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Biogeosciences Discussions

Interactive comment on "Biomass production in experimental grasslands of different species richness during three years of climate warming" *by* H. J. De Boeck et al.

Anonymous Referee #1

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General comments

This manuscript reports findings from the first combined biodiversity and climate warming experiment, simultaneously manipulating two major drivers of global environmental change. The results will therefore be very interesting for the global change research community. The authors found that increasing species richness increased above- and belowground biomass production, supporting results from many other biodiversity experiments. They attributed this effect to increased resource complementarity, while the selection effect played no significant role. Warming caused a significant reduction in productivity due to increased heat and drought stress, especially during summer. Inter-

estingly, and in contrast to the expectation based on the insurance hypothesis, highest plant diversity did not result in an alleviation of perturbation effects as the negative effects of warming became more, rather than less, pronounced at the 9-species level.

The experimental design is appropriate to answer the research questions (but see comment below), the statistical analyses are sound and the writing is very clear and concise.

The authors show due caution in the interpretation of their data, and are able to back up their lines of argumentation with additional data from other publications from the same experiment. The conclusions dawn are therefore sound and convincing. Thus, the whole experiment will presumably become a classic example of successful global change research, representing a necessary step further to understand the multiple and complex interactions between various drivers of environmental change.

Specific comments:

I only see some minor flaws in this study, and the authors may want to comment on these issues: Most importantly, the design confounds species richness (S) and the presence of key functional groups (FG), namely nitrogen-fixing legumes. While all mixed communities are composed of all three functional groups (legumes plus grass plus herbs), the monocultures are - obviously - not. It is well known from both agricultural and ecological studies that legumes positively influence biomass production in mixtures with non-fixing species due to an N-fertilization effect (facilitation). This effect also occurs in rich agricultural soils (as used here, additional information on soil nutrient content would be helpful) and disappears only at rather high levels of N fertilization. Thus, by comparing biomass production along the gradient of S, the significant diversity effect could be attributed solely to the presence/absence of legumes. This would also explain why there were no differences between the 3- and 9-species level. I suggest to include the facilitative effects of legumes into the discussion about the underlying mechanisms of increased biomass production in mixtures.

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Interactive Comment

Literature: In the introduction and/or discussion, I suggest citing other studies that manipulated drought in natural grassland communities and that found similar results (e.g. Kahmen, A., J. Perner, and N. Buchmann. 2005. Diversity-dependent productivity in semi-natural grasslands following climate perturbations. Functional Ecology 19:594-601.) and those that also manipulated several global change drivers simultaneously such as the BIOCON experiment that (biodiversity, CO2 enrichment, N-deposition: Reich, P. B., J. Knops, D. Tilman, J. Craine, D. Ellsworth, M. Tjoekler, T. Lee, D. Wedin, S. Naeem, D. Bahauddin, G. Hendrey, S. Jose, K. Wrage, J. Goth, and W. Bengtson. 2001. Plant diversity enhances ecosystem responses to elevated CO2 and nitrogen deposition. Nature 410:809-812.). Finally, it might be interesting to relate your experimental findings on biomass reduction under warming with data from natural ecosystems experiencing heat waves (e.g. Reichstein, M., P. Ciais, D. Papale, R. Valentini, S. Running, N. Viovy, W. Cramer, A. Granier, J. Ogee, V. Allard, M. Aubinet, C. Bernhofer, N. Buchmann, A. Carrara, T. Grunwald, M. Heimann, B. Heinesch, A. Knohl, W. Kutsch, D. Loustau, G. Manca, G. Matteucci, F. Miglietta, J. M. Ourcival, K. Pilegaard, J. Pumpanen, S. Rambal, S. Schaphoff, G. Seufert, J. F. Soussana, M. J. Sanz, T. Vesala, and M. Zhao. 2007. Reduction of ecosystem productivity and respiration during the European summer 2003 climate anomaly: a joint flux tower, remote sensing and modelling analysis. Global Change Biology 13:634-651).

Page 4617, line 14-17: it is not fully clear to me why increased water uptake would have been necessary to support higher biomass production? Light or nutrient complementarity would be enough, and the reduced water availability in mixtures could be a biomass-effect only (more water needed to support higher biomass production).

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