

Comment on bg-2021-145

Anonymous Referee #2

Referee comment on "Episodic subduction patches in the western North Pacific identified from BGC-Argo float data" by Shuangling Chen et al., Biogeosciences Discuss., <https://doi.org/10.5194/bg-2021-145-RC2>, 2021

This manuscript describes a method for detecting water subduction associated with mesoscale eddies in the western North Pacific and estimates of the amount of material transported into the mesopelagic zone. The authors detected episodic subduction patches using spicity and oxygen anomalies from the BGC-Argo dataset. They found 288 subduction patches, most of which were observed between March and August in the Kuroshio Extension region. Most of subduction patches were found below the annual permanent thermocline depth (450 db). They estimated export rates of oxygen and carbon on the order of 175 to 417 mg O₂ m⁻² day⁻¹ and 85 to 159 mg C m⁻² day⁻¹. The method used in this manuscript to detect subduction is very interesting. It is also an important finding that many subduction patches exist in the Kuroshio Extension region and that many of them are deeper than the permanent thermocline. On the other hand, it is important to know the distribution and amount of material transport by subduction, but the analysis and discussion are not sufficient. There are some problems with estimation the amount of material transported by subduction. I cannot recommend this manuscript for publication. I request significant revision and additional discussion.

Major comments

1) In this study, subduction patches were detected using a unique method. The spatial (horizontal and vertical) distributions of patches and seasonal variation of number of patches are discussed respectively, but it will be necessary to combine them. If the authors are going to discuss oxygen export by subduction, the patches must be considered separately shallower and deeper layers than the permanent pycnocline. Since the depth of permanent pycnocline differs between the subtropical and subarctic region, it is also necessary to distinguish between the regions.

2) Oxygen and carbon inventories should be estimated in each region and depth after classifying the water masses as described above. Subduction patches shallower than the permanent pycnocline are not isolated for long time because they dissipate in the next year. On the other hand, subduction below the permanent thermocline, where carbon can be sequestered from the atmosphere for long time, is the important transport process. It will be difficult to clarify the entire spatial distribution of patches below the permanent pycnocline and to estimate the amount of material transported by subduction using Argo dataset. However, it may be meaningful to calculate the mean value of the patches separately by area and depth, and compare them.

Specific comments

- Line133-136: The material transport by subduction is a topic of great interest to Biogeochemical scientists. However, "spicity" is not a familiar parameter, so a detailed explanation of spicity is needed.
- Line242-244: The authors assume that the lifetime of subduction patches is one year. However, it is expected to vary depending on the depth and the region. This calculation should be reconsidered.
- Fig.4b: The anomalies of spicity, indicated by boxes in Fig.4b, is unclear.
- Line297-303: The fact that anomalies were observed four consecutive profiles does not mean a sustained or a large spatial subduction event. A further analysis of the water mass using the surrounding water temperature and salinity would be necessary to show the spread of the subduction.
- Fig.5: The distributions of EKE and SLA are unclear. It might be better to use only contour line instead of color gradients.
- Fig.6: I do not think it is necessary to apply smoothing to these graphs; it would be easier to show them in a monthly summary, as in Fig.2S.
- Line 398: AOU or Δ AOU?
- Line 403-404: The authors mention high levels of phytoplankton production as the cause of the strong AOU anomaly from March to August, but it should be clear whether this indicates the release of oxygen from phytoplankton production or the consumption of oxygen by decomposing large amount of organic matter.
- Table2: I cannot understand what inventories and exports on the peak height mean.
- Line 463-469: The oxygen export rate calculated here should not be compared to the oxygen consumption rate in the Southern Ocean.