General comments:

Despite the increasing significance of BGC models, the model validation is limited to the comparison with satellite estimates of surface properties, the climatological data, and/or sparse in-situ observations. In recent years, the fast growing BGC-Argo network provides opportunities to evaluate BGC models in an unprecedented spatial and temporal resolutions. Since there is a large number of floats at the global scale, it becomes difficult to evaluate the global model through the point-to-point comparison which has been used in the regional model. This study suggests some BGC-Argo-based metrics to evaluate a global model and provides some diagnostic plots to display these metrics. This manuscript is well structured and easy to follow. I would suggest to publish after minor revision.

Specific comments:

P5 Line 18-23: The BGC-Argo-based POC concentrations were obtained from the filtered bbp signals and therefore should be the small, slow-sinking POC (i.e., 0.2-20μm) (Dall'Olmo and Mork, 2014; Lacour et al., 2019). In the following model description (P6 Line 15-16), the authors mentioned that their POC model had two size classes. Which modelled POC class was compared with the BGC-Argo based one?

Based on Roesler et al. (2017), the BGC-Argo based chlorophyll were suggested to be divided by a factor of 2 due to the systematic error in fluorometers. It seems that the authors did not apply this correction to the chlorophyll. If not, this can partially explain the model underestimation of surface chlorophyll in the high-chlorophyll regions (please see the Figure 4). The authors should include some descriptions on how they process the BGC-Argo based chlorophyll.

P5 Line 25-30: I am concerned with the comparisons between the global model and the estimates from CANYON-B neural network which is also a model. Although it has been validated with some independent observations (e.g. the GO-SHIP cruise data and BGC-Argo floats), differences between the global model and the CANYON-B neural network may come from the CANYON-B neural network's deviation from the observations.

P8 Line 1-2: Since the POC concentrations vary a lot (~ 2 orders of magnitude) within the mesopelagic zone, the averaged POC concentrations will be skewed to the upper layers right below the mixed layer. In addition, the reference is not approporiate here since the upper bound of mesopelagic zone was defined as the base of productive layer (the maximum of mixed layer and the euphotic zone) in Dall'Olmo and Mork (2014).

P8 Line 13: What is the definition of H? I guess it is the mixed layer depth (MLD).

P13 Line 26-29: I don't agree with this sentence "However, *this seems to have a limited effect on the export of POC* …". First, the conclusion here is anti-intuitive because the authors mixed

up the POC concentration with the POC export flux. In the north Atlantic, the POC concentration is largely determined by the small, slow-sinking POC. Although the relative contributions of small, slow-sinking POC has been recently addressed, the POC export flux is dominated by the gravitational sinking flux of large, fast-sinking POC, which is estimated by multiplying the concentration and sinking velocity. Therefore, the large differences in the POC export flux can be hide by the similar POC concentrations. Second, the lower sPOC but the similar levels of POC_{meso} (Figure 6) can be a result of the suboptimal parameter values, e.g. the underestimated remineralization rate. However, this cannot deny the sensitivity of POC_{meso} to the primary productivity. This is very likely that the POC_{meso} will vary a lot if the authors change the modeled primary productivity.

Reference

Dall'Olmo, G. and Mork, K. A.: Carbon export by small particles in the Norwegian Sea, Geophysical Research Letters, 41(8), 2921–2927, doi:https://doi.org/10.1002/2014GL059244, 2014.

Lacour, L., Briggs, N., Claustre, H., Ardyna, M. and Dall'Olmo, G.: The Intraseasonal Dynamics of the Mixed Layer Pump in the Subpolar North Atlantic Ocean: A Biogeochemical-Argo Float Approach, Global Biogeochemical Cycles, 33(3), 266–281, doi:10.1029/2018GB005997, 2019.

Roesler, C., Uitz, J., Claustre, H., Boss, E., Xing, X., Organelli, E., Briggs, N., Bricaud, A., Schmechtig, C., Poteau, A., D'Ortenzio, F., Ras, J., Drapeau, S., Haëntjens, N. and Barbieux, M.: Recommendations for obtaining unbiased chlorophyll estimates from in situ chlorophyll fluorometers: A global analysis of WET Labs ECO sensors, Limnology and Oceanography: Methods, 15(6), 572–585, doi:10.1002/lom3.10185, 2017.