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Ocean Science
Discussions

Interactive comment on "Modeling the effects of size on patch dynamics of an inert tracer" *by* P. Xiu and F. Chai

Anonymous Referee #2

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This paper performs several numerical experiments, where a patch of dye of different sizes are introduced into a flow field and the fate of the patch is examined. The dilution of the patches appear to follow theoretical dispersion, but the timescales appear different depending on the initial size of the patch. The bottom line is that bigger patches take longer to disappear and maintain higher values for longer - so could have more impact in, for instance, iron fertilization experiments.

I think a version of the paper is worth publishing, however I have some serious queries about the consequences of some of the definitions (such as "disappear") and a concern that there is no attempt to see how normalizing the results with the total amount of dye introduced would impact the inferences.

Main concerns:

1) the definition of "disappearance" of the patch is given when the dye drops to 0.1. How would a different definition change your results (e.g. Laws 1/e)? In fact the dye never disappears, but becomes increasingly diluted. What would happen if you used a specific value rather than a ratio as the definition (see 2 below). If this dye was iron and introduced at 2nM, would its impact be totally gone if it "disappeared" (i.e. 0.2nM) as given by the definition here. I suspect not - so absolute values are still relevant here.

2) larger patches have larger amounts of dye added. Is there some way to normalize your results with this in some way? For instance would the same amount (mass) of dye added in a smaller patch take as long to "disappear", if the definition of "disappear" was based on on an actual rather than relative value. I think an additional experiments (or diagnostics) to see the impact of total amount of dye on the results is warranted to address this question. This is especially true given that the authors motivate these experiments by iron fertilization experiments.

3) even given the above, the authors should be careful on extrapolating their results to iron fertilization experiments - this is after all a passive tracer that they are looking at here, and the timescales of the biological uptake may change the dispersion results significantly. There are few statements in the text that mention this limitation: I think more should be mentioned in this regard in abstract and conclusions.

4) nothing is mentioned about the (smaller) scales that are missed by the physical model. It would be good to mention that your model does not capture all the scales and speculate on what is being missed as a consequence.

Some details:

1737 line 1-3: I think you mean that "impact of patch size" was not investigated. As written here you suggest that influence on phytoplankton bloom and carbon cycling

was not investigated - and that is obviously not correct.

1737 line 7-10: I think the biology could have an order 1 impact – if the biological timescale is quicker than the advection and diffusion timescale, then I think this statement is incorrect.

1737 line 14-17: It would be nice to have a brief explanation of why the growth goes in these two stages.

1737 line 19: I think you mean "first" not "second" stage here?

1738 line 16: Since nutrients are not addressed in this article, K(N*-N) seems a bit confusing.

1739 line 13-14: Why do you say "IT is very similar to SF6". In what manner (inert)?

1739 line 22: What happens if you use 1/e instead?

1739 line24-25: How was this fitting technique done?

1739: line 25: remove "that"

1742 line 17: "While note..." is an awkward sentence. Also, I think you need more clarification in this regard through out the paper.

1744 line 8-15: Similar results would probably also be true if you had used different locations instead of different initialization time. Given this, it suggests you need to be more emphatic that exact times calculated here are not important, but rather the sequence of dispersion.

1745 line 14: "larger patches have more nutrients". I think you mean more "iron" - this sentence is not clear.

Figures: the axis labels (numbers and words) are much too small.

Interactive comment on Ocean Sci. Discuss., 6, 1735, 2009.