

## ***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.***

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The paper aims to disentangle the role of global mean, meridional and azonal temperature changes on large scale atmospheric circulation (specifically focusing on jet stream, storm track, planetary wave and Hadley Cell) in the Northern Hemisphere. In order to separate the effect due to each one, the authors carried on simulations with a statistical-dynamical atmosphere model (SDAM) Aeolus 1.0. The authors found that the strength of the Hadley cell, storm tracks and jet streams depends almost linearly on both the global mean temperature and the meridional temperature gradient whereas the zonal temperature gradient has little or no influence.

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The paper is potentially interesting, however a lot of fundamental references (see below) are missing in the introduction, and a detailed description of the model and model-set up is needed.

Specific comments:

p2 n.10: The description of the underlying mechanisms controlling the width and the strength of the Hadley Cell is poor. The authors did not mention the static stability and the tropopause height as factors influencing the Hadley Cell (Held, I. M. (2000), The general circulation of the atmosphere. paper presented at 2000 Program in Geophysical Fluid Dynamics, Woods Hole Oceanographic Institution, Woods Hole, Mass., AND Lu et al., 2008 - these references must be included in the main text). Baroclinic instability also plays a role on the strength and extent of the Hadley Cell: please refer to a number of papers by Tapio Schneider.

p3 n. 15: SDAM has been never introduced as acronym before this line (except in the abstract).

p3 n.15 - 20: It is strongly encouraged a detailed description of the model and model-set-up used in this study with a dedicated sub-section in Data and Methods.

p7 n.25 "Our analysis indicates that a higher absolute meridional and azonal temperature gradient leads to a larger Hadley cell width, and we observe only a very weak dependence on the global mean temperature."

In order to improve the discussion of main findings, the author might want also to refer to a new paper in which the strength and the width of the Hadley Cell and its relationship with global mean temperature and meridional temperature gradient has been investigated in a wide range of climate conditions (D’Agostino et al., 2017, <http://onlinelibrary.wiley.com/doi/10.1002/2017GL074533/abstract> ). Another important study investigating the effect of static stability, tropopause height and meridional temperature gradient in future climate projections on Hadley Cell strength, is "A mechanism

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for future changes in Hadley circulation strength in CMIP5 climate change simulations" by Seo et al., 2014 (<http://onlinelibrary.wiley.com/doi/10.1002/2014GL060868/full> ).

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