

REVIEW COMMENTS FOR THE MANUSCRIPT: “ASSIMILATING BIO-OPTICAL GLIDER
DATA DURING A PHYTOPLANKTON BLOOM IN THE SOUTHERN ROSS SEA
(BG-2017-258)” BY DANIEL E. KAUFMAN, MARJORIE A. M. FRIEDRICHS, JOHN C.
P. HEMMINGS, AND WALKER O. SMITH JR.

The authors present a data assimilation study that optimizes parameters in a one-dimensional biogeochemical model using glider observations in the southern Ross Sea. They show insensitivity of the result to the geographical location of observations, but the optimizing parameters is sensitive to the sampling frequency.

The paper is overall well-written, but I hope the reviewers be able to address comments that I have.

- The procedure can be clarified more. This study utilizes a one-dimensional model for 3D observations. Does the cost function use all the observations and estimate one set of the parameter? Or is there an optimized parameter set for each location? If the first approach is used, do you expect that the optimized parameter values represent the distribution of those obtained by the second approach?
- The authors argue that the data assimilation performance is sensitive to the observation sampling frequency due to “mesoscale variability”. Mesoscale variability also means the variation in space with the scale of $O(100\text{km})$. But it is odd to see that the geographical region does not show a big impact on the performance. Could the author comment on this?
- By construction, the role of advection is not considered in this study. Can authors comment on the role of advection in this region? Do authors think the insensitivity of the assimilation performance to the geographical location of observations is related to the omission of advection?
- line 85. The effort on estimating biological state variables can be listed here. (e.g., Song, H., C. A. Edwards, A. M. Moore and J. Fietcher, 2016: Data assimilation in a coupled physical-biogeochemical model of the California Current System using an incremental lognormal 4-dimensional variational approach: Part 3, Assimilation in a realistic context using satellite and in situ observations. *Ocean Model.*, 106, 159-172.)
- section 2.1: What is the vertical resolution of the model?
- line 114: The full name of BCO-DMO can be given.

- line 115: 5-m vertical binning is done using averages? or weighted average?
- Equation for the cost function shows that the observational error covariance is estimated using the standard deviation of the observations. Is this right? I think using standard deviation may overestimate the observational error if the blooms dominate the chlorophyll variability. If the error levels of the instruments are known, why not use these values?
- section 2.4: Personally, it is not easy to digest this method. Maybe a diagram can help me and readers to understand the assimilation procedure better.
- lines 244–245: Can you provide the number for the difference? If these two cases (50 m vs 200 m) are not significantly different, I would rather present the one with 200 m. Is it because of the computational time? (Also I hope the authors say something about the speed of this data assimilation calculation).
- section 2.6.2: Are there any changes in spatial coverage between “glider”, “cruise” and “satellite” data cases? If they have the same spatial coverages, naming this way may confuse readers because it is obvious that their spatial coverages are significantly different.
- lines 474–476: Do authors have any ideas why satellite-derived data underestimates carbon export?
- lines 480–483: I think the phrases after “and it is” are not necessary. Please consider to remove them.