

Interactive comment on “Hadley cell expansion in CMIP6 models” by Kevin M. Grise and Sean M. Davis

Anonymous Referee #3

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General comments:

This is a very thorough and thoughtful study on the expansion of the Hadley cell across CMIP5 models/CMIP6 models/reanalyses. It clearly lays out the key similarities and differences between CMIP5 and CMIP6, and sets the differences between the models and reanalysis in a useful context. I have one main comment, and if it is addressed, the manuscript would be suitable for publication.

My comment is that the role of the pattern of SST warming for the NH JJA contraction should be discussed. For CMIP5 models, there are significant differences in Hadley cell edge response between the amipFuture and amip4K experiments for the NH JJA season. So it would be helpful if results from the amip4K experiment were shown for comparison. Furthermore, Zhou et al. (2019) argue that an ITCZ shift related to the

pattern of enhanced equatorial SST warming drives the subtropical circulation contraction during NH JJA. This is different from the present manuscript, in which it is argued that a general SST warming (pattern not required) forces the equatorial contraction during summer.

Minor comments: 1) How do you define the PSI500 Hadley cell edge for NH JJA if PSI never becomes positive in the tropics, and hence a zero-crossing does not exist? In my experience this occurs for some years in certain models. 2) How exactly is the "response" defined for the abrupt4xCO₂ experiment (Fig. 1)? I.e. over what period of the abrupt4xCO₂ experiment are you averaging?

References:

Zhou, W., S.-P. Xie and D. Yang (2019): Enhanced equatorial warming causes deep-tropical contraction and subtropical monsoon shift. *Nature Climate Change*. 9. 834-839.

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