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Earth System Dynamics
Discussions

Interactive comment on "Sensitivity of the tropical climate to an interhemispheric thermal gradient: the role of tropical ocean dynamics" *by* Stefanie Talento and Marcelo Barreiro

Anonymous Referee #2

Received and published: 1 January 2018

General Comments:

In this paper, the authors employ a climate model hierarchy to understand the climate response to an idealized interhemispheric thermal gradient (ITG). The model hierarchy consists of an atmospheric general circulation model (AGCM) under two coupled configurations. In the first configuration, the AGCM is coupled to a slab ocean model everywhere on the globe. In the second configuration, the AGCM is coupled to a slab ocean model everywhere except in the tropics where it is coupled to a reduced gravity ocean model to yield a total of four simulations. The two configurations are run under two scenarios: a scenario in which no forcing perturbation is applied and in a scenario

in which the idealized ITG is imposed to yield a set of four simulations. Using the four simulations, the role of ocean dynamics in the climate response to extratropical forcing perturbations is studied. The authors demonstrate that including tropical ocean dynamics mutes ITCZ shifts in response to imposed ITGs. Further, the authors show that the tropical seasonal cycle is intensified and in response the ENSO is weakened when ocean dynamics are included.

The paper nicely complements the recent results of Kay et al (2016) who showed a similar climate response to an imposed extratropical forcing in a climate model hierarchy and emphasizes the importance of ocean dynamics in determining the ITCZ response to forcing perturbations. The paper is structurally and logically well organized. I suggest publication with the following revisions.

Specific Comments:

Major Comment

My major comment on this paper pertains to the lack of discussion on the recent relevant results of Green and Marshall (2017) and also, as pointed by Reviewer 1, of Schneider (2017) that provide a physical pathway for how ocean coupling mutes the ITCZ response to interhemispheric energy perturbations. The findings of these papers and their relevance to this study are described adequately in Major Comment 1 by Reviewer 1, so I will skip repeating the discussion here. I however have a few minor and a number of technical comments that I list below.

Minor Comments

Line 79: Consider including a sentence or two describing the simplified physics

Lines 51, 128, 150, 216, 291: Consider using the word 'significant' only when referring to statistical significance. Otherwise, I suggest replacing with synonyms like 'considerable' etc.,

Technical comments

Line 33: trough -> through

Line 46: being -> with

Line 63: being -> with

Line 74: find -> found

Line 90: validate its results comparing -> validate its results by comparing

Line 106: That means that, for momentum and heat fluxes, the oceanic and atmospheric components of the model exchange anomalies computed relative to their own model annual mean → In this strategy, the oceanic and atmospheric components of the model exchange momentum and heat flux anomalies computed relative to their own model annual mean

Line 108: superimposed to -> superimposed on

Line 108: wide -> width

Line 113: analogous -> analogues

Line 116: in the Control the simulated annual mean SST -> the annual mean SST in the control simulation

Line 125: than the observed and with the -> than the observed, with the

Line 126: as do in the observations -> as it does in the observations

Line 132: pattern consists in cooling -> patterns consists of cooling

Line 136: .asymmetric -> asymmetric

Line 136: is superposed to a -> is superposed on a

Line 155: focus in -> focus on

Line 155: produced to → produced in

Line 201: being September-November (SON) the period of strongest cooling and the June-August (JJA) period the one -> September-November (SON) being the period of strongest cooling and June-August (JJA) being the period

Line 202: this negative -> the negative

Line 270: being the signal produced with the RGO coupling weaker in terms of annual means -> with the signal produced in the RGO coupling case being weaker in terms of annual means

Line 215: Figure 10a shows SST anomalies and not wind anomalies. Please refer to appropriate figure.

Line 255: Timmermann et al., (2007) is missing from the list of references.

All figures: Please include headings for figure panels as visual aids

Figure 1 and 2: increase font size for x and y labels in figures 1 and 2.

Figure 11: The figure panel corresponding to Forced_slab (Figure 11a) is missing

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