

Supporting information for “Intermodel spread in Walker circulation responses linked to spread in moist stability and radiation responses”

Margaret L. Duffy^{1,2}, Paul A. O’Gorman²

¹National Center for Atmospheric Research, Boulder, CO

²Massachusetts Institute of Technology, Cambridge, MA

Corresponding author: Margaret L. Duffy, mlduffy@ucar.edu

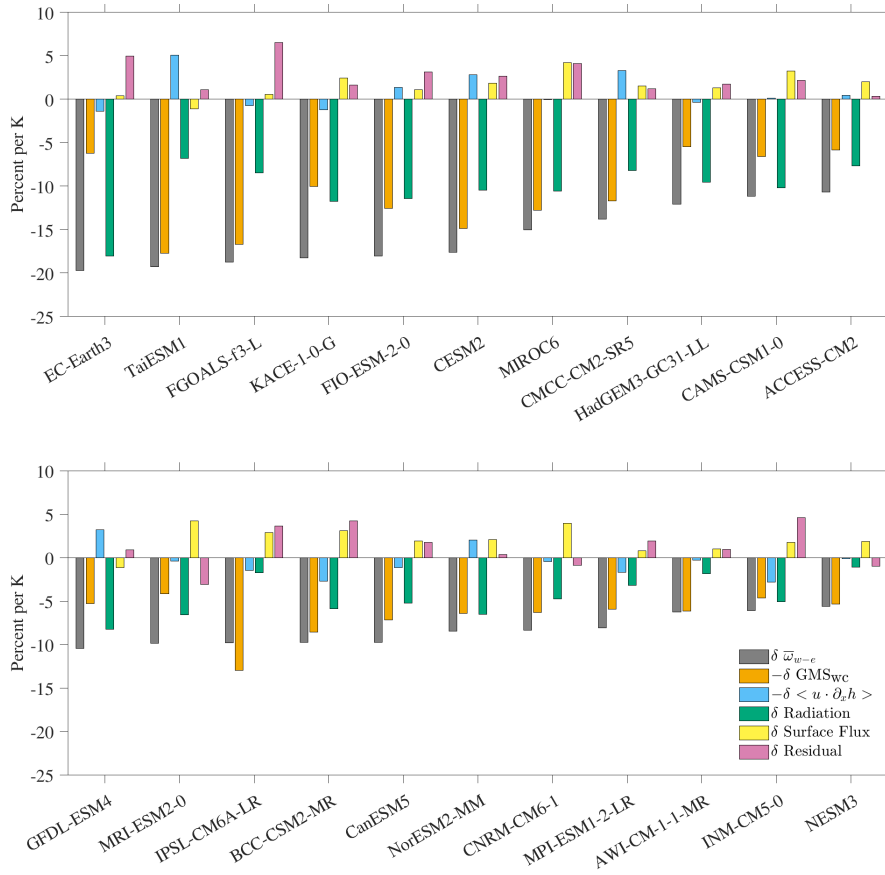


Figure S1. Same as Figure 1a for individual CMIP6 models, sorted by WC response.

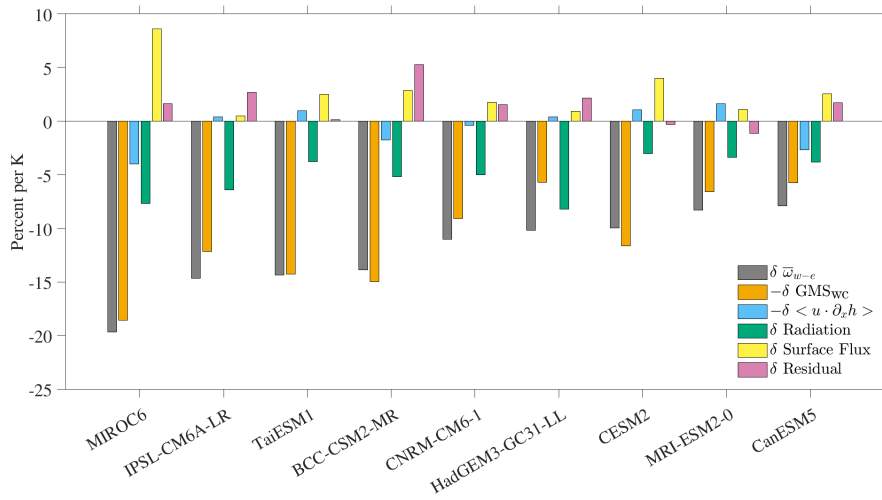


Figure S2. Same as Figure 1b for individual AMIP models, sorted by WC response.

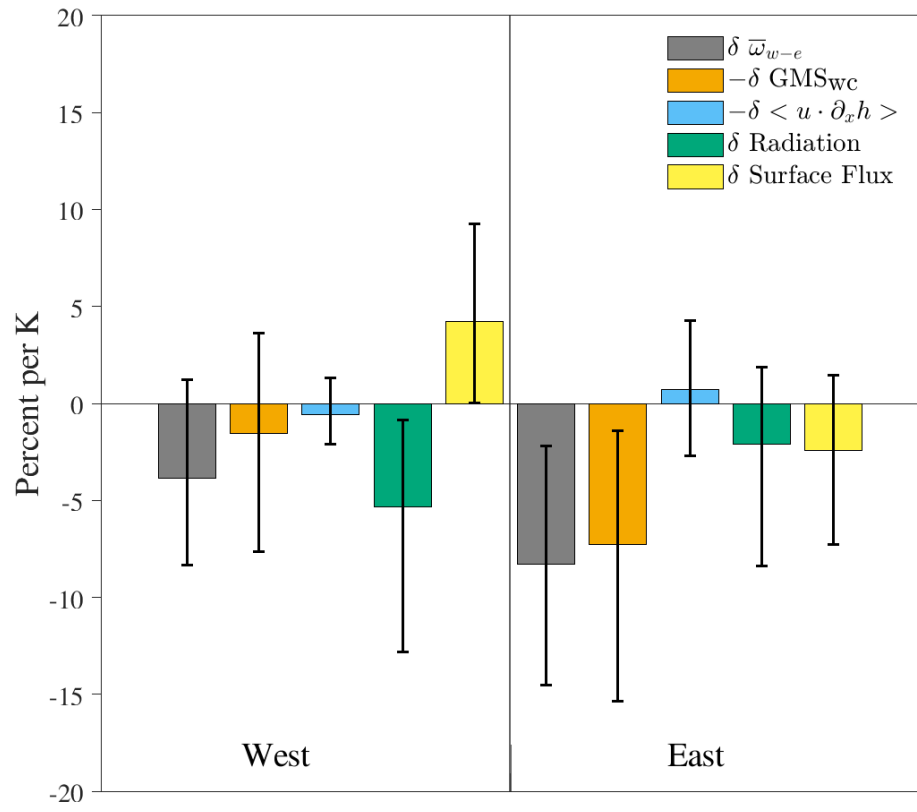


Figure S3. Same as Figure 1a (CMIP6) separated into west and east contributions to $\delta \bar{\omega}_{w-e}$.

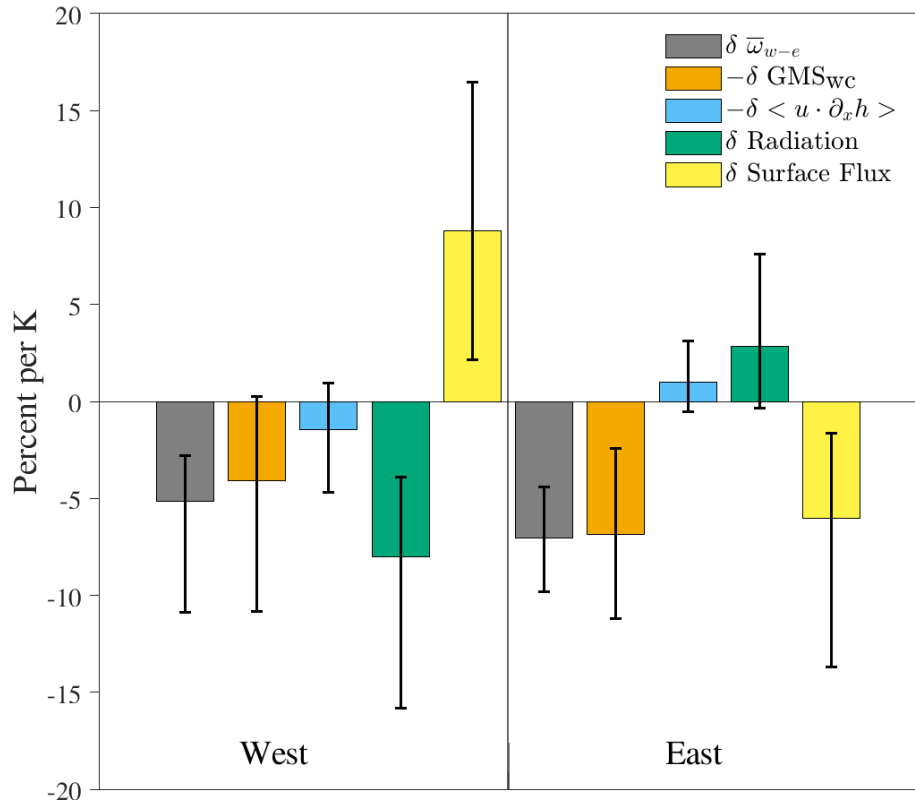


Figure S4. Same as Figure 1b (AMIP) separated into west and east contributions to $\delta \bar{w}_{w-e}$.

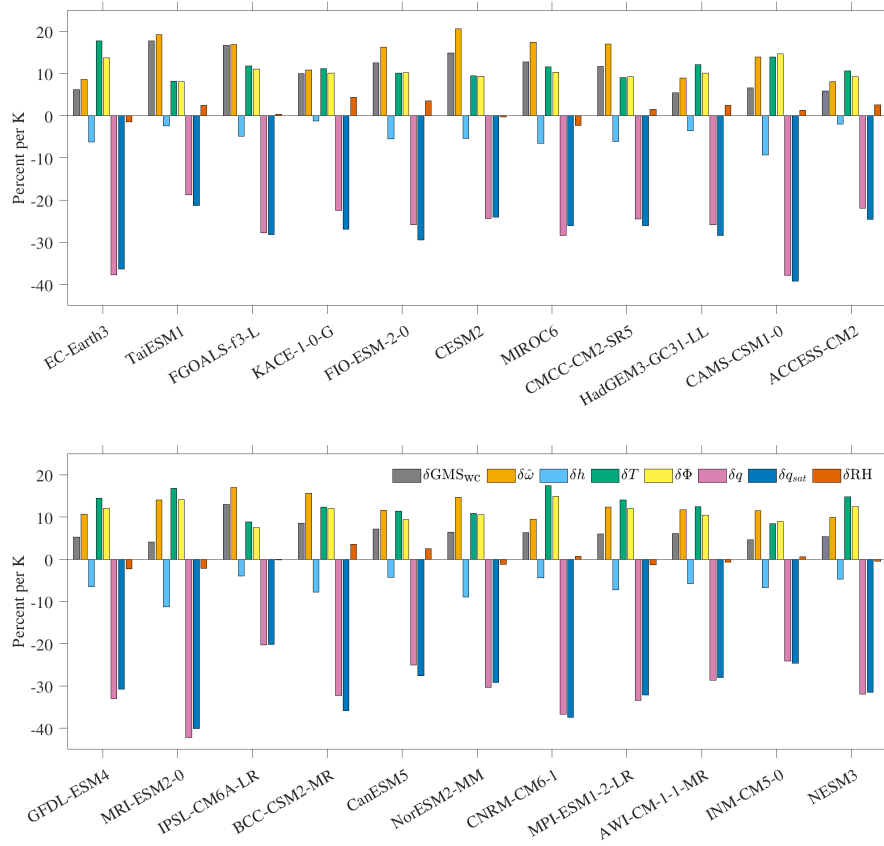


Figure S5. Same as Figure 6a for individual CMIP6 models, sorted by WC response as shown in Figure S1.

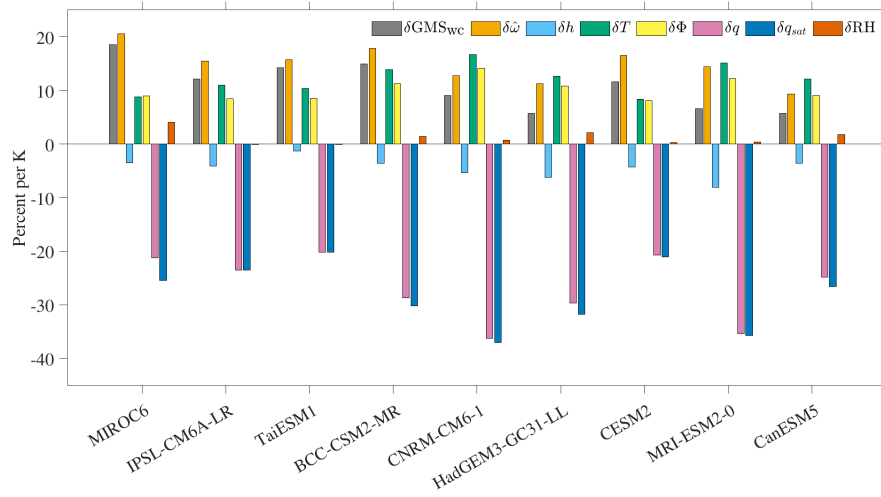


Figure S6. Same as Figure 6b for individual AMIP models, sorted by WC response as shown in Figure S2.

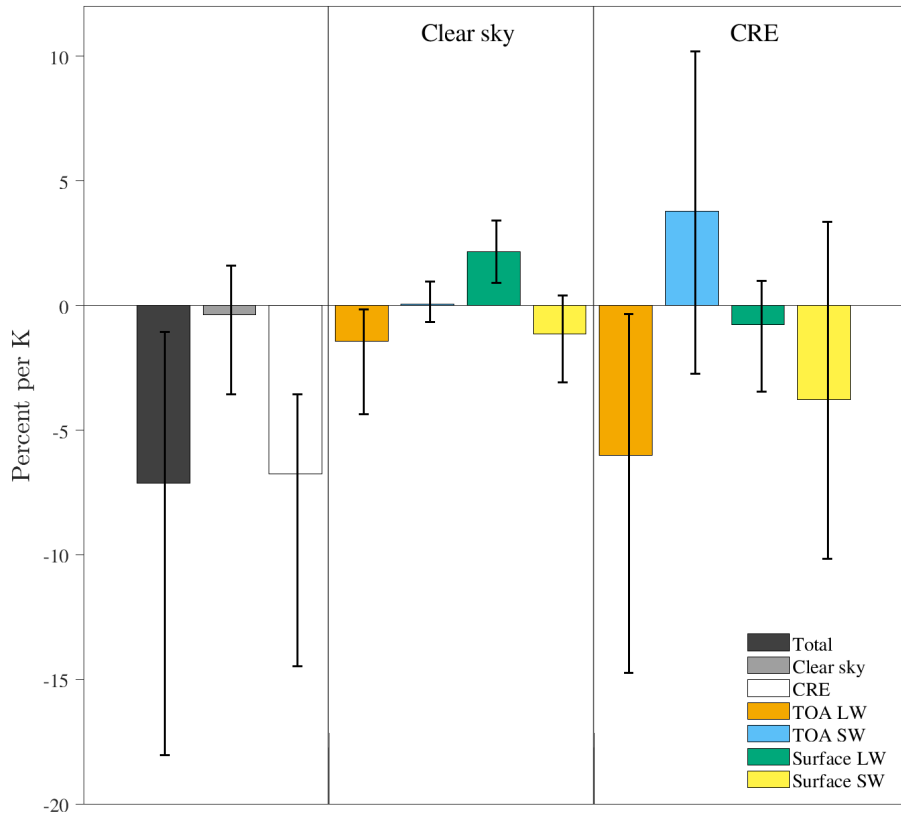


Figure S7. Decomposition of radiation contribution to WC response in CMIP6 models (black) into contributions from clear sky (gray) and cloud-radiative effects (white). The clear sky and CRE contributions are each further decomposed into contributions from top of atmosphere longwave radiation (orange), top of atmosphere shortwave radiation (blue), surface longwave radiation (green), and surface shortwave radiation (yellow) for both clear sky (left) and cloud-radiative effects (right). Top of atmosphere contributions come from radiative fluxes that are positive down and surface contributions come from radiative fluxes that are positive up. The whiskers cover the entire spread across models for each term.

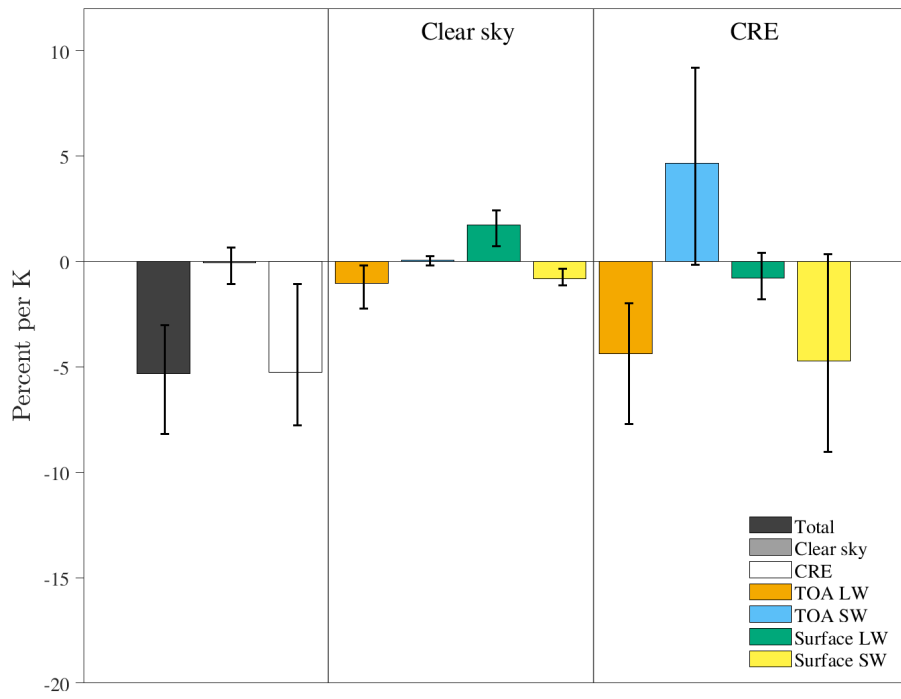


Figure S8. Same as Figure S7 for AMIP models.

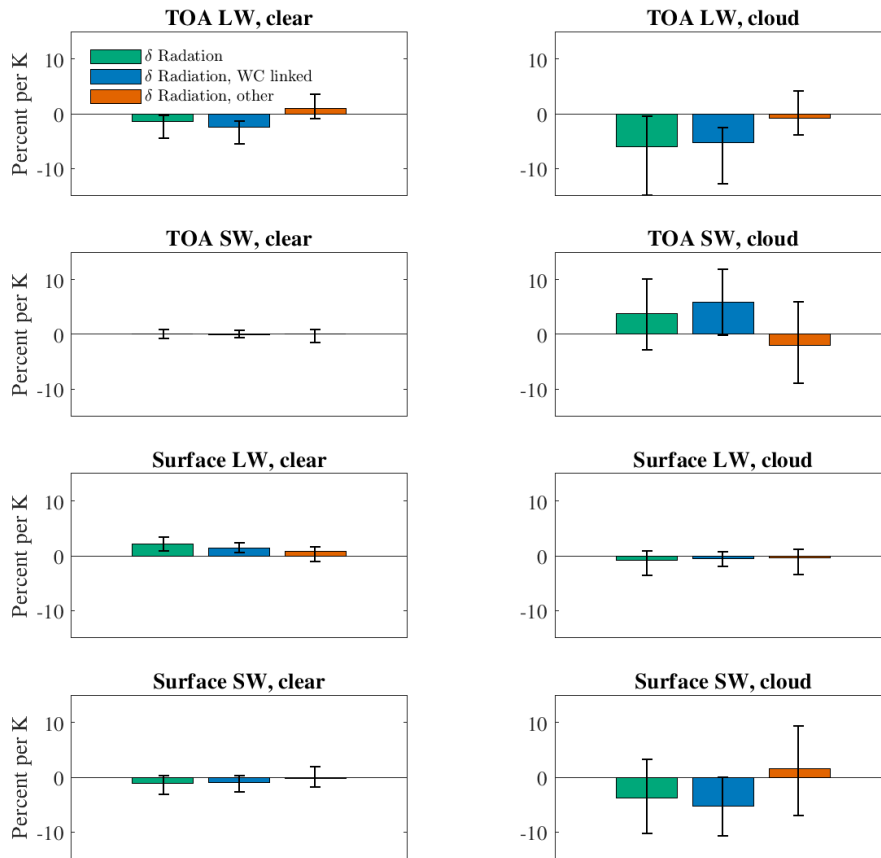


Figure S9. Same as Figure 1c (CMIP6) but for each component of the total radiation contribution. The whiskers cover the entire spread across models for each term. TOA terms are positive down and surface terms are positive up.

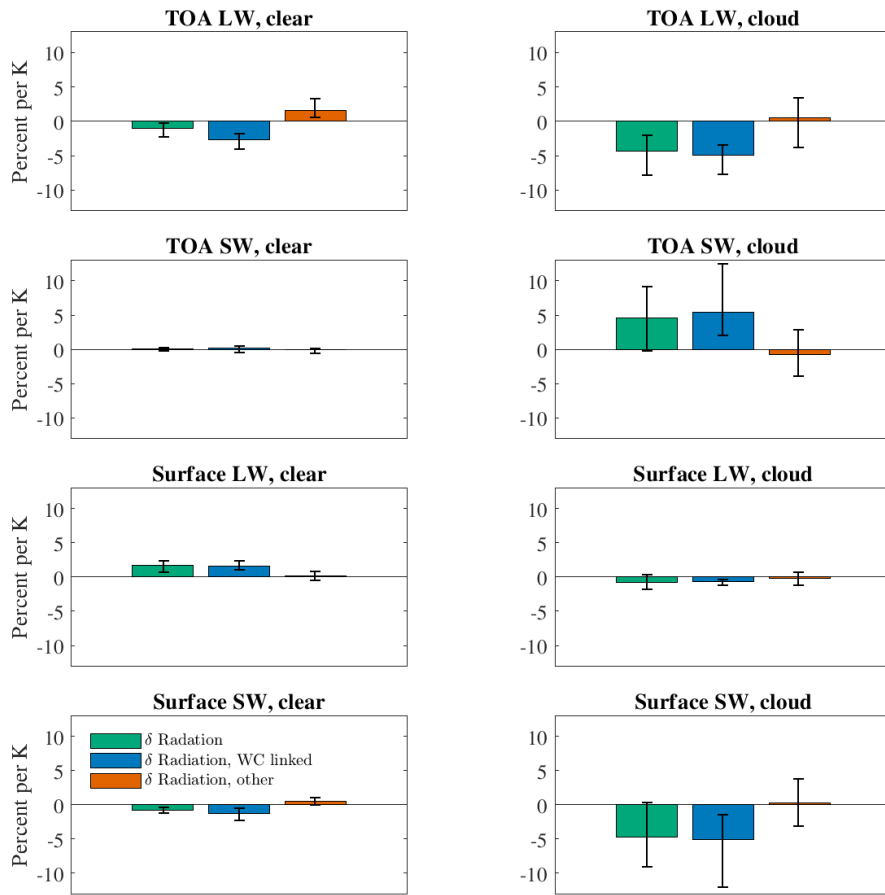


Figure S10. Same as Figure 1d (AMIP) but for each component of the total radiation contribution.

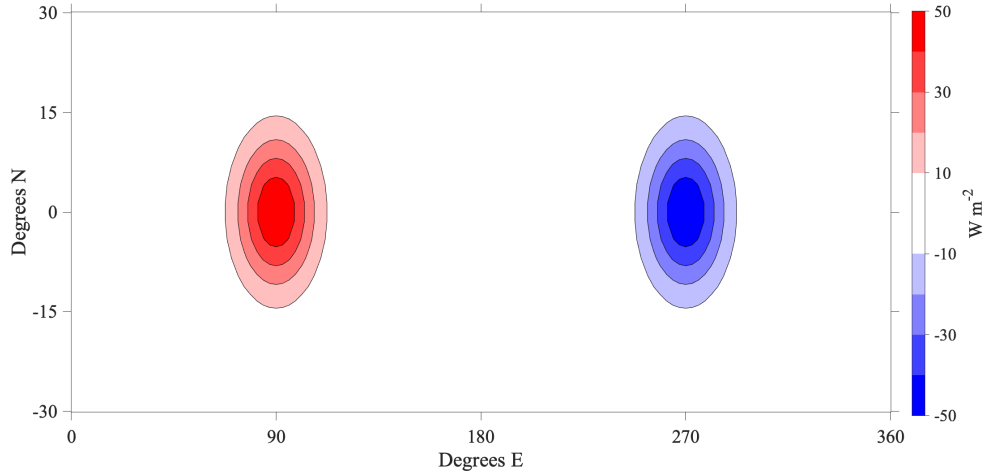


Figure S11. Imposed zonally anomalous Q flux in the idealized GCM simulations.

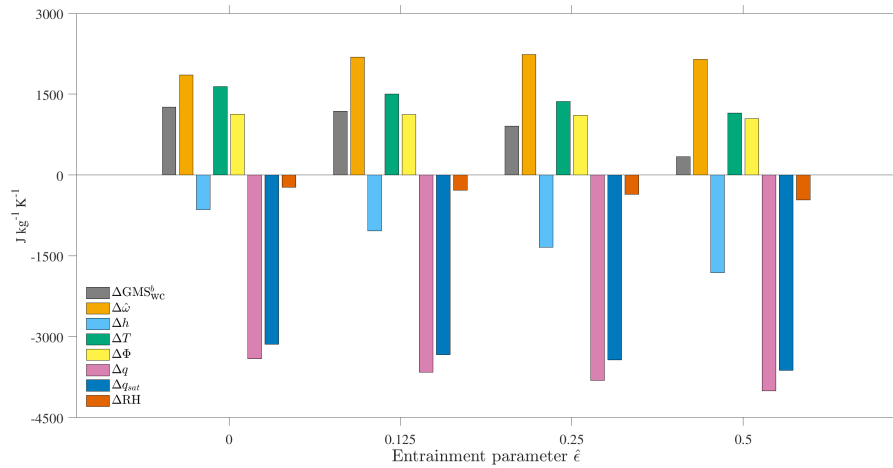


Figure S12. Same as Figure 9 except changes are in units of $\text{J kg}^{-1} \text{K}^{-1}$ instead of percent per K.

References

- Bentsen, M., Olivière, D. J. L., Seland, o., Toniazzo, T., Gjermundsen, A., & et al. (2019). NCC NorESM2-MM model output prepared for CMIP6 CMIP historical and ScenarioMIP ssp585. Earth System Grid Federation. (Version: 20191108 [dataset]) doi: <https://doi.org/10.22033/ESGF/CMIP6.506>
- Boucher, O., Denvil, S., Levassasseur, G., Cozic, A., Caubel, A., Foujols, M.-A., & et al. (2018). IPSL IPSL-CM6A-LR model output prepared for CMIP6 CMIP historical, ScenarioMIP ssp585, CMIP amip, and CFMIP amip-future4K. Earth System Grid Federation. (Version: 20180803 [dataset]) doi: <https://doi.org/10.22033/ESGF/CMIP6.1521>

Table S1. CMIP6 and AMIP models, variant IDs, and citations.

Center	Model	CMIP6	AMIP	Citation
CSIRO-ARCCSS	ACCESS-CM2	r1i1p1f1		Dix et al. (2019)
AWI	AWI-CM-1-1-MR	r1i1p1f1		Semmler et al. (2019)
BCC	BCC-CSM2-MR	r1i1p1f1	r1i1p1f1	Wu et al. (2019); Xin et al. (2019)
CCCma	CanESM5	r1i1p1f1	r1i1p2f1	Swart et al. (2019); Cole et al. (2019)
NCAR	CESM2	r4i1p1f1	r1i1p1f1	Danabasoglu (2019)
CMCC	CMCC-CM2-SR5	r1i1p1f1		Lovato and Peano (2020)
CNRM-CERFACS	CNRM-CM6-1	r1i1p1f2	r1i1p1f2	Voldoire (2018)
EC-Earth-Consortium	EC-Earth3	r1i1p1f1		Consortium (2019)
CAS	FGOALS-f3-L	r1i1p1f1		Yu (2019)
FIO-QLNM	FIO-ESM-2-0	r1i1p1f1		Song et al. (2019)
NOAA-GFDL	GFDL-ESM4	r1i1p1f1		Krasting et al. (2018); John et al. (2018)
MOHC	HadGEM3-GC31-LL	r1i1p1f3	r5i1p1f3	Ridley et al. (2019); Webb (2019); Good (2020)
INM	INM-CM5-0	r1i1p1f1		Volodin et al. (2019)
IPSL	IPSL-CM6A-LR	r1i1p1f1	r1i1fp1	Boucher et al. (2018)
NIMS-KMA	KACE-1-0-G	r1i1p1f1		Byun et al. (2019)
MIROC	MIROC6	r1i1p1f1	r1i1fp1	Ogura et al. (2019); Tatebe and Watanabe (2018); Shiogama et al. (2019)
MPI-M	MPI-ESM1-2-LR	r1i1p1f1		Wieners et al. (2019)
MRI	MRI-ESM2-0	r1i1p1f1	r1i1fp1	Yukimoto et al. (2019)
NUIST	NESM3	r1i1p1f1		Cao (2019)
NCC	NorESM2-MM	r1i1p1f1		Bentsen et al. (2019)
AS-RCEC	TaiESM	r1i1p1f1	r1i1fp1	Lee and Liang (2019); Shiu et al. (2021)

- Byun, Y.-H., Lim, Y.-J., Shim, S., Sung, H. M., Sun, M., Kim, J., & et al. (2019). NIMS-KMA KACE1.0-G model output prepared for CMIP6 CMIP historical and ScenarioMIP ssp585. Earth System Grid Federation. (Version: 20190920 [dataset]) doi: <https://doi.org/10.22033/ESGF/CMIP6.2241>
- Cao, J. (2019). NUIST NESMv3 model output prepared for CMIP6 CMIP historical and ScenarioMIP ssp585. Earth System Grid Federation. (Version: 20190728 [dataset]) doi: <https://doi.org/10.22033/ESGF/CMIP6.2021>
- Cole, J. N., von Salzen, K., Swart, N. C., Kharin, V. V., Lazare, M., Scinocca, J. F., & et al. (2019). CCCma CanESM5 model output prepared for CMIP6 CFMIP amip-future4K. Earth System Grid Federation. (Version: 20190429 [dataset]) doi: <https://doi.org/10.22033/ESGF/CMIP6.1301>
- Consortium, E.-E. (2019). EC-Earth-Consortium EC-Earth3 model output prepared for CMIP6 CMIP historical and ScenarioMIP ssp585. Earth System Grid Federation. (Version: 20200310 [dataset]) doi: <https://doi.org/10.22033/ESGF/CMIP6.181>
- Danabasoglu, G. (2019). NCAR CESM2 model output prepared for CMIP6 CMIP historical, ScenarioMIP ssp585, CMIP amip, and CFMIP amip-future4K. Earth System Grid Federation. (Version: 20190401 [dataset]) doi: <https://doi.org/10.22033/ESGF/CMIP6.2181>
- Dix, M., Bi, D., Dobrohotoff, P., Fiedler, R., Harman, I., Law, R., & et al. (2019). CSIRO-ARCCSS ACCESS-CM2 model output prepared for CMIP6 CMIP historical and ScenarioMIP ssp585. Earth System Grid Federation. (Version: 20210317 [dataset]) doi: <https://doi.org/10.22033/ESGF/CMIP6.2281>
- Good, P. (2020). MOHC HadGEM3-GC31-LL model output prepared for CMIP6 ScenarioMIP ssp585. Earth System Grid Federation. (Version: 20200114 [dataset]) doi: <https://doi.org/10.22033/ESGF/CMIP6.10845>
- John, J. G., Blanton, C., McHugh, C., Radhakrishnan, A., Rand, K., Vahlenkamp, H., & et al. (2018). NOAA-GFDL GFDL-ESM4 model output prepared for CMIP6 ScenarioMIP ssp585. Earth System Grid Federation. (Version: 20180701 [dataset]) doi: <https://doi.org/10.22033/ESGF/CMIP6.1407>
- Krasting, J. P., John, J. G., Blanton, C., McHugh, C., Nikonov, S., Radhakrishnan, A., & et al. (2018). NOAA-GFDL GFDL-ESM4 model output prepared for CMIP6 CMIP historical. Earth System Grid Federation. (Version: 20190726 [dataset]) doi: <https://doi.org/10.22033/ESGF/CMIP6.1407>
- Lee, W.-L., & Liang, H.-C. (2019). AS-RCEC TaiESM1.0 model output prepared for CMIP6 CMIP historical, CMIP, ScenarioMIP ssp585, and CMIP amip. Earth System Grid Federation. (Version: 20200817 [dataset]) doi: <https://doi.org/10.22033/ESGF/CMIP6.9684>
- Lovato, T., & Peano, D. (2020). CMCC CMCC-CM2-SR5 model output prepared for CMIP6 CMIP historical and ScenarioMIP ssp585. Earth System Grid Federation. (Version: 20200622 [dataset]) doi: <https://doi.org/10.22033/ESGF/CMIP6.1362>
- Ogura, T., Watanabe, M., & Hirota, N. (2019). MIROC MIROC6 model output prepared for CMIP6 CFMIP amip-future4K. Earth System Grid Federation. (Version: 20190705 [dataset]) doi: <https://doi.org/10.22033/ESGF/CMIP6.885>
- Ridley, J., Menary, M., Kuhlbrodt, T., Andrews, M., & Andrews, T. (2019). MOHC HadGEM3-GC31-LL model output prepared for CMIP6 CMIP amip. Earth System Grid Federation. (Version: 20191001 [dataset]) doi: <https://doi.org/10.22033/ESGF/CMIP6.419>
- Semmler, T., Danilov, S., Rackow, T., Sidorenko, D., Barbi, D., Hegewald, J., & et al. (2019). AWI AWI-CM1.1MR model output prepared for CMIP6 CMIP historical and ScenarioMIP ssp585. Earth System Grid Federation. (Version: 20190529 [dataset]) doi: <https://doi.org/10.22033/ESGF/CMIP6.359>
- Shiogama, H., Abe, M., & Tatebe, H. (2019). MIROC MIROC6 model output prepared for CMIP6 ScenarioMIP ssp585. Earth System Grid Federation. (Ver-

- sion: 20190627 [dataset]) doi: <https://doi.org/10.22033/ESGF/CMIP6.898>
- Shiu, C.-J., Lee, W.-L., & Hsu, H.-H. (2021). AS-RCEC TaiESM1.0 model output prepared for CMIP6 CFMIP amip-future4K. Earth System Grid Federation. (Version: 20210820 [dataset]) doi: <https://doi.org/10.22033/ESGF/CMIP6.9683>
- Song, Z., Qiao, F., Bao, Y., Shu, Q., Song, Y., & Yang, X. (2019). FIO-QLNM FIO-ESM2.0 model output prepared for CMIP6 CMIP historical and ScenarioMIP ssp585. Earth System Grid Federation. (Version: 20191226 [dataset]) doi: <https://doi.org/10.22033/ESGF/CMIP6.9047>
- Swart, N. C., Cole, J. N., Kharin, V. V., Lazare, M., Scinocca, J. F., Gillett, N. P., & et al. (2019). CCCma CanESM5 model output prepared for CMIP6 CMIP historical, ScenarioMIP ssp585, and CMIP amip. Earth System Grid Federation. (Version: 20190429 [dataset]) doi: <https://doi.org/10.22033/ESGF/CMIP6.10205>
- Tatebe, H., & Watanabe, M. (2018). MIROC MIROC6 model output prepared for CMIP6 CMIP historical and CMIP amip. Earth System Grid Federation. (Version: 20181212 [dataset]) doi: <https://doi.org/10.22033/ESGF/CMIP6.881>
- Voldoire, A. (2018). CNRM-CERFACS CNRM-CM6-1 model output prepared for CMIP6 CMIP historical, ScenarioMIP ssp585, CMIP amip and CFMIP amip-future4K. Earth System Grid Federation. (Version: 20181203 [dataset]) doi: <https://doi.org/10.22033/ESGF/CMIP6.1374>
- Volodin, E., Mortikov, E., Gritsun, A., Lykossov, V., Galin, V., Diansky, N., & et al. (2019). INM INM-CM5-0 model output prepared for CMIP6 CMIP historical and ScenarioMIP ssp585. Earth System Grid Federation. (Version: 20190610 [dataset]) doi: <https://doi.org/10.22033/ESGF/CMIP6.1423>
- Webb, M. (2019). MOHC HadGEM3-GC31-LL model output prepared for CMIP6 CMIP historical and CFMIP amip-future4K. Earth System Grid Federation. (Version: 20191216 [dataset]) doi: <https://doi.org/10.22033/ESGF/CMIP6.435>
- Wieners, K.-H., Giorgetta, M., Jungclaus, J., Reick, C., Esch, M., Bittner, M., & et al. (2019). MPI-M MPI-ESM1.2-LR model output prepared for CMIP6 CMIP historical and ScenarioMIP ssp585. Earth System Grid Federation. (Version: 20190710 [dataset]) doi: [10.22033/ESGF/CMIP6.6705](https://doi.org/10.22033/ESGF/CMIP6.6705)
- Wu, T., Chu, M., Dong, M., Fang, Y., Jie, W., Li, J., & et al. (2019). BCC BCC-CSM2MR model output prepared for CMIP6 CMIP historical, CMIP amip and CFMIP amip-future4K. Earth System Grid Federation. (Version: 20200720 [dataset]) doi: <https://doi.org/10.22033/ESGF/CMIP6.2856>
- Xin, X., Wu, T., Shi, X., Zhang, F., Li, J., Chu, M., & et al. (2019). BCC BCC-CSM2MR model output prepared for CMIP6 ScenarioMIP ssp585. Earth System Grid Federation. (Version: 20190314 [dataset]) doi: <https://doi.org/10.22033/ESGF/CMIP6.1725>
- Yu, Y. (2019). CAS FGOALS-f3-L model output prepared for CMIP6 CMIP historical and ScenarioMIP ssp585. Earth System Grid Federation. (Version: 20191013 [dataset]) doi: <https://doi.org/10.22033/ESGF/CMIP6.1782>
- Yukimoto, S., Koshiro, T., Kawai, H., Oshima, N., Yoshida, K., Urakawa, S., & et al. (2019). MRI MRI-ESM2.0 model output prepared for CMIP6 CMIP historical, ScenarioMIP ssp585, CMIP amip, and CFMIP amip-future4K. Earth System Grid Federation. (Version: 20190625 [dataset]) doi: <https://doi.org/10.22033/ESGF/CMIP6.623>