

Interactive comment on “Variability of annual CO₂ exchange from Dutch Grasslands” by C. M. J. Jacobs et al.

Anonymous Referee #2

Received and published: 4 July 2007

The paper presents an inter-comparison of CO₂ exchange (NEE) measurements of eight different grassland sites in The Netherlands (some of which have been previously published). The available datasets cover different periods between 10 month and 4 years length. The different datasets are analysed in terms of a respiration/assimilation partitioning and the non-linear regression method as described e.g. by Falge et al. (2001) for gap filling purposes. With the obtained fitting parameters, the inter-site and inter-annual variability of the CO₂ exchange of the eight sites are calculated using weather data from one single station for the years 2002-2005. In addition, a similar analysis of the inter-annual variability is made for two individual sites for which flux data are available for all 4 years.

The topic matches the scope of the Biogeosciences journal. The presented analysis is

Full Screen / Esc

Printer-friendly Version

Interactive Discussion

Discussion Paper

an interesting synthesis of available CO₂ exchange measurements for grassland and peatland ecosystems on a national scale. However, the manuscript has to be improved for various aspects, detailed in the following, before final publication.

GENERAL COMMENTS

1) The authors argue in the introduction, that they want to contribute to the question of the greenhouse gas (GHG) budget of grassland ecosystems. However, as pointed out e.g. by Veenendaal et al. (2007), Soussana et al. (2007a), and Ammann et al. (2007) - all referenced in the manuscript - the relevant quantity in that respect is not just the CO₂ exchange (NEE) but the total carbon budget (change in the carbon storage) of the grassland ecosystems including the carbon import and export by management. Since the sites presented in this study are subject to very different management practices, it is even more important to include the management effects in the inter-comparison. Veenendaal et al. (2007) show for the Stein site, that it has a slightly negative NEE (micrometeorological sign convention) but represents a strong source of carbon, when the harvest export is considered.

2) Since the differentiation between organic and mineral soils is very important in the present study, the organic matter content of the relevant soil layers should be given for all sites (e.g. include in Table 1). Furthermore the carbon budget of an organic soil (decomposition of soil organic matter) strongly depends on the water table depth as well as on the actual and previous management intensity. These factors should be considered more in Section 3.3. Consequently the upscaling of the NEE by spatial contribution of mineral and organic soils is much too simple in my opinion.

3) I accept that the analysis of the inter-site variability of the eight stations using weather data from one single station for the year 2005 is a useful procedure. However, the similar analysis of the 'virtual' inter-annual variability for 2002-2005 does not seem to give meaningful or relevant results. The variability for Re and GPP obtained in this way is much smaller than the true inter-annual variability at the Haarweg and Cabauw

BGD

4, S737–S742, 2007

Interactive
Comment

Full Screen / Esc

Printer-friendly Version

Interactive Discussion

Discussion Paper

stations. Because the annual respiration and assimilation parameters are likely to be influenced by the weather conditions, a distinction between the total inter-annual variability and the purely weather related inter-annual variability cannot be made in this way.

SPECIFIC COMMENTS

p1505, line 21ff.: How can the LAI of the grassland be kept constant at about 2.9, when it is mown weekly? Does it mean that there is still an LAI of 2.5 or higher left directly after the cut?

p1505, line 24f.: As far as I understand, the 'NMI grass height meter' does not measure the true height of the grass canopy but uses a disc with a certain weight, that compresses the grass canopy to some degree so that the reading height is proportional to the LAI or biomass.

p1507, line 2ff.: Since no literature reference is given for the Haastrecht site, some basic information about the flux measurement should be given: measurement height and the spatial extension of grassland fields in the direct surrounding.

p1509, line 23f.: It is acceptable to use the ecological sign convention (instead of the micrometeorological one). But then, also the ecological term NEP (net ecosystem productivity) should be used for consistency reasons, instead of NEE which appears in the literature mostly with the micrometeorological sign convention. ($NEP = GPP - R_e$).

p1510, line 9: The use of the symbols in Eq. 3 is somewhat unusual and might be misleading. I suggest to follow Lloyd and Taylor (1994) and use R_{10} for the reference respiration at 10°C and T_0 for the "zero respiration temperature".

p1510, line 18ff.: As far as I know, all cited references (Reichstein et al, 2005; Ruppert et al., 2006; van Dijk and Dolman, 2004) focussed on forest ecosystems, which may show a different behaviour than grassland ecosystems. Since the use of the air temperature T_a for the respiration parameterisation is unusual for grassland, I suggest that

Full Screen / Esc

Printer-friendly Version

Interactive Discussion

Discussion Paper

the authors give more arguments for the use of Ta or that they show a comparison for the two options (Ta and Ts) for sites where both temperatures are available.

p1512, line 21: The argumentation for considering only the temperature dependence of the GPP is not really convincing. A good correlation between LAI and temperature cannot be expected for intensively managed grassland (with cuts or rotational grazing). After each cut, the LAI and also the photosynthesis is strongly decreased (independent of temperature).

p1515, line 23ff.: The paragraph about the use of GPP1000 instead of GPPmax should be moved to the 'Materials and Methods' Section. Consequently, equation 4 should be reformulated using GPP1000 instead of GPPmax (see e.g. Falge et al., 2001, Agr. For. Met., 107, 43-69).

p1517, line19f.: The formulation is ambiguous. Does the given value represent the mean annual respiration of the 'Haarweg' site (mentioned in the previous sentence) or of all sites (like the GPP given in the following sentence)? Only the second option would be meaningful. In addition, it should be clearly mentioned what the +/- ranges given with the average values mean (std. deviations or std. errors; inter-annual or inter-site variability).

p1519, line 7ff.: The comparison of the variability within The Netherlands and at the European scale (results of Gilmanov et al., 2007) is somewhat misleading. The sites of Gilmanov et al. are spread all over Europe and over different altitudes, but they are all managed grasslands (with either grazing or cutting). Thus their variability may be attributed predominantly to the different climatic conditions. On the other hand, the similarly large variability in the results of the present study obviously results mainly from the very different management (leading to different ecosystem types).

p1519, line 23: I do not understand the statement "...it may be concluded that emission factors ... cannot simply be interpolated from larger to smaller regions." How would the emission factor for a large region be determined in the first place? I think the

[Full Screen / Esc](#)[Printer-friendly Version](#)[Interactive Discussion](#)[Discussion Paper](#)

formulation should be "...from smaller to larger regions."

p1520, line 27ff.: The two statements "The light conversion factor alpha is more or less a constant for all analysed ecosystems..." and "Inter-annual variability of alpha ranges from 20 to 60% ... and is similar to the inter-site variability" within the same paragraph seem to be contradicting. Please explain.

TECHNICAL CORRECTIONS

p1500, line 3: Use colon instead of semi-colon

p1500, line 4: What does "rotational grassland region" mean? Please explain.

p1500, line 7f.: "...to partition NEE into gross primary production (GPP) and ..."

p1510, line 9: There is an inconsistency between Eq.2 and Eq.3 concerning the minus sign.

p1510, line 10f.: The correct units of E_0 is 'K' and not '1/K' (replace also in Fig. 2). In order to get consistent units in Eq. 3, all temperature quantities must have the same units (preferably K).

p1511, line 5: "as long as" instead of "as long as if"

p1511, line 16: "...the effect on the annual sums of Re ..."

p1512, line 11 (Eq.4): Write " Re " instead of " $Reco$ " (like in the text).

p1517, line 9ff.: The references to Fig. 6 and 7 in the text are obviously mismatched and thus the two figures should be exchanged.

p1520, line 26: The formulation "...due to differences in climatological factors ..." is misleading. A more correct and clear formulation is: "...due to inter-annual differences in weather conditions ..."

p1530, Fig. 3: The y-axis title should be " Re " instead of " Ro "

BGD

4, S737–S742, 2007

Interactive
Comment

Full Screen / Esc

Printer-friendly Version

Interactive Discussion

Discussion Paper

Interactive
Comment

Full Screen / Esc

Printer-friendly Version

Interactive Discussion

Discussion Paper