Influence of tropical waves on the ITCZ and energy transports in idealized TRACMIP simulations

Tropical rainfall is paramount to many societies and ecosystems, yet climate model projections of past and future rainfall changes in the tropics remain subject to large uncertainties. The TRACMIP model intercomparison project (Voigt et al., 2016) provides a set of idealized simulations that help to understand the fundamental mechanisms governing tropical rainfall, in particular the zonal-mean intertropical convergence zone (ITCZ) (Donohoe et al., 2013; Schneider et al., 2014; Bischoff and Schneider, 2014). In contrast to the expectation from theory, the TRACMIP model simulations do not conform to the established ITCZ framework that links the ITCZ position to cross-equatorial energy transport (Biasutti and Voigt, 2019). Besides seasonal changes between deep and shallow convection modes and circulations, our initial analysis suggests that this failure could be due to eddies, or tropical waves.

The thesis will thus investigate the existence of tropical waves in the TRACMIP simulations, their impact on energy transport, their behavior during the seasonal cycle, and their response to increasing atmospheric carbon dioxide. For this, the wave filtering tool developed at IMK-TRO by Schlüeter et al. (2019a) and Schlüeter et al. (2019b) will be used, with filtering by means of precipitation, outgoing longwave radiation and velocity potential at different heights from TRACMIP 3-hourly output. The work will allow for a deeper understanding of the role of tropical waves for climatological rainfall in the tropics and the ITCZ position, which so far has been largely ignored. The TRACMIP data is available locally or can be accessed via the Pangeo Cloud. The project requires experience or at least a strong interest in learning how to use python for the analysis of large climate model datasets, as well as an interest in tropical weather and climate dynamics.

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References


