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Biogeosciences Discussions

Interactive comment on "Quantifying impacts of the drought 2018 on European ecosystems in comparison to 2003" *by* Allan Buras et al.

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Main comments by Anonymous Referee #1 (please see also the attached pdf)

In this manuscript, the authors compare the climatological features of two intense drought events over Europe, the 2003 and 2018 heatwaves. From a climatological analysis, they carry on to analyze the effect of both events on European vegetation. The authors' results are based on a suite of statistical analyses of MODIS-based vegetation indices combined with a widely used land cover map. Their main conclusion is that the 2018 heatwave had a stronger effect on European vegetation than the 2003 one.

General comments Overall the manuscript is well written and follows a logic questioning

line going from the climatology of the heatwave to the effect on vegetation. However, I am not convinced by the relevancy of the way the main question is addressed. From the first climatological data shown by the authors it is obvious that the 2003 and 2018 events are very different in terms of location (baltic countries in 2018 versus central Europe in 2003) and timing (july was the beginning of the 2003 heatwave whereas it was the end of the 2018 one) and, even though it is not shown, in initial conditions. These crucial differences are however mostly ignored in the way the analyses are designed, potentially pointing to severe flaws in the results, that I detail below. This observation leads me to suggest more detailed analyses be carried out before publication.

REPLY: Thank you very much for your constructive review, which highlights important aspects and potential ambiguities and will help us to considerably improve our manuscript. While we agree with most of your critiques, we would like to emphasize that we do not ignore the differences of the two drought events: Fig. 6 was particularly designed to highlight that the peak of the drought-response in different land-cover types was delayed in 2003. As shown in Fig. 6 the lowest value of mean NDVI-quantiles of coniferous and mixed forests was lower in 2018 compared to 2003, while broadleaved forests displayed more similar NDVI-quantiles. Regarding arable land and pastures the lowest values occurred later in time and were lower in 2003. We refer to these results in lines 247-250 in the initial submission. Moreover, section 4.2.2 of the initial submission discusses possible effects related to the differing location, i.e. the drought 2018 hit potentially less adapted ecosystems at higher latitudes which may have caused the observed stronger ecosystem response in 2018. We agree, that these points need more emphasis and we will do so in the revision of our manuscript by:

1) Visualizing the temporal development of climatic conditions in a similar manner as for NDVI in Fig 6 in the main text and adding an animated gif to the supplementary which depicts the spatiotemporal development of climatic water balance anomalies (i.e. an animated version of Fig. 3 from January to October) to quantify the preceding initial conditions of the two events (moist winter and early spring in 2018 thus bene-

ficial conditions at the onset of 2018 vs. dry late winter in 2003 thus less beneficial initial conditions in 2003) and the development in course of the drought events, 2) Providing yet another supplementary gif which will visualize the temporal development of NDVI quantiles using maps and histograms (animated version of Fig. 4 throughout the growing season) from beginning of May until end of October to allow for assessing the temporal development of the two drought events, 3) Comparing and modelling the climatic features and ecosystem response representative of the peak of drought in each year (i.e. July/DOY 209 in 2018 vs. Aug/DOY 241 in 2003) instead of for July/DOY 209 only and revise the underlying analyses of Figs. 4, 5, and 7 accordingly. 4) Emphasizing the spatiotemporal effects in the discussion, in section 4.2.2.

As can be seen in the figures attached to this reply, these additional analyses confirm our initial conclusion since:

I) The area featuring extreme drought (lower than 2 negative standard deviations) was larger in 2018 compared to 2003 (1.4 times larger, i.e. 1.35 million km^2 in 2018 vs. 950,000 km^2 in 2003).

II) The drought response of the considered ecosystems affected a larger area in 2018 compared to 2003 (again 1.4 times larger, i.e. 820,000 km^2 featuring the lowest quantile in 2018 and 570,000 km^2 in 2003).

III) The drought response was stronger in 2018 compared to 2003 as expressed by significantly steeper regression slopes, the differences between 2003 and 2018 now even became stronger.

Please also find a detailed point by point reply to the comments raised by referee #1 in the supplementary pdf.

Please also note the supplement to this comment:
https://www.biogeosciences-discuss.net/bg-2019-286/bg-2019-286-AC3-supplement.pdf

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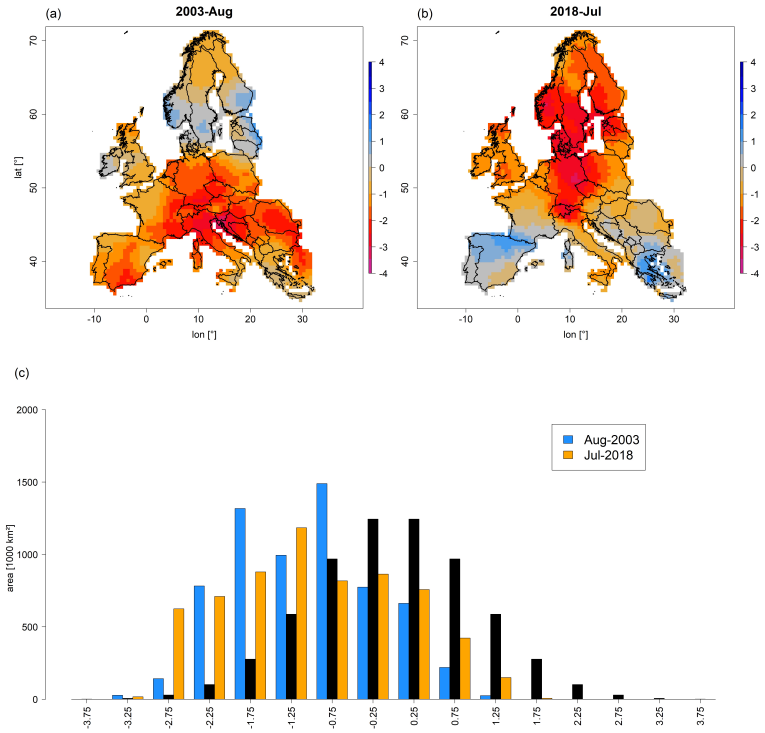

Fig. 1. CWB integrated over 4 months for 2003 (a, May-Aug) and 2018 (b, Apr-Jul) as well as the corresponding histogram. Blue colors refer to 2003, orange colors to 2018.

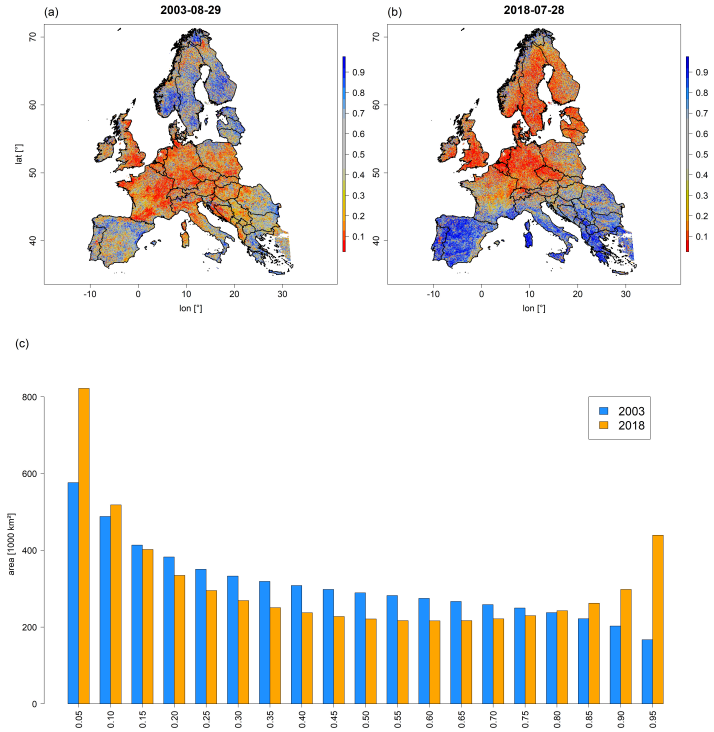

Fig. 2. Comparison of MODIS NDVI quantiles between end of August 2003 and end of July 2018 along with the corresponding histogram. Blue colors refer to 2003, orange colors to 2018.

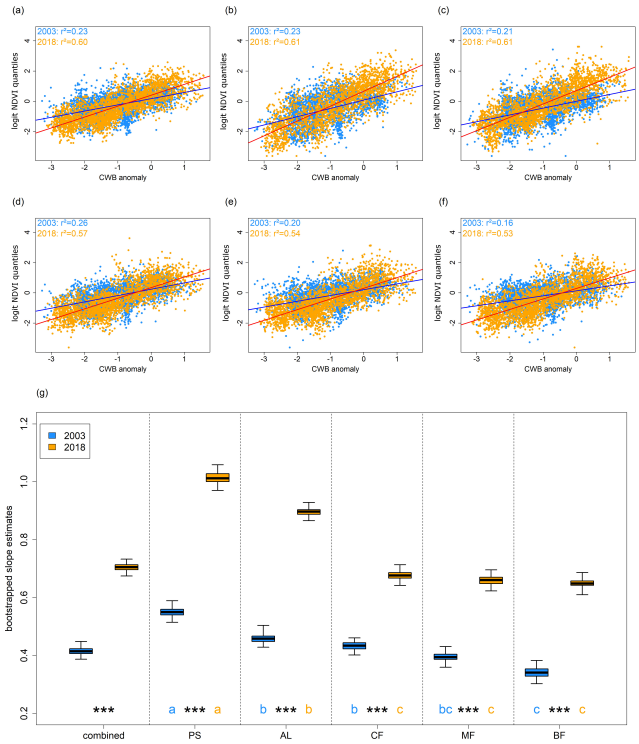

Fig. 3. Scatterplots depicting the relationship between MODIS NDVI quantiles for end of August 2003 and end of July 2018 and CWB integrated over May-August and April-July, respectively.