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Precipitation bias over the Western Indian Ocean in an Atmospheric GCM: Role of the meridional SST gradient

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Most of current coupled and uncoupled GCMs show a remarkable positive precipitation bias over the western south-equatorial Indian Ocean (IO) which develops in spring and reduces during the monsoon season. A comprehensive characterization of this bias and associated atmospheric circulation by means of the GFDL AM3 model shows that the precipitation bias is related to anomalous near-surface meridional convergence over the western IO. The convergence is suggested to be in large part modulated by the local meridional sea surface temperature (SST) gradient. The enhanced equatorial precipitation is responsible for an anomalous Hadley-type meridional circulation which greatly affects the simulated monsoon evolution over India. Experiments with the GFDL spectral dry dynamical core model show that an anomalous heat source over the western IO induces a anomalous convergence and associated large-scale subsidence over northwestern India, with eastward Rossby wave propagation. Experiments with AM3 are run to test the sensitivity of the model to the meridional SST gradient over the western IO. The pattern of the vertical circulation is very sensitive to the magnitude of the gradient, with important feedbacks on clouds, diabatic heating, and radiation. This important mechanism controlling the simulated precipitation distribution over South Asia should be considered in the interpretation and attribution of regional precipitation variation under climate change.