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Ocean Science
Discussions

Interactive comment on "The influence of temperature and salinity variability on the upper ocean density and mixed layer" *by* R. W. Helber et al.

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The main criticism from Anonymous Referee #1 is that our paper does not clearly describe our contribution to the understanding of mixed layer dynamics. The referee notes that the MLD and SLD algorithms are not described in detail and sometimes produce improper values. While MLD and SLD are imperfectly known, the details of the algorithms are not critical and our results highlight the competing influence of temperature and salinity on the vertical structure of the global upper ocean density field.

The concerns of Referee #1 can be addressed by clarifying three main points: (1) While the MLD algorithm may fail to identify the mixing depth, it still describes the depth of

uniform density. (2) This paper mainly describes temperature and salinity variability below the MLD. (3) We highlight the differences between regions of the ocean.

MLD is the depth of isotropic density and SLD is the depth of increasing sound speed. We are primarily concerned with the differences between these two measures rather than accurate estimates of the mixed and sonic layer depths.

For example, MLD estimated from in situ profiles at high latitudes is generally very deep because temperature is nearly uniform with depth. Salinity is often the critical factor in these profiles. The estimated value for MLD may not be the true penetrative depth of upper ocean turbulence but it is a reliable indicator of uniform density over the upper ocean. The Turner angle computed over the upper 200 m also characterizes the upper ocean uniquely in these cases. The statistical relationships of these quantities remain robust regardless of whether MLD represents the upper ocean mixing depth or not.

Our focus is on mapping the temperature and salinity in terms of their competing role in upper ocean structure. The existence of barrier and transition layers highlights the fact that for density, temperature and salinity do not have the same behavior. The differences between the SLD and MLD accentuate the differences in the role of temperature and salinity in the upper ocean. The statistics show the importance and character of those roles as then vary around the ocean. As long as the same methods are used for the entire ocean, differences between one region of the ocean and another will be robust.

A point that needs to be made more clear is that our focus is below the MLD. We wish to identifying the regions of the ocean where temperature and salinity compete for control below the mixed layer. This is important because the details of how temperature and salinity variability transition from the mixed layer to the ocean interior have applications in prediction of sub-mesoscale circulation as well as climate scale processes.

Interactive comment on Ocean Sci. Discuss., 7, 1469, 2010.