

Review #2 of Dietze and Löptien's "Argon Saturation in a Suite of Coupled General Ocean Circulation Biogeochemical Models off Mauretania" (manuscript #: 2024-918)

General comments:

The authors of this manuscript examine the model-simulated inaccuracies in diapycnal mixing that cannot be explained by the horizontal resolution near Mauretania and find that it's comparable to advection numerics and choices of background diffusivity by making use of argon saturation as a proxy for effective mixing. The method makes use of Argo saturation and is simpler than previous methods for detecting spurious diapycnal mixing, except is somewhat similar (in signal detection capability and complexity) to that of Holmes et al. (2021). The distinction between using Argon saturation for diagnostic purposes (spurious diapycnal mixing) as opposed to constraining mixing parameters in ocean models in a data assimilation application needs to be better clarified because there are long passages in the introduction's text that seem to suggest that the authors are going to choose Argo saturation over, for example, biogeochemical tracers, which are used (e.g., in a submitted paper by Ellison et al.) for the other application. This manuscript further points out nuances with using Argo saturation as a proxy for diapycnal mixing, such as the fact that equilibrating air-sea fluxes can erase oversaturation signals, which makes Argo saturation less than perfect for diagnosing spurious diapycnal mixing. But in the way the authors experiments are designed (e.g., using different background diffusivities), their conclusions can be drawn. I suggest technical revisions. Specific comments are listed below:

Specific comments:

Line 21: "erroneous" is still spelled incorrectly (currently spelled "erroeneous")

Line 68: "... so complex that the essence..." should have an example cited such as "... so complex (e.g., Ilıcak (2016)) that the essence..." where Ilıcak (2016) is Ilıcak's "Quantifying spatial distribution of spurious mixing in ocean models" in Ocean Modelling

Line 81: Before the sentence, "The relatively novel approach..." the authors should insert a sentence like, "While argon saturation is poorly observed, especially when compared with the observational coverage of biogeochemical tracers, for example, this study makes use of argon saturation as a model diagnostic, not a data constraint." I suggest this because the reader may get the idea that Argo saturation is used as a data constraint to calculate ocean mixing parameters with the previous discussion about how studies have done that to date, and if one wants to ultimately use observations of Argo saturation to guide ocean mixing, they will only have a single transect going south from Alaska, a couple of zonal transects in the equatorial Atlantic Ocean, and a couple of meridional transects in the equatorial Atlantic Ocean of Argo concentrations in the World Ocean Database. This seems like the best place to clarify that Argon saturation is used here more for diagnostic purposes of spurious diapycnal mixing in ocean models.

Line 205: "... integration time of maximal three years) which constrains potentially spurious effects..." should be "... integration time of a maximum of three years) which limits potentially spurious effects..."

Line 230: "...can be indicative for spurious dispersion)." should be "... can be indicative of spurious dispersion)."

Lines 335-336: The sentence, "We suspect that the same holds..." can be deleted because it doesn't add anything (just speculation).

Line 393: The authors are missing an end parenthesis: "(Porcupine Abyssal Plain and POMME region, respectively)."