

EGU23-10041, updated on 25 Apr 2024

<https://doi.org/10.5194/egusphere-egu23-10041>

EGU General Assembly 2023

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Tropical and extratropical circulation biases and the Southern Hemisphere Hadley cell width

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The widening of the Southern Hemisphere tropical meridional circulation has been attributed to various forcings from increased greenhouse gases, ozone depletion and natural variability. While climate models can reproduce some characteristics of this observed change, there is some uncertainty in the operating mechanisms and driving regions setting the edge of the tropical circulation. Here we examine the impacts of systematic model biases of the atmosphere-only Unified Model onto the simulation of the Southern Hemisphere tropical extent. We utilise nudging experiments with prescribed sea-surface temperatures, where potential temperature and horizontal winds are relaxed back to reanalysis for a 20-year period. Specifically, experiments with regionally-defined bias correction aide to determine the influence of remote model biases on the tropical width. The experiments are applied to different tropical width metrics previously identified to measure the boundary between the tropical to extratropical circulation. We uncover a more consistent improvement of the location of the Hadley cell edge by correcting Southern Hemisphere extratropical circulation biases, than tropical ones. The analysis is further expanded to the range of atmosphere-only model simulations of the Coupled Model Intercomparison Project Phase 6 (CMIP6). We explore the relationships between tropical and extratropical biases and the models' representation of the Hadley cell.