

Mesocosm experiments in ocean alkalinity enhancement research

This is a valuable manuscript to describe the general characteristics of the mesocosm approaches, as well as specific considerations to test the efficacy of OAE applications using pelagic and benthic mesocosms.

My major concern is about the possibility of study long-term (several years) effects of OAE applications in the marine systems using mesocosm approach. The authors are well aware about this limitation as they mentioned that “*Another drawback of mesocosm experiments is their limited duration, (Line 101-102) ...*”. This aspect may not be related directly to this “mesocosm chapter” and probably it is discussed in other chapters, however to convince public opinion, it is necessary that no harm will be done to marine ecosystems at long-term too. Therefore, it could be good to be mentioned and discuss a little bit more about the need of studies on long-term effects of OAE on marine ecosystems in this chapter.

Otherwise, the manuscript is very fin. I’ve some comments, questions and suggestions which I present below that I hope will make the manuscript more precise.

Line (L) 57-58: Therefore, to cover the seasonal succession, it is needed to conduct a mesocosm experiment during several seasons. Could it be possible to maintain such mesocosm experiment during the year(s)? In any case, it could be good to mention something about this aspect as it was suggested above.

L61: inorganic nutrient concentration, I would suggest to add a “s” for concentration as there are several nutrients.

L66: *biological characteristics (e.g. ecosystem vulnerability, time of season)*. System vulnerability depends on the communities present at the moment of the mesocosm experimentation. So, “communities” could be added as a first example of biological characteristics.

L68-69: *Key research questions which can be addressed adequately in mesocosm experiments are:* The first, second and last mentioned items are not the Key research questions which can be addressed in the mesocosm experiments, but they are requirements which can be established before mesocosm OAE experiment.

L81: I would suggest to use “communities” here in plural as there are several communities (bacterial, phytoplankton, zooplankton, etc.).

L141-143: addition of freshwater into the upper layer or brine into the bottom layer of a mesocosm, could be considered as a new treatment engendering marine organism responses to less or more saline water. This could provide additional complication for interpretation of the results regarding the effect of OAE.

L161: *1) What are alkaline mineral dissolution rates under ambient conditions?* As the results come from mesocosm experiment, “ambient conditions” could be replaced by “mesocosm conditions”.

L164-166: Are there some published papers regarding these OAE benthic mesocosm experiments? If so, please mention them. The references were not mentioned for the OAE pelagic mesocosm, if there are some references for pelagic mesocosm, please mention them as well in the pelagic mesocosm's section.

L169: Please replace “filter” by “screen” and give an example of the size of screening.

L175 : Please give examples for the monitoring frequency: high frequency? every some hours? daily, weekly? etc.

L177-182: *Water circulation approach.* It could be useful to refer in the text, the number of the figures presented in the manuscript (Fig. 3). It was mentioned in L185, but it could be also indicated before.

As well, please also refer in the entire text to the number of the figures presented in the manuscript.

L179: ... *a constant flow of water.* In the area with the tide water movement, the flow of water could/should be adjusted regarding the tide water movement? It is necessary or not?

L186: Please provide examples about replicates (at least 2?, 3?, > 3?).

L192-193: Please also give some insights about the type of sediments (sandy, rock, etc.) and benthic organisms that can be tested in the benthic mesocosms regarding OAE studies? All types of sediment and benthic organisms can be used and tested in the benthic mesocosms? If the experiment covers for example one year, how could be studied the “recruitment” of some benthic organisms that a part of their life happens in the pelagic system? It will be good if these aspects (types of sediment and benthic species) could be mentioned in the manuscript with some examples.

L200-206: *The time for equilibration may differ for pelagic and benthic habitats. Adequate monitoring during this pre-manipulation phase can determine when a new steady state is reached and confirm whether all mesocosms have similar starting conditions.*

This means that the T0 samples of all mesocosms should be taken and analyzed and if the results are similar for all mesocosms, thereafter the real manipulation can be started and monitored. Please provide the type of samples (physical, chemical and/or biological), with some examples, which can be taken and analyzed during this pre-manipulation phase. This information will also help better understanding of the L255-257.

L212-213: *Some species may even perform diurnal vertical migration, which also should be accounted for in the sampling strategy.* Which sampling strategy should be considered related to diurnal vertical migration of organisms? Sampling during the night? At which depths? Because “taking depth-integrated water samples » cannot help to study diurnal vertical migration.

L214-221: What are the conclusions of this paragraph? In the OAE mesocosm experiment, cleaning of the mesocosm walls can/should be done or not? If yes, this additional precipitation nuclei in the water column could not provide the artifacts in the experiment and result interpretation?

L262: Please name here these different minerals, waste materials and electrochemical products and provide the references.

L277: Please use entire words for MRV at the first use in the text (Monitoring, Reporting and Verification?).

L285-293: This paragraph is very important and recommendations are very reasonable and logic.

L296-307: Some references are welcome for this section.

L314-315: *It is therefore recommended to use minerals with high dissolution rates (e.g. CaO, Ca(OH)₂) and small grain sizes to ensure dissolution before the mineral particles reach the bottom of the mesocosms.* As the mesocosms are not very deep, and regarding to estimation of settling rate of these grains, what size these grains should have to dissolve before reaching the bottom of the mesocosm? It could be useful to provide in the text a notion about the grain sizes (less than ??) which are recommended to be used regarding the mesocosm depth.

L318: What could be the interaction of “secondary precipitation” with organisms in the water column of the mesocosm or in the mesocosm wall? It could be useful to provide some insights about this potential interaction(s), or if the effect of secondary precipitation on organisms is not clear, it can be mentioned in the text.

L328: Please identify the mineral which was added.

L365: *... addition of olivine is between 0.059 and 1.4 kg per square meter of seafloor without posing a risk to benthic biota.* How about the risk for the planktonic organisms? Are these values independent of the water column depth over the benthic biota? Are they the same for example if there are some cm or 1 m of water column over the sediment?

L386-387: *Care is needed to prevent hypoxia inside the chambers.* How does one know the hypoxia occurred inside the chambers. By measuring continuously at high frequency oxygen concentrations inside the chambers? Otherwise?

L501-504: Please replace m³ by m³ in legend of Figure 1, and also show the scale for the bottom right figure (or mention the depth of the KSOMOS mesocosm unit in the legend).

End of the review.

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