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Biogeosciences Discussions

Interactive comment on "Apparent oxygen utilization rates calculated from tritium and helium-3 profiles at the Bermuda Atlantic Time-series Study site" *by* R. H. R. Stanley et al.

Anonymous Referee #3

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The authors use oxygen, tritium and ^{3}He data from the BATS site in the subtropical northwest Atlantic for the period 2003 to 2006 to derive apparent oxygen utilization rates (AOUR) as well as carbon export fluxes. Specific transit time distributions (TTD) that were theoretically derived for 1D advective/diffusive transport are applied to describe the age distributions of the waters in the upper 1000 m at the BATS site.Published tritium source functions together with the BATS tritium and ^{3}He data are used to estimate the mean water mass age Γas well as the Γ/Δ TTD parameter at all depths. AOUR values are calculated from observed apparent oxygen utilization (AOU) und the mean water mass ages obtained from the TTDs. The authors also calculate the AOUR integral for the upper 500 m as an estimate of carbon export flux. An

error analysis is provided and results are compared with published values.

The manuscript addresses important biogeochemical questions and provides new data and results. The paper is suitable for publication in Biogeosciences after themajorissueslisted below have been addressed. Most of these issues have to do with the way the AOU data as well as the estimated AOUR rates and export fluxes should be interpreted.

The authors correctly explain the fact that oxygen utilization observed at a given depth at the BATS site should not be seen as being caused by vertical processes(such ascarbon export and remineralization) at the BATS site alone,but has to be interpreted as the integrated result of remineralizationand oxygen utilization along the entire path of the water massfrom theoutcrop regions further north and northeast to the observation site.Thus, the estimated AOUR rates and export fluxes represent *regional estimates* of productivity and remineralization (as stated in the abstract), rather than local fluxes or rates at the BATS site.

Determining the exact areas of "influence" is difficult and would require knowledge of the specific water spreading pathways in the region.Maps of outcrop regions (Fig. 6) suggest path lengthsof several thousand kilometers for the thermocline waters at BATS.Biological productivity in the outcrop regions (north and northeast of BATS) tends to be much higher compared to productivity at BATS, and the observed AOU values at BATS to a large extent appear to reflect productivity and remineralizationfurther north and northeast.

The following parts of the paper are inconsistent with above interpretation:

- Sentence p 9998/l 19-21in the Conclusions implies that a local flux has been estimated.
- Table 1 and section 4.2 imply that present export fluxes can be compared with independent estimates of carbon export based on sediment trap and ^{234}Th data.

However, due to the relatively small statistical funnel of shallow sediment traps and the short half-life of ^{234}Th, the latter estimates represent "truly" local fluxes, which shouldnot directly be compared with AOUR derived estimates. In fact, the discrepancy between both methods could be explained by the contribution of high-productivity areas to the north and northeast of BATS on AOU.

- Because of the regional effects discussed above one would not expect a Martin-curve for AOUR or export flux, but rather a projection of the spatial (meridional) productivity gradients onto the vertical. So, the discussion on deviations from Martin-like vertical profiles in section 4.1 appears artificial and should be deleted.
- The plots of tritium and 3He data from the upper 500 m at the BATS station (Fig. 9) are used to confine the Γ/Δ parameter of the TTD. This would be valid if the predominant transport (advection and mixing) was vertical (diapycnal). Under the paradigm of predominant transport along isopycnals(see above) plots of tritium and 3He on isopycnals would be required. It is unclear what conclusion can be drawn from Fig. 9.
- It is unclear whether specific TTD forms derived for 1D advective/diffusive are applicable to the thermocline circulation of the North Atlantic and whether the Γ/Δ range in reality is much larger than the one assumed.

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