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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

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We thank the reviewer for his/her constructive comments and suggestions.

We have given full consideration to the comments in the revised manuscript which includes: a discussion of the results of Green and Marshall (2017) and Schneider (2017) as well as figure modifications to make them easily interpreted by the reader.

Please find below a point-by-point reply to the questions raised. A marked-up manuscript version (with tracked changes) converted into a pdf is also uploaded as a supplement.

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 Re-

viewer 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.

********** Agreed. The results of the two mentioned papers have been included in the Introduction and Summary and Conclusions section. **********

Minor Comments

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

********** Agreed. The following text has been added to the model description: "The model includes parameterizations of: large-scale condensation, shallow and deep convection, shortwave radiation (using 2 spectral bands), longwave radiation (using 4 spectral bands), surface fluxes of momentum, heat and moisture, and vertical diffusion" **********

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

********** Agreed **********

Line 33: trough -> through

********** Agreed **********

Line 46: being -> with

********** Agreed **********

Line 63: being -> with

********** Agreed **********

Line 74: find -> found

********** Agreed **********

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

********** Agreed **********

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

********** Agreed **********

Line 108: superimposed to -> superimposed on

********** Agreed **********

Line 108: wide -> width

********** Agreed **********

Line 113: analogous -> analogues

********** Agreed

****

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

********** Agreed
****

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

********** Agreed
****

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

********** Agreed
****

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

********** Agreed
****

Line 136: .asymmetric -> asymmetric

********** Agreed
****

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

********** Agreed
****

Line 155: focus in -> focus on

********** Agreed
****

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

********** Agreed
****

Line 202: this negative -> the negative

********** Agreed
****

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

********** Agreed
****

Line 215: Figure 10a shows SST anomalies and not wind anomalies. Please refer to appropriate figure. Disagreed, the Figure reference is correct.

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

********** Agreed, the reference has been added. **********

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

********** Agreed, headings indicating the experiment or key information has been added. **********

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

********** Agreed
****

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

********** No panel is missing, as there is no thermocline anomaly in the case of slab ocean model. However, the figure caption was incorrectly referring to 2 panels. The caption has been corrected now. **********

Please also note the supplement to this comment:
https://www.earth-syst-dynam-discuss.net/esd-2017-113/esd-2017-113-AC2-supplement.pdf

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