

Ocean Sci. Discuss., referee comment RC3  
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## **Comment on os-2021-35**

Anonymous Referee #3

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Referee comment on "Can assimilation of satellite observations improve subsurface biological properties in a numerical model? A case study for the Gulf of Mexico" by Bin Wang et al., Ocean Sci. Discuss., <https://doi.org/10.5194/os-2021-35-RC3>, 2021

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This study implements DEnKF-based data assimilation of satellite sea surface temperature, sea surface height and chlorophyll, and in situ temperature and salinity, with a physical-biogeochemical model of the Gulf of Mexico. The results are validated using the assimilated data plus profiles from five independent BGC-Argo floats, with a particular focus on subsurface biogeochemistry. Following the validation, a change was made to the light attenuation parameterisation to improve the fit to BGC-Argo chlorophyll.

The paper is well written and the experiments and results useful and well described. Subject to a few minor revisions, detailed below, I recommend publication in Ocean Science.

P2 L41 - "discretion schemes" should presumably be "discretization schemes"?

P3 L65-70 - while less focus has definitely been given in the literature to validating the subsurface than the surface, it's not as rare as this paragraph would suggest. Some of the studies already referenced, and more besides, perform some validation of the subsurface, including on a point-to-point basis. See e.g. Fontana et al., 2013; Ford and Barciela, 2017; Mattern et al., 2017; Cossarini et al., 2019. The paragraph should be rephrased accordingly.

P3 L74 - I think "Garcon" should be "Garçon".

Is any transformation performed for chlorophyll to deal with non-Gaussianity?

Do the observation errors used account for representation error? Is this likely to affect results?

P8 L04 - would additional metrics, even just bias and correlation coefficient, give additional information? Furthermore, chlorophyll and other biogeochemical variables are not normally distributed. Is RMSE appropriate here?

P10 L56 - can the uncertainties be quantified?

P11 L87 - how was significance calculated?

P11 L93-94 - what method was used to calculate the old and new parameterisations?

Please comment further on why Fig. 9 shows limited improvement in the free run with the new parameterisation. Does this imply that the parameterisation is too tuned to the BGC-Argo data, or that state-parameter estimation might be the best long-term approach?

Fig. 1 - please state what the red square represents. Is this the model domain?

Fig. 3 - please include units where appropriate. (a-e) should probably be (a,b,d,e).

Fig. 7 - should the observations be included in a subplot here, as in Fig. 4?

Fig. 10 - what is meant by DCM increment? DCM is not one of the state variables included in the assimilation.

Fig. S3 does not appear to be referred to in the text. More generally, the figures in the supplement could reasonably be included in the main paper, but I appreciate the desire to limit the number of figures.