

***Interactive comment on* “Contrasting biosphere responses to hydrometeorological extremes: revisiting the 2010 western Russian Heatwave” by Milan Flach et al.**

Anonymous Referee #1

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Summary:

This manuscript presents a case study analysis to examine the impacts of compound events through a comparison of hydrological (via soil moisture) and biospheric (via GPP) perspectives in the season preceding, and during, the Russian 2010 heatwave. The paper provides a case for why singular extreme events need to be examined under different perspectives to understand the full implications of these events across multiple sectors. It is a nice study however I was anticipating a more indepth analysis of the processes that connect the two events. Its almost there and perhaps only requires minor revision of the text to achieve this.

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Main Comments:

1) The hydrological event and the biospheric events don't have the same spatial coverage which makes it hard for those new to the concept of compound events to appreciate how the events evaluated in the manuscript are indeed related. Could the authors perhaps provide a stronger case for why these distinctive events should be considered together beyond the 'different disciplinary perspectives' by delving into how one may be a result of the other. The commentary around Figure 1 on page 3 makes it difficult to reconcile the fact that the two events are related. Perhaps part of the confusion also stems from having a spring event, a summer event and then considering these events defined in terms of either the biospheric and hydrological perspective (so effectively giving 4 events to compare). I think this can be resolved by amending the text and including more discussion on how these events fit together.

2) The narrative in section 2.2 was hard to follow in that there is some information that may be better to remove (e.g. defining extremes using global thresholds) or a dependence on jargon that not everyone may understand (some examples noted in the minor comments). Given that the manuscript aims to articulate a methodology for extracting information on compound events this could be revised. Would it be possible to add some illustration to the schematic in Figure 2 to clarify how the spatiotemporal segments are defined and extracted.

3) I was a bit disappointed in the lack of discussion of the processes involved that led to this combination of events over Spring and Summer. Figure 7 provides some insight into how the unique the RHW event was but stronger statements could be made about whether the spring event was a necessary condition for the RHW.

4) The concluding paragraph seems to suggest that the positive GPP anomaly in spring offsets the negative anomaly in summer such that the net effect is a positive impact. This is slightly misleading given there were still substantial consequences on crop productivity in summer. This makes it hard to reconcile the 'GPP compensation' as nec-

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essarily a positive impact. This text needs careful revising.

Minor Comments:

5) There are a couple of instances where the text is awkward and could be revised e.g. page 2 line 21: 'In 2010 the depleted state of soil moisture was one important driver which locally amplified the high temperature regime' could be written as 'In 2010 a negative soil moisture contributed to increased temperatures'

6) When calculating anomalies, it is still useful to know what they are anomalous to. Please include the reference period to which the anomalies are derived from for all figures that are showing anomalies.

7) I don't understand the phrase 'impact-agnostic approach' on Page 3

8) Page 3-4 "For instance, a popular approach is to consider an observation in a single (ideally normally distributed) anomaly variable to be extreme if it deviates by more than two standard deviations from the variable's mean values." Perhaps include references here that use this approach. Many studies on extremes also use other definitions from the Expert Team on Sector-specific Climate Indices (ET-SCI) which use percentile thresholds to identify extremes.

9) Page 4, line 11: replace 'constellations' with 'combinations'

10) Page 4, last paragraph: it may be useful to note the native resolution of the datasets that are used. I gather that the regriding of the land cover classification was done using a conservative or nearest neighbour approach?

11) Page 5, first paragraph: is there a reason why the median is used? Obviously because it is less susceptible to outliers but perhaps worth noting why. I'm also not sure who would define regional extremes using a global threshold so perhaps omit this suggestion and simplify the narrative.

12) Page 5, line 20: 'sort the median seasonal cycles according to the permutation of

temperature' I'm not sure what is meant by 'permutation of temperature'

13) It would be nice if Figure 4 and Figure B2 could be combined as this shows the contrast between the hydrometeorological and biospheric events and at the moment this feels concealed in the present form

14) Don't forget to do a spell check!

15) Page 9, second paragraph: I'm not quite comfortable with the phrase "In total, 41% of the summer carbon losses are compensated by an anomalously productive spring" because it implies that there was a recovery in GPP after the summer event which we don't actually know here. We only know that impact of the summer event is not as severe as it could have been because of the excess productivity in spring. Perhaps this can be resolved by using a word other than 'compensation'.

16) I like the narrative discussing the results according to vegetation type as this goes a long way to understanding differences in the spatiotemporal structure of the events.

17) The narrative for Figure 7 is too concise, here would be an opportunity to emphasise how unique the RHW compound event really was

18) Last sentence on page 13 seems to be contradictory to the narrative of the second paragraph on this page.

19) Page 14, line 3: 'constellation' makes me think of stars. I think 'conditions' would be more appropriate here.

20) Page 14, line 11: "this finding highlights the importance of forest ecosystems to mitigate the impacts of climate extremes" Be careful here, as there is some location dependence. Furthermore, how much is this a necessary result of the preconditioning in spring? The focus of the paper isn't the mitigation potential of forests so perhaps its better to remove this statement.

21) The text in supplementary section S1 seems to be repetition of the text in the main

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manuscript. Either elaborate more or remove.

22) Supplementary Figure S3 4 – x axis labels: what is ‘tempanoms’ and how is this distinct from ‘temp’ – I’m guessing it’s the anomaly? The caption needs more information to understand what is actually plotted here. Is the data aggregated to obtain the spatial mean or are all grid cells used to construct the linear models?

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