

Interactive comment on “Perturbation experiments to investigate the impact of ocean acidification: approaches and software tools” by J.-P. Gattuso and H. Lavigne

Anonymous Referee #1

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The manuscript presents a review of the perturbation techniques applied when studying the impacts of ocean acidification and discusses the pros and cons of each technique, thereby focusing on the carbonate-pH chemistry. The thermodynamic calculations are done with the software package “seacarb” and in the manuscript the authors also present the syntax of 5 new functions of this software that are tailored for the chemistry of those perturbation techniques.

General comments & Recommendation

The manuscript is well written and (in general) clearly presented and the authors give

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proper credit to the relevant literature. However, the manuscript more appropriately fits into the category of a ‘technical note’ rather than a ‘scientific paper’, because it does not present any novel ideas, methods, concepts, tools, or data. Hence, I suggest labeling it accordingly. A more appropriate title, for example, could be: ‘Technical comments on perturbation experiments used to investigate the impacts of ocean acidification’.

Although there might be the need for a software package, such as seacarb, in the ‘ocean acidification community’ with functions tailored to the perturbation techniques, as also commented by referee #1 in his Access Review, I do not agree that this justifies to award the ‘manual’ of a software package with the merit of a ‘scientific article’. Advertising of the software package and new functions is acceptable, though.

The underlying thermodynamic equations (mass action laws for the carbonate dissociation and calcium carbonate dissolution in water as well as Henry’s law) are ‘chemistry 101 knowledge’ and also the pressure, temperature, and salinity dependence of the thermodynamic constants is well known. The manuscript of Gattuso & Lavigne does not present any new algorithms for the calculation. Moreover, the authors just present 5 ‘black box’ functions, which they do not explain, where actually trivial and simple algebraic equations exist as analytical solutions to the 5 problems (since the phosphate and silicate dissociation usually can be neglected). The respective equations and solutions have been published many times in the past, recent ones are the book of Zeebe & Wolf-Gladrow or Millero (2007) Chem.Rev.107. Therefore, I suggest that the description of the syntax of the seacarb functions is completely removed from the manuscript into the electronic supplement. The same applies for the example calculations (which would actually be useful in the seacarb manual (April 22, 2009), where they are not included!).

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As conclusion, I recommend re-submission of the manuscript as a technical note in a more condensed format, focusing on a critical discussion and evaluation of the perturbation techniques. The current figures and tables provide a good basis for this.

Major comments

1) The description of the syntax of the seacarb functions and the example calculation rip the discussions of each of the perturbation techniques into 2 parts and therefore, should be completely removed from the text. See also general comment above.

2) The sections for each perturbation technique need clearer formatting. I suggest sub-headings, e.g.:

3.1 Gas bubbling

Intro sentences with history and description. . . .

3.1.1 pH-stat

Pros:

Cons:

3.1.2 Bubbling with premixed gases

Pros:

Cons:

This will greatly improve the presentation and enable the reader to follow the evaluation more easily.

3) For the 'addition of high-CO₂ seawater' technique no evaluation (pros and cons) is given. Are there none?

4) The underlying thermodynamic equations or trivial algebraic solutions for each problem could be given in the supplement instead or in addition to the 'black box'

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seacarb functions.

Minor comments

1) There are quite a few typesetting and grammatical mistakes as well as awkward wording in the manuscript that need correction and polishing.

Some examples are:

- p. 4427, l. 4-6: re-write as: 'The approach of adding CO₃²⁻ and/or HCO₃⁻ appears to be of limited practical use because most variables of the carbonate system reach values that are far from the 2100-target values.'

- p. 4421, l. 7: 'latter' instead of 'later'

- p. 4421, l. 11+12: 'co3' and 'hco3' instead of 'CO₃' and 'HCO' since this is the spelling in the seacarb function. Also: 'amount of HCO₃⁻' instead of 'HCO₃²⁻'.

- p. 4421, l. 16: 'The respective commands . . . are:' instead of '. . . command . . . are, respectively'. This mix-up of 'singular noun' and 'plural verb' or vice versa actually happens several times in the manuscript.

2) The figures need to be enlarged, because the labels are hard to read. Line widths should also be increased.

3) In Fig. 3 the "f" values are missing in all plots.

4) p. 4422, l. 3-4: pH values in the text do not match those in Tab. 2: 7.793 (not 7.993) for 2100 and 7.942 (not 7.941) for the open system.

p. 4423, l. 18: same problem: the pH of 2100 is 7.793 in Tab. 2 and 7.993 in the text.