Introduction

The climate in West Africa is mainly characterized by the strong moisture contrasts between the moist monsoon flow to the south and the dry Harmattan air to the north. The interface between these two flows, called the Inter-tropical discontinuity (ITD), shows a distinct annual cycle (from 6°N in January to 20°N in July). Important factors for the onset of the monsoon season are processes in the planetary boundary layer (PBL). By using a combination of ground-based remote sensing observations it is possible to get a comprehensive and continuous view on PBL temperature, humidity and wind conditions as satellites do not provide satisfactory information of the lowest atmospheric layers.

In the frame of the AMMA project, two supersites were operated continuously during the year 2006:

- **Djougou/Nangatchori** (Barin, 9.7°N, 1.7°E) equipped with a HATPRO, a 14-channel microwave radiometer, a Doppler Micro Rain Radar (MMR) as well as in situ sensors.
- **Niamey** (Niger, 12.5°N, 2.0°E) hosting the Atmospheric Radiation Measurement (ARM) Mobile Facility (AMF) with similar instrumentation and additional cloud radar and radiosonde launches.

Water cycle variables

Radiative heating/cooling (Fig. 2) is strongly controlled by the presence of water vapour and clouds. The moistening of the region through PBL transports from the South (Gulf of Guinea) sets the stage for the monsoon onset (Fig. 3). Due to its location about 400 km more to the North Niamey stays dry until mid-July (onset of peak monsoon) and has about half of the cloud cover (Fig. 4). At both locations most of the precipitation occurs in August and receives but Niamey receives only a third of the yearly precipitation.

![Figure 2](image)

**Fig. 2:** Top: Annual cycle of daily maximum and minimum temperature for Niamey (red/yellow) and Djougou (dark/light blue). Bottom: Diurnal temperature range.

![Figure 3](image)

**Fig. 3:** Annual cycle of daily mean IWV derived from microwave radiometer observations (black: data gaps were filled with GPS observations) and precipitation for Nangatchori (left) and Niamey (right).

**Interannual Variability of Dry Season**

Early 2006 was unusually moist over the region and characterized by several outbreaks of monsoon air from the south (Fig. 3). Peak IWV in February was 42 (32) kg/m² at Djougou (Niamey) which is close to monsoon season values. A major rain event on 15 February brought more than 50 mm of rain at Djougou. The driest conditions were present in early April (see also Fig. 1).

The southward retreat of monsoon air started in October and took place much faster than the onset. The last rainfall in Niamey was on 19 October, whereas Nangatchori stayed dry after 2 November.

The dry season 2006/2007 started with a very dry December with several days of IWV values below 10 kg/m². Unlike the year before, in January 2007 very dry conditions and strong Harmattan winds predominated over the whole region.

![Figure 4](image)

**Fig. 4:** Annual cycle of cloud occurrence in 2006 (black: percentage of daily cloud cover detected by ceilometer; grey: percentage of days without clouds; white: no data available) for Djougou/Nangatchori (left) and Niamey (right).

Discussion and Conclusions

- The two datasets from Niamey and Djougou/Nangatchori provide unique information about the conditions in the lower atmospheres over West Africa. The one-year deployment gives a very good overview of the annual cycle. However, the dry season in 2006 was unusually moist and the situation in early 2007 was rather different with considerably lower IWV and temperatures.
- The high temporal resolution of these measurements compared to radiosondes allows the analysis of temporal boundary layer development and the passage of fronts.
- Future analysis will connect the information on the water cycle with dynamical structures observed by the wind profiler. In addition the role of radiative processes will be studied in more detail using surface radiation and satellite observations.