

Interactive
Comment

Interactive comment on “Impacts of elevated CO₂ on phytoplankton community composition and organic carbon dynamics in nutrient-depleted Okhotsk Sea surface waters” by T. Yoshimura et al.

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We appreciate the reviewer’s encouraging comments and suggestions on our manuscript. In the following, we describe the changes we have made in response to the reviewer’s comments.

Responses to the first Major Comment

1. In the Sea of Okhotsk, spring phytoplankton bloom occurs from May through July (Sorokin and Sorokin, 1999; Nakatsuka et al., 2004). The phytoplankton bloom depletes more than 20 $\mu\text{mol L}^{-1}$ of nitrate in the surface, and the low nutrient environments were maintained in the summer season (Nakatsuka et al., 2004). So we sam-

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pled the post spring bloom community. As pointed out by referee#1, a large part of the primary production would occur during the phytoplankton bloom, but significant primary production and biogenic particle flux are reported during the summer season in the Sea of Okhotsk in Sorokin and Sorokin (1999) and Nakatsuka et al. (2004). We believe that the assessments of the impact of pCO₂ increases on phytoplankton are needed for the summer season as well as for the spring bloom period. We detail this in the Introduction (P3, L83–90) and the Results and Discussion (P6, L166–172; P6, L183–186; P11, L319–321).

Responses to the second Major Comment

2. We added new results of microscope analysis on microzooplankton as Table 2 in the Results and Discussion of the revised manuscript. We discussed the drawbacks of a bottle incubation experiment, and also mentioned about the interaction between phytoplankton growth and microzooplankton grazing during the 14-day incubation (P9, L269–301).

Responses to Specific Comments

3. Comments on first paragraph in Introduction: We added information about the CO₂ manipulation experiment using coccolithophores by Riebesell and colleagues, and others (P2, L48–51).

4. Comments on Materials and Methods: The spring phytoplankton bloom occurs around June in the Sea of Okhotsk, and after that, nutrient-depleted condition hold in the surface during summer. We sampled such low nutrients and low biomass community. We mentioned this in the Introduction (P3, L83–90) and the Results and Discussion (P6, L166–172; P6, L183–186; P11, L319–321).

5. Comments on Results and Discussion: We believe that more than 20 $\mu\text{mol L}^{-1}$ of nitrate is depleted during the spring diatom bloom in the Sea of Okhotsk (Nakatsuka et al., 2004). If we assume the Redfield ratio (C/N=6.6), this is equivalent to 200

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ppm pCO₂ drawdown in the seawater which is equilibrated with atmospheric pCO₂ of 380 ppm. The plankton community used in the present experiment is a post-bloom community under depleted nutrient and lowered pCO₂ conditions. We mentioned this in the Results and Discussion (P6, L166–172; P6, L183–186).

6. Comments on P6 (P4149), third paragraph: Liu et al. (2009) measured phytoplankton growth rate at the same site during the same cruise using a dilution method. We clearly state this in the Results and Discussion (P9, L274–278). Unfortunately, we did not measure primary production and bacterial production.

7. Comments on P7 (P4150), bottom of first paragraph: We agree with the reviewer's comment. To our knowledge, however, no results are published on the change in fucoxanthin/chl-a ratio with the change in pCO₂. We described the possibility in the Results and Discussion (P8, L227–229).

8. Comments on P8 (P4151?), bottom of first paragraph: We described the possibility of the enhanced glycolate excretion under increased photorespiration in the Results and Discussion (P9, L255–258).

9. Comments on P8 (P4151?), last few lines: In the revised manuscript, we shorten this speculative discussion and simplified the interpretation of our results (P8, L241–268; P10, L302–328).

10. Comments on P9 (P4153?), top paragraph: Again, we agree with referee's comment, but we believe the importance of experiment using post spring bloom community in the Sea of Okhotsk as well as other subarctic seas. We mentioned this in the Results and Discussion (P11, L319–321; P11, L337–339).

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