

23 Jan 2024

Editor decision: Publish subject to minor revisions (review by editor)

by Gemma Coxon

Public justification (visible to the public if the article is accepted and published):

Dear authors,

Many thanks for your careful revisions to the paper. Your article was reviewed again by one of the original reviewers who recommended the paper was published as is. I also reviewed your paper and have some suggested minor revisions below that I kindly ask you to address. The paper will then be reviewed once again by myself, but will not be sent to external referees. I am looking forward to receiving the revised version of the manuscript.

Best wishes,
Gemma Coxon

Thank you very much for the careful review. Please find our responses to comments below in blue.

In addition to your comments and suggestions, we also combed through the manuscript to fix any remaining typos and grammatical errors, improve clarity and readability by rewriting sentences as needed, and improving figure/table readability and quality.

L16 – 18. ‘Decreases in uncertainty....’ This sentence doesn’t make sense to me – can you rewrite and clarify?

We have revised this sentence to read:

Model estimates of GPP and ET during flash drought reduce to rates similar to what is observed during the winter indicating that plant function during drought periods is similar to those of dormant months.

L21. ‘Frequency and severity of extreme droughts’ should be ‘The frequency and severity of’

Thank you for the suggestion. This change was made to the manuscript.

L25. I am not sure what you mean by development time. Development of what?

We have updated this sentence to clarify that we meant worsening soil and meteorological conditions. Additionally, we have added Christian et al., 2024 as a more recent reference that further supports this point.

Work over the last decade has improved methods for identifying flash droughts based on rates of intensification of dry soils and concurrent elevated temperatures and atmospheric aridity (see Christian et al., 2024 and Lisonbee et al., 2021 for a summary of flash drought definitions and indicators).

L60. 'Vegetation type and growth stage can plan an important...' should be 'Vegetation type and growth stage can play an important...'

Thank you for the suggestion. This change was made to the manuscript.

Figure 8. I find it quite difficult to interpret this graph with the different symbols for every month. Are there clear differences between months? If not, I would just use one shape, or maybe two shapes for Spring and Summer?

The authors appreciate this suggestion as differences were not easily distinguishable by month in this figure. We implemented the suggested two-symbol approach with "early" and "late" growing seasons indicated instead of using a different symbol for each month, and edited the legend accordingly.

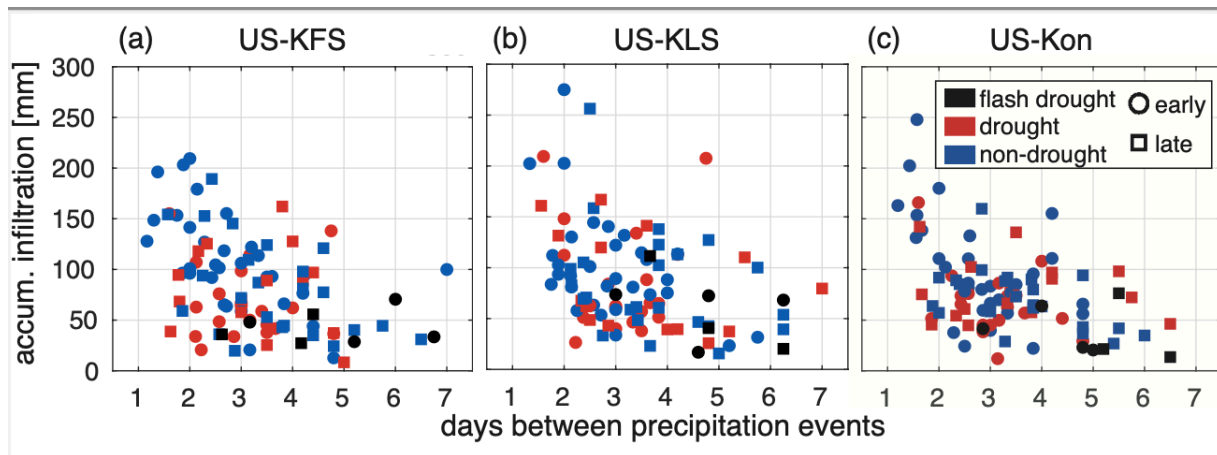


Figure 8. Monthly infiltration accumulation vs average days between precipitation events within a single month for (a) US-KFS, (b) US-KLS, and (c) US-KON. Each shape indicates whether the month occurs in the early growing season (circle: April - July) or late growing season (square: August - October). Colors distinguish flash drought (black) from drought (red) and non-drought (blue) years

L450-470 and Figure 14. This section should be in the results as you are presenting figures and analysing results.

Thank you for this helpful comment. We moved this text and accompanying figure to the results Section 3.3.3, with the exception of the first sentence L450-451, after the results for

GPP from the modeling work. The figures and sections that followed were renumbered accordingly.

Discussion – the discussion section is currently 8 pages long. I would recommend a critical look at the content of the discussion and consider whether it is all needed as your key messages and discussion points get a little lost.

Thank you for this suggestion. For the initial revision, we worked hard to emphasize the main points about plant responses to flash drought and explain the processes that drive differences between models and observations. In doing so, we may have been redundant in trying to get our key points across to readers. We've since removed some of those redundancies (outlined below), which shortened the discussion by 3 pages and the manuscript by 2 pages.

Since most of Section 4.1.1 was moved to Section 3.3.3, we combined subsections 4.1.1 and 4.1.2 into one subsection 4.1, keeping the original title. Similar changes were made with Sections 4.2 and 4.6, and in combining parts of section 4.5 and 4.6.1. The new Discussion Sections are:

- 4.1 Mechanisms Controlling Plant Responses to Drought
- 4.2 Surface and Sub-surface Water Movement
- 4.3 Linking Carbon and Water Fluxes
- 4.4 Uncertainty in Vegetation Responses
- 4.5 Model Performance and Limitations
- 4.6 Implications for Land-surface Models

Overview of changes to the Discussion sections and justifications:

Section 4.1

- The first sentence and last paragraph remain. L451-470 were moved to make Section 3.3.3 as suggested.

Section 4.2 - We made this one section by combining 2 shorter subsections.

- L510-514 provided overly specific detailed results about infiltration and evaporation which can be generalized as: "Across all three study sites, infiltration exceeds evaporation in the growing season in drought and non-drought years (Figures 7, 10)."
- L521-525 moved to next section at L536
- Excluding L521-525, L 519-531 rewritten to be more concise.

Section 4.3

- Removed two sentences at L537-539 because they were redundant with L651-655, which is now moved to this section from section 4.6.2.

- Rearrange the first two sentences at L542 and remove the next sentence at L543 to help with flow.

Section 4.4 - We cut L562-570 because the details were deemed redundant and/or unnecessary towards describing how uncertainty from ensemble estimates differs during drought and non-drought periods. Specifically, the text was redundant with lines 290-292 and 325-330. This led to rearranging Section 4.4 into two paragraphs to help with flow and readability.

- L571-576 were moved to follow L555 "...uncertainty in phenology shrinks during dry periods."
- The first sentence of the paragraph beginning at L561 is now followed by L555-560.

Section 4.5 - We merged Section 4.5 with Section 4.6.1, using the title from Section 4.6 "Model Performance and Limitations". Much of the discussion in the original Section 4.5 Land Cover Influences was evaluating model performance by comparing outputs to observations, so there was a natural connection.

- We cut L578-585 (except the sentence on L579 beginning "Effects on infiltration...") because it was deemed redundant with results on lines 333-339. L579 was moved to the conclusion at L691.
- L585-586 is better placed in section 4.1 L498 with the discussion of GPP, stomatal conductance and high VPD.
- We cut the first sentence of Section 4.6.1 so that the new section begins with L604 "Our modeling approach permits..." Then L587-600 follows to make the first paragraph of this new section.

Several sentences were removed from Section 4.6.1 because they clouded the point being made comparing models outputs to observations. After removal, some rearranging had to be done to ensure readability (see new organization below). Sentences/lines removed:

- L607-612 - Details do not further contribute to the point.
- L614-615 - Redundant and further justified in L338-339.
- L619-621 - Too much detail.
- L628-630 - This sentence provided too many details of results from Hosseini et al., 2022 that do not enhance the argument comparing how models differ from observations.
- L638-641- Details of soil moisture comparisons do not further contribute to the argument comparing results and observations.

Section 4.6 comprises what remains after editing section 4.6.2.

The following lines were (re)moved

- L646-651 - The points covered here are a bit off topic for Implications for LSMs. Moreover, they continue to draw comparisons between modeling and observations, which has already been discussed at length in the previous section.
- L 651-655 was moved to Section 4.3

- L655-656, which was in direct response to one reviewer comment, has been moved to the previous section before the sentence beginning, “Differences in DCHM-PV and AmeriFlux Gpp cannot be fully attributed to...”
 - L658-660 have into the subsequent paragraph about stomatal adaptations at L667.
 - L667-679 has been broken into two sentences to enhance readability. And an additional citation (Guo, et al., 2022) has been added to further support our suggestion to improve model representations of adaptive stomatal regulations.
 - L671-673, sentence beginning with “Future studies...” moved up to L665 and reworded to enhance readability.
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New references from introduction and discussion.

Christian, J. I., Hobbins, M., Hoell, A., Otkin, J. A., Ford, T. W., Cravens, A. E., ... & Mishra, V. (2024). Flash drought: A state of the science review. *Wiley Interdisciplinary Reviews: Water*, e1714.

Guo, J. S., Bush, S. E., & Hultine, K. R. (2022). Temporal variation in stomatal sensitivity to vapour pressure deficit in western riparian forests. *Functional Ecology*, 36(7), 1599-1611.