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Ocean Science
Discussions

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 #1

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This study presents an ensemble data assimilation scheme for ocean colour, based on stochastic parameterisations and the SEEK filter. A 24-member ensemble is run for one year with and without assimilation, and assessment made of the ensemble spread and fit to observations. The assimilation generally improves both of these, as long as the prior ensemble spread is sufficient. If not, then the assimilation can degrade unobserved variables. This impact was reduced in a short experiment where the assimilation was applied only to anomalies from model climatology.

The paper is interesting and well written, and the assessment clear and balanced. A few things need expanding on or clarifying, as detailed below, but if those are ad-

dressed then I recommend publication in Ocean Science.

Major comments:

Given that the paper is taking a previously used deterministic assimilation scheme (e.g. Fontana et al., 2013) and turning it into an ensemble scheme, I was surprised that no comparison was made to a static implementation of the SEEK filter. I appreciate that the main focus of the paper is to study the ensemble aspects, and that ensembles give probabilistic information that is more widely useful, but given the 24-fold increase in computational cost, it would be useful to see how the ensemble median compares to a deterministic assimilation run. A deterministic run is mentioned in the text (lines 98-99) but not presented, so hopefully this would not involve too much extra effort. It could either be an extra sub-section of the results, or incorporated into some of the existing figures.

The last paragraph of Section 2.3 briefly states that ensemble sizes of 12, 24 and 60 members were compared, and 24 able to give similar results to 60. The issue of ensemble size is an important one that will be of wider interest, so I think this assessment should be presented in the paper.

Section 4.3 is very interesting but also brief. It's fine for it to just be a one-month experiment, but it would be useful to expand on both the methodology (e.g. is the seasonal cycle considered in calculating the climatology?) and the assessment (what's the general impact on chlorophyll skill?).

Minor comments:

Figures: Many use a rainbow colour scheme, which is increasingly discouraged (e.g. Hawkins et al., 2015; https://doi.org/10.1038/519291d). There is no "best" colour scheme I can recommend, but it is worth considering if there is a more appropriate colour scheme for these plots.

Figure 1: It would be best to mask out areas which are not in the model domain (e.g.

the Pacific and eastern Mediterranean).

Line 65: “eddy-resolving” should be “eddy-permitting”.

Line 67: “ERA-INTERIM atmospheric fields (Brodeau et al., 2010).” The reference refers to ERA40, not ERA-Interim.

Lines 98-99: “a deterministic simulation . . . for a period of six years” – this doesn’t seem to be presented?

Lines 107-108: Please provide a little more detail on the perturbations, so the casual reader doesn’t need to read the references.

Line 163: Worth clarifying that only SeaWiFS, MODIS and MERIS are used for 2005.

Line 170: Remove “completely”.

Line 173: “NOOA” should be “NOAA”.

Line 232: “satellite swaths leave imprints of their trajectory”. It would be good to discuss why this might be happening in the Discussions section. Is it due to the 1 degree localisation radius? Does it imply that the increments are not being retained by the model?

Lines 254-255: “preserves its reliability . . . showing a better reliability.” I understand what’s meant, but it’s maybe worth rephrasing these two sentences to be clear about how the reliability has/has not changed.

Line 293: “ the metric tends to zero”. Perhaps I misunderstand what’s meant, but it looks to me like this is a seasonal feature, and the resolution is starting to increase again the following spring, rather than it tending to zero and staying near zero.

Figures 6 and 9: In the labels, the black text on dark blue for “Satellite product” is very hard to read, and “WOA2008” is grey in the label but black on the plot. I think it worth altering how the labels are plotted for clarity. Also, what’s the reason for the dotted grey

line at 50m depth?

Figure 7: The x-axes should be labelled with “N” rather “W”. What is the reason for the bold dotted lines at 150m and 200m?

Line 375: “An inferior boundary that may cause this overestimation.” I think this needs expanding on.

Line 404: “the ensemble is not stochastic enough”. I think a more accurate phrasing would be “the ensemble has insufficient spread” or something similar.

Line 409: “a more homogeneous ensemble”. Again, I think this needs rephrasing. The histogram is more homogeneous, which means the ensemble has more appropriate spread, rather than being homogeneous itself.

Lines 450-454: Is the assimilation just having a weaker impact, or is it having a better impact due to the reduction of model bias in the assimilation?

Line 462: “unusable”. Arguably, but I would suggest “of limited use” or “insufficient”.

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