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Diurnal cycle of the ITD before the monsoon onset over Benin: ground-based measurements and mesoscale modelling

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In the frame of the AMMA project, a large set of ground-based remote sensing instruments was operated in 2006 in the area of Djougou (Benin, 9.7°N, 1.7°E). These observations with a high temporal resolution made it possible to describe the ITD (Intertropical discontinuity) structure and dynamics in much detail. Apart from surface meteorological observations, in particular microwave radiometers, lidars and wind profilers turned out to be useful for this type of study.

The annual variation of the ITD position is a crucial process for the West African climate system. The ITD marks the border at the surface between dry harmattan air to the north and the moist monsoon air to the south. The northward move of the ITD preceding the monsoon onset causes the advection of moist air in the lower troposphere into still very dry areas. It is assumed that this low-level moisture transport is a key factor for the monsoon system in West Africa.

As a result of the temporally highly resolved measurements mentioned above, it was possible to observe a distinct diurnal cycle of the ITD position. During night-time a sharp low-level front which divides moist and relatively cool air masses to the south as well as dry and hot air masses to the north, moves northward with a speed of about 12 ms^{-1}. This flow is rather shallow ($<$ 1 km deep), but changes the atmospheric

conditions of this layer completely. E.g. Microwave radiometer measurements show a temperature drop in 200 m above ground of up to 7 K within 10 minutes, associated

by an increase in IWV of > 5 kgm^{-2}. After sunrise, through turbulent mixing the moisture is lifted up and distributed over the lower troposphere up to 4000 m above ground.

Following the data analysis of boundary layer observations over Central Benin, the mesoscale model MesoNH has been run with a horizontal resolution of 10 km for a 4-day period in April 2006. The goal was to see whether the model is able to reproduce the diurnal cycle of the ITD position and which larger-scale processes are relevant in this context. First results are very promising and show that the depth of the monsoon layer and the meridional extent of the ITD variation are well captured by the model.

This presentation will first give an overview of the model setup and then describe briefly the synoptic situation during the period of the model run. After that, the main focus will be on the structure of the lower troposphere as seen by the model and on the comparison between the model output and a variety of different observations over Central Benin.