Biogeosciences

Discussions

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Interactive comment on "El Niño–Southern Oscillation (*ENSO*) event reduces CO_2 uptake of an Indonesian oil palm plantation" *by* Christian Stiegler et al.

Anonymous Referee #2

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Stiegler et al. study the response of surface-atmosphere fluxes from an oil palm plantation to variability in climate including fire-induced haze. The analysis is important but there are many aspects of the manuscript which should be improved before it is ready for publication.

On p 2 L 25 note that this is for the same total amount of PAR. Haze also decreases PAR at the surface and can decrease net photosynthesis for this reason.

p3 L20: this notion wasn't fully developed in the introduction. A good place to start might be: Steiner, A. L., Mermelstein, D., Cheng, S. J., Twine, T. E., & Oliphant, A. J. (2013). Observed impact of atmospheric aerosols on the surface energy budget. Earth

More detail about how transformation and adding an intercept reduced goodness-of-fit would be forthcoming. Especially adding the intercept; it is unclear to me how adding more parameters (in this case an intercept) would make goodness of fit worse. Also, are all of the terms necessary? Information criteria-type analyses (e.g. AIC, BIC) can help discriminate against unnecessary terms to come to a simpler and more robust synthesis. e.g. on L 30 p 5, all of these terms may be 'significant', but some may be relatively unimportant for explaining the variance of observations and can perhaps be safely excluded from the model.

What was the cost function for determining parameters? Least squares?

I don't really understand section 2.3.1. Is this a type of sensitivity analysis? How does this add to an already unique analysis?

3.2 and elsewhere: expressing fluxes as means of half hourly values plus or minus standard error can be misleading: do these values integrate the same proportion of daytime and nighttime data? If one of the time periods has more nighttime data due to seasonal differences in prevailing winds, the values could be different for this reason. (The paragraph beginning line 22 is better.)

bottom of p 7: define 'dim light'. Light that is 'dim' to our eyes is probably below the CO_2 compensation point (because human eyes respond logarithmically to light levels).

The paragraph on L 10 p 8 is unconvincing: was energy flux partitioning impacted by haze in addition to surface drying or was the latter the most important? Energy flux analyses in the manuscript could be better-developed as a whole.

Section 3.4: I'm not sure how extending the analyses behind the range of variability observed in the (linear) models is a good way to estimate the impacts of additional haze. This could bring for example far more ozone, which was not considered and is probably critical for photosynthesis here. In brief, I recommend dropping the intensified

drought/haze analysis with a non-mechanistic model and adding instead more detail about sensible and latent heat fluxes, the analysis of which at the moment seems like an afterthought.

4.1: 'relatively resistant against drying soil'...with respect to the range of drying observed here. It probably just wasn't quite dry enough rather than the plants being insensitive to soil moisture.

Good detail about oil palm physiology throughout. More biogeochemical/biogeophysical studies should include these important details about fruiting, etc.

Interesting that oil palm is insensitive to VPD up to 17 hPa given the rather large sensitivity of other tropical plants to VPD, see:

Fu, Z., et al., 2019. The surface-atmosphere exchange of carbon dioxide in tropical rainforests: Sensitivity to environmental drivers and flux measurement methodology. Agric. For. Meteorol. 263, 292-307.

Kiew, F., et al., 2018. CO2 balance of a secondary tropical peat swamp forest in Sarawak, Malaysia. Agric. For. Meteorol. 248, 494–501.

Wu, J., et al., 2017. Partitioning controls on Amazon forest photosynthesis between environmental and biotic factors at hourly to inter- annual timescales. Glob. Change Biol. 23, 1240–1257.

Section 4.2 is likewise weak...the model cannot consider the impacts of elevated temperatures beyond temperature optimums on reducing photosynthesis. Include instead perhaps an analysis of energy fluxes, which comprise hypothesis b and are never adequately described thereafter.

Conclusions and elsewhere: some discussion of ozone would be forthcoming. This isn't measured (and rarely is) but may (or may not) be important here.