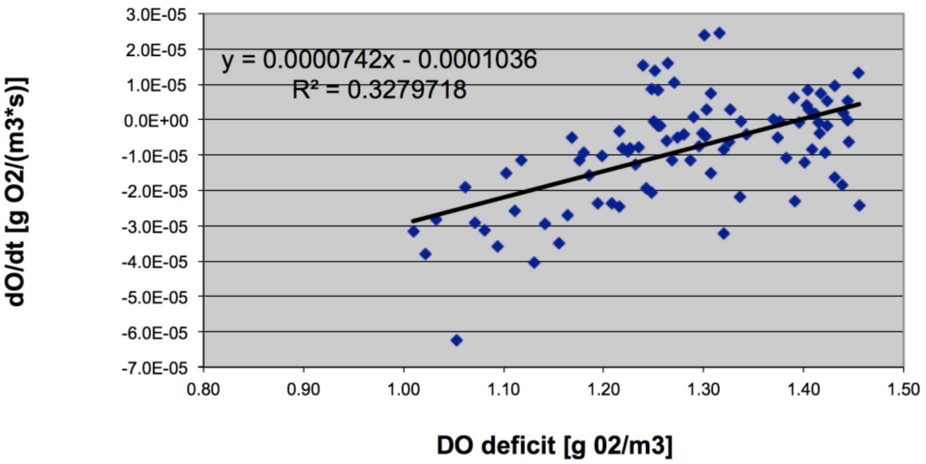
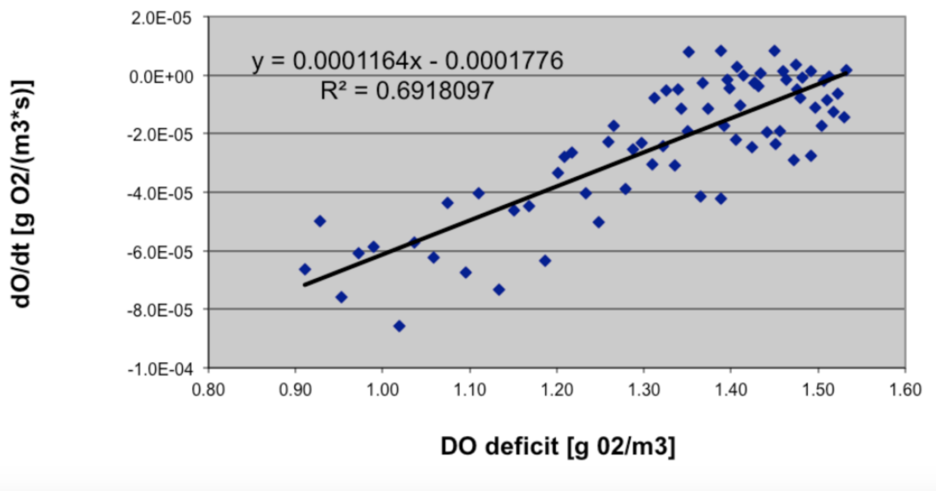
Dear Robert,

thank you very much for your interest in our study and your helpful comments. We agree with you that the estimation of the reaeration rate is probably the most critical step in the estimation of open-channel metabolism, and deserves further discussion. In order to present a short and concise paper, we tried not to overburden our paper with methodological details, but we are happy to discuss your suggestion (see point-by-point response below) and to add this information to our paper.

COMMENT: One point I would like to see more complete discussion of is how the aeration rates were calculated. It would be nice to see a plot of dDO/dt = ER + K(DO_deficit) for a few nights that were considered significant.

RESPONSE: The nighttime regression procedure is a rather standard technique, widely used in open-channel metabolism studies (e.g., Young & Huryn, Ecol. Appl. 9: 1359-1376). This technique is particularly suitable for rivers with considerable GPP that causes considerable daytime DO increases, and stable nighttime DO plateau. It is suitable for streams with Koxy<0.5 m h^{-1}, such as the investigated river (see Demars et al., Limnol. Oceanogr.: Methods 13, 356–374). Below we show two plots (the better fit with $p<0.01$ and $R^2=0.69$ and the worse one with $p<0.05$ and $R^2=0.33$) from the first two sampling weeks at station R2 to give an impression about the variability in the encountered nighttime patterns. The regression slope corresponds to the Koxy (in 1/s) in these representations. In our study, we only considered significant nighttime regressions ($p<0.05$).





COMMENT: Adding confusion to the aeration rate discussion is the reported units of appendix S2 in g O2/(m3*s). Is this a typo? Why not use the same units as the text in 1/day (line 215)?

RESPONSE: Yes, this is a typo. The y-axis units for plots in S2 should be 1/day. Thank you!

COMMENT: Also, given the relatively low aeration rate and high productivity, why not use a parameter fitting approach to model metabolism and aeration rate? It seems a more robust approach than the nighttime regression method.

RESPONSE: Inverse modeling approaches, such as BaMM (Holtgrieve et al., Limnol. Oceanogr., 55: 1047–1063) and BASE (Grace et al., Limnol. Oceanogr.: Methods 13: 103–114) require PAR irradiance input data for the simultaneous estimation of reaeration and metabolism. Unfortunately, we do not have adequate PAR data available for the studied river. Whether inverse modeling yields more reliable reaeration estimates than the nighttime regression method (and under which circumstances?) has not been tested in the literature to our knowledge. In our opinion, the best approach would be to obtain reaeration rates from different methods (gas tracer experiments, nighttime regression, inverse modeling) in future studies. However, we believe that our reaeration estimates (ranging from about 6/d to 16/d across 3 sampling stations and 50 sampling days) are realistic estimates for the investigated river.

COMMENT: Your study finds very high GPP and ER estimates compared to others. This could be a direct result of an overestimate of the aeration rate. I find that a more robust method, or convincing discussion of the aeration rate, is necessary to support these findings. If an entirely new analysis applying a parameter fitting model is perhaps infeasible, empirical values from hydrodynamics and morphology would be helpful.

RESPONSE: To our knowledge, the nighttime regression technique has not been shown to be less robust than other methods in the literature. We see the available methods rather as complementary techniques. For example, gas tracer approaches are considered a direct and reliable method to measure reaeration, but represent only a temporal snapshot, and can yield unreliable results if conservative tracer dilution is not adequately quantified. The nighttime regression method estimates reaeration over a longer time scale and has been found to work well in less turbulent, productive streams, but is often not very useful in turbulent, shaded headwater streams. Inverse modeling may be the most integrative approach, but measured diel DO and temperature data can sometimes be uninformative and prior information (such as field tracer studies) is needed (see Holtgrieve et al., Limnol. Oceanogr.: Methods 14: 110–113). However, if not established for a specific sampling site, empirical equations may be the most uncertain option to estimate reaeration, as results of different empirical equations vary widely (at least 40-125% error in estimates, see Demars et al., Limnol. Oceanogr.: Methods 13, 356–374). Considering two contrasting hydromorphological parameter sets from our study (20 June 2014, low discharge, 9.1 m^3/s; and 12 July 2014, high discharge 32.7 m^3/s), reaeration rates estimated by the two most commonly used empirical equations indeed varied considerably, but yielded consistently higher reaeration rates than our nighttime regressions for these days (Table 1).

Table 1. Comparison of reaeration coefficients estimated in this study with those estimates from empirical models for the same reaches.

Reach	Owens 1974 (surface renewal model) K_{oxy}^{20} (/d)	Tsivoglou & Neil 1976 (energy dissipation model) K_{oxy}^{20} (/d)	Nightime regression K_{oxy}^{20} (/d)
Low Q			
D	29	42	11
R1	51	36	9
R2	17	19	7
High Q			
D	48	127	11
R1	30	73	9
R2	15	45	9

Therefore, we do not think that overestimations of reaeration rates explain the high metabolic rates in our study. As discussed in the paper, we measured river metabolism during the peak of macrophyte growth in summer. This may explain the high rates of GPP and R in our study, and consequently, lower rates may be expected in other seasons.

COMMENT: Also, would it be possible to apply the two-station method if you combined reaches? My rough calculations indicate a reach length of about 3000 meters would be appropriate from your hydraulics and aeration rate.

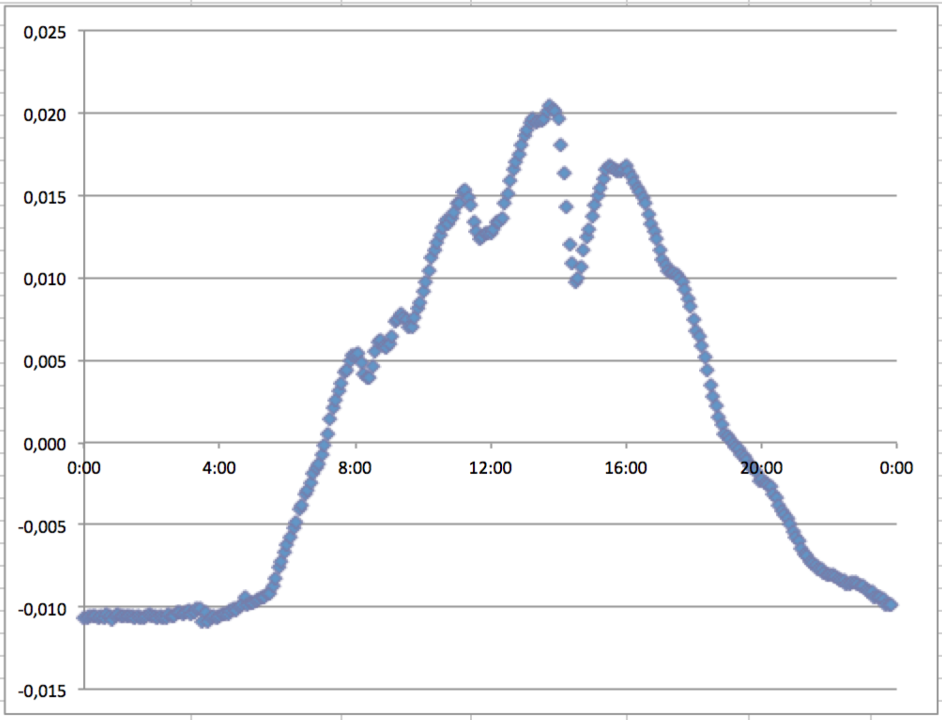
RESPONSE: According to Demars et al. (Limnol. Oceanogr.: Methods 13, 356–374), the 2-station method is applicable to reach lengths 0.4 v/k to 1.0 v/k. In our reach system, this range corresponds to:

D	3283 - 8280 m
R1	2765 - 6912 m
R2	1624 - 4061 m

R1+R2	2199 - 5497 m
all 4 reaches	2482 - 6205 m

Thus, we cannot evaluate separate reaches in our study, but are at the lower end of this range (slightly above 0.4 v/k) for all 4 reaches combined and for R1+R2, and can therefore possibly estimate 2-station metabolism for these combinations, at least at low flow conditions. Combining all reaches is of limited use for the aim of our paper to evaluate restoration effects, but combining restored reaches R1 and R2 may indeed provide useful information. In response to your comment, we evaluated 2-station metabolism for a few sampling days for R1+R2 and it indeed appears to work. Below please find the results of the application of the 2-station method for the first sampling day (June 20, 2014). Rates of GPP were only slightly higher for the combined reaches R1+R2 using the 2-station method than for the longer reach evaluated by the 1-station method at station R2 (that included a longer unrestored upstream section), i.e. 11.4 vs. 8.8 g DO m^{-2} d^{-1}. Rates of R, were only slightly lower with the 2-station method, i.e. 9.6 vs. 11.2 g DO m^{-2} d^{-1}. If consistent across our dataset, these results would further support our hypothesis of increased river metabolism due to restoration. In the revised manuscript, we will test the 2-station method systematically for the combined reaches R1+R2 for all sampling days, and report the data.

Ecosystem Respiration	9.59	g O2/m2 d
Gross Primary Production	11.36	g O2/m2 d
Net Ecosystem Production	1.76	g O2/m2 d
P:R	1.18	



(values on y axis in g DO m-2 d-1 /1000)

REFERENCES:

Demars et al., Limnol. Oceanogr.: Methods 13, 356–374.
Holtgrieve et al., Limnol. Oceanogr., 55: 1047–1063.

Holtgrieve et al., Limnol. Oceanogr.: Methods 14: 110–113.
Grace et al., Limnol. Oceanogr.: Methods 13: 103–114.