Revised points for Reviewer 2 (Dr. Pierre Polsenaere)'s comments:

The submitted manuscript suffers from a lack of information (M&M section with in situ measurements and computations) and organization (especially the result and discussion section) which make difficult to follow and understand the approach and associated results (data set link is not mentioned in the MS sections, only at the end, maybe it can help but the link doesn't work). For instance, seagrass distribution/dynamic and other (than wind, temperature gradient) abiotic environmental parameters should be better described and linked to found gas transfer velocity parametrization. Also, some conclusions should be dampened a bit or reformulated particularly when authors compared their K600 parameterization obtained from a six days dataset in one season, to other different coastal ecosystems cited in the literature. In this way, please see the specific comments below to help in the revision of the different sections and the overall manuscript. I would recommend further revisions to allow the publication of the present paper of Dobashi and T. Ho for the journal EGUsphere.

- We thank the reviewer for the constructive comments. We fixed the link to our data, and it should work now (From the link provided ("https://doi.org/10.5281/zenodo.6730934"), please click "Version Florida 10.5281/zenodo.7087773" in the right column.

Title: It should be specified since very general in the present form.

- OK. we added "— results from a $^3He/SF_6$ tracer release experiment" to the title.

Abstract:

- l.11-12: the general comparison between the present study and other coastal/open oceans is delicate since other environmental factors (than wind speeds) can be involved and controlled k.

- Yes, we agree that the present study's location has different characteristics from other coastal and open oceans. In this sentence, we compare "*k*(600) at the same speed", which is not "*k*(600)". By comparing "*k*(600) at the same speed" with other ecosystems, we can say that factors other than wind speeds have effects on *k*(600). Then, we can start discussing what caused the lower *k*(600).

- l.13-14 and 16-17: I would dampen this conclusion due to the limited data set and specific studied meadow compared to other seagrass systems worldwide (temperate, subtidal versus intertidal, depth, current, turbidity, rainfall, heat fluxes….).

- The effect of depth and current are weak in this region because the current speed is weak in this region and so the bottom-generated turbulence should be weak. It's not clear why the reviewer thinks turbidity affects gas exchange. There was almost no rain during our survey, and heat flux may be related to the air-sea temperature difference which is discussed in manuscript.

- l.14: other settings? Please specify.

- We replaced "other settings" with "other coastal and offshore regions".

1 Introduction:

- l.21: an important part of seagrass above biomass (refractory matter) is also exported and does not sink to the bottom.

- We discussed it by adding the following phrase.

  "Because the organic carbon produced via photosynthesis easily sinks to the bottom and some of the organic carbon stays in the ocean as a refractory matter, seagrass meadows are expected to be blue carbon sinks that can help mitigate the increase of anthropogenic CO_2".

- l.22: Please update the reference adding other more recent works on carbon seagrass storage

- We updated the information by citing Mcleod et al., 2011. The modified sentence is as follows.

  "Seagrasses are estimated to bury 45−190 g C m^{-2} yr^{-1}, a significantly higher rate compared to terrestrial forests (0.7−13.1 g C m^{-2} yr^{-1}; Mcleod et al., 2011; Duarte et al., 2005)".

- l.25: high methane emissions from seagrass meadow have also been recently shown (see Schorn et al. 2021, PNAS 2022 Vol. 119 No. 9 e2106628119).

- Thank you for the info. We cited the paper you provided. The added sentence is as follows.

  "Schorn et al. (2021) also reported that the seagrasses in the Mediterranean Sea emit 106 μmol m^{-2} d^{-1} methane, mainly from their leaves."

- l.26-27: the link with seagrass here is not clear, please specify.

- They investigated the soil of seagrasses. We added "seagrass meadows in" to the sentence.

- l.33: go further citing other involved parameters (and associated studies) in turbulence control. Also, it lacks in the introduction a review on existing works on gas transfer velocity determination according to (i) coastal ecosystem typology (lagoon, coastal ocean, estuary, seagrass presence or absence, ….) and (ii) methodology, for instance k can also be determined through simultaneous sea-air CO2 fluxes using floating chamber, Eddy Covariance techniques and spatial water pCO2, before focusing on the Florida Bay as done in the next paragraph.

- We added more citations (Ho et al., 1997, 2000) discussing the other parameter of rain. We made a new paragraph to discuss (ii) methodology. For (i), we further introduced the gas transfer experiments in a bay in Hawaii and in an emergent wetland.

New paragraph: "Knowledge of the gas transfer velocity (*k*) is needed to understand the role of seagrass ecosystems in the global carbon cycle, since air-sea CO_2 flux is a function of *k* and the air-sea difference in the partial pressure of CO_2 (pCO_2). There are several methods to determine *k* in the field. The $^3He/SF_6$ dual tracer technique, which we employed in this study, is a mass balance technique that involves injecting these tracers into the ocean and determining *k* by measuring the change in the ratio of the two gases with time. The direct flux techniques, such as the eddy covariance method, measure the CO_2 flux in the air and CO_2 concentration both in the sea and air to derive *k*. *k* can also be estimated from the transfer velocity of heat by assuming that the gas and heat transfer velocities are related by their diffusivities; however, the estimated gas transfer velocity from heat, k_H, have been found to overestimate the actual *k* (e.g., Atmane et al., 2004)."

Discussing the other parameter of rain: "In the case of rain, rain rate is included in the parameterization because rainfall increases subsurface turbulence and *k* (Ho et al., 1997a, 2000)."

gas transfer experiments in a bay in Hawaii and emergent wetland : "Ho et al. (2018a) examined *k* in the Kaneohe Bay in Hawaiʻi and showed that *k* can be estimated well by wind speed where the depth is deeper than 10 m." "Ho et al. (2018b) examined *k* in emergent wetland where the depth < 1 m, and showed that *k* can be parameterized from heat flux, rain rate and current velocity there.".

- l.37: please be more specific citing for these studies the used methodology (k, atmospheric CO2 exchanges) among wind speed/gas parametrizations and ecosystem typology as well (presence of seagrasses?).

- We explained how Wanninkhof (1992) determined his parameterization as follows.

  "Zhang and Fischer (2014) determined the air-sea CO_2 flux to be 3.93 ± 0.91 mol m^{-2} yr^{-1} in Florida Bay; they used the wind speed/gas exchange parameterization determined from bomb-produced ^{14}C inventory in the ocean by Wanninkhof (1992)."

2 Material and methods:

l.49: could authors give an idea of seagrass densities in the 2000 km2 and in the specific studied area (Fig. 1). As it stands there is not enough information on spatial seagrass distribution, phenology (carbon stocks and fluxes, …) and concrete relationships done between seagrasses and k parametrization.

- There is a density information 2nd sentence after this sentence. We also added the seagrass density around the study area as follows.

  "Seagrass density varies across the bay, and its standing crop is 0−20 g dry weight m^{-2} in summer around our study area (bottom figure in Fig. 1) (Zieman et al., 1989). The seagrasses in Florida Bay show seasonality, and their standing crop becomes larger in spring and summer and smaller in fall and winter (Zieman et al., 1999).".

- l.60-65: figure caption should be specified and better linked do M&M following sections; it is in between in the submitted MS with cited measured parameters without information on how (sensors, frequencies, …) and when (duration) it was measured. The second zoomed figure should be even more restricted to better see the sampled area. In consequence, we are a bit lost when results and discussion section comes, i.e. parameter origins (sensor used, where, when, frequencies, duration, …).

- We moved Figure 1 to the end of the measurement section. We used a more zoomed figure for the second figure. We added more detailed Material & Method information to the manuscript.

- 2.2.: when and how long were tracers injected? Why?

- We injected 2 days before the first SF_6 survey (April 1, 2015) because the generator didn't work the first day when we were out. We added this information:

  "We injected ^3He and SF_6 at a ratio of 1:340 into the water at the study location (25.0107°N, 80.692°W; green star in Fig. 1) on 1 April 2015 for 1 minute via a length of diffuser tubing."

2.3.: How many? Where (specify it in Fig. 1)? When?

- We specified it in Fig. 1 and added this information to the manuscript as follows.

  "We collected 16 ^3He samples (~40 mL each) at 26 stations in copper tubes mounted in aluminum channels and sealed at the ends with stainless steel clamps between April 1 and 8 2015 (yellow triangles in Fig. 1)."

  "84 discrete SF_6 samples were taken at the same stations (yellow triangles in Fig. 1) using 50-mL glass syringes and submerged in water in a cooler until measurement back on shore at the end of each day."

- 2.4., l.89-90: where? When? How? L.92: black square in Fig. 1, how far form the site and why did authors use additional wind data?

- We added this information:

  "Hourly tidal amplitude, water surface temperature, and salinity data from the same site (blue dot in Fig. 1) between 2015 and 2019 were obtained from Everglades National Park (https://www.ndbc.noaa.gov/)." and "The tidal amplitude was measured using a digital shaft encoder (WaterLog H331). Water temperature and salinity were measured using multiparameter sondes (Hydrolab Quanta until 5 March 2019; OTT-Hydromet OTT-PLS-C thereafter)".

  "Additional wind speeds measured using a sonic anemometer (Vaisala WXT532) at ~3 m above the sea level at 25.07209°N, 80.73511°W (pink square in Fig. 1, 7.4 km away from the blue dot) between 2015 and 2019 were obtained from Everglades National Park to compare *k* derived from this study and *k* estimated from published parameterizations."

L.96-97: a given range for Z0 is given without any explanations on which ecosystem typology in the Florida Bay and how it was measured, please specify. Is the used average Z0 value enough precise for calculations? Maybe I did miss something but why Amorocho and DeVries (1980) equation was not used to compute wind speed data at 10 m?.

- Thank you. It turned out that the (Cornelisen and Thomas, 2009) is not appropriate to our study. We used Amorocho and DeVries (1980) and recalculate. The overall results did not change significantly.

- 2.5., l.100: pCO2 measurements, used frequency? Where? L.106: "specific times", "at regular time intervals" could you specify it? L.107: CO2 standard concentration?

- We added the info as follows

  "We measured the pCO_2 along the boat track (red dots in Fig. 1) using an underway system based on the design of Ho et al. (1997b) and incorporating the suggestions from Pierrot et al. (2009)"

  "The interval between measurements was 41 s".

2.7., l.158-159: the last sentence is a little bit awkward, in section 2.7 important testing was done to fit in a precise way coefficient Schmidt numbers especially according to temperature, so why was it not done for salinity in a same way?

- Because the effect of salinity on Sc is not well investigated, as written between the 4th and 7th sentences in 2.7. We also added the following sentence in Section 2.7.

  "While the effect of temperature on molecular diffusion coefficient is well investigated, the effect of salinity has been the subject of fewer studies."

L150-151: various salinity, you mean 0 and 35, don't you? Various temperatures from 0 to 40°C, could you specify (step, number of values?)? By the way, what are salinity range, mean values in Florida Bay in general and at your sampling area during the study? No result on it in the submitted MS?

- We did not mean 0 and 35 when we used the term "various salinity". The Sc for the salinity of 0 and 35 are just examples. We added the following phrase.

  "The last two columns are the calculated Schmidt number for 20°C, and salinities of 0 and 35 as examples, respectively.".

- We do not need to specify the step and number of values, and our equations can be applied to any temperature between 0 and 40°C.
- Salinity was 40.7 ± 0.1 (range=40.4-41.0). We added the temperature and salinity information to section 3.1.

- 3.1, l.183: how many k600 values were taken into account to obtain this average value? That information is lacking in the M&M section and in turn this result value is unclear and one might wonder if this result is comparable to other k600 values found in the bibliography (Fig. 2).

- We have 4 $k(600)$ values since we have 6 ^3He and SF_6 data points and need to calculate the derivative using equation (3). We added the information that we have 6 ^3He and SF_6 data points as follows.

  "We used the mean ^3He and SF_6 concentration for each day to determine k, so there are six $^3He/SF_6$ data points between April 3 and 8 (Fig. 2f)."

- Fig. 2: five stations were sampled according to M&M l.173. Four observations appear in Fig. 2, could author explain (is it 4 or 5 or anything else)?

- We have 6 ^3He and SF_6 data, 4 $k(600)$ points, as explained in the above comments. M&M173 says 5 stations because we need to neglect the first value to calculate cvRMSE using equation (6).
- We clarified M&M1.173 more as follows.

  "N is the number of stations sampled after the initial sampling (5 for table 2 and 2 for Fig. 5e)"

l.200-201: what did authors mean by "this parametrization" and "K600 between 2015 and 2019"? It is not clear. Could one have further elements or descriptions (sites, measurements, …) at minima instead of only having the two above references?

- "This parameterization" refers to equation 7. We clarified it as follows.

  "k for CO_2 at in-situ temperature and salinity between 2015 and 2019 were also calculated using the equation (7) and the previously published parameterizations (Table 3)."
- We were discussing k, not k(600). Thank you for pointing it out. We replaced k(600) with k.

- l.202-203: and using old parametrizations, could we also have those values or at least element of comparisons (%, …)?

- We compared our results and published studies as follows.

  "Annual averaged k ranged between 3.7–4.3 cm h^{-1} in Florida Bay between 2015 and 2019, while published parameterization would yields values of 6.9–11.6 cm h^{-1}"

- l.205: I think Results and discussion section should be reorganized, presenting and fully describing first (which has not been done yet) temporal series of measured environmental parameters (grouping Figs. 4 and 6 or at least water pCO2 measurements for instance, Fig. 5) and then K600 descriptions and comparisons with plots (Figs. 2, 3) and tables and relevant controlling environmental factors on k600. As it stands, it is not possible for the reader to see how the ecosystem functioned during these six days experiments before understanding K600 calculations with controlling factors.

- We made new section 3.1 to discuss the environmental settings as follows. As the reviewer suggested above, we discussed the salinity during our experiment here.

  "During the experiment, wind direction was predominately from the east, and wind speeds increased towards the latter part of the study period (Fig. 2a). The mean and the standard deviation of the wind speed during the study period was 5.5 ± 2.0 m s^{-1} (range=0.12–12 m s^{-1}). Mean water temperature showed diurnal pattern with a mean and standard deviation of 26.3 ± 1.3°C (Fig. 2b). The diurnal pattern of the air temperature was weak, as the mean and standard deviation were 25.1 ± 0.6°C. The air-sea temperature difference showed diurnal cycles, which was mainly driven by the diurnal cycle of the sea temperature, consistent with observations by Van Dam et al. (2020). Salinity was consistent throughout the study period (41 ± 0.1) (not shown). The tide consistently showed semidiurnal cycles with an amplitude of ≤ 0.2 m throughout the study period."

- l.207-208-209: idem, wind speed, air-sea temperature gradients, tidal amplitude are very briefly presented here in a K600 parametrization paragraph so it is hard to follow. Again, environmental parameters should be presented first before K600. Sub-sections with clear titles in 3.1 section would clearly help as well.

- We made new section 3.1 to discuss the environmental settings, as we answered in the above comment.

- Table 3: I don't understand well, parametrizations presented in Table 2 were applied to the same datasets (?) over the same area (?) each year between 2015 and 2019 as the present study. It is too bad because, it is not explained by the authors in a clear way in the M&M to help the reader to follow and appreciate measurements and the approach done in the present study. It should be done in the revised version.

- Table 2 corresponds to section 2.8. Table 3 corresponds to section 2.4. We added an explanation of why we used the wind speed data between 2015 and 2019, which will let readers understand the meaning of table 3. The modified sentence in section 2.4 is as follows.

  "Additional wind speeds measured using a sonic anemometer (Vaisala WXT532) at ~3 m above the sea level at 25.07209°N, 80.73511°W (pink square in Fig. 1, 7.4 km away from the blue dot) between 2015 and 2019 were obtained from Everglades National Park to compare *k* derived from this study and *k* estimated from published parameterizations".

If I understand well, the K600 equation obtained from the six days tracer experiment is then applied for each year between 2015 and 2019, am I correct? Which (stations, frequency, sensor, etc…cf. M&M comments above) wind measurements were used for these calculations? How other environmental parameters varied during each year? Variations in K600 values (min-max, …) should be presented and described along other environmental parameters variations.

- Yes, that is correct. We wrote the explanation of wind speed measurement in more detail (stations, frequency, sensor, etc. We added annual averages of sea temperature, salinity and tidal amplitude to table 3.
- We added the range of *k* (min and max) to Table 3.

- l.227: again "in four periods", nothing is explained on this choice by the authors….? Why?

- Because four are the maximum number of periods we can calculate the cvRMSE using the 6 data points. We added the reason why we calculated cvRMSE separately as follows.

  "To investigate the relationship between environmental parameters and the deviation between measured and estimated air-sea gas exchange, we examined the relationship between temperature difference and the deviation between observation and the models by calculating cvRMSE separately in four periods (Fig. 5)."

- l.233-237: wind, limited fetch are potential explanations for weak K values indeed, what about other environmental factors such as turbidity, current speeds, depths, rainfall events, heat fluxes…? Authors should discuss this as well as seasonal abiotic and biotic (seagrass growth, phenology, algae, …) effects on gas transfer velocities in Florida Bay since K600 equation presented in the study was obtained during one punctual Spring experiment. Those elements should be discussed in this results and discussion section to go further.

- We do not understand why turbidity affect gas exchange.
- The impact of current speed and depth is weak since the current speed is weak and thus the bottom-generated turbulence is weak. We observed almost no rain during the experiment (rain amount was 0 during our observation period except there was one hour with 0.5 inch per hour, which is small). We discussed the seasonality of seagrass since the wave attenuation by the seagrass depends on the seagrass density as follows.

  "The seagrasses in Florida Bay show seasonality, and their standing crop becomes larger in spring and summer and smaller in fall and winter (Zieman et al., 1999)."

  "Although the experiment was conducted over a short period of 8 days, our new parameterization, equation (7), fit the observations well; This implies that equation (7) can be applied even in different seasons and years if the wind speed is in the range of 0.12–12 m s^{-1} and seagrass conditions are similar."

- The relationship between heat flux and gas transfer velocity was investigated by Van dam et al., 2020. We are discussing their study and our study in the previous paragraph.

- Fig. 4: see above comments, environmental parameter chronologies should be better described in the MS and linked to K600 analysis after. Here, there are six observation points?

- Yes, we have 6 observational plots since we have 6 pairs of ^3He and SF_6 data. We described more about the material and method as suggested in the other comments.

Fig. 5: it should be modified (graphs a to d separated from graphs e and f) and presented in a clearer and more homogeneous way along the text, there is everything in this figure, similarly to Fig. 4 that should be modified as well (graphs a separated from graphs b, c, d). Graph presentations and associations for each figure should be modified in the revised version.

- We added the notation of "Period 1"~"Period 4" to the Figures 5(a)~(d) so that readers can understand the relationship between (a)-(d) and (e)-(f). We did not separate figures, but now readers can see when is period 1 from figures (a)-(d) easily.

- Fig. 6: idem and wind speed and K600 values should also be added.

- We added the time series of *k* to Fig. 2e. wind is already shown in Fig. 2a.

- l.250 (3.2): as written l.255, authors should emphasize this aspect of further tracer or simultaneous air-sea CO2 fluxes and water pCO2 measurements to get more precise k600 parametrizations over seagrasses since (i) dataset here is short (six punctual days) and (ii) relationships between k600 determination with seagrass dynamic (density, phenology, …along with previous works in the area) are not enough shown in the present MS.

- OK. We discussed the future study as follows.

  "Specifically, measuring the seagrass density and conducting dual-tracer experiment simultaneously is needed to relate the *k* and vegetation distribution."

- We also discussed the implication of the short experiment as follows.

  "Although the experiment was conducted over a short period of 8 days, our new parameterization, equation (7), fit the observations well; This implies that equation (7) can be applied even in different seasons and years if the wind speed is in the range of 0.12–12 m s^{-1} and seagrass conditions are similar.".

- l.256: how many air and water pCO2 values were used or measured? (cf. M&M section, information lacking).

- We added the information in method section as follows.

  "In total, 1,261 and 13 xCO_2 data were taken from the water and air, respectively."

- l.259: what about nighttime period, are there available measurements (pCO2, flux, …) from previous works? It should be discussed. L263-264, assumptions are too speculative and authors should not go too far in their conclusions. Oversaturation periods (respiration, calcification) at night probably exist at their sampling site and additional simultaneous measurements of water/air pCO2 and associated fluxes should be done to draw more precise conclusions (among cited references).

- To investigate pCO_2 during the nighttime, we referred to the pCO_2 data from NOAA near the observational station (15 km away from our station). At NOAA's station, the CO_2 flux was always negative and amplitude of diurnal fCO_{2water} was 25–53 μatm between April 3 and 8, 2015. We modified the sentence as follows.

  "Although we did not conduct pCO_2 measurement during the night and so the calculated value is biased toward daytime, the daily averaged pCO_{2water} and CO_2 flux during the whole observation period would still be lower than pCO_{2air} and negative, respectively, considering that the observed pCO_2 was as low as 228 μatm and the CO_2 flux at the NOAA station (aqua diamond in Fig. 1) was always negative with diurnal fCO_2 amplitude of 25–53 μatm between April 3 and 8, 2015."

- It could be interesting to better mention in this section other K600 determinations and associated studies among tracer experiments such as floating chamber and particularly atmospheric Eddy Covariance techniques for air-water CO2 flux measurements with simultaneous water pCO2 measurements.

- We discussed the paper from Van Dam et al. 2020 in the previous section, which determined *k* from heat flux. As far as we know, there are no air-sea gas exchange measurements using the floating chamber or eddy covariance technique in Florida Bay.

- l.271: cyanobacteria bloom seasonality, what about seagrass as it is the main objective of the paper focusing on seagrass ecosystem?

- That is a good point. Thank you. We discussed it as follows.

  "The seasonality of seagrasses may also contribute to the seasonality of pCO_2 and CO_2 flux, as its productivity also shows seasonality (higher in spring and summer and lower in fall and winter) (Zieman et al., 1999).".

-l.280: the last sentence is not well formulated and should be modified instead calculating CO2 fluxes from Van Dam et al. 2021 with the 4.5 cm h-1 averaged value authors got in this study and analyzing the difference between both values.

- Ok. We re-calculated the excess CO_2 using our equation (7). The modified sentence is as follows.

  "Van Dam et al. (2021) also calculated the excess CO_2, which is the CO_2 concentration difference between water and air to achieve the annual CO_2 flux of 6.1–7.0 mol m^{-2} $year^{-1}$, in Florida Bay to be between 5.2 and 6.0–7.0 µmol kg^{-1}, using a mean *k* of 11.7 cm h^{-1}; we recalculated the excess CO_2 to be between 14 and 16 µmol kg^{-1} using the *k* of 4.3 cm h^{-1}, which is parameterized from this study (Table 3). The recalculated excess CO_2 almost double their calculation of 5.2–6.0 µmol kg^{-1} and hence require more CO_2 input".

4 Summary:

- l.284-285: again, authors should dampen their conclusion when they compare ("overpredict" word used) obtained K600 values with other from bibliography since (i) they got it over few days in one particular season, (ii) other parametrizations were obtained in very different (and so not comparable) coastal ecosystems (open ocean, rivers, estuaries) and (iii) relationships with seagrass dynamic and distribution and other environmental parameters are not fully described in the present study.

- It is true that the parameterization from published studies overpredict *k* in this area, and it is one of our main results. Even though it was a short experiment, we covered a wide range of wind speeds. We added the discussion about the effect of rain and bottom-generated turbulence as you commented above.