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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 #1

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The paper presents a method for determining the mixed layer depth (MLD) of oxygen profiles. The authors propose that the MLD is the depth at which the relative difference between the O₂ profile and the O₂ at a reference depth of 10 dbars is 0.5%. The method is evaluated with 251 profiles collected to the west of the Antarctic Peninsula. The method is compared to various standard methods for calculating MLDs, particularly threshold methods using various temperature and potential density criteria and to the curvature method developed by Lorbacher et al. (2006). They find that the 0.03 kg/m³ criterion from de Boyer Montegut et al. (2004) produces the closest MLDs to their method.

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I think in general the study is worthwhile, and could be important to gas and biological studies. However, the study has some serious limitations, and the authors either need to extend their analysis or restrict some of their assertions.

My main concern is that the small scope of the work limits its applicability to other studies. The authors developed their method with 251 profiles from a coastal region near the Antarctic Peninsula, yet they asserted that their method could be used in the entire Southern Ocean. They need to provide evidence to support this assertion. Showing that their method works for a much wider range of profiles from the entire Southern Ocean would greatly expand the impact of the paper.

The authors claim that because the O₂ profile depends on biology, it gives a more complete picture of all relevant processes occurring in the mixed layer (compared to temperature or density), therefore allowing for a more accurate MLD calculation. Couldn't biology also obscure the MLD?

In Figure 5, many of the MLDs look pretty close to 10 m depth. Does choosing a shallower reference depth change the MLD? How does changing the relative difference criterion change the MLD distributions?

1506-9 different than 1506-13 I don't think that I would say that the criteria was established by numerical analysis based on your description

1507-21 has an extra period

1508-15 I might say near-surface reference value 1508-16 Previous studies have found that well-resolved vertical profiles are necessary to use gradient-based criteria successfully.

1510-3 need a space in O₂ profiles

1511-12 I would move some of the discussion of number of profiles/quality control into the CTD acquisition section 1511-15 by objective, numerically determined z_{mix} to identify a suitable O₂ . . . Do you mean you tested a number of different criterion,

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compared them to the visually identified MLDs, to settle on 0.5%? 1511-21 'allow comparing' sounds odd 1511-26 confusing description of the various comparisons in the introduction to this section.

1512-1 selected three-widely 1512-21 is BM0 temperature criteria in relation to the surface value? Also maybe specify which criteria come from which study

1513-21 Is it fair to use the subjective MLD in the comparison with the other methods?

1513-23 To me, this paragraph belongs in the next section.

1514-9 You extend your results to apply to the southern ocean, a much bigger area than the scope of the study. You could cite other studies that have shown this as well.

1514-23 You've still had to define the 0.5% difference and the reference depth, so to me it is actually more similar to the threshold methods than Lorbacher

1515-11 maintain consistency 1515-16 remove 'were done.' 1515-26 In case of BM . . . sounds odd

1516-1 should be BM04. I would add that you are comparing density to density in this paragraph. It's a little confusing. 1516-18 than the other climatologies

1517-4 should be as instead of than

1518-28 lower, or deeper?

1519-18 influence production calculations 1519-19 'resolution of the instrumental parameter used in the criterion to define it' is a confusing phrase. The second sentence could also use some simplifying/clarification. 1519-27 interpolation method, or the vertical resolution of the fields

1520-1 sentence needs work 1520-25 I'm not convinced of this. You haven't shown evidence that this criterion would work outside of the very small area of study in the paper.

Figure 4 - I'd say potential density differences, not salinity differences

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