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***Interactive comment on “Influence of seasonal monsoons on net primary production and CO<sub>2</sub> in subtropical Hong Kong coastal waters” by X. C. Yuan et al.***

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Received and published: 11 September 2010

Comments from handling editor (Alberto V. Borges)

I read the ms and made my comments on the very first version of the ms, hence, Line numbers refer to those in that version and not to the line numbers in the BGD version published on-line.

It would nice if the integrated primary production, respiration, air-sea CO<sub>2</sub> fluxes, photic depth, mixed layer depth, SSS, SST, positions, dates, etc. . . are given in a tabular form as a supplement of the paper. Researchers that compile these data to carry out meta-analysis (e.g. Gattuso et al. 1998, Gazeau et al. 2004, Hopkinson and Smith 2005)

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will certainly be grateful to the authors to be able to access the raw data rather than having to scan them from figures of the paper.

The authors could attempt to establish correlations between the measured rates and environmental variables such as temperature, salinity, chlorophyll-a, or other variables. Such analysis can be enlightening (e.g., Hopkinson and Smith, 2005).

L 27 : Here and everywhere in the ms. I assume that the net metabolic balance was computed as the difference between the integrated primary production values derived from the  $^{14}\text{C}$  incubations and the dark community respiration (DCR) (L133). If this is the case then there is problem in terminology : Net primary production (NPP) = gross primary production (GPP) – autotrophic respiration. What the authors computed is net community production (NCP):  $\text{NCP} = \text{GPP} - \text{autotrophic respiration} - \text{heterotrophic respiration} = \text{GPP} - \text{community respiration}$  (e.g. Gattuso et al. 1998). Please update the text everywhere (and figures).

L 50-54: Please note that besides organic carbon inputs, eutrophication also corresponds to enhanced nutrient fluxes. These tend to increase primary production. The balance of both will determine how the  $\text{CO}_2$  flux will evolve. Relevant references on the subject that could be added here are : Mackenzie et al. (2004), Gypens et al. (2009), Borges & Gypens (2010).

L 124-138 : Please specify if light profiles were carried out and please specify which model was used to integrate vertically the primary production (e.g. Platt).

L 124-138 : Here or elsewhere in the ms it needs to be mentioned that due to short incubation time (4h) the  $^{14}\text{C}$  rates are assumed to be representative of GPP and not net primary production (e.g. Gazeau et al. 2007). This then allows the computation of NCP as  $\text{GPP} - \text{DCR}$ .

L 152: Another way to normalize the data, that is thermodynamically more correct, is to compute total alkalinity (TA) from  $\text{pCO}_2$  at in-situ temperature and DIC, and re-

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compute  $p\text{CO}_2$  from TA and DIC at the mean temperature. Indeed, the Takahashi et al. procedure assumes an isochemical water-mass which cannot be the case for the present study. Please note that the correct reference for this equation is Takahashi et al. (1993).

L 268: this statement is wrong, and the authors actually say it latter (and their data-sets illustrate it). So why make this statement? Why not directly say that trophic status and air-sea  $\text{CO}_2$  fluxes do not equate (based on what has already been published in literature) ?

L 278: the Borges et al. (2006) paper should be cited here, as it is one the first (if not the first) to compare trophic status and air-sea  $\text{CO}_2$  fluxes in coastal environments based on consistent data-sets (acquired at the same time) and across several ecosystems.

L 296-297 : This statement is incorrect. Sarma et al. (2001) provide such a comparison for DIC, pH and  $p\text{CO}_2$ .

L 336: As far as I understand this equation is not necessary to understand the computations made (and saying that  $\text{DIC}_{\text{input}}$  and  $\text{DIC}_{\text{output}}$  were computed from  $\text{O}_2$  is very confusing). Please only refer to equation given in Line 339 (that should be numbered) saying that the terms of the mass balance are ... and that  $\text{DIC}_{\text{mixing}}$  is computed as the closing term of the mass balance.

L343 : I assume it's the "air-sea fluxes" of  $\text{CO}_2$  that were used ? please specify in text.

L366-352: More details are needed to define the terms of the mass balance. As the text stands it's very difficult to follow what the authors did:

First, specify if " $\Delta\text{DIC}(\text{pelagic NPP})$ " (that need to be changed in " $\Delta\text{DIC}(\text{pelagic NCP})$ ") corresponds to the values integrated in the photic depth ? or integrated in the mixed layer ? The problem is that the  $\Delta\text{DIC}(\text{air-sea fluxes})$  only affects the DIC in the mixed layer; if mixed layer is shallower than photic depth, then there is an inconsistency in the mass balance if  $\Delta\text{DIC}(\text{pelagic NCP})$  was integrated in the whole photic depth.

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Second, if the mass balance of DIC is looking at the DIC changes in the mixed layer, then there is no point in including the  $\Delta\text{DIC}(\text{benthic respiration})$  term in the mass balance. The closing term will correspond to the flux of DIC from depth including whatever DIC was added by benthic respiration to the upwelled water.

Finally, the  $\Delta\text{DIC}(\text{mixing})$  term will include the vertical inputs but also the horizontal inputs. This needs to be mentioned and discussed. If the authors can find a way to work out the horizontal inputs of DIC, this would then allow to look at only the vertical fluxes of DIC.

L 366: Since the Ducklow and McCallister (2004) work (6 years ago), several papers have addressed the air-sea  $\text{CO}_2$  fluxes in coastal environments (Borges 2005; Borges et al. 2005; Cai et al. 2006; Chen and Borges 2009; Laruelle et al. 2010). From these papers there is an emerging picture on the drivers of  $\text{CO}_2$  fluxes in coastal environments and magnitude of those fluxes. So nowadays things are not that “controversial” as stated.

L368: There are several recent papers on  $\text{CO}_2$  fluxes in coastal upwelling systems (see hereafter) that could be cited in this section.

L377-379: There is an alternative explanation, and actually the data reported by the present paper fits with that explanation. As developed by Borges (2010), coastal upwelling systems in the Atlantic are sinks for  $\text{CO}_2$  (Borges and Frankignoulle 2002; Huertas et al. 2006; González-Dávila et al. 2009), while those in the Pacific (Friederich et al. 2002; 2009) and Indian (Goyet et al. 1998) are sources of  $\text{CO}_2$  (based on data-sets that adequately capture the seasonal cycle, hence excluding studies that only reports limited data during a single season). This relates to the conveyor belt. Denitrification removes  $\text{NO}_3^-$  while not affecting DIC. Hence, there is a relative enrichment of DIC compared to  $\text{NO}_3^-$  as the water masses age (i.e. travel from the Atlantic to the Pacific and Indian). Also, oxygen minimum zones are much more developed (and shallower) in the Indian and Pacific than in the Atlantic. Refer to Borges (2010) for an

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in depth discussion on this topic.

#### Minor comments

Most abbreviations (NPP, DO, etc. . .) were defined several times in the ms. Please define an abbreviation only ONCE, when it is used for the FIRST TIME in the main text (abstract excluded).

L 243 : DOC abbreviation not defined

L 258: bacterial respiration => BR

L 266: replace heterotrophy by trophic status

L 435 : This reference could be replaced by Borges and Frankignoulle (2001) Distribution of surface carbon dioxide and air-sea exchange in the upwelling system off the Galician coast, *Global Biogeochemical Cycles*, 16: 4/1-4/14, doi:10.1029/2000GB001385, that is a more extensive discussion on air-sea CO<sub>2</sub> fluxes in the Galician upwelling system.

#### References

Borges A.V. (2010) Present day carbon dioxide fluxes in the coastal ocean and possible feedbacks under global change, IN *Oceans and the atmospheric carbon content* (P.M. da Silva Duarte & J.M. Santana Casiano Eds), in press (paper can be requested from corresponding author, alberto.borges@ulg.ac.be)

Borges A.V. & N. Gypens (2010) Carbonate chemistry in the coastal zone responds more strongly to eutrophication than to ocean acidification, *Limnology and Oceanography*, 55, 346-353

Borges A.V., L.-S. Schiettecatte, G. Abril, B. Delille & F. Gazeau (2006) Carbon dioxide in European coastal waters, *Estuarine, Coastal and Shelf Science*, 70(3), 375-387  
Borges, A. V. (2005), Do we have enough pieces of the jigsaw to integrate CO<sub>2</sub> fluxes in the coastal ocean?, *Estuaries*, 28(1), 3–27.

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Borges, A. V., B. Delille and M. Frankignoulle (2005), Budgeting sinks and sources of CO<sub>2</sub> in the coastal ocean: Diversity of ecosystems counts, *Geophys. Res. Lett.*, 32, L14601, doi:10.1029/2005GL023053.

Borges, A. V., and M. Frankignoulle (2002), Distribution of surface carbon dioxide and air-sea exchange in the upwelling system off the Galician coast, *Global Biogeochem. Cy.*, 16(2), 1020.

Cai, W.-J., M. H. Dai and Y. C. Wang (2006). Air-sea exchange of carbon dioxide in ocean margins: A province-based synthesis, *Geophys. Res. Lett.*, 33, L12603, doi:10.1029/2006GL026219.

Chen, C. T. A., and A. V. Borges (2009), Reconciling opposing views on carbon cycling in the coastal ocean: continental shelves as sinks and near-shore ecosystems as sources of atmospheric CO<sub>2</sub>, *Deep-Sea Res. II*, 56(8-10), 578-590.

Ducklow, H.W., and McCallister, S.L.: The biogeochemistry of carbon dioxide in the coastal oceans, In: *The sea*, Vol 13, Chap 9, *The Global Coastal Ocean*, edited by: Robinson, A.R., Brink, K., and Rothschild, B.J., Harvard University Press, Cambridge, MA, 269–315, 2004.

Friederich, G. E., J. Ledesma, O. Ulloa, and F. P. Chavez (2008), Air–sea carbon dioxide fluxes in the coastal southeastern tropical Pacific, *Prog. Oceanogr.*, 79(2-4), 156-166.

Friederich, G. E., P. M. Walz, M. G. Burczynski, and F. P. Chavez (2002), Inorganic carbon in the central California upwelling system during the 1997-1999 El Niño-La Niña event, *Prog. Oceanogr.*, 54(1-4), 185-203.

Gattuso J.-P., M. Frankignoulle & R. Wollast (1998) Carbon and carbonate metabolism in coastal aquatic ecosystems, *Annual Review of Ecology and Systematics*, 29:405-433, doi:10.1146/annurev.ecolsys.29.1.405

Gazeau F., B. Gentili, S.V. Smith, M. Frankignoulle & J.-P. Gattuso (2004) The Euro-C2892

**BGD**

7, C2887–C2894, 2010

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pean coastal zone : characterization and first assessment of ecosystem metabolism, Estuarine, Coastal and Shelf Science, 60(4): 673-694.

Gazeau F., J. J. Middelburg, M. Loijens, J. –P. Vanderborght, M.–D. Pizay & J.–P. Gattuso (2007) Planktonic primary production in estuaries: a comparison of the  $^{14}\text{C}$ ,  $\text{O}_2$  and  $^{18}\text{O}$  methods, Aquatic Microbial Ecology, 46, 95–106.

González-Dávila, M., J. M. Santana-Casiano, and I. R. Ucha (2009), Seasonal variability of  $\text{fCO}_2$  in the Angola-Benguela region, Prog. Oceanogr., 83, 124-133.

Goyet, C., F. J. Millero, D. W. O'Sullivan, G. Eiseheid, S. J. McCue, and R. G. J. Bellerby. (1998), Temporal variations of  $\text{pCO}_2$  in surface seawater of the Arabian sea in 1995, Deep-Sea Res. Pt I, 45(4-5), 609-623.

Gypens N., A.V. Borges & C. Lancelot (2009) Effect of eutrophication on air-sea  $\text{CO}_2$  fluxes in the coastal Southern North Sea: a model study of the past 50 years, Global Change Biology, 15(4), 1040-1056

Hopkinson, C.S.J., Smith, E.M., 2005. Estuarine respiration: an overview of benthic, pelagic and whole system respiration. In: del Giorgio, P.A., Williams, P.J.L. (Eds.), Respiration in aquatic ecosystems. Oxford University Press, Oxford, 123-147

Huertas, E., G. Navarro, S. Rodríguez-Gálvez, L. M. Lubián (2006), Temporal patterns of carbon dioxide in relation to hydrological conditions and primary production in the northeastern shelf of the Gulf of Cadiz (SW Spain), Deep-Sea Res. Pt. II, 53, 1344-1362.

Laruelle G.G., H.H. Dürr, C.P. Slomp & A.V. Borges (2010) Evaluation of sinks and sources of  $\text{CO}_2$  in the global coastal ocean using a spatially-explicit typology of estuaries and continental shelves, Geophysical Research Letters, 37, L15607, doi:10.1029/2010GL043691

Mackenzie, F.T., A. Lerman, and A.J. Andersson (2004), Past and present of sediment and carbon biogeochemical cycling models, Biogeosciences, 1, 11-32.

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**BGD**

7, C2887–C2894, 2010

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Sarma, V. V. S. S., M. D. Kumar, and M. Manerikar (2001), Emission of carbon dioxide from a tropical estuarine system, Goa, India, *Geophys. Res. Lett.*, 28(7), 1239-1242, doi:10.1029/2000GL006114.

Takahashi, T., J. Olafsson, J. Goddard, D. W. Chipman and S. C. Sutherland (1993), Seasonal variation of CO<sub>2</sub> and nutrients in the high-latitude surface oceans: A comparative study, *Global Biogeochem. Cycles*, 7, 843-878.

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Interactive comment on Biogeosciences Discuss., 7, 5621, 2010.

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