

## ***Interactive comment on “Carbon fixation prediction during a bloom of *Emiliana huxleyi* is highly sensitive to the assumed regulation mechanism” by O. Bernard et al.***

**Anonymous Referee #2**

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### **General comments**

In this paper the authors used a model to test different scenarios concerning the regulation of calcification and photosynthesis in *Emiliana huxleyi*. They considered either carbon dioxide, bicarbonate, carbonate or the calcite saturation state to be a regulating factor. They run the models at three different concentrations of atmospheric carbon dioxide and compared the carbon dynamics, including export within and between the models.

The qualitative results of this paper directly follow from DIC speciation chemistry: if production is made a function of  $\text{CO}_2$  or  $\text{HCO}_3^-$  then it increases with atmospheric  $\text{CO}_2$

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and if a function of  $\text{CO}_3^{2-}$  or  $\Omega$  it decreases. Since sedimentation rate is constant in this model it follows production. The quantitative results of this paper are of no scientific interest, because they are not based on measured rates, do not include competition among phytoplankton groups and include no mechanisms that might have made the results depart from those predicted from DIC speciation.

### **Detailed comments**

- Proofreading by a native speaker would be highly desirable. Many sentences are difficult to understand, but on close reading suggest they were written to make foregone conclusions sound new.
- “Model simulations suggested that only the models where carbonate ion regulates calcification could reproduce the decrease in calcification rate after a  $\text{pCO}_2$  doubling, hence refuting the general assumption of a regulation by  $\text{HCO}_3^-$ .”

This is a misleading statement, as the ongoing discussion in the literature is not at all concerned with carbonate chemistry – everybody accepts that carbonate decreases with an increase in  $\text{pCO}_2$  AT CONSTANT ALKALINITY- but some experiments show an increase in calcification and others a decrease under these or similar circumstances (constant DIC). Thus, the issue is not whether calcification decreases with increase  $\text{CO}_2$  once you’ve set calcification to respond to carbonate, but whether the latter is the case or not.

- Pg. 5341 and 5342: Paragraph more or less copied from Bernard et al. 2008
- Eq. 4 would be understandable if it were multiplied by  $\alpha$
- From Eq. 16 to 20, an approximation of the DIC speciation is presented, and then it is stated that this approximation wasn’t used. Delete this section.

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- The text at the end of 3.1 and Figure 1 suggest that there is no sinking POC, while Eq. 23 and Table 4 say there is.
- The four models are calibrated to give the same behaviour at  $p\text{CO}_2=380$  ppm and are then run at a lower  $p\text{CO}_2$ . Predictably, the four reference runs at present  $\text{CO}_2$  then behave completely differently, so that it becomes very difficult to see what the relative effect of a  $p\text{CO}_2$  doubling is.
- By using growth rate to calibrate the model, the temporal dynamics of the four reference runs are very different. Amongst others, this means that the peak in N:C occurs at different times, with repercussions for the carbon dynamics and the conclusions. I very much doubt that the large differences that they find in the reference runs are robust. E.g., what would have been the results if they had used  $\alpha$  or some other model variable to calibrate the model?
- Pg. 5356 line 9 and 10: There is no two-fold difference in the  $\text{HCO}_3^-$  model run

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Interactive comment on Biogeosciences Discuss., 6, 5339, 2009.