Kroeker et al report on a meta-analysis of seagrass ecosystem metabolism from a selection of recent studies. Major goals of this study were to identify variations in ecosystem metabolism due to 1) seasonality, 2) regional differences, and 3) biological/thermal drivers, and determine the extent to which seagrass ecosystem metabolism may help to mitigate coastal OA. Unfortunately, this study suffers on two major fronts. First, the literature considered in this meta-analysis is very incomplete, and for some reason only considered dissolved oxygen-based studies (omitting all studies estimating NCP from carbonate system measurements). Secondly, the very simplistic (bordering on sloppy) approach to carbonate chemical accounting is troubling, given that the key aim of the meta-analysis was to address possible OA effects of seagrass metabolism. Because of these concerns, I find that the conclusions of the study are not supported by the analysis presented, making this work unsuitable for publication at Biogeosciences. To appropriately address the key questions of this study will require a complete re-compilation and analysis of the dataset, with an eye towards more-appropriate carbonate chemical accounting.

Specific comments:

136: The authors raise two concerns regarding the existing literature, 1) that no data exist for the N Pacific, and 2) no studies exist using direct DIC measurements. For 1), the authors should see Tokoro et al (2014) and more recent work from the group. Regarding point 2), there are in fact quite a few studies which have relied directly on DIC or DIC+TA measurements to quantify NCP in seagrass meadows. At least one of these studies (Van Dam et al., 2019) was included in this meta-analysis, and it is not clear why the authors chose to omit these and other DIC-based metabolism estimates. Others including DIC measurements include, but are probably not limited to: Perez et al 2018; Eyre et al., 2011; Ribas-Ribas et al., 2011, Dollar et al., 1991; Turk et al., 2015

143-145: There is another major conceptual flaw here regarding the treatment of data collected using different methods. It is unclear what the authors intend NCP to represent. Is this only a consideration of benthic community productivity? Or is it inclusive of water column processes as well? While some approaches may be direct metrics of water column + benthic NCP (mass balance or eddy correlation in some cases), others are very clearly metrics of only a single component of NCP. For example, *benthic* chambers explicitly exclude water column production, and are therefore only metrics of *benthic* productivity. Larger benthic chambers which include greater water-column heights may be some combination of water column and benthic NCP. It is therefore hard to understand why all methods were combined, except for 'mass balance'.

168: Again, there *are* studies in this meta-analysis that measured changes in seawater DIC directly.

170-175: The goal of this study was to assess the ability of seagrasses to mitigate coastal OA. This is necessarily a question of carbonate chemistry variability, and as such, I find the DO-based approach used here to be highly suspect. Yes, if PQ and RQ are exactly 1:1, then a conversion of DO-based NCP to DIC-based NCP is appropriate. However, there is no reason to think that either PQ or RQ should be 1:1 in a seagrass meadow where a variety of processes consume/produce DIC (calcification, anaerobic metabolism) irrespective of Oxygen exchange. As such, prior measurements place PQ somewhere between 0.5-2.6 (Turk et al., 2015), and direct comparisons of NCP_DO and NCP_DIC show very weak correlations (Barrón et al., 2006), certainly not 1:1 behavior (Van Dam et al., 2019). As a related factor, anaerobic metabolic processes in sediments can generate appreciable sediment-water TA fluxes in seagrass meadows. The impact of this on carbonate chemical buffering (thereby OA-amelioration) will depend on the stoichiometry and relative rates of the various anaerobic processes.

While direct measurements of sediment-water TA fluxes as well as PQ/RQ variability are limited for seagrass systems, they are available. Therefore, the approach of Kroeker et al of simply ignoring TA sources/sinks, and assuming a 1:1 stoichiometry for converting DO to DIC is inadequate. In order to address the hypotheses of this study, the authors will need to revisit their meta-analysis and make some effort to 1) address uncertainty in PQ/RQ, and 2) incorporate calcification and anaerobic metabolic TA sources/sinks.

234: As with the previous comment, the "steady state box model" presented here suffers from the same issue described above. By estimating NCP_DIC from NCP_DO, then calculating the effect of this NCP_DIC on pH, the authors are again directly linking DO to pH without considering any biogeochemical processes beyond aerobic respiration and photosynthesis. This is not appropriate, as high rates of denitrification, sulfate reduction, and calcification are known to affect DIC and TA dynamics (thereby pH buffering) in seagrass meadows. Calculating changes in pH from DO alone necessarily ignores anaerobic metabolism and can only result in a positive effect of NCP on pH (as is presented in this box model Figure 6). As such, the simple model presented here does not help to address whether seagrass meadows (not just the seagrass aboveground biomass) can mitigate local OA.

339: "…seagrass meadows in both geographies were net autotrophic…". Yes, these sites were on average net sources of O2, and were therefore net autotrophic with respect to O2. However, net metabolism with respect to C will be lower that O2-based metabolism, due to anaerobic metabolism in sediments (generating DIC and TA). Without accounting for these processes in some way, DO-based metabolism is simply not informative to an assessment of trophic state in the context of OA.

References:

Tokoro, T., Hosokawa, S., Miyoshi, E., Tada, K., Watanabe, K., Montani, S., et al. (2014). Net uptake of atmospheric CO2 by coastal submerged aquatic vegetation. *Global Change Biology*, *20*(6), 1873–1884. https://doi.org/10.1111/gcb.12543

Perez, D. I., Phinn, S. R., Roelfsema, C. M., Shaw, E., Johnston, L., & Iguel, J. (2018). Primary Production and Calcification Rates of Algae-Dominated Reef Flat and Seagrass Communities. *Journal of Geophysical Research: Biogeosciences*, *123*(8), 2362–2375. https://doi.org/10.1029/2017JG004241

Eyre, B. D., Maher, D., Oakes, J. M., Erler, D. V., & Glasby, T. M. (2011). Differences in benthic metabolism, nutrient fluxes, and denitrification in Caulerpa taxifolia communities compared to uninvaded bare sediment and seagrass (Zostera capricorni) habitats. *Limnology and Oceanography*, *56*(5), 1737–1750. https://doi.org/10.4319/lo.2011.56.5.1737

Dollar, S. J., Smith, S. V., Vink, S. M., Obrebski, S., & Hollibaugh, J. T. (1991). Annual cycle of benthic nutrient fluxes in Tomales Bay, California, and contribution of the benthos to total ecosystem metabolism. *Marine Ecology Progress Series*, *79*(1–2), 115–125. https://doi.org/10.3354/meps079115

Barrón, C., Duarte, C. M., Frankignoulle, M., & Borges, A. V. (2006). Organic carbon metabolism and carbonate dynamics in a Mediterranean seagrass (Posidonia oceanica) meadow. *Estuaries and Coasts*, *29*(3), 417–426. https://doi.org/10.1007/BF02784990

Van Dam, B. R., Lopes, C., Osburn, C. L., & Fourqurean, J. W. (2019). Net heterotrophy and carbonate dissolution in two subtropical seagrass meadows. *Biogeosciences Discussions*, 1–26. https://doi.org/10.5194/bg-2019-191

Ribas-Ribas, M., Hernández-Ayón, J. M., Camacho-Ibar, V. F., Cabello-Pasini, A., Mejia-Trejo, A., Durazo, R., et al. (2011). Effects of upwelling, tides and biological processes on the inorganic carbon system of a coastal lagoon in Baja California. *Estuarine, Coastal and Shelf Science*, *95*(4), 367–376. https://doi.org/10.1016/j.ecss.2011.09.017

Turk, D., Yates, K. K., Esperance, C. L., Melo, N., Ramsewak, D., Dowd, M., et al. (2015). Community metabolism in shallow coral reef and seagrass ecosystems, lower Florida Keys. *Marine Ecology Progress Series*, *538*(Hatcher 1997), 35–52. https://doi.org/10.3354/meps11385