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Earth System Dynamics
Discussions
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Interactive comment on "The sensitivity of the large-scale atmosphere circulation to changes in surface temperature gradients in the Northern Hemisphere" *by* Sonja Molnos et al.

Anonymous Referee #2

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general comments:

This paper investigates the sensitivity of a statistical-dynamical model to three thermal properties of the atmosphere: meridional and zonal temperature gradients and global temperature. The experiment setup is designed to study the effect of changes in these properties on some tropical and extratropical components of the general circulation.

The paper is well structured and potentially provides some novel insight into the cancelling effects of the observed past and modelled future climate change. It fits well into the theme of ESD. Having said that I have some concerns about the methodology and cannot recommend it for publication at its present state.

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specific comments:

- The model temperature forcing is not clear. For example, what is the vertical structure of the forcing? What exactly is T_1 and T_new? I'm not sure what updated temperature means. Is this a restoration temperature field like in the Held-Suarez model?

- Could you include more plots of the zonal asymmetries to support the discussion? I would also put less emphasis on the fact that increasing the meridional temperature gradient increases the jet strength, since this is to be expected from the thermal wind balance.

- How is the separation into planetary and synoptic scale waves done? E.g. are you using the Lanczos filter or just running mean? Also, the planetary wave definition uses departures from the zonal mean, but synoptic eddies are included in this. Discussion of stationary wave changes would be helpful.

- Using a vertically integrated EKE would be more robust, in that it would eliminate the possibility that the changes are due to the EKE maximum moving vertically. some key literature on GCM modelling of the atmospheric response to changes in thermal structure is missing (e.g. work by Tapio Schneider, Paul O'Gorman, Amy Butler, etc.)

technical corrections:

P2 L22: positive trend -> strengthening trend?

P2 L24: reference

P3 L5: the Hadley Cell

P4 L1: chapters -> sections

P5 L4: using 300 hPa to diagnose the jet location: no results for the jet latitude are presented

P5 L21: orange line -> dashed line?

P5 L23: please clarify what you mean by “zero-crossings”

P7 L12: vice versa: it is not clear to me what exactly this is referring to

P7 L12: please clarify what you mean by “wave-shaped structure”

P9 L19: . . .temperature gradient in this study.

P10 L1: gradients

P10 L13: Arctic

P10 L31: . . .observed by previous studies, which. . .

P11 L1: In contrast -> In addition

P11 L2-3: please clarify what you mean by this sentence

Fig 2, 5: Please improve the colour scale

Fig 5: no label on y axis

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