Weather Clim. Dynam. Discuss., referee comment RC1
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Comment on wcd-2021-63

Anonymous Referee #1

Referee comment on "Tropical influence on heat-generating atmospheric circulation over Australia strengthens through spring" by Roseanna C. McKay et al., Weather Clim. Dynam. Discuss., https://doi.org/10.5194/wcd-2021-63-RC1, 2021

Synopsis:
This study of McKay et al. aims to quantify the effect of remote drivers on spring maximum temperatures in Australia. Focusing on ENSO, IOD, and SAM, the authors find that early spring maximum temperatures are more closely related to the extatropical circulation anomalies and late spring maximum temperatures are rather due to tropical variability. Analysis of the Rossby wave activity flux reveals that the increasing influence of the tropics is due to Rossby wave teleconnections emerging from the tropical Indian Ocean. Overall, the results are presented in a clear manner and the conclusions are justified. However, there are numerous instances where clarification is needed. In particular, the introduction could become more streamlined by restructuring parts of it (see major comment #1). Once the comments have been addressed, I think this paper is a worthwhile contribution to Weather and Climate Dynamics.

Major comments:
1) Introduction: Overall, the introduction is extensive and contains the relevant literature. I appreciate this very much! However, the introduction could become more streamlined through restructuring parts of it. In some cases, information is given that only fits the context to a limited extent (l. 60-61), or information is given too late in the text. For example, SAM is introduced in l. 72 but the information that SAM's negative phase is associated with an equatorward shift of the eddy-driven jet is only provided in line 94. To guide the reader a bit more, one could also list the main drivers (ENSO, IOD, SAM) in an introductory sentence and explain that the link to Australian spring temperatures is provided in the following. Further, the drivers are introduced in the order ENSO, IOD, SAM. However, when discussing the connection of heat conditions during spring (line 107 and after), the order is SAM, IOD, ENSO. As suggested before, please double-check the structure of the introduction and make sure that it follows a logic structure. I am convinced that the readership will appreciate this.

2) Numerous studies emphasize the importance of land-atmosphere interaction for the occurrence of heat waves/heat extremes (e.g., Fischer et al. 2007; Hirsch et al. 2019) and the authors actually discuss this aspect in Section 7. However, the regression models to reconstruct monthly maximum temperature anomalies introduced in this study are purely

based on oceanic/atmospheric predictors. By what degree would these models improve if additional predictors representing the land surface conditions (e.g., soil moisture) were considered. I strongly encourage the authors to conduct an analysis in this direction since it would (1) help to quantify the percent variance explained by the land-surface conditions, (2) raise interesting questions concerning the importance of the antecedent weather conditions in winter and the resulting moisture, and (3) potentially identify important sources of subseasonal predictability which is one of the motivating factors for this study.

Minor comments:
Title: From my point of view the title is not clear. It could mean that the tropical influence strengthens in a changing climate or during spring. According to my understanding, the latter is meant. To make this more clear the authors could write "Tropical influence on heat generating circulation over Australia strengthens in the course of spring".

l. 15: Please consider to specify "develop in a warming climate". I guess this is the meaning here.

l. 60-61: This sentence appears to me a bit out of context. The sentence before and after describe the relation of ENSO and IOD to Australia's drier conditions and temperature. So, why is it important here to mention that ENSO and IOD co-vary?

l. 91: I guess it is not ENSO, IOD and the TPI in general that promotes anomalously high geopotential height. Please specify the phase that is referred to here (El Nino vs La Nina, positive/negative IOD etc).

l. 100: Do the authors mean "dryness"?

l. 151: Please note that ERA5 is available from 1950 to almost present. I guess the authors are saying that in this study ERA5 data are used for the period 1979-2019. Please clarify.

l. 153: In Latex, please insert \, between number and unit, e.g., 500\,hPa.

l. 193: Please write "a" (radius of the earth) in math mode (a).

l. 199: Please double-check this sentence. According to Takaya and Nakamura, WAF is parallel to the local three-dimensional group velocity of a Rossby wave packet. In my

view, the WAF itself is not propagating.

l. 229 and elsewhere: Also here, please check the meaning of the sentence. To my understanding one should rather say "... with the wave activity flux predominantly indicating a Rossby wave propagation from the subtropical Indian Ocean...".

l. 296: Are these winds also southerly when not considering anomalies but the actual wind? Caution is required when interpreting wind anomalies. If the actual wind is also southerly this could be mentioned in the text in support of the interpretation.

l. 381: Are you saying that WAF indicates a Rossby wave propagation along the jet waveguide from Africa or is it to Africa? This would be difficult to see since Africa is hardly shown on the map. Please clarify.

l. 388: Better provide the information on what "waveguide" is referring to when it is first introduced in the text.

l. 516: That much of the atmospheric patterns associated with heat through spring are explained by neither the tropical TPI nor SAM is also related to my major comment #2. Would land-atmosphere processes explain at least parts of it?

l. 554-557: This is an interesting thought. Quinting and Reeder (2017) actually show that air masses ending up in upper-tropospheric anticyclones during heat waves are strongly diabatically heated during their ascent south of Australia. So, their results potentially support the hypothesis given here concerning the storminess just to Australia's south.

Figure 1: To better match the order of the remote drivers in the text, my suggestion is to reorder the panels of Fig. 2: SAM, Nino, DMI, TPI. In the caption of the figure, please correct units (e.g., hPa\,s^{-1}). The caption was probably rendered incompletely as its last sentence ends without a subject.

Figure 4: I guess it is Ks instead of K. Also, how exactly are the monthly mean climatological Ks calculated. Are these again obtained through linear regression? Please explain in the text.

Technical Notes:

l. 73: Please place comma after the references.

l. 75: I guess "to" is not needed here.

l. 97: I guess it should be "deflecting" instead of "defecting".

l. 165: "impact" instead of "impacts".

l. 254: I guess "of" is missing between "poleward" and "that".

l. 305: I assume that "appears" needs to be deleted.

l. 320: Insert "to" between "relative" and "that".

l. 569: "associated" instead of "associate".

Figure 2: "Area-averaged" instead of "areal-averaged".

References:

Fischer, E. M., Seneviratne, S. I., Lüthi, D., and Schär, C. (2007), Contribution of land-atmosphere coupling to recent European summer heat waves, Geophys. Res. Lett., 34, L06707, doi:10.1029/2006GL029068.

Hirsch, A. L., Evans, J. P., Di Virgillio, G., Perkins-Kirkpatrick, S. E., Argüeso, D., Pitman, A. J., et al (2019). Amplification of Australian heatwaves via local land-atmosphere coupling. Journal of Geophysical Research: Atmospheres, 2019; 124: 13625– 13647. https://doi.org/10.1029/2019JD030665

Quinting, J. F., & Reeder, M. J. (2017). Southeastern Australian Heat Waves from a Trajectory Viewpoint, Monthly Weather Review, 145(10), 4109-4125