

“ Tropical circulation and associated precipitation responses underidealized global warming simulations ” by Karpasitis et al.

Authors studied the ITCZ changes under 2°C and 4°C Global Warming Levels (GWLs) above the pre-industrial conditions. Their results show that the global zonal mean ITCZ will contract with a higher global mean temperature and an overall weaker updraft is projected. The precipitation intensity of the ITCZ band becomes stronger, despite the weakening of the Hadley circulation and its ascending and descending branches, with decreased precipitation projected in the descending branch over the sub-tropics. This study is interesting and the method is straightforward. However, these findings listed in the abstract are consistent with previous findings. There is a lack of new finding, so it is suggested for a rejection.

Main points:

- 1) TIPMIP models are coupled models which are well known for their “double ITCZ” problems. Therefore, results, particularly those for southern hemisphere ITCZs over different sections may not be physically valid.
- 2) Main results from the abstract are
 - a) “the global zonal mean ITCZ will contract with a higher global mean temperature, with a general displacement toward the winter hemisphere.”

The ITCZ generally shifts towards the hemisphere with atmospheric energy convergence and this has been investigated with many publications (Hwang et al. 2013; Allen et al. 2015; Wang 2015; Haywood et al. 2016). Generally, the atmosphere has energy convergence in winter hemisphere and divergence in summer hemisphere.

- b) “In the various regions, the ITCZ response to increasing global temperatures generally varies, but overall, weaker updrafts are projected. “

The following sentence is cited from Byrne et al. (2018):

“Most CMIP5 models (24/32) predict reduced ITCZ strength (i.e., weaker upward motion) under global warming (Fig. 3c), with a median fractional weakening of 0.69%/K and an interquartile range of 1.75%/K. As is the case for changes in ITCZ width, this weakening is more robust across climate models than changes in ITCZ location, though there is considerable inter-model spread.”

- c) “The precipitation intensity of the ITCZ band becomes stronger, despite the weakening of the Hadley cell circulation and its ascending and descending branches, with decreased precipitation projected in the descending branch”

This has been well documented by Byrne et al. (2018).

References:

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Hwang Y-T, Frierson DMW, Kang SM (2013) Anthropogenic sulfate aerosol and the southward shift of tropical precipitation in the late 20th century. *Geophysical Research Letters*, 40:2845-2850

Haywood JM, Jones A, Dunstone N, Milton S, Vellinga M, Bodas-Salcedo A, et al (2016) The impact of equilibrating hemispheric albedos on tropical performance in the HadGEM2-ES coupled climate model: Equalizing hemispheric albedos in HadGEM. *Geophysical Research Letters*, 43:395–403. <https://doi.org/10.1002/2015GL066903>

Wang C (2015) Anthropogenic aerosols and the distribution of past large-scale precipitation change. *Geophysical Research Letters*, 42:10876–10884