

Interactive comment on “Climate feedbacks in the Earth system and prospects for their evaluation” by Christoph Heinze et al.

Anonymous Referee #1

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General comments:

Heinze et al. provide a comprehensive review of various climate feedback processes in the Earth System Models (ESMs). Overall, this is a timely review paper, as we continue to add complexity to the ESMs which in turn make it difficult for us to understand feedback processes and quantification of uncertainty in climate projections by these models. I don't see any significant issues with the paper. At the same time, this paper discusses a broad spectrum of the feedback processes, and I don't have the expertise to evaluate some portions of the manuscript, especially those dealing with chemical and biogeochemical feedbacks. I have a couple of minor comments that the authors may consider in revising the paper. Otherwise, I recommend the paper be accepted.

Specific comments:

C1

P19, section 3.2.3 Mid-latitude cloud amount feedback: This is a critical feedback process in the ESMs, and a more detailed discussion is desirable. The misrepresentation of the extratropical low-level clouds is a significant problem in most of the climate models in CMIP5. The biases in the simulation of these clouds cause increased absorption of shortwave radiation by the southern ocean which is attributed as the reason for the double ITCZ problem in those models (Hwang and Frierson, 2013).

P23, section 3.4.2 Tropical circulation response to a warming climate. The discussion of Pacific Walker Circulation (PWC) response to global warming is incomplete, as the authors present one viewpoint about this widely debated problem. The argument by Vecchi et al. (2006) that the PWC weakens in a warming climate in response to a differential rate of increase in precipitation and atmospheric humidity was later contradicted (e.g., Tokinaga et al., 2012; Sandeep et al., 2014). Tokinaga et al. (2012) have shown that the PWC variability in the 20th century was related to the changes in the east-west gradient of equatorial Pacific sea surface temperature. Sandeep et al. (2014) have shown that the PWC can even strengthen while the global convective mass flux weakens, contradicting the arguments of Vecchi et al. (2006).

References:

Hwang, Y-T and Frierson, D. M. W. (2013) Link between the double-Intertropical Convergence Zone problem and cloud biases over the Southern Ocean, PNAS, 110 (13) 4935-4940

Sandeep, S., Stordal, F., Sardeshmukh, P.D. et al. (2014) Pacific Walker Circulation variability in coupled and uncoupled climate models, Clim Dyn, 43, 103-117

Tokinaga, H, Xie S-P, Deser, C, Kosaka Y, Okumura YM (2012) Slowdown of the Walker circulation driven by tropical Indo-Pacific warming. Nature, 491(7424), 439–443

Interactive comment on Earth Syst. Dynam. Discuss., <https://doi.org/10.5194/esd-2018-84>, 2018.

C2