Biogeosciences Discuss.,
https://doi.org/10.5194/bg-2017-340-RC1, 2017

Biogeosciences Discussions
Open Access
EGU

Interactive comment on "Continuous measurement of air-water gas exchange by underwater eddy covariance" *by* Peter Berg and Michael L. Pace

Anonymous Referee #1

Received and published: 13 September 2017

This manuscript describes an important methodological advance for aquatic sciences by demonstrating that the eddy covariance method can be applied from the water-side of the air-water interface to measure oxygen and heat fluxes and to derive standard gas exchange coefficients. The method is used successfully at three shallow river sites where physical processes, especially heat exchange, are found to drive diurnal variations in gas exchange. The paper is well organized with careful, highly reasoned arguments for the approach and data treatments. The data examples are clear and mostly convincing.

The only troubling part of the paper is sections that describe the possible methodolog-

Printer-friendly version

Discussion paper

ical bias produced by temperature effects on the O2 sensor time series and how the authors have corrected their measurements for this bias. Although I agree this bias is likely and needs to be understood, I do not think the authors have shown they really know its magnitude. They estimate a ∼3% change in the oxygen reading per 1 degree C, and even with relatively small temperature fluctuations (<0.1 oC) this creates a bias about 3 times the measured signal (Figure 6). What if the effect was 4% or 2% instead of 3%? How consistent is the effect between optode sensors and their films? Is the effect proportional to the oxygen concentration or independent of oxygen concentration? Since the response time of the thermistor is faster than the optode, does this alter the correction? In short, the authors need to independently measure the magnitude of the temperature effect before applying a correction. This might be done with experiments where the oxygen partial pressure is held constant but temperature varied. Otherwise, the applied corrections may be creating more bias than they are removing.

If the authors can address the above concern any remaining revisions to the paper will be minor. Below are listed areas by line number that might be clarified.

Line 25. I question whether it is known that physical controls are “prevalent in lotic systems”. Perhaps it would be better to say “can be prevalent in lotic systems and adds uncertainty to assessments of biological activity for such systems that are based on water column O2 concentration changes”.

Line 30. What is meant by “erosion in the surface water”? Erosion of what?

Lines 78-80. Awkward sentence. Please restructure.

Line 87. Omit “but” in this sentence.

Line 93. Indicate where and how the tracer additions are made.

Lines 103-104. Change “studied” to “studies” and then clarify what is meant by “fitting measurements done in other aquatic systems”.

Line 108. “many standard estimates” of what? Please clarify. Are you talking about

Printer-friendly version

Discussion paper

carbon budgets?

Line 125. Reword as: “we were able to derive parallel fluxes. . .”

Line 126. Reword as: “proof-of-concept tests that were up to 40 hours long at three river sites.”

Line 131. Reword as: “All measurements were made from. . .”

Line 140. How was the measurement position ∼5 cm below the interface determined? Later (line 222) can you indicate how sensitive the storage term correction is to changes in this measurement?

Line 144. Why is the senor not identified as manufactured by Rinko?

Line 155. Separate into two sentences here. Indicate how reproducible the response times are with each fresh sensor film put on the optode tip.

Line 158. Why reference Fig. 2a here?

Line 169. Change to “PAR sensor”.

Line 183. “as level as possible” is vague. Can you indicate within a certain number of degrees from vertical? Please clarify how tilt changes were corrected for within the time span of a 15-min burst as the sensor must bob up and down some.

Line 191. The key word here is “detectable”. There may still be high frequency signals lost because they are not detectable by these sensors.

Line 227. It would be helpful here if the authors gave more information about how the “Spectra version 1.2” code treats the data. Also, what is meant by “several consecutive data segments”? How does this relate to what is shown in Fig. 4?

Line 237. It would be helpful for the authors to present the relationships for calculating k600 even though they are in the papers cited.

Line 256. Since the data is presented as hourly fluxes, why not change the units in the

figures to per hour rather than per day?

Line 269. Suggest reword as: “controlled by a driver apart from the river current velocity or winds. . .”.

Line 272. Unclear what results are being referred to here.

Line 317. I do not see why the authors reference Gundersen et al. 1998 here? This paper discusses the temperature sensitivity of oxygen microelectrodes that operate by different principles than optodes. The microelectrode temperature effect is usually related to the gas solubility in the membrane and changes in the diffusion rate.

Lines 352-355. Good argument here. Correct the spelling of “concentration” in line 355.

Line 371. Reword as: “This, in turn, changed the. . .”

Line 380-383. Can the authors take this argument further perhaps with an illustrative example?

Line 399. Do the authors have any temperature profiles from their sites that may illustrate temperature stratification during the day?

Line 410. Change to: “was first developed”

Lines 416-417. It is unsatisfying that the authors call for more studies of the temperature bias. As noted above, they need to include more concrete studies in the context of this paper.

Line 436-437. It would be helpful if earlier in the paper the authors indicated the magnitude of the O2 storage term relative to Jeddy (Equation 3).

Table 1. Add standard deviations to the parameters in the right three columns.

Figure 1c. Add arrows to indicate each identified item and indicate that the “independent dual O2-temperature sensors” are the miniDOT sensors and the sensor used for

Printer-friendly version

Discussion paper

EC is a Rinko sensor.

Interactive comment on Biogeosciences Discuss., https://doi.org/10.5194/bg-2017-340, 2017.

Printer-friendly version

Discussion paper