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Moisture environment of a mesoscale cloud system: a case study from the 2006 AMMA campaign

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Water vapor of the free troposphere is one of the dominant greenhouse gases in the atmosphere and is part of a strong feedback on climate change. One of the main processes that govern the distribution of water vapor in the tropical belt is deep convection that redistributes the moisture in the upper levels. The processes at play are nevertheless not well understood. In particular the relative role of the physics (convective detrainment) versus the microphysics (evaporation of cloud condensate) in building the moisture distribution in the free troposphere of the ITCZ deserves inquiry.

Two channels onboard the Meteosat Second Generation (MSG) satellites were designed to observed the water vapor of two overlapping layers of the free troposphere: in the upper levels (5̃00-200 hPa) with channel 5 (6.2μm) in the mid-levels (7̃00-300 hPa) with channel 6 (7.3μm). Under clear sky conditions or in the case of low-level cloudiness, the measured brightness temperatures are interpreted in terms of vertically integrated humidities “Upper Tropospheric Humidity” and “Free Tropospheric Humidity” (channels 5 and 6 resp.). MSG observations also provide documentation on the cloudiness through a cloud classification (upper, mid and low level clouds) developed by the meteorological center of Lannion and a mesoscale convective systems (MCS) tracking algorithm developed at LMD. These data have been retrieved during the Special Observing Period of AMMA at the MSG nominal resolution (3km at nadir, 15min), thus allowing to study the links between UTH/FTH and the cloudiness at the scale of the convective systems.

The analyses are performed over the Niamey area (Niger), during the active phase of the 2006 monsoon (July 24th – 30th), and reveal a strong link between the variations of humidity (both UTH and FTH) and the frequency of high clouds, the maximum being reached for a lag of 6 to 7h, thus suggesting the role of detrainment from those clouds in the humidification of the free troposphere. Other analyses concerning a specific convective system observed near Djougou (Benin) on July 28th and the distribution of humidity in its close environment will be shown.