Response to reviewers comments on "Describing rainfall in northern Australia using multiple climate indices" by Cassandra Rogers and Jason Beringer

We thank the reviewers for their thoughtful comments and support for the quality of the manuscript. We have taken the reviewers comments seriously and have used them to suggest improvements that will strengthen the manuscript.

Anonymous Referee #1

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General comments

This manuscript describes an interesting study designed to evaluate how well several climate indices correlated with the spatial and temporal patterns of rainfall along a severe rainfall gradient in the Northern Territory, Australia. The investigators used a rainfall record from 1900 to 2010 and correlated the climate indices to rainfall at 16 locations along a rainfall gradient from 1600 mm/y to 200 mm/y. They investigated the relationship at annual, seasonal and monthly scales. The sites used are known at the North Australian Tropical Transect (NATT). The study found that across the NATT the AUSMI index provided the best correlations at a monthly time step while the TSI index was the best predictor at an annual time step. The study only examined correlations, so no cause and effect relationships could be determined.

Specific comments Recommendations for improvements to the manuscript:

- 1. Revise the Introduction to focus more on the topic of this study rather than on the ancillary C1 topics of climate change and vegetation dynamics. Of course, variability in rainfall can have important effects on vegetation and is likely to change under future climates, but the study did not examine those things.
 - a. The reviewer raises a good point and the introduction will be revised to focus on rainfall variability and climate modes affecting the region.
- 2. The presentation of the results was generally clear, but the Australia-wide data presented in Figures 5 and 6 and Tables 4 and 5 seemed out of place. I recommend putting that information in a supplementary materials section, or perhaps at the end of the Results and Discussion section as a separate topic, or omitting it.
 - a. As suggested by the reviewer, the discussion referring to Figures 5 and 6 will be moved to a new section towards the end of the Results and Discussion section. These figures will be used to discuss the correlation strength between rainfall and climate indices over the NATT in the broader Australian context.
 - b. We argue that Table 4 is necessary for showing correlation strengths over the NATT and therefore should remain in the paper. Correlation strengths will be added to this Table to make it more useful.
 - c. Table 5 will be removed as recommended.
- Similar to (2), if I correctly understood the time lag analyses mentioned briefly in sections 2.5 and
 3.3.4, they were conducted at continental and Northern Territory scales and also do not fit well with the other analyses done using the NATT. I recommend either omitting the discussion of the time lag

analysis or more fully incorporating it into the manuscript by providing additional information and data.

- a. Additional information, including the addition of a figure, will be added to this section to better incorporate the time lag analysis
- 4. I think the Results and Discussion section would be improved by discussing the strength of the correlations between the climate indices and rainfall across the NATT. The authors pointed out that the correlations were highest at the northern end of the transect due to the dependability of the monsoon rainfall in that area, but did not address the low r2 of even the best-correlated index at the southern end of the transect, or that most of the climate indices were very poorly correlated with rainfall at all time scales across the entire NATT (see Figures 7 and 8). Discussing the reasons for this would be a useful addition to the manuscript.
 - a. More discussion will be added to address the nature of the correlations and physical processes that may be influencing these.

Technical corrections

- p. 2, line 4, substitute effects for implications
 - o Will change
- p. 3, line 19, "has been shown to feedback to affect. . ." is awkward
 - Will remove "to feedback"
- p. 5, line 14 substitute in for is
 - Changing in to is, i.e. from "which results in greenhouse gas emissions" to "which results is greenhouse gas emissions" sounds awkward. This change has not been made
- p. 5, line 20, mention where the rate change takes place along the transect
 - o Will mention
- p. 15, lines 13-14, mention that all of the correlations are low at the southern end of the transect
 - o Will mention
- p. 17, lines 23-24, this seems contradictory to Table 3 that shows an increase in rainfall over time for all points on the transect.
 - The section that the reviewer refers to states "This research has reinforced the notion that future water availability is uncertain due to both unknown trends and relationships between climatic phenomena and natural climate variability, and the uncertainty surrounding the effect of anthropogenic climate change on precipitation" and we feel there is nothing in this paragraph related to "increase in rainfall over time for all points on the transect" and therefore we have not modified this sentence.
- p. 17, lines 25-29. This discussion is off topic. Please modify or omit.
 - We do not agree that this section of the paper is off topic as it discusses some of the possible causes of the correlations between rainfall and the TSI. These sentences have been rewritten slightly to make this clearer.
- p. 18, lines 5-18.
 - We are not sure what the reviewers concern is with this section of the paper.

- The first two paragraphs of the Conclusions C2 did not describe much about the key findings of the study. Either revise or omit.
 - Will remove.