Resolution and Performance of the Cloudy Sky Ratio using Measured Brightness Temperatures from Ground-Based Microwave Radiometers

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The field campaign of DYNAMO/CINDY2011 took place in the central equatorial Indian Ocean between September 1, 2011 and January 5, 2012. The experiment was primarily designed to improve understanding of the Madden-Julian oscillation (MJO) in the region. Observations of vertical moisture profiles, cloud structure, precipitation processes and the planetary boundary layer are necessary to improve understanding of MJO initiation. A number of remote sensing instruments, including NCAR's S-PolKa (dual-wavelength S- and K_a-band) radar and the University of Miami's microwave radiometer, were deployed to estimate water vapor and cloud structure. These instruments were collocated and scanned a common volume of the troposphere at various azimuth and elevation angles. The University of Miami's microwave radiometer performed brightness temperature measurements at 23.8 GHz, affected mostly by water vapor, and at 30.0 GHz, primarily sensitive to cloud liquid water. These measurements were performed continuously to estimate slant water path and liquid water path during various weather conditions, including clear and cloudy skies, as well as precipitation of various intensities.

This work focuses on classifying clear and cloudy skies as well as precipitating conditions using ground-based brightness temperature measurements during DYNAMO. To perform this classification, the cloudy sky ratio (CSR) was defined as the ratio of the brightness temperature at 23.8 GHz to that at 30.0 GHz. This technique uses the principle that during clear sky conditions brightness temperatures at 23.8 GHz are larger than those at 30.0 GHz, and the ratio varies slightly depending on the atmospheric water vapor density. However, this relationship changes when there is liquid water in the atmosphere. As the amount of liquid water in the atmosphere increases, the brightness temperatures at 23.8 GHz and 30 GHz converge to a similar value, yielding a CSR near unity. Furthermore, the presence and intensity of rainfall significantly affect the CSR value due to the amount of liquid water in the atmosphere as well as effects of scattering from hydrometeors.

The performance and resolution of the CSR will be evaluated based on a quantitative comparison with simultaneous reflectivity measurements from the collocated S-PolKa radar.