Biogeosciences Discussions

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Comment on bg-2021-111

Anonymous Referee #2

Referee comment on "Temporal dynamics of surface ocean carbonate chemistry in response to natural and simulated upwelling events during the 2017 coastal El Niño near Callao, Peru" by Shao-Min Chen et al., Biogeosciences Discuss., https://doi.org/10.5194/bg-2021-111-RC2, 2021

General comments

This is a well written article describing an interesting and relevant study. I found the article to be a little imbalanced with respect to a discussion of the uncertainties and potential complications in the interpretation of the results. For example, there was a very thorough discussion of the uncertainties in the chemical measurements and carbon system calculations, but almost no discussion of the potential complications introduced by the brine addition or the mesocosms themselves. I know that these mesocosms have been used for many years and have been well described, but it still would have been useful to at least mention some of the potential issues associated with some of the major findings (e.g. how might the setup itself have contributed to the change in ecosystem structure). I also think the authors could have tried other approaches to try and separate the gas exchange carbon loss from the biological uptake. Related to this, I was surprised that there was no discussion of the dissolved oxygen in the mesocosms. The methods indicate that DO was part of the CTD package. Since the article is about OMZ waters, I would have expected a section on oxygen changes. DO can also help clarify the biological versus gas exchange losses.

Specific comments

Line 39 – technically the denitrification and anammox processes do not remove nitrogen from the ocean…at least without considering the required mixing to the surface and gas exchange. It would be more correct to say that these processes remove biologically available nitrogen.

Line 45 – There is no “uptake” of anthropogenic atmospheric CO2 in these high CO2 upwelling waters. You may have less degassing of the waters because of elevated atmospheric CO2, but that is not the same as uptake of anthropogenic atmospheric CO2.

Line 105:129 – I understand the concept behind the brine additions, but it seems that this could affect the ecosystem structure in the mesocosms. How do the authors know that this artificial halocline did not impact the results? In a similar vein, upwelling not only

brings up high CO_2 and high nutrient waters, but it also brings up colder waters. I assume the water added to the mesocosms was not temperature controlled, so how might that affect the results?

Line 232 – unnecessary underlining

Line 391:393 – The authors say that it is difficult to determine how much CO_2 was lost due to gas exchange because the Wanninkhof flux equations do not work in mesocosms. Since the mesocosms are essentially closed systems (except for exchange with the atmosphere), why can't the authors do a water carbon budget at the beginning of the experiment and the end to determine how much carbon was lost from the system? With the change in water chemistry and quantification of the particulates in the sediment trap, the change in total carbon should reflect the loss to the atmosphere.

Line 403:406 – How might the lack of POC buildup be related to the artificial halocline created from the brine addition? Would this keep the particles from settling out, allowing them to be recycled more effectively than one would observe in the natural environment?

Line 407:408 – By recovering from CO_2-undersaturation, do the authors mean that the waters were taking up CO_2 from the atmosphere? I am surprised that there has been no discussion of oxygen concentrations up to this point. Would dissolved oxygen help sort out the biological from gas exchange components?

Line 420:421 – The bird droppings are unfortunate. The authors raise the issue of nutrient addition, but I wonder if they could potentially impact the pH of the system?

Line 478:480 - How do the authors know that the change in ecosystem structure resulted from the change in nutrients with the upwelled water and not from the change in hydrodynamics (e.g. mixing) within the mesocosm? Is there evidence in the coastal ocean of similar changes in structure associated with the upwelling?