Biogeosciences Discuss., 6, C1480–C1482, 2009
www.biogeosciences-discuss.net/6/C1480/2009/

Biogeosciences
Discussions

Interactive comment on "Coupling of surface *p*CO_2 and dissolved oxygen in the northern South China Sea: impacts of contrasting coastal processes" *by* W. Zhai et al.

F. F. Pérez (Referee)

fiz.perez@iim.csic.es

Received and published: 9 August 2009

Overall comment: This paper presents new observations of the sea surface pCO2 and O2 obtained in the South China Sea during a 17-days summer cruise. The authors describe the different pCO2 and O2 ratios with respect to different open ocean and coastal dynamic systems (upwelling, river plume). The presented results may have applicability in many coastal systems with large physical and biogeochemical gradients. This study represents a very interesting example of how to evaluate the metabolic status of communities and other coastal processes according to coastal pCO2 and O2 relationships. The results are very valuable information that adds to coastal pCO2 in-

ternational data synthesis and global carbon budget computations. Although there are no innovative procedures in the interpretation of the variability of pCO2-O2 relationships for this kind of studies, the quality of the observations and their description are worth to be spread amongst the scientific community. The Revelle factor is described as one of the most important factors that control pCO2 and account for the pCO2 and O2 relationships. Although air-sea gas exchanges are also considered, their relative importance is somewhat lessened compared to photosynthesis-respiration ratios based on the argument that primary production is rather low in most of the study area.

Specific comments: Page 6254, Lines 5-6: " According to Broecker and Peng (1982) and Stigebrandt (1991), we used the 2.5% super-saturation as the effective DO saturation level considering the bubble effect"

It is not clear whether this consideration should be made in coastal waters where subduction of water masses is not a prominent process. In fact, excess O2 seems to be slightly negative, by about 5 micromol/L. The authors should further discuss what are the implications of their assumption in the results and the associated uncertainties.

Page 6257, lines 20-24: The slope computed using equation 2 is about 1.45 microatm/micromol O2 or 339 microatm/%OD. This value should be given in the paper here, not only in later paragraphs (page 6259). In any case, this value is twice the one given by the slope given in figure 4 (green line). If this computation is correct, the difference should be explained.

In addition, estimation of the uncertainties should be provided and discussed.

Page 6259. Excess number of decimal places / expression of accuracy for DELTA(CO2*)=1.18. In any case, the uncertainty for this estimate should be provided. In other words, this same CO2:O2 ratio could be generated from river-sea mixing, not only from photosynthesis / CO2 outgasing. It seems as if the CO2 and O2 exchanges maintained a stable slope over time whenever the CO2 gradients are large enough to balance the O2 air-sea flux.

Epigraph 4.2 Influence of air-sea exchange on pCO2-DO relationships in offshore regions. This section addresses the importance of air-sea gas exchanges in order to account for the pCO2-O2 ratios found offshore and in the river plume. The steep slopes stem from the combined effect of photosynthetic activity and the high rates of CO2 exchange. The authors correctly state that this is modulated by a combination of metabolic and physical processes during the long-distance mixing with offshore waters. However, no explanation is given to try to justify the high slope of -1465 microatm obtained. This slope is 10 times higher than the theoretical slope estimated using the average air-sea gas changes of O2 and CO2. These values suggest that there exists a pCO2:O2 ratio that stabilizes air-sea gas exchanges after the long-distance mixing, equilibrating the losses of CO2 and O2 and maintaining the ratio in coastal and offshore environments. In offshore conditions, the authors acknowledge the low productivity and long displacements of surface water masses. However, this can also occur in the river plume where residence times are lower but the CO2 and O2 gradients are very high. In addition several segments in transects E and C (Fig 5a) have high slopes that could be due to air-sea gas change effects or to mixing between surface water masses affected at varying extents by air-sea CO2 exchanges and photosynthetic activity. Technical comments: Fig. 2. It should be explained why 70 m depth is used as the reference for continental shelf instead of 100 m, which is the line plotted in Fig 1. Fig. 5. Correct ‘exchenge’ by ‘exchange’

Please also note the Supplement to this comment.

Interactive comment on Biogeosciences Discuss., 6, 6249, 2009.