The Cloud Population and Onset of the Madden-Julian Oscillation over the Indian Ocean during DYNAMO-AMIE

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Variability of the cloud population in the central-equatorial Indian Ocean is observed in the context of the Madden-Julian Oscillation (MJO) during the DYNAMO and AMIE field campaigns. Radar observations from the S-PolKa radar system characterize the types of clouds and their structures, including the depth of convective cores. In order to gain insight into the relationship between clouds and humidification of the troposphere leading and during an active MJO event, the work compares variability of cloud cover and precipitation to that of tropospheric humidity and upper-level zonal wind using highly resolved and co-located rawinsonde measurements extended spatially by a reanalysis dataset.

Several important conclusions are gleaned from the results. The variability in stratiform cloud cover dominates variation in cloudiness associated with the MJO. Areal coverage of stratiform clouds, convective cloud echo top height, and tropospheric humidity above 850 hPa rapidly increase nearly concurrently over about three days near MJO onset. Thus, the "discharge-recharge" hypothesis is not valid for MJO convective events observed during DYNAMO. Pre-existing ambient humidity does not solely control the distribution of convective cloud top height in the low- to mid-troposphere, and upper tropospheric humidity anomalies lag the presence of anvil clouds. Thus, clouds likely play an influential role in tropospheric humidification. 2-4 day variability in precipitation is observed during widespread convective events and is probably related to inertia-gravity and mixed-Rossby gravity waves. Large-scale trapped equatorial modes play a major role in controlling cloud growth by making the environment conducive to active convection, which in turn, further enhances the environmental humidity.