Biogeosciences Discuss.,
https://doi.org/10.5194/bg-2019-60-AC4, 2019

Biogeosciences Discussions
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Interactive comment on "Oxygen dynamics and evaluation of the single station diel oxygen model across contrasting geologies" *by* Simon J. Parker et al.

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Received and published: 24 July 2019

Thank you for reading paper and helpful comments.

"I would therefore strongly recommend that the abstract be revised to better reflect the purpose of the paper. i.e. the point stressing that this paper is " about evaluating model structures, not quantifying parameters", needs to be right up front."

Ok.

"Minor point: Page 2, Line 4. Suggest changing 'components' as this word was used in the previous sentence to refer to P, R & reaeration. "

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Agreed.

"I would like to see a little more explanation about HOW R/k can be used to interrogate the validity of the model used for fitting diel O2 curves."

Assume both R and k are constant. And given (at nighttime):

d(DO)/dt = -R + k(DOsat - DO) [Equation 1]

Then:

(1) A plot of d(DO) against (DOsat - DO) will give a straight line with slope k and constant term R. This is used to calculate a ratio R/k (ratio 1)

and:

(2) When d(DO)/dt is zero, (DOsat - DO) is measured. This gives a different method of calculating the same quantity, R/k (ratio 2).

If ratio 1 equals ratio 2, then Equation 1 adequately describes the nighttime DO dynamics. If, however, they are not equal, then Equation 1 does not adequately describe the processes.

For the 16th May, for example, for the Ebble ratio 1 is 1.6 and ratio 2 is 1.7. But for the Avon, they are equal (3.05).

If you then look at the simulations, the figures below (Figure 1 and Figure 2) show optimised models for the night of the 16th of May for the Ebble and the Avon. Grey circles are observations. Grey line is simulation not accounting for temperature. Black line is simulation accounting for temperature (i.e. of the form, R = R20 ˆ(T-20), where R20 is respiration at 20 degrees C, T is temperature in Celsius). The right hand panel shows the residual plots (observed DO minus simulated DO). The fit for both (Ebble and Avon) is good, but the residuals for the Ebble show that the data depart from the model in a systematic way.

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This does not demonstrate that R is not constant, but demonstrates that the assumptions are not upheld and it is a measure of the extent to which the model deviates from the data.

"Page 2, Line 20. Equifinality hinders resolving ER and k when %DO saturation is very close to 100% or when there is very little change in %DO over the day, it is not a universal problem."

If changed to 'can be hindered', is that acceptable?

"Page 3, Line 26. It has already been stated that precision and accuracy of the DO sonde data is of fundamental importance in reliably identifying points where the change in DO is zero. Yet there is no mention at all of how accuracy of the deployed sondes was verified. Probe drift would be a major confounding factor in this analysis."

It's true that drift could be a confounding factor, so I've done some additional analysis (Figure 3). I have made the following assumptions. The probe has drifted over some unspecified period by 0.5 mg DO per litre. Drift over the course of any single night is negligible. Temperature has not drifted (although I could test for this also).

The effect of this is to reduce the DO deficit at zero DO change from 1.7 to 1.2 mg DO per litre and the corresponding Hornberger-Kelly ratio from 1.61 to 1.11, so even if there were drift it wouldn't affect the conclusion. The test (comparing Hornberger-Kelly ratio with DO deficit) most likely examines the shape of the DO curve; it's not about magnitudes (I think).

"Page 5, Line 13. The cause of this sudden change in the rate of decline?"

I don't know. I could speculate that it is because labile organics have been consumed, but that would be too convenient for the overall argument (although that is a possible explanation). It is a long time series (each river is about half million records), so it's hard to explain local features.

"A change in discharge will almost certainly change k and this relationship will be id-

iosyncratic for each site depending on stream channel shape, wetted area, roughness etc. Are these additional factors responsible for some of the variation observed in this data set?"

Could it be k which is not constant? Of course, it's possible that k is different across sites, but could k change during the course of one night according to the same pattern for several nights in a row? I have attached a plot for discharge (Figure 4). There is no difference in the discharge that would account for differences between Ebble and Avon. It could be that windspeed is changing every night in the same way and therefore k is changing, but changes in the windspeed would be similar across all sites. Therefore, changes in windspeed could only account for the behaviour if the Wylye and Avon were sheltered, and buffered from the effects of changes in windspeed. Yes, this is possible and cannot be ruled out. On the other hand, windspeeds tend to drop during the night, so that, if for the Ebble and Nadder, the explanation for variable k were falling windspeed, then you would expect DO to stagnate as the night progresses, but the reverse is the case.

"Is there any significant time-of-day dependent topographic shading of any of these streams over the study reach integrated by the sonde? If so, this may then affect time of peak DO."

Yes, this is true. This cannot be ruled out. Also, if time to peak is shorter duration, then time to minimum (after sunset) is likely (although not inevitably) to be shorter duration. But early time to peak (and early time to minimum) for both Nadder and Ebble together with the fact that it is those two which are violating the model assumptions corroborates (not failsafe, just an additional line of evidence) this statement from Schindler et al. (2017).

"Such increases in nighttime oxygen concentrations were observed in several of our study streams and appear to be diagnostic of two-stage ecosystem metabolism."

It doesn't prove it, it's just an additional line of evidence.

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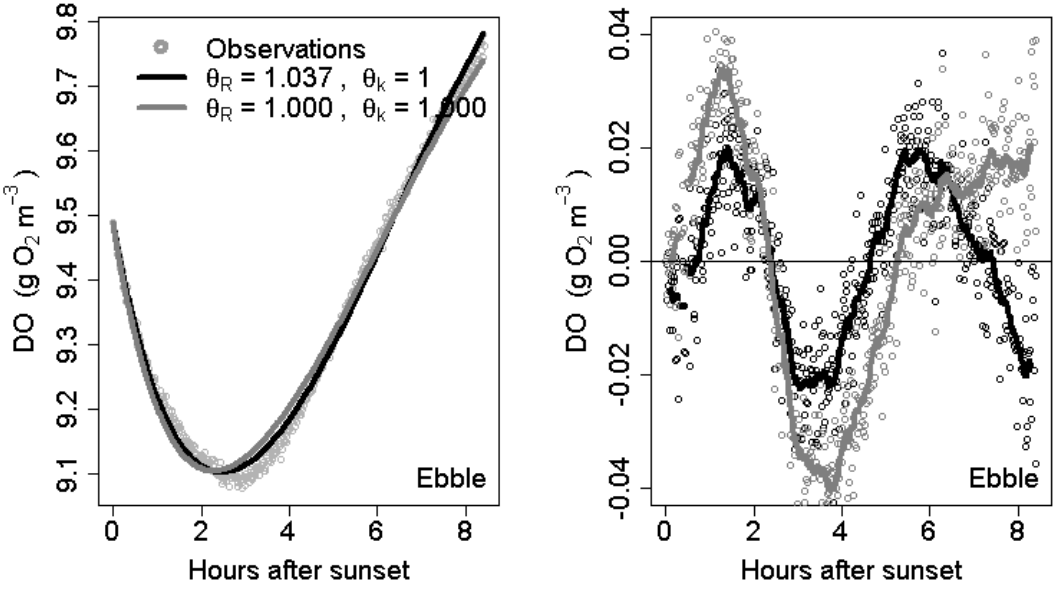

Fig. 1. Modelled DO Ebble 16th May

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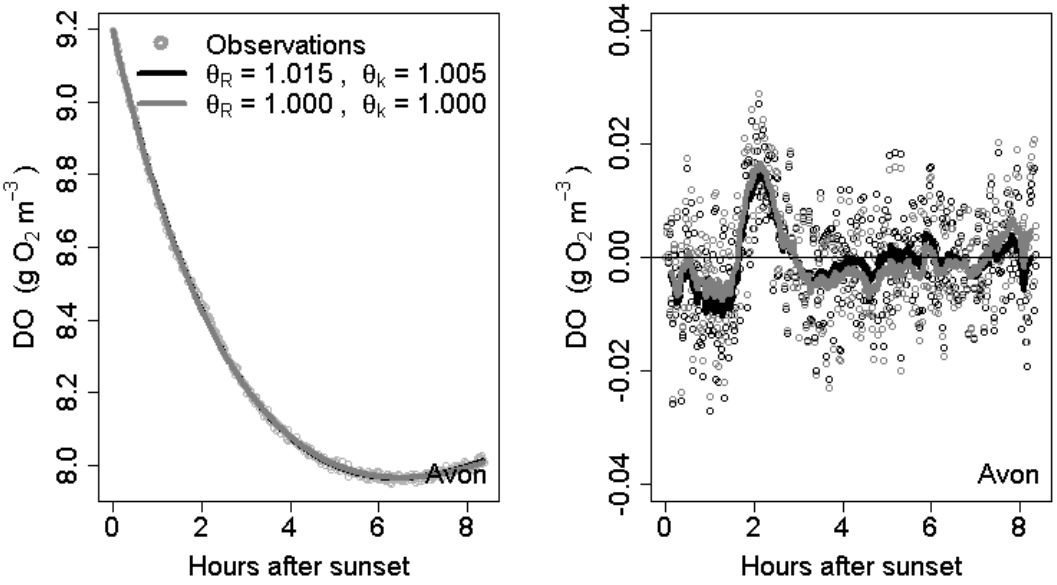

Fig. 2. Modelled DO Avon 16th May

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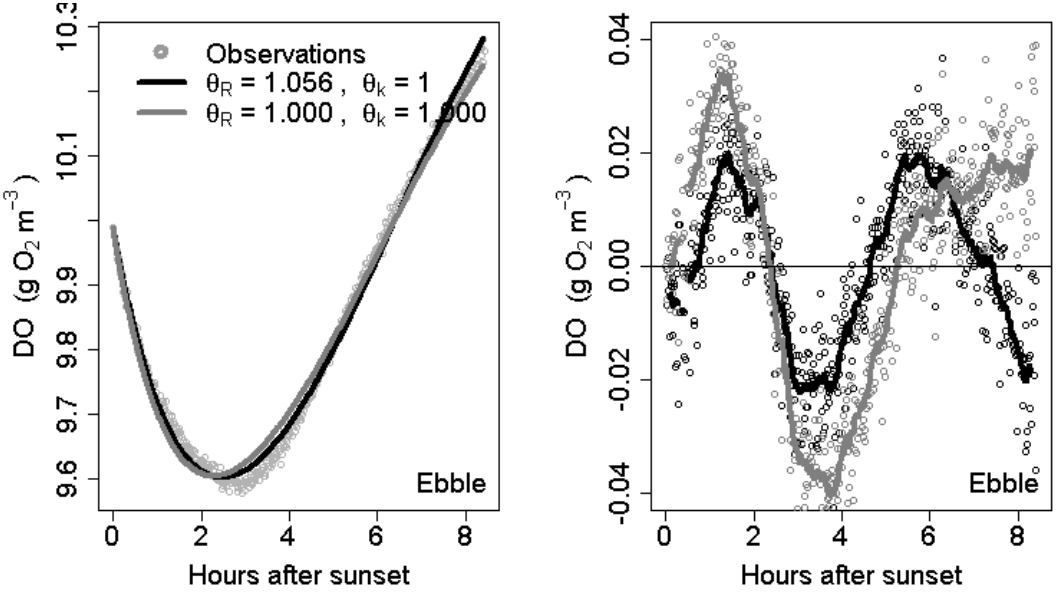

Fig. 3. Effect of assumed drift (Ebble 16th May)

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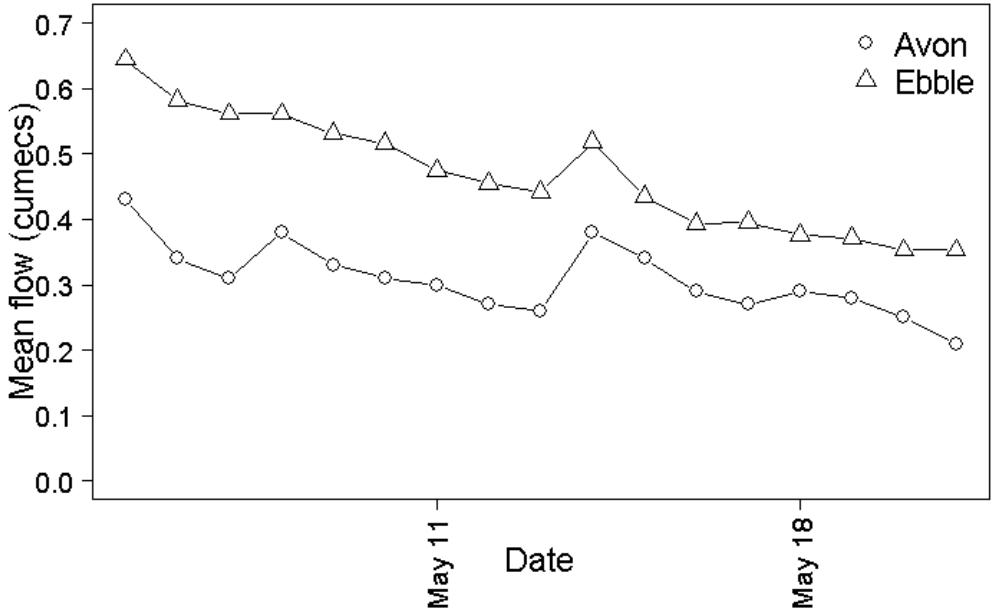

Fig. 4. Discharge for two rivers (Avon and Ebble)

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