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Interactive comment on “Drought-associated changes in climate and their relevance for ecosystem experiments and models” by H. J. De Boeck and H. Verbeeck

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Summary

The manuscript by De Boeck and Verbeeck addresses the issue of changes in atmospheric conditions during drought and their impact on plant functioning. Without a doubt, this is a highly relevant issue that, as also indicated by the authors, has been largely overlooked in the scientific literature so far. The manuscript is concise, well structured and well written, and I recommend the manuscript to be accepted for publication in Biogeosciences after minor changes have been made to it. These are

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General comments

The main message of the manuscript is that “experimental and modeling efforts should taken into account other environmental factors than merely precipitation”. If they decide to do so, however, the manuscript in its present form does not provide much of a quantitative framework for this. Results are presented in figures or in tables as changes in K or %. For the results to be used directly in either experimental or modeling studies, information on the physical magnitude of the changes as well as the background value and not just the relative changes should be provided. This can be solved by extending Table 2 to include the following information on station level, or to insert an additional table listing the mean across stations (including the fields in Table 2):

- Average minimum temperature [K]
- Average mean temperature [K]
- Average maximum temperature [K]
- Average sunshine hours [h]
- Increase in sunshine hours during drought [h]
- Average RH
- Increase in RH during drought [% RH]
- Average VPD [hPa]
- Increase in VPD during drought [VPD]

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This would facilitate direct application of the main findings presented in the manuscript. The drought characteristics (count, av length, max length) could be skipped if necessary since these numbers are a direct consequence of the arbitrary choice of the 0.01 and 1 mm thresholds.

Droughts are the key focus of the paper and the authors clearly thought about how droughts should be defined (i.e. as an extreme relative to a local climatology). However, it is not clear from the text (in particular Page 466, Lines 23–26) how this is exactly done. The authors mention a ratio (“the ratio of running averages without significant precipitation equaled 0.01 across the dataset”), but without clearly specifying what this ratio is (i.e. in a complete sentence like “the ratio of ... to ...”). Please be clear to the readers what exactly is done here. Does it mean the ratio of the total number of days of periods or the ratio of the number of events exceeding x ? If possible or necessary, illustrate it graphically. In addition to this, it is not clear from the text what is done with droughts that start before March 15 or end after October 15. Is data from outside the March 15–October 15 period taken into account when a drought starts or ends outside this period?

Experiments with the ORCHIDEE model form a significant part of the manuscript, but some key information is missing that is needed to interpret the results. For instance how is the direct impact of radiation, temperature and VPD on stomatal opening modeled, and how is this different for grassland and forest? The authors go into quite some depth over what the model does (input/output), but it would be more relevant to the focus of the manuscript to learn about its key equations and assumptions that deal with vegetation/atmosphere exchange during drought (specifically radiation and VPD control).

Apparently the current manuscript is a follow-up study of De Boeck et al. (2010) in which the focus was on heat waves rather than droughts. It would be of interest to present a short but quantitative comparison between drought and heat wave conditions, so that the added value of this manuscript with respect to previous work becomes

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Specific comments

Page 464, Line 7/Page 466, Line 10/other: Each station record is not a dataset by itself if they all come from the same source (i.e., KNMI). I would prefer the use of: “observational records of weather stations across Europe”.

Page 465, Line 4: Change “recent examples” into “a recent example” if only one example is given.

Page 466, Line 16: Why not provide the formula here that is used to calculate VPD from daily mean values?

Page 471, Line 13: It is not true that more sensible heat always leads to less clouds, see e.g. the paper by Ek and Holtslag (2004).

Figure 1: In my experience hPa is more commonly used for VPD in vegetation modeling than Pa.

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References

Ek, M. B., & A. A. M. Holtslag (2004), Influence of soil moisture on boundary layer cloud development, *J. Hydrometeorol.*, **5**(1), 86–99.

De Boeck, H. J., F. E. Dreesen, I. A. Janssens & I. Nijs: Climatic characteristics of heat waves and their simulation in plant experiments, *Global Change Biol.*, **16**, 1992–2000, 2010.

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