

## ***Interactive comment on “Fueling primary productivity: nutrient return pathways from the deep ocean and their dependence on the Meridional Overturning Circulation” by J. B. Palter et al.***

**Anonymous Referee #1**

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The authors present an interesting model study exploring the significance of the large scale overturning circulation for low latitude productivity. The current study builds on previous work (Sarmiento et al. 2004; Marinov et al. 2006) highlighting the global significance of northward nutrient transport within sub-antarctic mode water (SAMW). In particular the authors describe in greater detail how the SAMW supply path varies within models containing different representations of the overturning circulation and discuss some more general implications of a potentially significant SAMW supply path. The manuscript is timely, adding considerable detail to what remains a recently de-

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scribed process. Moreover, given the apparent importance of the SAMW supply route in a number of contexts (e.g. as discussed by the authors in the final section), I believe the manuscript can make a significant contribution to the field and hence in general support publication in biogeosciences. I first have a number of relatively minor issues/suggestions which the authors might like to consider.

Page 4051. The discussion of theoretical considerations of driving mechanisms for the overturning circulation (based largely on Ganadeskian 1999) was potentially a bit long/complicated given the limited direct use later?

Page 4053, line 5. This sentence is a bit awkward, suggest ‘which are just under half as intense...’

Page 4053 and Table 1. Model nomenclature might be a bit confusing to those not already familiar with the MOM3 suite. Although ‘HH’, ‘LL’ ECMWF ‘P2A’ are explained clearly, (e.g. Table 1), a non-familiar reader would likely have to keep referring back to this table and interpreting the numbers contained. It might help to put simple descriptors next to the values in the table (e.g. ‘high’ next to diapycnal diffusivity in ‘HH’, ‘low’ next to Hellerman wind stress, rather than simply highlighting certain values in bold?

Page 4053. ‘Clockwise’ is possibly a bit of a confusing description here. Clockwise only applies in the case where north is represented to the right? Some brief clarification might help.

Page 4054. The partitioning of (‘new’) production into a sinking flux and a source term for DOP is apparently spatially invariant? Do the authors know how robust the current conclusions might be to relaxation of this assumption? e.g. one might expect that the proportion sinking might be higher (lower) in high (low) latitude systems?

Page 4055. Why are the results presented for the LL-ECMWF after a longer spin up period, presumably this model takes longer to reach near steady-state?

Page 4056, line 10 onwards. I appreciated the authors’ careful distinction of the ‘pre-

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formed' and 'remineralised' pools and how these differ from traditional uses of these terms. I additionally wondered whether further clarity could be provided by using a different term, at least for the 'preformed' pool as labelled in the model runs, potentially 'pre-labelled' or 'pre-tagged'?

Page 4057, line 24 onwards and Fig. 7. Presumably the authors would argue that the better agreement between 'P2A' and the radiocarbon distribution suggests that this model contains the most realistic representation of the overturning circulation (i.e. dominance by the Southern Ocean). However they don't really return to this point when later discussing the contribution of SAMW nutrients. E.g. would they argue that the importance of this pathway in the real ocean is likely towards the upper end of the values in Table 3 and on page 4063 they would presumably argue that within the real ocean, Southern Ocean mixing/upwelling dominates nutrient resupply?

Page 4058, line 6. This sentence was a bit confused, both the HH and the LL models have the same winds, they only differ due to differences in  $K_v$  and  $A$ . Suggest, '... Not surprisingly the LL model, which is also forced with...'

Page 4065, line 25. Within the formation region of SAMW, ample fixed nitrogen in surface waters will also restrict nitrogen fixation.

Figure 13. From the graph presented, a contribution of half the nutrients from the preformed pool looks high? (the grey bars all appear to be <half the length of the remineralised bars). What is the actual value?

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