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Local air–sea interaction in ITCZ simulations

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We investigate how air–sea interaction affects an Inter-Tropical Convergence Zone (ITCZ) simulation in the SAMIL2.08 atmospheric general circulation model (AGCM). In a control experiment (Exp1) with the observed sea surface temperature (SST) prescribed in the AGCM, there exists a problem of excessive precipitation over much of the Tropics and insufficient precipitation over the equatorial Indian Ocean and the Pacific. The equatorial drought belt arises from the compensatory descending motion associated with exaggerated deep convection over the tropics in both hemispheres. A double ITCZ disappears in a coupled experiment (Exp2) with the same AGCM as used in Exp1 coupled to an interactive ocean mixed layer within the great warm pool. This finding demonstrates that local air–sea interaction can modify the SST pattern, thereby regulating the climate mean state via the following processes. Local air–sea flux exchanges in tropical convective regions such as the ITCZ tend to cool SST via negative cloud–radiation and wind–evaporation feedbacks. Such changes further modify the tropical atmospheric circulation structure such that the equatorial compensatory descent in Exp1 is replaced by the equatorial convergence zone, as seen in nature. A third sensitivity experiment (Exp3), with the AGCM driven by the monthly SST field derived from the coupled experiment, yielded similar results to those obtained in Exp. Overall, the results indicate that a reasonable depiction of the air–sea coupling process is important to successfully simulating the tropical precipitation pattern, as the atmosphere is closely coupled with the ocean over the tropics.