

Interactive comment on “A simple metabolic model of glacial-interglacial energy supply to the upper ocean” by J. L. Pelegrí et al.

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We are grateful to Dr. Vázquez-Domínguez for his comments to the Pelegrí et al. (2011) discussion paper. We are happy that he finds our metabolic approach of interest and the results encouraging. Dr. Vázquez-Domínguez asks us to clarify several issues. These are the following: the definition of metabolic rate as a gross or net rate, the equivalence between "net energy supply" and "oxygen", and the heterotrophic *versus* autotrophic character of the Earth System. I will next go over these three items.

In our discussion paper we explain that Brown et al. (2004) combine the standard view of the metabolic rate of an heterotroph, as the energetic transformations sustained through respiration, with the argument that photosynthesis is an inverse reaction to the rate of respiration, to propose that metabolic rate would be equivalent to gross

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autotrophic primary production. For an autotroph, however, respiration is intrinsically linked to photosynthesis and subtracts to the final rate of conversion of solar energy; therefore, we propose the metabolic rate of an autotrophic ecosystem to be net autotrophic primary production. This issue is to be clarified in the revised manuscript.

We agree that our usage of "energy" needs to be clarified from the very beginning of the manuscript. When examining the ocean's metabolism we should have made clear that carbon, either organic or inorganic, is our energy unit. Inorganic carbon is a potential energy unit, its rate of transformation into organic carbon being a measure of the rate of incorporation of solar energy to the Earth System. This is to be clarified in a revised manuscript.

Finally, we do view the Earth as a long-term mean autotrophic system. By "long-term" we mean its average state over at least one glacial-interglacial cycle (we choose such period because our study focuses on glacial-interglacial variations, which we assume correspond to state oscillations, but the required averaging period could certainly be much longer). We agree with Dr. Vázquez-Domínguez that the Earth System temporarily switches between (globally-averaged) heterotrophic and autotrophic systems. Actually, our results indicate that during a substantial portion of the interglacial state the system indeed becomes heterotrophic. However, solar radiation is the ultimate energy source for the Earth, an intrinsically autotrophic system.

References

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