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Biogeosciences Discussions

Interactive comment on "A simple method for air/sea gas exchange measurement in mesocosms and its application in carbon budgeting" *by* J. Czerny et al.

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We thank anonymous referee #1 for his elaborate remarks on our manuscript "A simple method for air/sea gas exchange measurement in mesocosms and its application in carbon budgeting". Corrections and amendments as suggested by the referee helped to improve the quality of the manuscript substantially.

Specific comments

Remark by referee #1: Abstract: line 9: cumulative extrapolations of bioassays.....explain term bioassay here. There is a switch from mesocosm to bioassay, unclear why that is.

Author's response: We changed the term "bioassay" to "rates measured in side-experiments". Often rates are measured from incubations of sampled mesocosm water, e.g. measurement of community production using changes in O2 or uptake of 14C in bottles. We just want to point out that handling issues known to cause problems in such methods can be avoided by measurement of carbon uptake directly inside the mesocosm. We will rephrase this section.

Remark by referee #1: P 11991 'For this purpose, in situ measurements using the whole enclosure as experimental vessel have to be elaborated, in order to avoid problems occurring when extrapolating from bottle incubations to the mesocosm'. It is unclear here what how the bottle incubations are linked to the mesocosms? What type of bottle incubations?

Author's response: We are referring to production rates measured in side-experiments (e.g. O2 production or 14C incorporation) as discussed in the last point. A comparison of these production rates to mesocosm fluxes like sedimentation or gas exchange is problematic because it is difficult to extrapolate from incubation conditions to temperature and light gradients present in mesocosms. We will clarify this by rephrasing the respective sentences.

Remark by referee #1: P 11991: Air-sea gas exchange rates are needed to calculate the rate of exchange between the ocean and the atmosphere. The rates are not needed for comparing gas concentrations between mesocosm experiments or ocean regions.

Author's response: We agree with the referee's opinion that concentrations can be compared without considering gas exchange rates. A change in concentrations is however a product of production as well as of loss rates. Zero change can be observed at high production rates when compensated by strong losses to the atmosphere, while an accumulation of a volatile compound can be observed even at low production when losses are very small. When gas exchange rates are known for two mesocosm experiments, net biological production can be calculated and directly compared between

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these experiments. We will clarify this by rephrasing this section.

Remark by referee #1: P 11991: line 20-21: sentence lacks meaning.

Author's response: We will rephrase the sentence.

Remark by referee #1: P 11991: line 26: what is CT?

Author's response: CT stands for "total dissolved inorganic carbon", we will move the explanation of this abbreviation to the place it is first used.

Remark by referee #1: P 11993, Line 5: what was the source and purity of N2O.

Author's response: The information will be included (N2O medicAL 98,0%) Air liquide

Remark by referee #1: P 11993, line 6: 'Additions were calculated: : :.'.Unclear what his means

Author's response: We will rephrase the sentence.

Remark by referee #1: P 11993, line 20: units in equation 1 do not square up.

Author's response: The formula was written that way to simplify the calculation. Pressure was left out as it has to be 1 bar during preparation of the solution following this procedure, as well as during gas exchange with the atmosphere. We will change the equation using consistently the unit "L" and include pressure (p) as follows:

Remark by referee #1: P 11994, line 22: headspace was added to what?

Author's response: To the sample vials. We will include this information.

Remark by referee #1: P 11994, line 24: mixing rates of what? The reference material was N2O in artificial air. We included this information.

Remark by referee #1: Equation 2: what is the variable d?

Author's response: We will clarify that equation 2 describes the concentration of N20 ( ) as an exponential function of the sampling day (d)

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Remark by referee #1: Fig. 2: Please relate the different trends to the pCO2 perturbations

Author's response: We will include following description of Figure 2: During the first days after the CO2 addition (day four), maximum efflux of ∼2 μmol CO2 per kg seawater and day was calculated for the highest CO2 treatment (∼1400 μatm) at a CO2 gradient of ∼1000 μatm. In the following two weeks the CO2 gradient was reduced by outgassing of CO2 in concert with biological uptake, so that fluxes on day 27 (gradient ∼450 μatm) were considerably lower. The decrease of fluxes as a result of decreasing CO2 gradients was less pronounced in the more moderately oversaturated mesocosms due to a higher buffer capacity of the carbonate system. About 0.5 μmol kg-1 d-1 of CO2 gassed into the water from the atmosphere in the non-manipulated control treatments (∼175 μatm). Here, biological uptake was roughly balanced by influx so that the gradient remained rather constant over time.

Remark by referee #1: Fig. 6 and 3 are referred to before Fig 2.

Author's response: This will be solved by introducing the reference given within the last comment.

Remark by referee #1: Potential errors section (3.3) is not clearly reasoned. Various errors are listed in a seemingly random manner.

Author's response: The potential error section will be restructured and overall uncertainty as a result of uncertainties in single measurements will be given in a table.

Remark by referee #1: P 12000, line 4: N2O analytics should read N2O measurements.

Author's response: Will be changed.

Remark by referee #1: P 12000, line 17: should read: too low

Author's response: Will be changed.

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