Ocean Science Discussions

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Comment on os-2021-35

Anonymous Referee #4

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-RC4, 2021

The study is investigated the ability of available satellite information on ocean surface physical and biological properties to constrain and improve simulated subsurface biogeochemistry in the Gulf of Mexico. The study also shows an example of using complementary Argo data. In this respect the paper nicely suits the frame of the journal. Generally, the manuscript is well structured and clearly written. The figures are of a good quality. I have got just minor comments (please see below) the authors might still want to consider before publishing the manuscript.

Title: an edit is required ”…assimilation of satellite physical and biological observations …”.

It is a bit confusing: the title emphasizing the use/role of satellite information in improving subsurface biogeochemistry, however Argo data are also assimilated. Could the title reflect the use of Argo data?

Specific comments:

Line 15:16. reads as BGC-Argo data are also assimilated complementary to the satellite data. Reads a bit contradictory to the title or vice versa the title reads contradictory to the statement.

P1, L18: “… into a three-dimensional biogeochemical model …”

P2, L30-31: How was the tuning done? To a certain extent it is still a kind of assimilation

of the information.

P2, L41: “discretization and numerical schemes” instead of “discretion”

P2, L45: “.” is missing in the end of the sentence.

P2, L48: suggest to add “(e.g. Chla)” after “satellite data of ocean colour have been the major source of observations”

P2, L51: correct reference is Pradhan et al., 2020

P4, L85-86: are the mentioned five BGC-Argo floats really independent if used for the model calibration (model optimisation even though by "trails-and-error")?

P5, L31: “observational operator” instead of “measurement operator”

P6, L53-54: The specified (assumed) observational errors for SSH and SST are quite small, which could lead to overfit to the data with possible deterioration of the state for other model variables.

P7, L79-80: Inflation is normally introduced to account for uncertainties in approximation of model error (due discrepancies in the forcing or internal model parameter/ parameterisations), which consequently alters the ensemble spread.

P7, L89-91: It would be nice to provide a reference to a study on model sensitivity to these particular parameters? A motivation and a reference to a procedure of parameter perturbation would support. Please also make it clearer whether the parameters are perturbed just to introduce more stochasticity to the system (e.g. Pradhan et a. 2019, 2020) or the data assimilation experiment considers also parameter estimation (Doron et al., 2011, Simon et al. 2015).

P8, L1-3: Please consider rephrasing this sentence. The length of the state vector should not affect crucially the computational cast. Normally the time required for the analysis (independent on the length of the state vector) takes much less than the computational expenses required for running the ensemble itself. It is worth providing another argument for justification of the choice of model variables included to the state vector.

P8, L4-12: It is worth showing both criteria RMSD and unbiased RMSD (+ additional? bias). In this case it would be clearer for the reader for which model variables the solution deviate systematically or randomly from the observations, whether the data assimilation allows to reduce bias (if any) or random part of the obtained differences between model and observations.

P9, L24: "This figure shows" or "This comparison shows"

Figure 2 could be slightly increased.

Supplement, Figure S3: a legend or more detailed figure caption is required.

References:

Doron, M., Brasseur, P., & Brankart, J.-M. (2011). Stochastic estimation of biogeochemical parameters of a 3D ocean coupled physical–biogeochemical model: Twin experiments, Journal of Marine Science, 87(3), 194– 207. https://doi.org/10.1016/j.jmarsys.2011.04.001

Pradhan, H. K., Völker, C., Losa, S. N , Bracher, A. and Nerger, L. (2020): Global Assimilation of Ocean-Color Data of Phytoplankton Functional Types: Impact of Different Data Sets , Journal of Geophysical Research-Oceans, 125 , e2019JC015586 . doi: 10.1029/2019JC015586

Simon, E., Samuelsen, A., Bertino, L., & Mouysset, S. (2015). Experiences in multiyear combined state–parameter estimation with an ecosystem model of the North Atlantic and Arctic Oceans using the ensemble Kalman filter. *Journal of Marine Systems*, 152, 1– 17.