

Interactive comment on “CO₂ exchange and Carbon balance in two grassland sites on eutrophic drained peat soils” by E. M. Veenendaal et al.

Anonymous Referee #1

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GENERAL COMMENTS

The paper presents an interesting comparison of two adjacent but differently managed peatland areas. The annual CO₂ exchange of the two sites measured by eddy covariance systems as well as the total carbon budget, including carbon import and export by management, is presented. The analysis of carbon removed by harvest is described in due detail, which is very important for carbon/GHG budget studies (and is unfortunately not always done in similar publications). It turns out, that the harvest removal is quantitatively much more important for the carbon budget than the CO₂ gas exchange (NEE). Despite the different management intensities of the two sites, their annual car-

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bon budgets (net carbon loss) are not significantly different from each other. However, the possible reasons and implications of this main result should be discussed in more detail (see specific comments below).

The topic of the paper matches well the scope of the journal. I therefore recommend publication after due consideration of the following specific comments and technical corrections.

SPECIFIC COMMENTS

p1636, line 4-12: I agree that the study of adjacent fields with the same climate/weather conditions is a good way for investigating management effects on the field scale (the same approach has been used e.g. by Allard et al. (2007) and Ammann et al. (2007) for grassland systems). However, in the present study there is not only a difference in management between the two sites, but also a significant difference in the soil composition (15% versus 24% organic carbon content). The possible effects of this difference should also be discussed in the manuscript.

p1639, line 21-24: To denominate beta as "minimum ecosystem flux" is not correct. Because in Eq. (1) the respiration (χ) is added to the photosynthesis term, beta corresponds to a maximum photosynthesis or assimilation which is only a part of the ecosystem flux (F_c). Moreover, beta has to be positive, because a negative sign would result in an inconsistency in the hyperbolic term of Eq. (1). I therefore suggest to display beta values generally with a positive sign and to use the expression "maximum assimilation" or "maximum photosynthetic uptake" throughout the manuscript. (the expression "minimum flux" for an extreme negative flux may be confusing anyway)

p1640, line 14: Why only R10 was fitted to the data? The large annual dataset would allow to also fit the other functional parameters E_0 and/or T_0 instead of prescribing them. This is especially important because the curve in Fig. 8 does not seem to be the optimum fit to the data!

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p1643, line 1: Fig. 3a is not necessary and can be omitted. The main information is given in the text and the P and N values are not used further in the manuscript. More important would be the C contents of the plant material, for which no data are presented. Later in the text (p1647, line 25) a C-content of 50% is mentioned. How was this value determined?

p1644, line 6: By visual inspection of the data plotted in Fig. 5, I estimate an average gap in the energy balance of about 30-35% rather than only 20% for daytime conditions. Although such an imbalance in the energy budget is not unusual, it may indicate a potential systematic error also in the CO₂ flux measurements. This should be discussed and considered in the uncertainty estimations.

p1644, line 17: The data plotted in Fig. 6 indicate, that there is a systematic reduction in the flux measurements up to about $u^*=0.14$ m/s (not only up to the applied threshold of 0.1 m/s). Was the threshold determined with an objective method, as described e.g. by Reichstein et al. (2005) or Papale et al. (2006).

p1645, line 14-17: I assume you wanted to say here "...did not show significant differences ...". Otherwise, a regression with the combined dataset would not be very meaningful.

p1646, line 25: Giving the gross photosynthesis (GEP) a negative value makes not much sense! Like beta (see comment above) GEP should be generally positive.

p1647, line 11: What is the (estimated) uncertainty of the annual NEE values? Is the difference between the two fields significant?

p1652, line 2-6: The formulation "The difference in NEE ...results in ..." is not correct and should be reversed. It is not the difference that results in the two individual values, but just the other way round!

p1653, line 9: Give a range of uncertainty for the C balance of the Oukoop site!

p1653, 15: Please discuss the reason why the two sites (with different management)

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show a very similar C-balance, in contrast to the hypothesis formulated in the introduction.

p1653, 16-22: If the obtained results are compared to contrasting literature results, possible reasons for the discrepancy should be discussed!

TECHNICAL CORRECTIONS

The manuscript contains many language mistakes, some of which are listed/corrected below. The correct spelling and syntax should be carefully checked throughout the manuscript.

p1633, title: Write "carbon" with small initial letter

p1634, line 22: Remove one of the double opening brackets

p1635, line 29: Remove "losses"

p1636, line9: Omit the comma

p1641, line1: "...height measurements were made at 4-8 week intervals ..."

p1641, line 10: Omit the comma

p1641, line 12: Write "range" with small initial letter

p1641, line 12: The plural form of "ton" is "tons". Please correct throughout the text.

p1641, line 14: I assume the minus sign in units "m3" is wrong

p1642, line 16: "...between 30 cm and 60 cm below the surface ..."

p1644, line 23: "Footprint calculations (Schuepp et al., 1990) for turbulent conditions gave values of ..."

p1647, line 4: "The resulting annual NEE balances showed a divergence ... "

p1647, line 20-21: "... (mean canopy height of land parcels was 29-35 cm before

mowing and ..."

p1648, line 2: Write "eddy" with small initial letter

p1649, line 19: Write "leaf" with small initial letter

p1650, line 17: "...but at this site there was generally ..."

p1652, line 9/10: Remove "probable range"

p1653, line 24: "Different management regimes resulted in ..."

References:

Allard et al.: Does an extensive grazing management mitigate the greenhouse gas budget of a semi-natural grassland? *Agric. Ecosyst. Environ.*, 121, 47-58, 2007.

Ammann et al.: The carbon budget of newly established temperate grassland depends on management intensity, *Agric. Ecosyst. Environ.*, 121, 5-20, 2007.

Papale et al.: Towards a standardized processing of Net Ecosystem Exchange measured with eddy covariance technique: algorithms and uncertainty estimation, *Biogeosciences*, 3, 571-583, 2006.

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