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Interactive comment on "Consistent calculation of aquatic gross production from oxygen triple isotope measurements" *by* J. Kaiser

Anonymous Referee #1

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After the pioneering work to evaluate oxygen production in aquatic ecosystem using oxygen triple isotopes by Luz and Barkan (2000), numerous investigations have been undertaken basically with their concept. Their simple and brilliant model, which could be found as equation (1) in this discussion paper, is very conducive and easily comprehensible to know that ^{17}O-excess (according to the definition by this discussion paper) of dissolved oxygen is basically controlled by mixing ratio of atmospheric and photosynthetic oxygen. This model, however, is based on the assumptions that 1) concentration of dissolved oxygen would be constant and 2) there would be no ^{17}O-excess occurred during gas evasion from water to air, that is, the ratio of fractionation factor during this process (γ_E) would be identical to that during respiration (γ_R). Additionally, values of both end-members are still in debate among investigators. The manuscript/discussion paper by Kaiser offers an excellent overview in every

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Interactive Discussion

Discussion Paper

detail for this topic. He proposes a newly-expanded equation which is free from constraints for concentration steady-state and absence of ^{17}O excess during gas evasion (equation 48). Additionally a completely explicit formula without assuming isotopic steady-state is proposed as well (equation 52).

Subsequently, he reviews all parameters in detail, especially to both end-members in Luz and Barkan model ($^{17}\Delta_P$ and $^{17}\Delta_{sat}$ as in equation 1).

Finally, sensitivity tests of each parameter with expected uncertainties and test calculation with observed data are demonstrated.

The main benefit of this paper is that it offers valuable insights not only for the isotope experts in this field, but also for the beginner and/or non-isotope communities who require another on-site observation method to evaluate both net and gross productivities in aquatic ecosystems.

The manuscript is very comprehensive and well written so that I can recommend this to be published in Biogeosciences basically as it is, with following corrections and recommendation.

Corrections:
P4027L15: The second term of the left hand of equation (27) must be c dδ/dt.

P4028L11: It should be necessary to describe that this equation (31) is derived from equation (28), which is under the consecutive situation with production and respiration only, because it is written in a different section.

P4032L1012: In equations (42) and (43), concentration term c must be multiplied to both right hands.

Recommendation:

P4035L14: It might be better for readers to describe that this equation (51) is derived from equation (47).

P4036L14: Likewise, seems better to describe that this equation (52) is derived from equation (46). These two are not essential but better to avoid from reader-in-maze.

P4059 (Figure 2): As far as my understanding, tests with variable $^{17}\Delta_P$ and $^{17}\Delta_{sat}$ use equation (1), whereas those with all other parameters use equation (48). Distinct separation between them, for instance, use warm and cool colors, change label order, etc., may help readers to understand more. Additionally, the figure caption should be revised accordingly.

P4044L13-15 P4059 (Figure 2): Unlike other parameters, θ and $^{17}\Delta_{sat}$ are dependent each other. Taking the θ values of 0.501 and 0.531 with fixed $^{18}\varepsilon_I$, $^{18}\delta_{sat}$, θ_E (same as θ but for gas evasion) values of -3.0, 0.690 and 0.516, respectively, $^{17}\Delta_{sat}$ values would then correspond to 44 and 103, respectively. It is 6 times larger than that from $^{17}\Delta_{sat}$ itself (assumed from 8 to 18), so that it seems to be reasonable to find remarkable errors of θ in Figure 2a relative to $^{17}\Delta_{sat}$. In other words, the range of θ uncertainty may be much unrealistic setting relative to other all parameters. I think this may be pointed out somewhere in the text if you would agree.

Interactive comment on Biogeosciences Discuss., 8, 4015, 2011.

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