

General comment:

The manuscript is well written, straightforward and descriptive. However, the most important item is not addressed and the section about the inter-annual variability has a bad approach in my opinion.

The authors have collected an impressive data set for CO₂ and related parameters across the English Channel and Bay of Biscay spanning a time period of two complete years. These measurements show the seasonal pattern of the air-sea CO₂ exchange that is related to net biological production, temperature, and physical processes.

Many of the things below are minor corrections to the text, but there are a few points that they should consider. Further, it seems to be not suitable for publication in the present form.

Specific comments:

Major question. The manuscript presents important mistakes in the discussion of the interannual changes observed in the Bay of Biscay. From the beginning, an error in the impact of the changes in the NAO index in the sampling region conditioned the development of this discussion.

Attending to the seasonal distribution of the variables showed in the Figures, the interannual changes recorded from underway measurements seem to be due to influence of continental inputs that are more abundant during negative NAO scenario at these latitudes (Perez et al., 1995, 2000). The surface waters during the first winter were less saline than during the second winter. The abnormally low temperature and the intense nutrient concentration of these waters seem to show the presence of a surface layer of freshwater as well. Moreover a situation of thermal inversion as it could be sampled during this first year would produce the intense mixing layer from temperature criterion observed in the manuscript. Please, check this supposition.

Page 9706 line 14: $\pm 4-6 \mu\text{mol kg}^{-1}$, it is a mistake.

Page 9706: It is not sufficiently clear as the correction of the DIC measurements were done. Please, describe with more detail.

Page 9707: There exist a number of formulations of piston velocity as a function of wind speed, and they often produce quite different air-sea fluxes. The authors should justify why they chose the formulations proposed by Nightingale et al. (2000) and Sweeney et al. (2007).

Page 9707: The authors chose the wind speed of the MET Office Gascoigne Buoy. Nevertheless the most used choices are the products obtained from QuikSCAT sensor and NCEP/NCAR re-analysis model. Could you also compute the air-sea CO₂ exchange using the wind speed obtained from QuikSCAT sensor or NCEP/NCAR model and describe the differences?

Page 9708: The temperature criterion ($\Delta T=0.5^\circ\text{C}$) yields estimations of mixing layer depth different that using density criterion. For this reason, I would like to know the seasonal distribution of MLD using density criterion.

Page 9711 line 10-13: The estimation of the impact in TA related to the growth of coccolithophores showed a minor influence on the total TA changes. Could this estimation be sub-estimated due to an unsuccessful sampling strategy or the sedimentation of particulate inorganic carbon?

Page 9712 line 1-2: According to the sentence “*The DIC concentrations showed an overall increase with latitude for all crossings*”, minimum value should be located in the Southern Bay of Biscay.

Page 9714: The C:N ratio of 8.4 represents an approximation of the mean value of the seasonal production (Körtzinger et al., 2001) while 6.6 is a the classical C:N ratio that describe the new production or the ratio of particulate organic matter in the mixed layer. Please, clarify.

Page 9714: The sampling region is within subpolar latitudinal band. Therefore a dominant negative NAO phase correspond with positive SST anomalies and less vigorous winter mixing than normal whereas positive NAO scenario is expressed by negative SST anomalies and an intensification of mixing processes during winter.

Page 9714: The analysis of interannual changes from two consecutive years using the NAO index whose signal in the subpolar (subtropical waters as well) North Atlantic is delayed approximately three years (Edeng and June, 2001) is not properly focused.

Page 9716: I have estimated the winter oceanic pCO₂ from the values of DIC, alkalinity, salinity and temperature that you showed in the Figures and I have not found similar values during the two winters. For example, the differences between February 2006 and February 2007 in the Northern Bay of Biscay (light blue) and Central English Channel (dark blue) were approximately:

Northern Bay of Biscay: ~15 µatm

February 2006 (Alk ~2333 µmol kg⁻¹; DIC ~2133 µmol kg⁻¹; SST ~12°C; SSS ~35.5)

February 2007 (Alk ~2333 µmol kg⁻¹; DIC ~2110 µmol kg⁻¹; SST ~14°C SSS ~35.7)

Central English Channel: ~ -50 µatm

February 2006 (Alk ~2335 µmol kg⁻¹; DIC ~2130 µmol kg⁻¹; SST ~9°C SSS ~35.25)

February 2007 (Alk ~2335 µmol kg⁻¹; DIC ~2130 µmol kg⁻¹; SST ~12°C SSS ~35.35)

References:

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Körtzinger, A., Koeve, W., Kähler, P., Mintrop, L., 2001. C:N ratios in the mixed layer during productive season in the northeast Atlantic Ocean. *Deep-Sea Research I*, 48:661–688.

Pérez, F.F., Ríos, A.F., King, B.A., Pollard, R.T., 1995. Decadal changes of the θ -S relationship of the Eastern North Atlantic Central Water. *Deep-Sea Research II*, 42(11/12):1849–1864.

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