Interactive comment on "Tune in on 11.57 µHz and listen to primary production" *by* Tom J. S. Cox et al.

Tom J. S. Cox et al.

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We thank this reviewer for her/his overall supportive comments and suggestions. Below we summarize the comments and suggestions, and we outline how we can incorporate these in a revised manuscript.

Comment: «This study presents a significant development to the frequency-based GPP estimation method by Cox et al. (2015, doi:10.1002/lom3.10046) [...] This elegant technique will really contribute to metabolism estimations, but future appliers must know under which circumstances the assumptions remain acceptable.»

Response: We aim for a minimal overlap between the 2 papers. We have already presented a brief summary these assumptions in the discussion section. But it is a

good suggestion to elaborate a little bit more on this. The discussion of the comparison of our results with some reference data (also suggested by this reviewer, see below) provides a good opportunity.

Comment: «At this point, it would be nice if the authors could explicitly point out the benefits of the new method compared to the one in Cox et al. (2015), where mean GPP was calculated in 14 d sliding windows, which apparently provided the same results. Overall, the presentation of results should be revised to really focus on the benefits of the new method, especially when compared to Cox et al. (2015). While this method has theoretically finer temporal resolution, the same kinds of figures are provided (fig 1,2,4top: time vs. estimated and modelled GPP), leaving some doubt it the new method delivers anything more than the previous one. Relations between estimation error and time or O 2 are not shown.»

Response: There are a number of benefits to the approach presented here. The major benefit is that complex demodulation gives a theoretically consistent framework to deal with time-varying amplitudes, and thus time-varying GPP. This is a major difference with the approach in Cox et al (2015). There, the theoretical derivation relies on O_2-fluctuations with constant diurnal amplitude. The pragmatic approach to deal with time varying GPP was to apply the results on moving windows.

As a surprising result of the current approach, we find that (in non-tidal systems) the temporal resolution is very fine: daily values of GPP estimate can be estimated. This would not be possible with the approach of Cox et al 2015.

A second advantage is that this theoretical framework allows to understand and analyze the impact of tidal harmonics. The impact of close to diurnal harmonics on the O_2 signal explains why the GPP estimates, when calculated with a 1 day filter are apparently fluctuating (Hoernum Tief site results) with ∼ 15 day period. As a result of this theoretically derived impact, we propose an averaging time of 15 days when applying Fourier methods in tidal systems. This result would not be able with the approaches in

Cox et al 2015. We will make this more explicit in a revised version of the paper.

Comment: «Convincing power could be increased if:

âĂć Fig 1 (bottom), 2 (bottom), and 4 (top) would show something more than the corresponding versions in Cox et al. (2015) [fig. 3 top, fig. 6 top]. »

Response: The figures in this paper and the ones in Cox et al 2015 are fundamentally different. Figures 1 and 2 here show daily GPP estimates, while in Cox et al 2015, 10day moving average of GPP was calculated. Figure 4 top shows the impact of a first order correction term on the estimate, demonstrating that this first order term is the major cause of the mismatch between the true GPP and 1 daily GPP estimate by complex demodulating the O2 time series. Nevertheless, the simulation on which these calculations are based are performed with the same model, hence the resemblance of the figures. We will clarify this in a revised version.

Comment: «âĂć the only non-synthetic application (Hörnum Tief) included some reference data, like in Cox et al. (2015). In its present version there is no way to judge if the calculated values had any reference to reality. »

Response: We thank this reviewer for this suggestion. Reference data from a nearby site can be added to a revised version of the manuscript, this will simultaneously allow us to briefly discuss the assumptions underlying the Fourier methods (see above).

Comment: «Pages 5-6: Findings about tidal components should be better organized in results: please use some subsections.»

Response: OK

Comment: «Page 7 Lines 4-5: These Fourier techniques make the implicit assumption that air-water exchange has a period that is far from 1 day, which in practice would mean a constant exchange rate during a day (shorter periods than a day seem unrealistic). This is not conceptually superior to the assumptions made in traditional methods. For the case of transport it may be true (but see remark about coastal winds and cor-

responding currents above)»

Response: Diel fluctuations in air water exchange are indeed assumed to be small compared to diel fluctuations due to GPP. This is part of the assumptions which we will elaborate more on in a revised version of the MS.

Comment «Page 8 Lines 3-5: Half of the rather brief conclusions relate to the preceding study. It would be nice to achieve a healthier balance between the new and the old findings.»

Response This section will be revised to achieve a healthier balance between the new and the old findings.