Comment on bg-2022-58

Anton Vrieling (Referee)

Referee comment on "Tracking vegetation phenology of pristine northern boreal peatlands by combining digital photography with CO2 flux and remote sensing data" by Maiju Linkosalmi et al., Biogeosciences Discuss., https://doi.org/10.5194/bg-2022-58-RC2, 2022

The current manuscript uses digital repeat photography for three peatland sites and compares this to other seasonally-variant observations, i.e. on precipitation, temperature, CO2 fluxes, and Sentinel-2 reflectance. The manuscript was clearly written, was scientifically sound, and provides interesting analyses. Nonetheless, I have a few considerations that may help to improve the work. My main comments are:

1. Some of the methodological choices are not sufficiently justified and evaluated against other approaches. For example, L100 indicates that daily GCC averages were used. However, with similar input data many reference studies use the 90th percentile of GCC values over 3 days (e.g.: https://doi.org/10.1016/j.agrformet.2011.09.009), which may help to reduce illumination effects and consequently smoothen the GCC profiles: why was this approach not followed here? Another question is why a 25% threshold for SOS/EOS was chosen (L166-167): although not an uncommon value, it would require justification. (see further issues in "specific comments")

2. While the EC method is an important reference, it remains unclear how the EC footprint relates to the various ROIs and how it can thus effectively represent the variability of CO2 exchange as caused by the different vegetation elements (and how this relates to the analysis provided here). We note that to better describe the phenology around AmeriFlux/NEON tower footprints, recently a paper was submitted to Scientific Reports that uses 3-m resolution Planet data to extract 10x10 km phenology for each EC tower.

3. L339-342: "to our knowledge" may require some careful checking of literature also, although "with this precision" gives room for interpretation. It would be better if the authors could relate to other studies that also separate different elements in phenoCams. Examples exist (although "with this precision" may need to be clarified!): https://doi.org/10.1016/j.rse.2020.112004 take different parts of the phenoCam image to look at grass/shrub/tree signals in a savanna. https://doi.org/10.1016/j.agrformet.2014.08.007 divides the camera image into small subsets for which SOS is calculated. https://doi.org/10.3389/fpls.2015.00110 looks at individual tree crowns in a single image. I would expect other studies to do this too. Perhaps this is not what authors mean, but I'd highly recommend to expand the "to our knowledge" to better clarify the innovation here and put it in perspective.

Specific comments:
- L32-41: the authors correctly indicate that a change of abiotic conditions (particularly warming) affects the C-balance due to increased take up of CO2. While this is correct, warming in peatlands also causes high CO2 emissions. While not a topic in this study, this aspect of the carbon balance could be highlighted here.
- L86-87: could the authors also indicate the height on the pole where the camera was mounted? This is quite crucial information in my view. The reported angle is probably the depression angle?
- Figure 1: red lines and numbers on a green background are not very clear. Particularly also for 10% of male who are red/green colorblind. I suggest changing color and increase siz of the numbers.
- L126: why was a base temperature of 5 degrees used here, and not 0 degrees for example? Could authors provide justification for this in the manuscript?
- L129-131: I would request the authors to rewrite these two sentences: I could not understand it. "Monthly average" of what and how can an average be divided in 3? What is the "value just before the increase"?
- L145-146: the minimum of two days is because there are overlapping orbits: this should be mentioned. Also I would like to read about how many cloud-free observations were available on average.
- L183-184: why not 15th, but 17th of June in Kaamanen?
- Table 2: please indicate in caption why those data are missing. In addition, explain why some entries are in bold font. Possibly the highest/lowest numbers? But then by for Lompolojänkka there are two (different) bold values for Max GP week?
- L200: could somehow the significance of these differences be indicated in the table?
- Figure 6: the figure now suggests that Lom for June > 10C is not significantly different from the others? Just to be sure that I interpret correctly, because the error bars suggest no overlap with the other two.
- Table 4: I could not find a clear explanation for the low R2 of 2018a at Halssiaapa: or is this because of what is written in L260-261?
- L371-375: great that the authors manage to also use the GCC levels; this is probably because the StarDot is a stable camera, whereas for cheap cameras (such as in https://doi.org/10.1016/j.jag.2020.102291) this is less the case.
- L394-396: this seems a relevant discussion. I suppose that the authors imply that for the vegetation that they study less of such non-photosynthetic biomass is present? In addition, the depression angle used by Vrieling et al (2018) is much smaller (i.e. less towards nadir) than in this study.
- L401: please specify "typically" every 5 to 10 days is for Sentinel-2 in general without overlapping orbits, but not for non-cloudy satellite images.
- L405-409: in this framework the RS mapping with PlanetScope could also be mentioned; several efforts exist at present, and the satellite constellation offers very frequent imagery at fine spatial resolution (3m).
- L419-420: this statement is a bit vague "more satellite data would be needed". The authors probably mean a finer temporal resolution resulting in more frequent cloud-free observations? Again, see also the previous comment.
- General: are the camera-data and/or GCC data somewhere available on a repository and/or part of a network like https://phenocam.sr.unh.edu?
- Figure A2: WTD is missing for 2019? Please report why in caption.
- Figure A3: GGDS: S is for "sum"? Add to caption for clarity.
- Figure A5b: caption: I believe that only no temperature data in class <5 for August (July should be deleted here).

Edits:
- L40: "has been verified" is somewhat vague here: could authors be more specific on the findings of those studies?

- L89: "in all cameras" should read "for all cameras"
- L114: "on an" should read "at the"
- L139: "filtered", but also "discarded" in the subsequent analysis?
- L351: remove "those" and replace "which" with "that"