

## ***Interactive comment on “Effects of climate warming and declining species richness in grassland model ecosystems: acclimation of CO<sub>2</sub> fluxes” by S. Vicca et al.***

### **Anonymous Referee #2**

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Vicca et al. have investigated the extent to which species richness in a plant community influences ecosystem CO<sub>2</sub> exchange in the light and in darkness for communities exposed to ambient and elevated air temperature at a field site in northern Europe. Rates of net ecosystem exchange (NEE) in the light and total ecosystem respiration (TER) in darkness were used to calculate gross primary productivity (GPP), based on the assumption that rates of TER measured in darkness are indicative of rates of TER taking place in the light. To correct for inter-treatment differences in biomass, comparisons of carbon flux were made using modelled data at a common dry mass and common measurement temperature or irradiance. To compare rates of TER at a common temperature, the authors increased air temperature to 3 and 8°C above ambient

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(for 2 days at each temperature) and then modelled the data to predict rates at a common temperature of 7oC. This data was then used to assess whether species richness impacted on the apparent degree of thermal acclimation of CO2 exchange processes in the model ecosystems.

I was keen to read the manuscript, as the stated aims are important and likely to be of interest to a wide audience. While I am generally positive about the study, I have several concerns about the manuscript in its current form. ¶ The calculation of TER at 7oC relies on the assumption that 2 days exposure to 8oC and then 3oC will provide a good indication of the instantaneous temperature response curve of the ambient and elevated temperature treatments. However, given that acclimation occurs within a 1-3 day period of a change in temperature (see papers by Bolstad and Atkin), it seems likely that the predicted rates of R at 7oC may have been erroneous. Perhaps I have missed something - but as it stands at present, it seems likely to me that the estimates of TER at a common temperature may be incorrect. ¶ The calculation of GPP relies on the assumption that measurements of TER in darkness are a good indicator of TER taking place in the light. Given the increasing acceptance that foliar respiration is lower in the light than in darkness, this assumption is unlikely to be correct, resulting in overestimates of GPP. A recent paper by Wolfhart dealt with this issue, showing that light inhibition of leaf R could substantially alter calculated rates of daily ecosystem R and thus estimates of GPP. In the absence of measurements of leaf R in the light, I suggest that the authors either focus on NEE in the light rather than GPP, or that they do a sensitivity analysis comparing modelled outputs in the absence and presence of light inhibition. ¶ A major concern I have about the manuscript is the lack of detail on experimental methods (e.g. page 1478, lines 20-25), such as what temperatures were used to determine TER at a common temperature (this is mentioned in the results, but not the Materials and Methods) and what time of day the TER and NEE measurements were made.

Other comments: ¶ Abstract, page 1474, line 7: Rephrase “At first sight”. Also, later in

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the Abstract, it would help if you briefly defined how you assessed acclimation

¶ Introduction, page 1474, lines 24-26. A more specific definition of acclimation is needed so that readers can see how you will assess whether acclimation has occurred (e.g. comparison of rates of R at a common measurement temperature). ¶ Page 1475, lines 5-30: here the text is rather start-stop, with the relevance of each topic for the manuscript not being immediately obvious. At the end of the Introduction, greater effort needs to be made to focus on the novel elements of the study - it is well established that respiration acclimates to long term changes in temperature, so the first hypothesis is not particularly novel. Also, the rationale behind the suggestion that the degree of acclimation may differ between communities differing in species richness is not apparent. Set up the rationale first.

Materials and Methods: ¶ Page 1477, line 16. Why were there an unequal number of replicates of each community? How were the communities established? ¶ Page 1478, line 18 onwards: How were the duplicate measurements combined? What temperatures were used? How long were plants exposed to each temperature? What impact did the temp treatments have on soil temp? Why was the above ground biomass harvested before the measurements? Had the vegetation regrown by the time of the measurements and if so, to what extent? ¶ Page 1479, line 13. When were the plant biomass measurements made? How was plant tissue dried? ¶ Page 1480, line 6. Provide evidence that photosynthesis was correlated better with irradiance than temperature. ¶ What time of day were the NEE and TER measurements made? ¶ Page 1481, lines 1-10. This section is very unclear and needs to be rewritten to improve clarity.

Results ¶ Why not show the actual TER and NEE measurements over time? ¶ Table 1. Provide more detail in the table legend. ¶ Table 2. It is not clear what the P values refer to. Similarly in Table 3.

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