Response to **Anonymous Referee #1**

**Note on color-coding**: Reviewer's comments are in black, responses in blue, and text/figure additions in green.

The paper 'Thermocline mixing and vertical oxygen fluxes in the stratified central North Sea' presents an interesting study of the oxygen dynamics in the thermocline and bottom boundary layer of the seasonally stratified North Sea. The authors quantify the supply of oxygen to the BBL from the base of the thermocline and highlight the importance of including this mechanism when studying seasonal oxygen depletion. They discuss potential implications of future climate warming on this oxygen supply to the BBL.
The paper is well written and well structured. I have some minor comments.

P9907, line 10 'economic' rather than 'economical'

> This has been changed

p9910 line 10 - discrete water sampling. No method details for Winkler samples

> We have added details on the sampling and titration procedure (see comment p9910 line 19). However, as Winkler titrations are routine laboratory measurements, we feel that there is no need to provide details on the actual reagents and volumes involved.

p9910 line 19 - was the CTD O2 sensor calibrated using the Winkler samples?

> Yes, in fact, all O2 sensors, CTD O2, AMT and optode were calibrated with Winkler samples. The CTD O2 sensor and the POZ Optode were calibrated both in the lab prior to the cruise and during the cruise using the Winkler samples. This now mentioned it explicitly in the Method section (see also response to p9916 L26-27):
> "The absolute O2 concentrations were calibrated against Winkler titrations (see below)."
> "The POZ lander was also equipped with a Winkler–calibrated O2 optode sensor (Aanderaa Data Instruments AS, Bergen, Norway) which recorded BBL O2 concentration continuously at 1 min intervals."
> "Each depth (i.e., each Niskin-bottle) was subsampled with three Winkler bottles of known volume (~62 ml on average) right after recovery and the samples were immediately fixed on deck. The samples were then stored in the vessel's cold room and titrated manually within 24 h after the sampling."

p9915 line 15 'Superimposed on the barotropic currents, we observed the presence of baroclinic velocity contributions (Fig. 3b and c).' is repeated on line 19

> This has been removed

p9916 line 23 - refers to figure 6 but there is no figure 6

The sentence on lines 21-24 refers to Fig. 4 – this was a mistake on our part. We have now corrected this within the text

p9916 lines 26 and 27 - refers to the O2 timeseries from the POZ lander but the method section (p9910) does not include details of the oxygen sensor on the POZ lander. Where does the -0.42 umol kg-1 d-1 come from?

We thank the reviewer for point that out. We have now expanded the section on the POZ lander to provide the required information and we added a figure to the support information showing the O2 timeseries (Supl. Figure 2). The additions read:

"The POZ lander was also equipped with a Winkler–calibrated O2 optode sensor (Aanderaa Data Instruments AS, Bergen, Norway) which recording BBL O2 concentration continuously at 1 min intervals."

"The apparent BBL O2 loss of -0.42 µmol $kg^{-1}$ $d^{-1}$ was determined from the POZ lander O2 optode time series (Supl. Figure 2) over 52 hours, ($R^2$=0.60). Though over a short time interval, the apparent BBL O2 loss was about -15 mmol $m^{-2}$ $d^{-1}$ and thus within 2% of the nearby North Dogger average presented by Greenwood et al. (2010)."

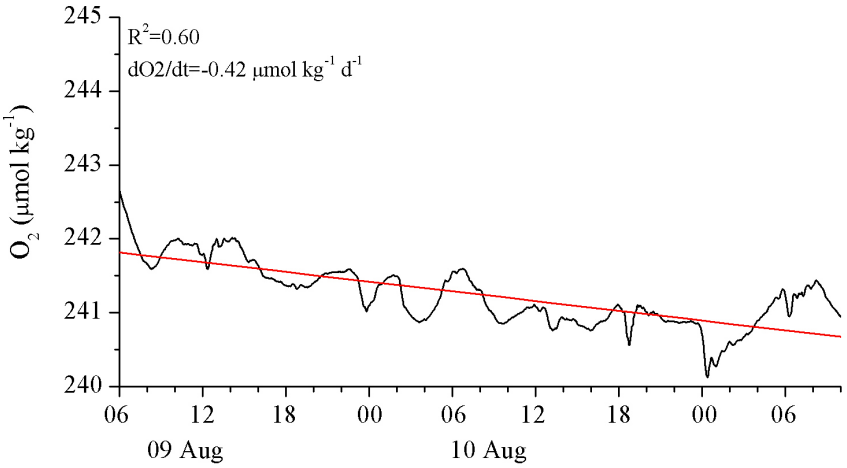
Figure 1 - change 'economical' to 'economic'

This has been corrected

Figure 4b - label on figure - change 'ensambles' to 'ensembles'

We have edited the figure accordingly.

**Supplementary Information**




SI Figure 2. Bottom water apparent $O_2$ loss as estimated from near-seafloor $O_2$ timeseries from the POZ-Lander.