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Biogeosciences Discussions

Interactive comment on "Using MODIS derived fPAR with ground based flux tower measurements to derive the light use efficiency for two Canadian peatlands" *by* J. Connolly et al.

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The article by Connolly et al. investigates the seasonal variability of the light use efficiency in two Canadian peatlands and investigates potential growth limiting factors. The article is linking flux tower measurements to a satellite-inferred proxy for productivity. Given the relevance of the productivity of peatlands for the global climate, it is of major importance to develop methodologies linking local high-resolution tower flux observations to regional to global scale satellite data. The basic methodology of this paper therefore makes a valuable contribution to the monitoring and prediction of peatland carbon dynamics in the future. The paper has however some weaknesses which

should be addressed in the revised version.

Specific comments

Monteiths LUE model used in peatlands

1. The linear relationship between biomass production and PAR as expressed by the light use efficiency model of Monteith is valid when growth is not limited by water, adverse climatic conditions, or nutrient shortage. The article analyses the growth limiting factors vapor pressure deficit and minimum temperature. It is essential to discuss also potential nutrient limitation when adopting the Monteith model to peatlands which are know for their nutrient-poor conditions (i.e. mention site-specific nutrient conditions/ Sphagnum nitrogen and potential seasonal variation).

2. It is well know that the light use efficiency varies among crops and I would expect also among different vegetation types within peatlands. In this article, an average LUE for all vegetation types is derived. I would expect that different plant functional types may react differently on e.g. water availability. Water contents in Sphagnum mosses above the optimum for net photosynthesis may reduce the photosynthesis through restriction of diffusion of CO2 into the moss chloroplast (e.g., K. Eric Van Gaalen et al., 2007, Oecologia 153, 19-28). Some of the variation of the LUE versus VPD relationship could result from the different response of the different plant functional types within the fetch of the flux tower and the MODIS pixel. Given the physiological dependence of the LUE, I wonder how reasonable it is to determine the LUE for peatlands at the ecosystem scale.

MODIS fPAR

I miss an indepth evaluation and advise a careful treatment of the MODIS data.

- How reliable are the data for the peatland area, i.e. how might the biome missclassification affect the MODIS fPAR values. Is the biome classification used in the fPAR full/backup algorithm? - Spatial resolution and coverage: How well do the reprojected

BGD

5, S834–S839, 2008

data after the 'rigorous transformation'fit the tower footprint. - Temporal compatibility of data from different sources: The composited MODIS fPAR product corresponds to the highest fPAR value within 8 days, while incoming PAR, NEE and ER are averaged for 8 days. This results in mixing up different conditions in the Monteith model. LUE might differ for variable illumination conditions (clear sky versus cloudy sky), while MODIS data correspond to rather clear skies. How severe is the loss of the diurnal variability of the LUE?

Some MODIS fPAR technical comments: Please indicate the exact name (e.g., MOD15A2) and download website of product, this is important as several versions are available. The official collection 4 data has the following issue: 'A bug was found in the code generating Collection 4 MOD15A2 FPAR product: FPAR under diffuse radiation was produced instead of fPAR under direct solar radiation, as required by the product specifications. The correction scheme to calculate FPAR under direct radiation for MOD15_BU was proposed, and MOD15_BU FPAR data set was re-processed in January 2005. The reprocessed version of MOD15_BU LAI/FPAR products is called C4.1.' ftp://primavera.bu.edu/pub/datasets/MODIS/readme.pdf

It seems like the quality flag data were not used whereas they are important to identify bad quality (technical problems) and backup algorithm data, and additionally indicate snow cover etc. Are snow covered data excluded (for example for Fig. 4 when deriving thresholds for LUE below 0 degrees)?

It is of importance to indicate some uncertainty indications, at the latest when preparing such results for modelling purposes. MODIS fPAR uncertainties are indicated in the original product.

Technical corrections

p. 1769, line 5: 0.4 to 0.7 um (not mm)

p. 1770, line 23: with a mean annual temperature of is

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5, S834–S839, 2008

p. 1772, lines 14-15, different spatial resolutions of products not used in this study are not relevant

p. 1772, line 18: 8-period should be 8-day period

p. 1772, line 20: flux tower footprint depends on measured variable (radiation or carbon fluxes) and environmental conditions (e.g. wind speed). Maybe some site-specific footprint analysis have been performed which could be referenced? Also, it depends on how representative the flux tower covered area is for the larger area

p. 1772, line 21: reference Lafleur

p. 1773, line 2: reference should read Sonnentag (instead of Sonnetag) and is missing in the reference list (I did not doublecheck the rest of the references)

p. 1773, line 3: this is not a proper equation

p. 1773, line 13-21: data formats and programs are not relevant, however a bilinear interpolation does not allow using quality flags (they are integers) and it is unclear what is meant by 'rigorous transformation'

p. 1774, line 18: which means

p. 1774, line 20: reference Bubier should not be italic

p. 1775, line 8: the estimated the canopy fPAR

p. 1775, line 11: incoming PAR is not named consistently throughout the article (i.e. sometimes only PAR, sometimes incoming PAR, sometimes arrow down with PAR)

p. 1776, lines 2-3: as mentioned earlier, malfunctions of the sensor are indicated in the quality flag

p. 1776, line 18: too cold

p. 1776, line 17 and Fig. 4: is epsilon driven by zero GPP only or is fPAR really low due to snow cover? How could the temperature threshold difference of Mer Bleue and

BGD

5, S834–S839, 2008

Western peatland be explained? Or might this indicate that the uncertainties of the epsilon estimation are really high? Given Fig. 4 it remains unclear the temperature threshold mentioned in the text was derived (or is it derived based on GPP?).

p. 1778, line 21: missing second bracket after references

p. 1779, line 16: as expected when were compared

p. 1781, line 29: given the American origin, I guess that it should be a technical report ;-)

p. 1784, line 8: IEEE T Geosci Remote is a peer-reviewed journal while IGARSS 03 is a conference proceedings

p. 1786, table title: indicate the meaning of the parameters

p. 1787, Fig. 1, 2, 5, 7: to increase readability and allow for a better comparison, it would be useful to have the same scale for the time axis for the Mer Bleue and Western peatland graph, the time axis is not very helpful (esp. Fig. 5), given that dates such as September 24 are described whereas it is hard to find back these data in the graphs.

p. 1788, Fig. 2 title: (A) 2000-2003 (instead of 2002-2003) for Mer Bleue

p. 1789, Fig. 3 title: you might stick with the Greek sign for epsilon or write out light use efficiency

p. 1790, Fig. 4: it would be useful to calculate the relationship and its significance, indicate site in figure title

p. 1791, Fig. 5: (B) 2003-2004

p. 1792, Fig. 6 title: site is missing, change (Dashed line) to (dashed line)

p. 1794, Fig. 8: Why does the time axis range from 1-46 (cannot be days or Julian days)

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5, S834–S839, 2008

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