



Atmospheric energetics over the tropical Indian Ocean during Indian Ocean dipole events

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The evolution of atmospheric perturbation potential energy (PPE) over the tropical Indian Ocean is analyzed during a composite positive IOD event using reanalysis datasets for the period 1948–2015. The IOD modulates the variation in PPE, which then affects perturbation kinetic energy (PKE) through energy conversion. The PPE anomalies in the lower troposphere (1000–850 hPa) as the dominant layer of the PPE in the whole troposphere (1000–150 hPa) present a dipole pattern corresponding to the anomalous variation in SST during the IOD event. When cold SST anomalies (SSTAs) first appear in the eastern Indian Ocean (IOD-E), they reduce the atmospheric PPE in the lower troposphere rapidly. The negative PPE anomalies lead to less energy conversion to PKE, restraining the surface wind convergence over the IOD-E and weakening the climatological Walker circulation. Meanwhile, the surface easterly wind anomalies strengthen, which depresses the thermocline to the west and gives warmer SSTAs in the western Indian Ocean (IOD-W). The PPE anomalies and energy conversion (CK) over the IOD-W are opposite to those over the IOD-E, the anomalous easterly wind continues to develop, and the positive SSTAs in the IOD-W reach a peak. Thus, the response of the Walker circulation over the Indian Ocean provides a positive feedback during the IOD event and explains the delayed effect of IOD-E SSTAs on IOD-W SSTAs.