

Interactive comment on “Changes in the Width of the Tropical Belt due to Simple Radiative Forcing Changes in the GeoMIP Simulations” by Nicholas Davis et al.

Anonymous Referee #2

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This paper documents the response of the width of the zonal mean tropical Hadley circulation to suddenly applied CO₂ and solar forcings. The work is timely, the writing understandable, the methods appropriate, and the figures mostly clear. Some results worth highlighting include the following.

1. Reducing the solar constant to counteract greenhouse gas induced warming may maintain a steady Hadley circulation in spite of a cooling stratosphere.
2. Model dynamical sensitivity is distinct from climate sensitivity (see Grise & Polvani, 2016).
3. Well-mixed GHGs produces a seasonally varying shift.

C1

My main criticism of the article is the same as RC1: the authors state that previous climate model studies have not "...examined how comprehensive climate models respond to simplified climate forcings." While this study is certainly useful, there is already other, similar work out there that ought to be discussed.

Specific comments

Line 102 - I don't believe the studies cited in this paragraph justify the statement that an increase in the height of the tropopause - independent from stratospheric cooling or tropospheric warming - drives a poleward shift in the circulation. I think this is an over-generalization.

Line 146 - What were some typical effective degrees of freedom calculated in this way?

Lines 237-245 - Good discussion of uncertainty.

Line 266 - "temperature structures" should probably be "zonal mean temperature structures"

Line 289 - I think that "successfully used to study tropical expansion" suggest more closure than the theory provides. It's proven useful but insufficient.

Lines 324-326 - Some clarification is needed here. I find the combination of "more linear", "more scattered," and "Despite the nonlinearity" all refer to the same result.

Technical comments

In the references There are missing DOIs (line 413), and several DOIs that point to the wrong paper (e.g. the DOI for the Allen & Sherwood reference about aerosols on lines 414-415 points instead to an Allen & Zender paper on Siberian snow cover).

The figures are nicely rendered, but some are carelessly produced. Figures 1, 4, 5, and 7-10 all use color as the only/primary way of conveying model information. "Do not use text color alone to convey information." I have attached a rasterized revision of Figure 1 which is much clearer, and a version of Figure 4 with a colorblind filter applied

C2

(roughly 1 in 10 men will perceive the figures this way.) Use symbols, or just annotate points with model names where it matters.

Interactive comment on Atmos. Chem. Phys. Discuss., doi:10.5194/acp-2016-340, 2016.

C3

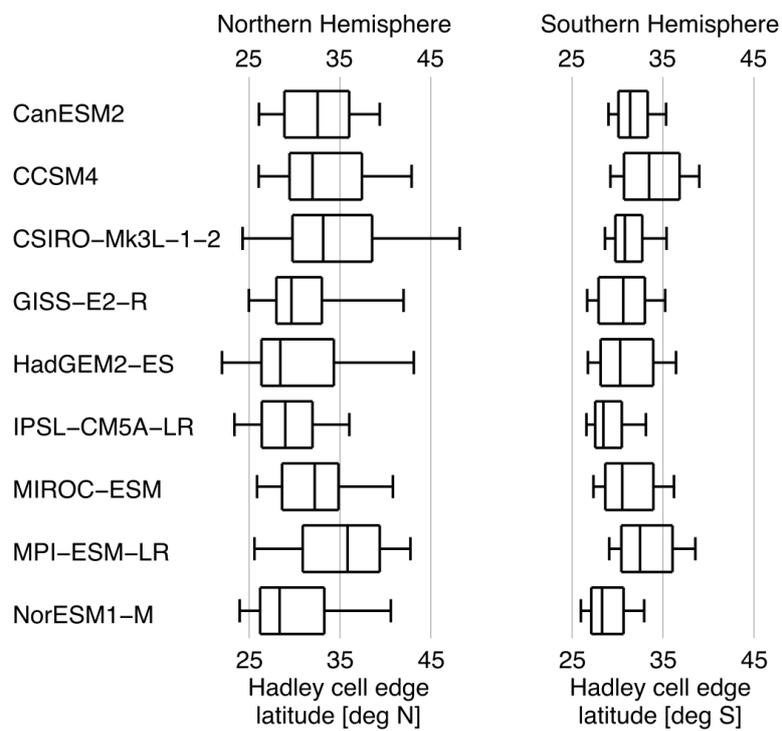


Fig. 1. revised for clarity

C4

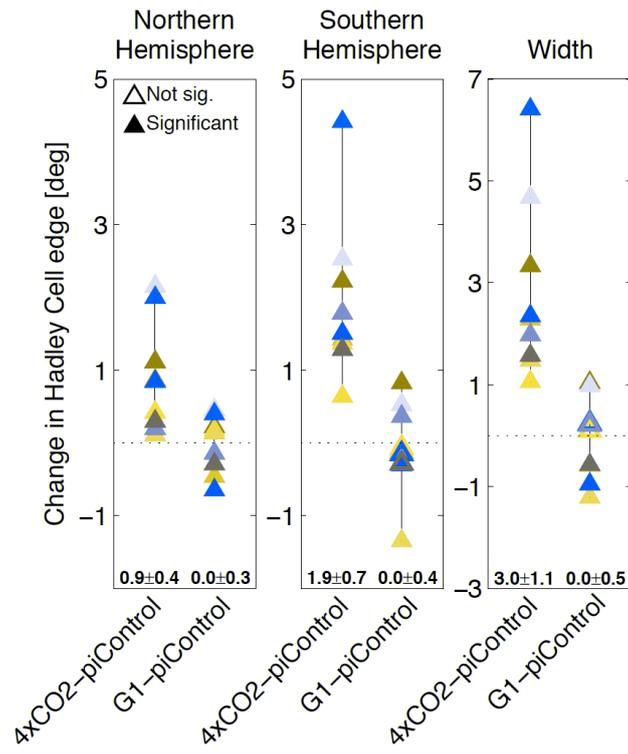


Fig. 2. colorblind proof