ~~On the contrary,~~ CO_2 emissions were remarkably lower when soils were flooded.

Line 276-277: Remarkably high peaks of soil CH_4 emissions were recorded in the three habitats, ~~despite~~ but also negative values, ~~(~~indicating net CH_4 consumption~~)~~ were ~~also~~ observed (Fig. 4b).

Line 277-279: In the halophilous scrub, soil CH_4 emissions were detected in April, June ~~(with high values)~~ and September~~, with~~ and the highest CH_4 absorption ~~being~~ was observed in February, when the soil was flooded.

Line 279-281: Maximum soil CH_4 emissions for the salt meadow were recorded in July ~~for the salt meadow~~, and for the glasswort sward in March or June in flooded and non-flooded soils, respectively, ~~for the glasswort sward~~.

Line 285: SR and ~~daily soil methane fluxes (~~SMF~~)~~ were

Discussion

Line 316-319: The same ~~occurred with~~ was true for *E. atherica* and *S.patula*. ~~being~~ their maximum photosynthetic rates at La Pletera (29.1 ± 2.4 and 20.8 ± 2.9 µmol CO_2 m-2 s-1, respectively) were higher than those previously reported for *E. atherica* (18 µmol CO_2 m-2 s-1, Rozema & Diggelen 1991) and for the annual species *Salicornia ramosissima* (14 µmol CO_2 m-2 s-1, Pérez-Romero et al. 2018) grown under controlled conditions.

Line 322-324: ~~Therefore, s~~Studies reporting photosynthetic rates of dominant salt marsh plant species under field conditions are scarce, and the values obtained often diverge substantially from those recorded under controlled conditions.

Line 335-338: Interestingly, photosynthetic rates of the studied species at La Pletera were much lower in autumn than in spring, despite the environmental parameters, such as temperature and soil moisture, ~~were~~ also being favorable ~~to~~ for photosynthesis in autumn, ~~(~~especially in October, where maximum temperature was 21°C and soil VWC was even higher than in March and April~~;~~.(Pascual, 2022). A possible explanation might be related ~~with~~ to the high accumulation of ions and soluble carbohydrates that in these species would present after a salt stress period, such as the one occurring which occurs in the Mediterranean salt marshes during summer.

Line 346-348: especially in March and May and before sunset, with values of photosynthesis reaching 12 µmol CO2 m-2 s-1; . These values are in agreement with data reported for Californian evergreen species (Saveyn et al., 2010) or for savannah shrubs and trees (Cernusak et al., 2006; Levy and Jarvis, 1998).

Line 357-358: Regarding night respiration rates, the highest values for the four species were recorded in summer (August) and/or autumn (November), being especially elevated with those found for the green tissues of *S. fruticosa* and *E. atherica* during these months being especially elevated.

Line 362: references are large

Line 364-365: In November, respiration rates were also very high despite that the minimum temperature was much colder (4.6 °C) than in August (22.2 ºC) and similar to February (5.9°C) (Pascual, 2022).

Line 384-386: On the contrary, the sparse vegetation, (which is only alive during few months) of the glasswort sward and the poorly developed root system of its dominant species, *S. patula*, would make negligible the contribution of roots to soil respiration in this habitat negligible.

Line 437: This would not be the case of in the salt meadow, the most distant habitat from the sea,