Geophysical Research Abstracts,
Vol. 10, EGU2008-A-00419, 2008
SRef-ID: 1607-7962/gra/EGU2008-A-00419
EGU General Assembly 2008

Precipitation variability due to Indian Ocean SST anomalies

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The effect of Indian Ocean sea surface temperature (SST) on precipitation is investigated using a multidecadal ensemble generated with the National Center for Atmospheric Research (NCAR) Community Atmospheric Model (CAM3). Observed monthly SST from the Hadley Centre for the period 1949-2006 has been prescribed in the global oceans to generate three sets of numerical experiments: a climatological run, a 5-member ensemble forced with monthly varying SST in the globe, and another ensemble with varying SST only in the Indian Ocean north of 20S. The rainfall response to Indian Ocean SST is analyzed by the difference between the forced experiment and the mean climatology, trends in simulated rainfall, and interannual-to-decadal variability of atmospheric fields. The largest differences between the control run and the Indian Ocean experiment occur over the tropics during austral wintertime (JJA). Trends in simulated rainfall suggest that the Indian Ocean warming has driven changes in tropical circulation, with a southward displacement of the Hadley Cell and consequent shift of the Inter-Tropical Convergence Zone (ITCZ) during JJA. The first SST mode of variability exhibits a basinwide uniform signal over the Indian Ocean. The positive phase of this mode shows an anomalous cyclonic circulation at low levels of the atmosphere east of Madagascar, and an upward motion throughout the troposphere, causing enhanced precipitation over the western Indian Ocean and east Africa. The second mode of variability is characterized by a zonal SST dipole in the tropical Indian Ocean. This pattern induces an east-west pressure gradient at the surface that in turn generates an anomalous cyclonic circulation at low- and mid- levels of the atmosphere. The anomalous circulation shifts the ITCZ northward and advects moisture

to the Madagascar warm pool, enhancing local precipitation.