

## ***Interactive comment on “Synchronized spatial shifts of Hadley and Walker circulations” by Kyung-Sook Yun et al.***

### **Anonymous Referee #2**

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This paper shows that warm pool SST anomalies in the decaying El Niño event generate a meridionally asymmetric Walker circulation response, which couples the zonal and meridional atmospheric overturning circulations. I think their results are overall novel and reasonable, and I would be happy to see this work on Earth System Dynamics after some minor revisions, particularly regarding discussions. Specific comments are as follows.

1) The authors focus on NINO 3 regions to explore the relationship between SST anomalies and Walker circulation. Recently, Central Pacific El Niño events tend to increase and also some papers suggested the increase of CP El Niño in a warm climate. I think that the relationship may be changed if we concentrate on the NINO4 region. The authors need to discuss the sensitivity of the NINO region on the relation-

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ship somewhere. 2) In figure 1, the temporal evolution of normalized PC from WC or HC almost coincides with the NINO3 index from 1979-2000. However, the relationship between the two indexes seems to be weakened after 2000. I would know possible reasons. I think that many reasons may be discussed – ENSO diversity, multi-decadal variability (IPO or AMO), and even global warming. 3) In figure 2, it is well known that the AMIP run tends to overestimate the atmospheric response given SST forcing. How much does the strength or duration length of phase synchronization may be changed in a coupled model? 4) In Figures 4 and 5, I would see the circulation pattern in the upper troposphere (200 hPa). If the authors think the upper-level circulation change is not relevant to this study, please mention the reason in the main text. 5) In figure 4, the 95 % significance level may be too low to show a strong shift of HC and WC. Why don't you use 99% or other higher criteria?

Please also note the supplement to this comment:

<https://esd.copernicus.org/preprints/esd-2020-70/esd-2020-70-RC2-supplement.pdf>

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