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Biogeosciences Discussions

Interactive comment on "Spatial and temporal CO_2 exchanges measured by Eddy Correlation over a temperate intertidal flat and their relationships to net ecosystem production" *by* P. Polsenaere et al.

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General comments:

CO2 fluxes data obtained with the micrometeorological Eddy Correlation (EC) technique carried out at different seasons over an intertidal lagoon are presented and discussed. In particular, net ecosystem exchanges at low tide are linked to the cover of Zostera noltii meadow. Such studies are needed to better understand the CO2 flux variability in coastal areas and the role of these systems in the global carbon cycle. The EC technique provides integrated measurements and is especially relevant. However, it should be supplemented by complementary approaches providing for example data on benthic and pelagic respiration and production to understand and untangle

processes that determine fluxes. Most of the interpretations given here suffer from not being supported by such data. Furthermore, some arguments of the discussion are not very convincing, if not invalid, and some references are not properly used. A serious revision is then recommended.

Specific comments:

1. In the introduction, the release of CO2 due to carbonate precipitation in aquatic system is not clearly presented (p 5456, l 5-12). Carbonate precipitation and dissolution affect DIC concentration. The precipitation of calcium carbonate results in the sequestering of carbon and decreases DIC but is accompanied by a shift of pH that induces the release of CO2 (see Ware et al, 1991. Coral Reefs 11: 127-130).

2. The third focus (p. 5458, l.13) being not attainable (as explained in the discussion) should not be announced in the introduction.

3. A detailed description of the data processing is given in Polsenaere et al (2011), which is just submitted and then not available. Reference to this paper should be avoided.

4. In the results section, when the lagoon is presented as a source or sink of CO2 to the atmosphere according to fluxes measured at each season, it would be more relevant to refer to daily fluxes rather than to average fluxes, provided that daily fluxes given in Table 1 do correspond to the mean daily budget. (The meaning of daily fluxes should be specified.) For example, daily fluxes ranged from 0.1 to 1.0 mmol.m-2.s-1 (i.e. source of CO2) in autumn 2007 at station 2 while average fluxes ranged from -10.0 to 18.6 (i.e. either sink or source of CO2).

5. The result section 3.5 is very confusing and comprises some part of discussion with references to published work. This paragraph should be rewritten. I suggest to present here only the evolution of the Zostera noltii cover (Table 2 should give results of the 5 satellite images analyse) and to relate spatial and temporal CO2 fluxes variations to it

only in the discussion.

6. The discussion section should be reorganized. It would make more sense to discuss first the diurnal and tidal changes in NEE and then to relate them to NEP. This would also permit the reader to understand the note in the Tables 2 and 3 and Figure 8 legend concerning discarded data.

7. The authors assumed that benthic CR was equivalent to NEE at night and benthic NEP was equivalent to NEE averaged over the daytime (p. 5471, l. 1-3), but the results they obtained in April 2009 refute this assumption. Indeed, other processes must be taken into account as negative NEE at night could not be ascribed to benthic CR. This should be discussed before interpreting as NEP NEE measured at the other dates.

8. The authors ascribed the highest positive CO2 fluxes at night at station 2 to benthic CR enhanced by the intense grazing of meiofauna and macrofauna on microphytobenthos (p. 5471, l. 24-28) and argued that this could confirm the more significant contribution of microphytobenthos at station 2 than at station 1. However, in intertidal sediments the major part of the benthic community respiration is generally ascribed to heterotrophic bacteria (see for example Hubas et al., 2006. MEPS 316: 53-68. and references therein). Furthermore, bacterial activity should be greater in Z. noltii bed sediments than in unvegetated sediments as demonstrated by Isaksen and Finster (1996. MEPS, 137: 187-194) in the Arcachon Bay.

9. The assumption that GPP and CR would be lower and characterized by a slower time scale variation in seagrass meadow than in microphytobenthic community is not valid. GPP and CR of Z. noltii beds have been shown to be as high as, or even higher than, in tidal microphytobenthic communities (see for example Ouisse et al., 2010. Hydrobiologia, 649: 3-11) and rapid response of both GCP and CR to environmental change (i.e. at tide scale) has been demonstrated (see Clavier et al., 2011. Aquat. Bot. 95: 24-30 or Ouisse et al., in press. doi: 10.3354/meps09274).

10. The reference to Spilmont et al. (2006) to explain processes leading to negative

CO2 fluxes at LT/Night (p. 5472, l. 11) is inappropriate and the given hypothesis are not convincing. First, as already pointed out (see point 8), the major part of the benthic community respiration in soft sediment is ascribed to heterotrophic bacteria and Spilmont et al. (2006) do measure release of CO2 to the atmosphere under dark incubations in spite of the microphytobenthos migration. Second, has the Z. noltii meadow of the Arcachon Bay been reported to be a site of high CaCO3 dynamics and does CaCO3 dissolution significantly occur under emersion? What are the assumptions of Zemmelink et al. (2009) who also reported negative CO2 fluxes at LT/Night?

11. There is no biological meaning in a linear relationship between light and production. Models classically used to relate production to light (i.e. light response curves) take into account a saturation (or even an inhibition) at high light.

12. The hypothesis of a reduced community metabolism at high tide compared to low tide (p. 5478, l. 11) is refuted by recent publications showing that carbon fluxes are far greater under water than in air on Z. noltii beds (Clavier et al., 2011. Aquat. Bot. 95: 24-30 and Ouisse et al., in press. doi: 10.3354/meps09274).

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