Impact of Moistening and Drying on Precipitating Monsoon Clouds System with METEOSAT and Ground Truth Measurements during CAMS-98 over the Indian Region

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Moistening and drying of the tropical upper troposphere in regions of low background humidity, primarily determined by transports from regions of convective outflow, is a key factor in global climate change studies. For the first time, based on METEOSAT Water Vapour channel measurements, it is shown that, large scale upper tropospheric drying occurs above regions of intense convection over continental India, and are found to be associated with air subsiding in the sinking limbs of large scale circulation systems. This drying is seen in the drastic reduction of the Upper Tropospheric relative Humidity (UTH, a METEOSAT derived product) from $\sim$60% to $\sim$30% in the layers between 600 and 200 hPa over Continental Tropical Convergence Zone (CTCZ). NCEP humidity measurements also support these inferences. This intense drying arrests the growth of deep cumulus cloud systems embedded in the CTCZ during the summer monsoon season as revealed in METEOSAT IR Brightness Temperature (IRBRT) measurements. Computation of normalized frequency of occurrence of IRBRT show that the percentage of pixels representing deep convection ($210 <$ IRBRT $<$ 260K) drastically reduces by almost 40-70% during the period of intense drying with $\sim$18% of the area being covered by clear sky pixels against the coverage of 3% during periods of intense convection. In response to the subdued convective activity, low level convergence weakens by $\sim$50% to reduce the moisture supply inhibiting the onset of new convection.

Analysis of simultaneous ground truth measurements of wind, temperature, humidity and rain data from a highly sensitive Mesosphere-Stratosphere-Troposphere Radar, Lower Atmospheric Wind Profiler, Optical Rain Gauge, radiosondes made for the period from July 17 to August 14, 1999 during the field experiment “Convection in Asian Monsoon, known as CAMS-98” along with the high resolution pixel data from IR channel onboard METEOSAT satellite has been carried out.

CAMS-98 measurements further reveal that mid tropospheric drying arrests precipitation processes in deep clouds for several hours.