Responses to Reviewer 1's comments

Summary:

This manuscript explored the shifting correlations between fire weather indicators and ENSO when AMO was in its positive and negative phases, and has shown interesting results about the combined effects of AMO and ENSO when they are in-phase and out-phase. The authors have tried to interpret the underlying mechanisms teleconnecting Atlantic SST, Australian temperature and precipitation, etc. I am gladly noticing the authors have tested several datasets for the same climate parameters in order to get robust results. This study has provided new information on the impacts of ENSO on fire weather in Australia, the method and analysis are generally solid, the writing is OK, and I suggest this manuscript should be accepted after a proper revision.

Reply: We are grateful to the reviewer for their insightful suggestions, which have significantly contributed to the enhancement of our manuscript. We have meticulously examined the comments and made the necessary revisions, hoping that the updated version meets the journal's standards. Our responses to each of the comments and suggestions are as follows. The referee's original comments are shown in blue. Our replies are shown in black. The corresponding changes in the manuscript are shown in *Italic black*

1. Statistically, individual AMO+ and ENSO+, and the combination of them, are in favor of a fire-prone climate (high temperature and low precipitation, Fig.2 S5 S6 S7), and this part is OK. But more studies are needed when interpreting the teleconnections: AMO was usually defined as the mean SST of the entire North Atlantic Ocean (including both North and Tropical Atlantic, as you defined in this manuscript). However, it's interesting to notice that the responses to North Atlantic Ocean SST are much weaker than those of the Tropical, and sometimes

even insignificant (Fig.3 4a 4b). Could the authors also show the SSTs time series or patterns for both North and Tropical Atlantic in the supplementary, so the readers could get an idea about at least their differences? I assume the close connection with Tropical Atlantic SST could arise from their closeness in latitudes, so the Rossby wave anomaly arising from a higher Tropical Atlantic SST is easier reaching Australia? which was indicated in Fig.4a? Anyway, more interpretations are needed in this section.

Reply: We appreciate the constructive and valuable suggestions provided. In response, we have presented the Sea Surface Temperature (SST) time series for both the North Atlantic (20°N-70°N) and Tropical Atlantic (0°-20°N) regions for comparison in Figure R1 (also in Figure S). The time series of SSTs were derived similarly to the definition of the Atlantic Multidecadal Oscillation (AMO) index, with detrending and 11-year moving average SST anomalies (Trenberth and Shea, 2006). Generally, the positive and negative phases in the two time series exhibit similar time periods. Both regions experienced negative phases during 1980-2000 and positive phases during 2000-2019. However, their trends in the recent decade differ, with SST decreasing from 2008 in the Tropical Atlantic, while remaining fluctuating in the North Atlantic.

Indeed, the correlations between North Atlantic SST and local factors are weaker than those of the Tropical Atlantic SST, which could be attributed to the closer proximity of the Tropical Atlantic to Australia. Nevertheless, the correlation from the North Atlantic should not be overlooked, particularly as the impact of the North Atlantic on Australia's precipitation is statistically significant across southern and western Australia (Figure 3e). Furthermore, the Atlantic Multidecadal Oscillation itself encompasses SST fluctuations in both the tropical Atlantic and the North Atlantic in the middle latitudes; therefore, the influence of the North Atlantic cannot be disregarded. We have included the following explanation in Lines 226-228 and cited it accordingly:

Furthermore, the influence of the tropical Atlantic appears more pronounced and statistically significant, which may be attributable to its closer proximity to Australia. Nevertheless, the impact of the North Atlantic on precipitation remains statistically significant across southern and western Australia, warranting further consideration.

2. Did you remove the global SST warming trend from AMO records? Obviously, most AMO indies are simply the regional means of SST, which combine signals of both global SST warming and multidecadal SST variations. I strongly recommend subtracting the 60°N-60°S mean SST from AMO as Trenberth and Shea (2005) did, or subtracting SSTs of the same latitude from North and Tropical Atlantic SST when you were conducting OBE. Reviewer#2 has already noticed this problem and questioned the role of global warming as well.

Reply: We appreciate the reviewer highlighting this aspect. While global warming might contribute to the observed correlation transition, as hypothesized in previous work (Mariani et al., 2018), the slowdown or even pause of the global warming trend between ~2000 and 2015 renders this hypothesis less plausible, prompting us to explore other potential causes, such as decadal climate variability (e.g., AMO).

Our study focuses on the role of decadal variability rather than global warming. Consequently, we indeed have detrended all physical quantities to minimize the impact of global warming on our analysis.

Following the definition in Trenberth and Shea (2006), we have also removed the global SST warming trend from the AMO records and presented the AMO index from 1870 to 2019 in Figure R1. It is worth noting that the AMO index time series in Figure 1b (1980-2019) is a subset of that in Figure R1 (1870-2019). This may inadvertently lead readers to believe that we did not detrend and remove the influence of global warming.

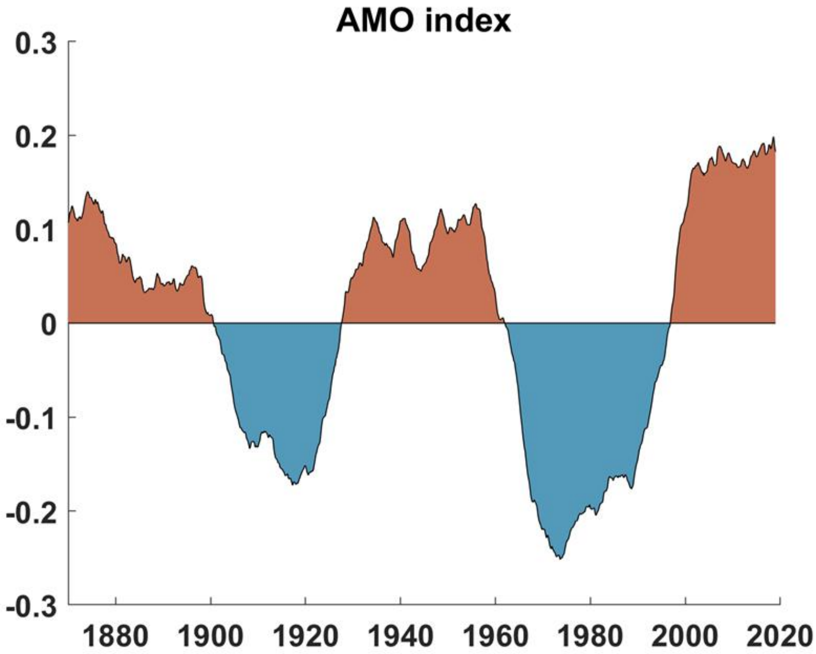

Figure R1 AMO times series from 1870 to 2019

To prevent potential misunderstandings, we have incorporated the following explanation in the Data and Methods section, specifically in Lines 79-80, and cited it accordingly:

All meteorological variables and climate indices undergo linear detrending to minimize the influence of global warming on the analysis.

References

Mariani, M., Holz, A., Veblen, T. T., Williamson, G., Fletcher, M. S., and Bowman, D. M. J. S.: Climate Change Amplifications of Climate-Fire Teleconnections in the Southern Hemisphere, Geophys. Res. Lett., 45(10), 5071-5081, https://doi.org/10.1029/2018GL078294, 2018.

Trenberth, K. E., and Shea, D. J.: Atlantic hurricanes and natural variability in 2005, Geophys. Res. Lett., 33(12), L12704. https://doi.org/10.1029/2006GL026894, 2006.