Biogeosciences Discuss., 11, C9048–C9049, 2015
www.biogeosciences-discuss.net/11/C9048/2015/

Biogeosciences Discussions
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Interactive comment on "Shape of the oceanic nitracline" *by* M. M. Omand and A. Mahadevan

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Received and published: 11 March 2015

This paper describes statistical relationships between nitrate and density along vertical profiles in the ocean. In particular nitrate concentrations are regressed onto a linear combination of density to the zeroth, first, and second powers. Two regimes are distinguished: one in which the relationship between nitrate and density is parabolic and one in which it is linear. A 1-d vertical diffusion model is used to rationalize the results in terms of the separation between the euphotic depth and the mixed layer depth. In cases where the euphotic depth extends less than 100m below the mixed layer depth the model produces a nearly linear relationship between nitrate and density. Otherwise the nitrate-density relationship produced by the model has curvature. This result is not surprising. In the absence of sources or sinks we expect a linear relationship between the tracers because they satisfy the same diffusion equation with a common eddy diffusivity. Only when the euphotic depth is significantly greater than the mixed layer depth

does the biological-uptake sink of nitrate extend over a large enough region of the water column to produce any appreciable deviations from linearity. However, this results seems artificial because in addition to the biological drawdown of nitrate included in the model there is also a remineralization of nitrate from sinking particulate organic matter. This important source term is missing in the model considered in the paper but needs to be included because it will almost always extend significantly below the depth of the mixed layer and will potentially break the linear relationship everywhere. I therefore recommend that the authors consider adding the remineralization of sinking particles, perhaps modelled as a power law F(z) = Jo*(z/zo)ËĘ-b. .

Thank you for this suggestion. We have added a remineralization source term to our model, which improves the results. We used an exponential profile for the sinking flux (Fig. 8) instead of the power law (Martin curve), because it makes the model solution more tractable and is also a good a description of the sinking flux profile. The sink and source terms of nitrate have different e-folding depths, but the total nitrate is now conserved in our model. Further, we choose the model parameters (mixed layer depth, euphotic depth) in accordance with the parameters at BATS and HOT. See Section 5 for a description of the revised model. As a result of the remineralization term, the shape of the modeled profile is much closer to the observed shape at BATS and HOT with a subsurface maximum and thereafter, nitrate which stays roughly constant with depth (Fig. 8).

Interactive comment on Biogeosciences Discuss., 11, 14729, 2014.