

Interactive comment on “Effects of climate warming and declining species richness in grassland model ecosystems: acclimation of CO₂ fluxes” by S. Vicca et al.

S. Vicca et al.

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1. Acclimation to temperature occurs within 1-3 days of a change in temperature. Therefore, predicted rates at 7 °C may have been erroneous.

We agree that acclimation can occur at relatively short timescales. However, our raw data and fitted basal rates of respiration and Q10 values (data not shown because we had 48 communities and this would dilute our message too much) did not suggest any sign of acclimation within the three day periods of our measurements. Hence, we are confident that the predicted rates at 7 °C are correct. In the revised manuscript, we have included this statement (p.7, line 23-25).

2. TER in the dark is not equal to TER in the light. Therefore, estimates of GPP may

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be incorrect.

We agree with the referee that TER in the dark probably differs from TER in the light, and that the absolute values for GPP may therefore be incorrect. However, recent unpublished studies by Bahn et al. and Janssens et al. suggest that the light-induced effect on TER is much smaller than on leaf respiration (5 to 10% on average). Furthermore, in this study our interest primarily lies in the relative differences in GPP among temperature treatments, not in absolute values of GPP. Thus, although we fully agree with this comment and that the GPP estimates are probably slightly overestimated, this is not relevant for our study. Nonetheless, we included a paragraph discussing this issue in the materials and methods section (p.5, line 29 - p.6, line 2).

3. What temperatures were used to determine TER at common temperature? What time of day were TER and NEE measurements made?

All flux measurements were made between 9h30 and 17h. In both treatments, the temperature ranged between 3 and 13 °C. This information was added to the revised manuscript (p.5, line 17 and p.6, line 16-17, respectively).

3. Abstract.

The suggested changes for the abstract were incorporated. The following sentence was added (p.1, line 24-28): “In order to test whether acclimation occurred, short term temperature response curves were established for all communities in both treatments. At similar temperatures, lower flux rates in the heated communities as compared to the unheated communities indicate thermal acclimation.” The sentence: ‘At first sightĚ’ will be deleted, and the next sentence was changed into: “Because plant cover was significantly higher in the heated treatment, we normalized the data for plant cover. Subsequently, down-regulation of both photosynthesis and respiration were observed.” (p.1, line 28 - p.2, line 2).

5. Definition of acclimation in the introduction.

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The referee desires a more specific definition of acclimation, such that readers can see how we assessed whether acclimation occurred. This information was included in the revised manuscript (p.4, line 1-7).

6. Introduction: the relevance of some parts was not clear.

We agree with the referee and have deleted 2 paragraphs of the introduction (line 12 to 24 on p.1475 of the previous version).

7. Restructuring the end of the introduction.

As requested, we revised the end of the introduction following the suggestions raised by the referee. We are very grateful to the referee for making these constructive comments (p.3, line 26 - p.4 line 12).

8. How were communities established, and why are there an unequal number of replicates for each community.

The set-up of the experiment is discussed in the paper of Lemmens et al., 2006 to which we referred. In our study, the replicates of species richness level 1 and 3 still differ in their species composition, whereas the communities with 9 species are identical. For this reason, more replicates are needed for $S = 1$ and $S = 3$ than for $S = 9$. Providing more detail on the experimental design would make this already difficult paper too long. Therefore, we opted to refer to De Boeck et al., 2006 (p.5, line 5-6).

9. How were duplicate measurements combined?

In each community, flux measurements were performed twice during each of three periods. To these six data, a regression line was then fitted, calculating quantum efficiency and maximum photosynthesis for the GPP data, and basal respiration rates and Q10 for the TER data (for each plant community). Subsequently, GPP100 and TER7 were calculated. This information was explicitly added to the materials and methods section (p.7, line 20-21 and p.8, line 3-4).

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10. What temperatures were used?

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11. How long were plants exposed to each temperature?

This was already included in the submitted version (Table 2 in the revised manuscript, Table 1 in the previous version).

12. Impact of temperature on soil temperature.

During our flux measurements we also measured soil temperatures, but did not use these measurements because we did not measure soil respiration and because TER correlated better with air temperature. Hence, we did not show these data. Nonetheless, if requested by the editor, we can add that, during our measurements, average soil temperatures did not differ between unheated and heated communities (mean soil temperatures were 6.89 °C and 6.81 °C in unheated and heated communities respectively).

13. Harvest of aboveground biomass and regrowth of the vegetation.

Harvest was part of the experimental design of the long term study (normal management of grassland) and not performed because of the current study. By the time of our measurements, the vegetation had regrown to some extent. The requested information on the extent of regrowth can be derived from Figure 2, which displays plant cover at the time of measurements.

14. Plant biomass measurements.

Plant biomass was not measured, but plant cover was measured immediately after flux measurements were made. For the SLA estimations, three leaves were dried for 48 hours at 70 °C. This was added to the revised manuscript (p.7, line 1-2 and line 7, respectively).

15. Evidence that photosynthesis correlated better with irradiance than with tempera-

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ture.

Correlation GPP vs. temperature: correlation coefficient = 0.15; $p = 0.013$

Correlation GPP vs. PPFD: correlation coefficient = 0.52; $p < 0.0001$

This information was added to the materials and methods section (p.7, line 26-27).

16. Time of day when NEE and TER were measured.

Cfr. #3

17. Unclear section in materials and methods.

We agree with the referee that this section was below standard and have improved it considerably. We thank the referee for pointing it out to us. The paragraph was ameliorated in the revised manuscript (p.8, line 20 - p.9, line 2).

18. Show TER and NEE measurements over time.

With 48 replicate communities, showing the time series of NEE and TER graphically was impossible. Moreover, these time series are also affected by variation in light and temperature and thus not directly comparable anyway. Therefore, we decided not to show the raw data but only the standardized fluxes that were normalized for temperature or light.

19. P values in Table 2 and 3.

In Table 2, these p values represent the probability for a statistically significant difference between SLA of species in unheated and heated communities. This information was added to the table legend. In Table 3 the legend already clearly stated that the p values corresponded to the regression of measured versus predicted fluxes. We have rephrased this legend to clarify this even more.

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