Ocean Sci. Discuss., 8, C574–C577, 2011
www.ocean-sci-discuss.net/8/C574/2011/

Ocean Science Discussions

Interactive comment on "Using dissolved oxygen concentrations to determine mixed layer depths in the Bellingshausen Sea" *by* K. Castro-Morales and J. Kaiser

Anonymous Referee #2

Received and published: 25 August 2011

The authors describe an oxygen based method to define the mixed layer depth (MLD) in the coastal Southern Ocean. They compare their method with other prominent profile based (temperature and density) criteria and with climatological MLD. They conclude that the oxygen based definition of MLD should be used for gas exchange studies.

The manuscript can be important for gas studies and related research, but it needs a few enhancements. First of all I have major concerns if the results of this study (based on a dataset in a very small region from a single cruise) can be expanded for the entire Southern Ocean or even wider. This has to be validated. An analysis of more profiles in different regions of the Southern Ocean would vastly improve the study.

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Interactive Discussion

Discussion Paper

The authors recommend using the oxygen based criterion for definition of MLD. They use in-situ profiles of temperature, density and oxygen to validate this conclusion. The inclusion of climatological MLD estimates is a different question and one should expect that MLD estimates from a climatology are not that accurate than in-situ defined MLD. This comparison was done in other studies before (i.e. Steinhoff et al., Biogeosciences, 2010).

The comparison with the MLD definition from Talley (1999) could be left out. One wouldn't expect good agreement when using a technique that was proposed for winter MLD.

When comparing the different criteria at the in-situ profiles I would include an additional calculation: the Lorbacher (2006) criterion is not limited to temperature and density, but can also applied to the oxygen profile.

The "methods" part needs major improvement. The data processing of the oxygen data from the SBE43 sensor should be described in detail. On page 1511, lines 7-10, the authors estimate the sensor precision from the readings in 2 dbar intervals. This precision depends strongly on the response time of the sensor and the speed of the CTD during heave or veer. Another point that is not discussed is how the authors deal with the hysteresis. The oxygen sensor shows a much bigger hysteresis effect than the temperature and salinity sensors, which again depends strongly on the CTD speed. This has to be taken into account and should be described in the manuscript.

Specific comments:

1507- 5: Looks like there is a space too much between "immediate. Likewise"

1507-14: one "ratio" too much

1507-21: no dot between ". . .ocean (Rintoul. . ."

1510-13: I would refer to Fig. 1 here and not in line 20

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1511-7-10: This number depends strongly on the time constant of the sensor and the velocity of the CTD during up- or downcast (see above)

1512-2: the “of” has to be deleted

1512-21-24: I’m confused. Please compare with Table 1, it looks mixed.

1513-9: The “(“ before Antonov has to be deleted

1513-21/22: Why using the subjective MLD? It’s not comparable to the other criteria that are objectively defined.

1515-13-16: This sentence makes no sense, please rewrite.

1516-16: Due to the number of different criteria it’s not clear if “zmix(0.03 kg m-3)” the BM04 climatology or the difference criterion for a profile.

1517-23: The abbreviation “ML” occurs the first time here. It should be introduced on page 1506.

1518-22-25: The statement sound a bit too hard. Looking at Fig. 4, the Lorbacher criterion is not much worse than Ds=0.03 kgm-3 criterion.

1519-18: the “of” can be deleted; a short statement why the diurnal variability can be neglected might be good.

1520-24: should be “interest”?

Table 1: Please check with text. Numbers do not agree.

Fig. 1: A colourbar for the shading instead of text would improve the figure.

Fig.2: The explanation (dashed line...) is not needed as there is a legend. Is the zmix(O2) the objective or the subjective MLD?

Fig. 3: The calculation of zmix(O2) is not a numerical algorithm.

Fig. 5: The figure is not required to understand the text. But if it should stay: one panel

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seems to be enough; please explain the marker in the figure caption OR use a legend.

Fig. 6: not needed.

Fig. 7: please explain the marker in the figure caption OR use a legend; caption of the y-axis must be “Dzmix”

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