

## Responses to Reviewer1

**We thank Reviewer 1 for his/her comments and provide our detailed responses below (in bold)**

### General Comment

The paper utilizes a coupled three-dimensional circulation and size-structured biological model to investigate biological variability and the associated physical-biological forcing processes. The model successfully captures the observed features and provides some insightful dynamic correlations between the variation of biological field and unique physical forcing in MAB. The paper is well organized and written and is acceptable to publish in Biogeosciences.

**We thank the reviewer for his/her kind comments and encouragement.**

### Specific Comments

1) P. 1562, line 1. The sentence “In winter, surface chlorophyll concentrations decline again compared to the fall” is not accurate. The model actually missed the decline shown in MODIS data (see Figure 2).

**We have refined this sentence as “In winter, observations show surface chlorophyll concentrations decline again compared to the fall.” We agree with the reviewer that the model missed the decline shown in MODIS data, and stated the following earlier in the manuscript: “A discrepancy is seen in the winter when the model overestimates chlorophyll concentration. This is likely due to excessive winter mixing produced by the turbulence closure scheme (*He and Chen*, submitted), an aspect we seek to improve in a future effort”.**

2) Subsection 4.1.2. High NO<sub>3</sub> concentrations in both 2004 and 2005 are induced by stronger mixing, as stated in the paper. However, there was a two-month lag between the NO<sub>3</sub> and phytoplankton in 2005, while no lag existed in 2004. Why? How is this related to the one-month lag stated before?

**We stated in 4.1.A that maximum phytoplankton concentrations are seen from March to May, approximately 1-2 months after the peaks in nutrient concentration. This is the case for 2005, 2006 and 2007. 2004 is somewhat unique as the nutrient concentration stays high throughout the entire spring season.**

3) P. 1567. How are MLD and BBL convergence defined and obtained?

**The MLD is defined as the water depth where the water temperature changes from SST is greater than 0.5 deg C (Levitus, 1982) The BBL convergence is calculated using the velocity field of the near bottom layer of the model.**

4) P. 1567, lines 20-21. Why the flux is quantified by TKE while it can be easily obtained from the model?

**The nutrient flux is calculated by integrating the nutrient concentration with normal velocity along the northeast boundary as shown by the thick line in Figure 1. The reason for showing TKE is to characterize the inter-annual variability of the shelfbreak circulation/jet intensity.**

5) P. 1569, line 6. The unit for each term is needed in Figure 13.

**The unit for each term is now stated in the caption of Figure 13.**

6) Subsections 4.2 and 4.3. The analyses in 4.2 shows that HADV and VADV cancel each other, given the impression that both upstream advection and vertical motion induced by BBL convergence are not important in NO<sub>3</sub> variation. It may be worthy checking the term calculation, particularly regarding to advection terms.

**We have double-checked the term calculation. Indeed, the horizontal advection and vertical advection largely cancel each other, but their residual is still of the same order of magnitude of other terms.**