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Evaluation of the structure of the monsoon over North Africa in the CMIP5 simulations for past, present, and future

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Studies using observational data indicate that interannual to multidecadal variability in the intensity, location, and latitudinal extent of the tropical rainbelt over North Africa can be associated with features in the upper-level circulation. Rainfall is correlated with the large core of ascent lying between the African Easterly Jet and the Tropical Easterly Jet. This region corresponds to the southern track of African Easterly Waves, which distribute the rainfall. The dynamics suggests that the moisture available for convection is strongly coupled to the strength of the uplift, which in turn is controlled by the characteristics of the African Easterly Jet and Tropical Easterly Jet, rather than by moisture convergence associated with the ITCZ. In particular, analyses of observational data indicates that the intensity of the tropical rainbelt is associated with the strength of the upper-tropospheric Tropical Easterly Jet, while the northward latitudinal extent is determined by the latitude of the mid-tropospheric African Easterly Jet. Surface gradients and ocean characteristics have important influences on the circulation aloft.

The CMIP5 preindustrial control simulations are first compared to NCAR-NCEP Reanalysis data to assess how well they simulate the observed atmospheric circulation features and precipitation over North Africa. Similar analysis is then performed for the available CMIP5 Mid-Holocene and Last Glacial Maximum simulations, and benchmarked with proxy data of precipitation changes. Finally, the CMIP5 RCP8.5 simulations are analyzed and evaluated using metrics relating changes in the monsoon rainfall to the African Easterly and Tropical Easterly Jets.