Statistical analysis of ground-based atmospheric remote-sensing observations in Nangatchori (Benin)

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Introduction

In the frame of the AMMA project, the Universities of Bonn, Munich and Cologne deployed three ground-based remote sensing instruments in Nangatchori (Benin, 9.7°N, 1.7°E).

- 14-channel microwave radiometer (HATPRO)
- Lidar ceilometer CT25K
- Low-power vertical Doppler radar (Micro Rain Radar MRR).

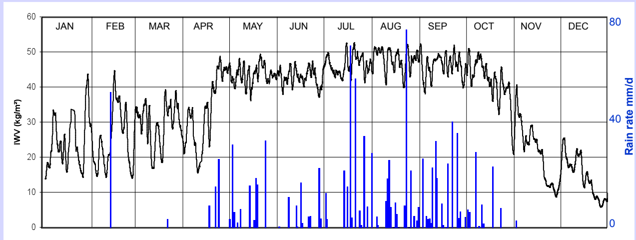
	Parameters	Temporal resolution	Measurement period
HATPRO	IWV, LWP, Temperature and humidity profiles	2 sec (15 min for elevation scans)	14 Jan 06 – 22 Jan 07 (no data in Feb/Mar due to mechanical problem), availability 75 %
Ceilometer	Cloud base height Backscatter	15 seconds	14 Jan 06 – 22 Jan 07 (some breaks due to power cuts), availability ~90 %
Micro Rain Radar MRR	Rain rate, drop size distribution, fall speed	10 seconds	23 Mar 06 – 22 Jan 07 availability ~90 %

In combination with surface meteorological data and co-located wind profilers, these instruments proved to be a good means to describe the lower troposphere over Nangatchori in detail.

The one-year deployment of many of those instruments gives a very good overview of the annual cycle of various atmospheric parameters. In addition, the high temporal resolution of these measurements compared to radiosondes allows the analysis of temporal boundary layer development and the passage of fronts.

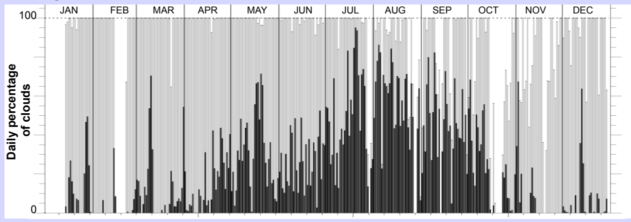
Overview over 2006

Integrated water vapor and daily rain amounts



Source: Rain data from Nangatchori measurements (thanks to C. Peugeot and others), IWV from HATPRO and GPS measurements (thanks to O. Bock)

Daily cloud cover

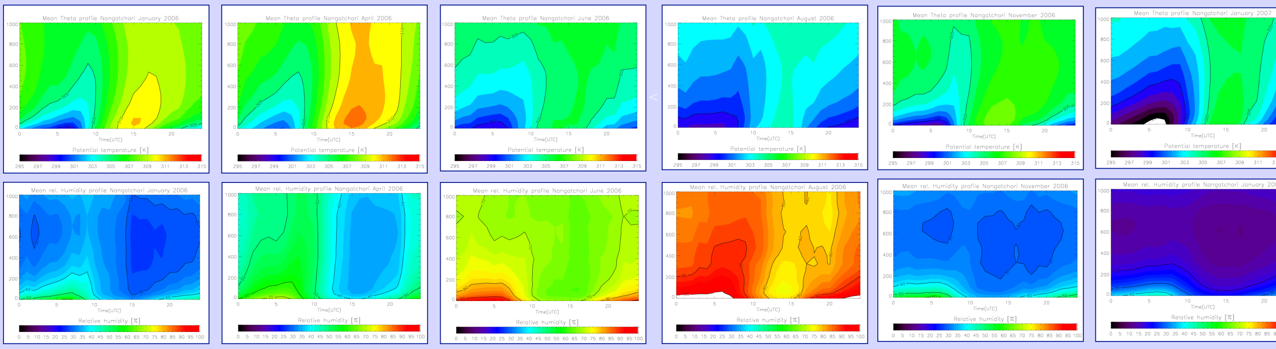


Source: Ceilometer observations in Nangatchori

Potential temperature and relative humidity profiles

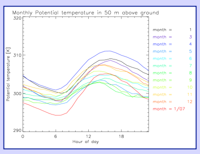
From HATPRO microwave radiometer measurements we derived temperature and humidity profiles up to 5000 m above ground. By scanning the atmosphere under different elevation angles, accuracy and vertical resolution of temperature profiles are enhanced for the lowest ~1500 meters (Crewell and Löhnert, 2007).

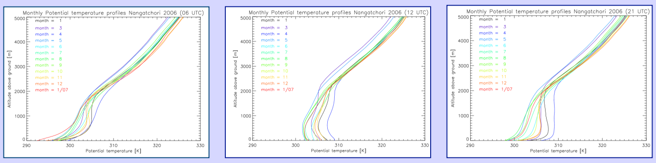
The figures below show a hourly mean value over all measurements performed during the specified month. The annual cycle of dry and wet seasons can be seen well in very different humidity values and the strength of night-time temperature inversions.



Diurnal cycle

These plots illustrate the diurnal cycle of potential temperature in Nangatchori. The lower plots show the vertical profile for different months and times of the day. At 06 UTC, the different inversion strength are interesting to see. Largest daytime heating occurs in April prior to the onset of the rainy season. At 21 UTC, a nice residual layer shows up in the plots.





References: Crewell and Löhnert, 2007: Accuracy of Boundary Layer Temperature Profiles Retrieved with Multifrequency Multiangle Microwave Radiometry, *IEEE Transactions on Geoscience and Remote Sensing, Vol. 45, No. 7*

Discussion and Conclusions

- The annual cycle of boundary layer temperature and humidity properties, as well as IWV was observed from January 2006 to January 2007, covering one whole cycle of dry and wet seasons. Especially the high temporal resolution of the measurements provided a completely new insight into atmospheric phenomena over Central Benin.
- One special feature in the dataset encompasses the very different conditions in January 2006 and 2007, respectively. This month lies in the middle of the dry season. However, in 2006, several outbreaks of moist air from the south reached Central Benin. In contrast, a strong harmattan season 2007 carried dry and cool air up to the Guinean gulf causing in completely different atmospheric conditions.
- Further studies will be carried out by discriminating cloudy and non-cloudy periods, as well as investigating the temporal development of the PBL with approaching rainfall during the wet season.

Information on water vapour statistics from Nangatchori see: Houngninou et al. Poster 4A.9
Overview of all observations in Nangatchori: Talk from Serça et al. (5.1) on Wednesday, 08:30
Nocturnal low-level jets observed in Nangatchori: Talk from Pospichal et al. (8A.1) on Thursday, 14:00