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Biogeosciences Discussions

Interactive comment on "Coastal upwelling fluxes of O_2, N_2O, andCO_2 assessed from continuous atmospheric observations at Trinidad,California" *by* T. J. Lueker

Anonymous Referee #2

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This manuscript presents a high resolution data-set from 2000 to 2003 of O2 and N2O air-sea fluxes derived from a model that uses the continuous measurements of those variables in the atmosphere at Trinidad Head (California coastal upwelling system). This approach allows inferring on changes and variability of primary production (based on the air-sea O2 fluxes) and nitrification (based on the air-sea N2O fluxes) in relation to upwelling events (based on water temperature and upwelling index) as already developed by Lueker et al. (2003) based on the 2000 and 2001 data-sets.

My main concern is the way the author computed the air-sea CO2 fluxes.

Unlike O2 and N2O, the CO2 air-sea fluxes cannot be derived from the continuous measurements of atmospheric CO2 at Trinidad Head because of the contamination from the terrestrial signal that blurs the air-sea CO2 flux signal.

Instead, the author used a relationship of pCO2 versus temperature and computed

pCO2 fields from SST satellite images (the air-sea CO2 fluxes were then computed from a gas transfer velocity parameterisation as function of wind speed). There are several problems associated with this approach:

1) Figure 6 clearly shows that in surface waters (temperatures from 12 to 14°C) pCO2 shows very large scatter. A look at data around 13.5°C shows that the scatter is about 100 μatm. Hence, the error derived from the interpolation of pCO2 versus temperature is roughly around +/- 50 μatm. This is probably close to the annually integrated air-sea gradient of pCO2. The author should at least provide an error analysis on the computed pCO2 and related air-sea fluxes based on the statistics from the linear interpolation of pCO2 versus temperature.

2) The interpolation of pCO2 versus temperature in Figure 6 is based on vertical profile data. Hence, the fit looks reasonably good because it includes pCO2 data at depth (where it is much less variable) than in surface waters (where it affected by air-sea exchange and biological activity).

3) The interpolation of pCO2 versus temperature should have logically been attempted with surface pCO2 versus SST based on continuous underway measurements of van Geen et al. (2000). It is possible that using such an approach, a relationship of pCO2 versus SST would have impossible to derive. Note that additional underway pCO2 data have been reported in the area by Takesue and van Geen (2002) and by Hales et al. (2003).

4) In the Chilean coastal upwelling system, Lefèvre et al. (2002) show that when a more or less robust relationship between pCO2 and SST can be achieved, it is specific to a given cruise. In other words, from one cruise to another, the pCO2 versus temperature relationship changes, probably in relation to different upwelled water masses, different primary production rates, air-sea exchange, ageing of the water mass, advection of different surface waters, etc.

In conclusion, substantial errors in pCO2 fields derived from pCO2 versus SST relation-

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ships are most probably incurred in coastal upwelling systems. I have strong doubts on the reliability of the air-water CO2 fluxes reported in this paper and they strongly undermine the more interesting conclusions based on the O2 and N2O data.

If the author is confident on his interpolation of pCO2 versus temperature, then I suggest that he provides a “validation” by comparing pCO2 computed from the continuous underway SST measurements with the corresponding continuous underway measurements of pCO2 from van Geen et al. (2000), Takesue and van Geen (2002), and Hales et al. (2003).

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