

## ***Interactive comment on “Assimilation of chlorophyll data into a stochastic ensemble simulation for the North Atlantic ocean” by Yeray Santana-Falcón et al.***

### **Anonymous Referee #2**

Received and published: 23 April 2020

This paper describes the assimilation of chlorophyll into a model of the North Atlantic Ocean using the SEEK assimilation method. The method relies on an ensemble of 24 members. The results show that the models' chlorophyll, which is the variable that is assimilated is improved after assimilation, however not in all regions. In some regions the model variability does not cover the observations and there the assimilation does not improve the chlorophyll. The model results also show that the non-observed variables (nutrients) are not necessarily updated to a better state and in some regions it increases in the upper 100 meters. Finally, they propose a method for alleviating this problem by only applying assimilation to the model fluctuations, this method is demonstrated for one month only.

C1

Overall, I find the paper well written with very interesting results that contribute to the development of data assimilation methods for biogeochemical models and is therefore relevant for OS. However, there are a few things that are unclear, so I propose some minor revisions to this manuscript before it is accepted for publication.

Main comments:

1) Method of generating the ensemble: here the paper simply refers to two publications and refer the reader to those. The method of generating the ensemble is very important and I think the reader deserves a short description of how this was done.

2) Update the paper structure: The method of only assimilating them model fluctuations around the climatology, should be introduced in the method section and the results presented in the result section. Then reserve the discussion section for discussion of the results. I am also confused by the sentence that starts with “For the sake of.. “ on line 416, so please clarify what you mean by the climatology in this case. Also specify which period is run. What happens to chlorophyll in this case, is the spread of the profiles increases or does it just appear that way in the figure 9?

3) Trying to understand the results in context of the physical model performance: It would be useful to have some information on the physical models' performance, I am thinking especially of the representation of the extent of the subtropical gyre, since that seems to be a problem area.

Other:

In the title and abstract ‘ocean’ is spelled with a capital O.

Abstract “... are assimilated daily into...!

Line 40 and onwards: Please explain the statement: “However, none of the latter studies explicitly incorporates the uncertainties in the ocean biogeochemistry introduced by stochastic approaches.” For example Ciavatta et al 2011, generates an ensemble by perturbing the background light attenuation, that would also be considered a stochastic

C2

approach, no? Do you mean that in this case the perturbations are done on the model parameters and not on the forcing?

Line 42: "...to what extent..."

Line 45: "To that end.."

Line 65: I would characterize 1/4 degree resolution as eddy permitting rather than eddy resolving.

Line 85: the model description mentions iron input from rivers, are any other nutrients supplied from rivers?

Line 106: Do you mean the "biogeochemical system"?

Line 108: Specify which key biogeochemical parameters were perturbed?

Line 115: It should be "cost efficient"

Line 118: "We observed that the..."

Line 123 exchange "one-day" with "daily composites"

Line 130 "commented on below..."

Line 136 delete "biomass" at the end of the sentence.

Line 215: suggest "minimize" instead on "diminish"

Line 224-225: suggest: "However, there is a too strong gradient between the oligotrophic conditions of the North Atlantic subtropical gyre and temperate waters to the north."

For the discussion: What could be done to reduce the 'stripes' left by the satellite swaths on the DA analysis?

The very northward region would be ice-covered during part of the season, is that included in the model?

C3

Please provide the name of the Longhurst provinces by names in addition to numbers in the figures, there is room for that and it will make the reading of the paper easier.

Figure 6 and 9: it is very difficult to read the black text on the dark blue background, try white text?

Figure 6: In province 6, the deeper nutrients also quite far off from the climatology also in the free run, why is that? Does it persist far down into the deeper layers?

Figure 7: Could you add a third column where you show the isolines of climatological nitrate?

Line 393: "... (1) it significantly reduces ..."

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C4