Coordination of the Lidar activities during AMMA field campaigns

- **review lidar systems**
  - ground-based - SOP and EOP
  - airborne, (Satellite)
- **scientific objectives from the AMMA-IIP: TT2b, TT7, TT8, TT9**
- **observation for SOP and EOP**
- **retrieval algorithms**
- **questions**

Ground-based lidar systems

AMMA super-sites:

- **Banizoumbou:** a) ISAC-CNR micro-lidar (PI: Francesco Cairo)

  λ = 532 nm, linear depolarization, (optionally 1064 nm)

  duration: SOP 0,1,2,3, and EOP, Status: to be delivered Oct 2005

  b) POLIS - LMU-Munich (PI: Matthias Wiegner), Status: ok

  λ = 355nm / 387 nm, linear depolarization at 355 nm

  duration: SOP 0, Jan./Feb. 2006

- **M'bour :** a) ISAC-CNR micro-lidar

  duration: SOP 0,1,2,3, and EOP

  b) Cimel Lidar LOA (PI: Didier Tanre), Status: delivered Aug 2005

  quasi continuous sampling, λ = 532 nm

  duration: SOP 0, 1, 2 Jan./Jun. 2006

- **Djougou:** a) Ceilometer Univ. Bonn (PI Susanne Crewell) , Status: ok

  duration: Jan. – Dec. 2006

  b) Cimel Lidar IPSL (PI: Jacques Pelon) , Status: to be delivered Oct 2005

  duration: SOP 0,1,2,3, Jan. – Dec. 2006

Ground-based lidar systems

Continuous monitoring:

- **Sahelian Transect** Micro-lidar, ISAC-CNR, Italy (PI: Francesco Cairo)
  λ = 532 nm (one also 1064 nm)
  location: Banizoumbou (Niger)
  Cinzana (Mali)
  M'bour (Senegal)
  duration: starting January/February 2006, 2 x 30 minutes a day
  EOP until the end of the project

- **Lidar ceilometer** CT25K, Univ. Bonn (Pi: Susanne Crewell)
  continuous observation, temporal resolution (15 s)
  location: Djougou (Benin)
  duration: Jan. - Dec. 2006

- MPL micro-pulse lidar mobile ARM facility (PI: Tony Slingo)
  λ = 523 nm, range 0-20 km
  location: Niamey Airport (Niger)
  duration: Jan – Dec 2006 (TT8) - Status: ok

- **TReSS** (multi-λ elastic & Raman channels backscatter) IPSL (PI: Cyrille Flamant)
  location: Tamanrasset (Algeria)
  duration: SOP 0, 1, 2, 3 - Status: ok.

Ground-based lidar systems

Sites / time	SOP 0	SOP 1	SOP 2	SOP 3	EOP	Partner
Banizoumbou (Niger)	micro-lidar POLIS	micro-lidar	micro-lidar	micro-lidar	micro-lidar	ISAC-CNR Munich
Cinzana (Mali)	micro-lidar	micro-lidar	micro-lidar	micro-lidar	micro-lidar	ISAC-CNR
M'Bour (Senegal)	micro-lidar Cimel-lidar	micro-lidar Cimel-lidar	micro-lidar Cimel-lidar	micro-lidar Cimel-lidar	micro-lidar	ISAC-CNR LOA
Djougou (Benin)	Ceilometer Cimel-lidar	Ceilometer Cimel-lidar	Ceilometer Cimel-lidar	Ceilometer Cimel-lidar	-	Uni Bonn IPSL
Tamanrasset (Algeria)	TReSS	TReSS	TReSS	TReSS	-	IPSL
Niamey Airport	MPL	MPL	MPL	MPL	-	NASA

Lidar activities during AMMA

Ground-based lidar systems

Airborne lidar systems

- **French F20 aircraft: base: Niamey; altitude: 10 km**

  1) LEANDRE new generation (LNG) (PI: J. Pelon)
  operating at 0.35; 0.53 and 1.06 µm). SOP 0
  2) LEANDRE 2, water vapour DIAL, SOP 1a, 2a1 (PI: C. Flamant)
  3) RALI (RAdar-LIdar combination) SOP 2a3 (PI: Alain Protat)

- **ULM base: Niamey (SOP0a1), Tamanrasset (SOP1a1) altitude: 5,5 km**
  LAUVA - 1 channel lidar, 355 nm; SOP 0a1, 1a (PI: P. Chazette)

- **German F20 base: Niamey; altitude: 12 km**

  nadir looking Doppler Lidar WIND SOP 2a1 (1-15 July 2006)
  (PI: O. Reitebuch)

- **M55/Geophysica base: Ouagadougou; altitude: 20 km**

  MAL 1 & 2 Remote Aerosol Profile (532 nm, depolarization), Funding???
  (PI: Valentin Mitev , Obs. Neuchatel), SOP 2a3,1-20 Aug 2006

- **SCOUT** ballon borne lidar MuLID, **base: Niamey;** SOP 1 and 2 (G. Di Donfrancesco)

Airborne lidar systems

Sites / time	SOP 0	SOP 1a	SOP 2a1	SOP 2a2	SOP2a3	Partner
	Jan/Feb 06	1 – 15 June	1 – 15 July	17 July – 25 Aug	1 – 15 Sept	
French F20	LNG	L 2	L 2		RALI	
ATR-42						
BAe146						
German F20			WIND			
ULM	LAUVA	LAUVA				
M55/Geophysica			MAL 1 & 2			
SCOUT		MuLID	MuLID	MuLID		

Scientific objectives from AMMA Implementation Plan

TT2b

WP 2.4.1 Aerosol radiative properties

- What is the regional and vertical distribution of the aerosols over WA, and what is its dependence on the seasonal cycle of the monsoon?
- How do the physical-chemical properties of mineral dust depend on source region (Sahara/Sahel)?
- How does the aerosol vertical layering control its radiative impact? AOD @ 500nm

WP 2.4.3 Effect of convection on regional chemical and aerosol budgets

- What is the role of convective physical processes: vertical transport, mixing, deposition on the budget of major oxidants and aerosols in the free troposphere over West Africa ?

Lidar activity: EOP Lidar Network

Scientific objectives from AMMA Implementation Plan

TT2b

Sahelian dust transect

Purpose: to assess the mineral dust budget at the regional scale

Instrument / Measurement	Geophysical Parameter
Aerosol sampling	Atmospheric mass concentration for PM10
Rain collector	Wet deposition
Passive collector	Dry deposition (mass and size distribution
Micro-lidar network	Aerosol vertical distribution aerosol identification

Table 4a : Measurements and retrieved parameter from the Sahelian Dust transect

Scientific objectives from AMMA Implementation Plan

TT7

Dry season: Jan-Feb 2006

The primary objectives of the SOP 0 are:

To perform high quality in-situ and remote sensing measurements of the optical and physical properties of anthropogenic biomass burning aerosols, mineral dust aerosols, and combinations of the two from sub-Sahelian West Africa.

…

To determine the consistency between in situ measurements/satellites and surface based remote sensing methods of the effects on the radiation budget of the Earth of the composite biomass and mineral dust aerosols.

….

Lidar activity:

ISAC_CNR micro lidars	at super-sites	-> backscatter coefficient, depolarization, and colour index
POLIS:	at Banizoumbou	-> extinction coefficient, depolarization
Micropulse lidar (MPL)	Niamey Airport	-> backscatter coefficient
Cimel Lidar	at M'bour and Djougou	-> backscatter coefficient
TRESS	at Tamanrasset	-> extinction coefficient, depolarization
LNG	onboard F/F20	-> extinction coefficient, depolarization
LAUVA	onboard ULM	-> backscatter coefficient

Scientific objectives from AMMA Implementation Plan

TT8

2.2.1.5 Lidar network during SOP Monsoon

The EOP lidar network, which involves an east-west array of stations (coordinated by TT2b) will be enhanced by a north-south transect of stations, with additional lidars located at Tamanrasset (Algeria) - TReSS - and M'bour (Senegal) – Cimel LOA. In addition to these instruments, a lidar ceilometer CT25K will be deployed at Djougou, and a Micro Pulse Lidar will be deployed at Niamey by the AMF.

Lidar activity:

TReSS, Cimel LOA, Cimel IPSL, Ceilometer and MPL, Jan - Dec 2006

Scientific objectives from AMMA Implementation Plan

TT8 **IOP**

Aircraft deployment strategy - SOP Monsoon

I1.1 Surface-atmosphere-aerosol: Inter-tropical front and heat low surveys (SOP1-a, SOP2-a1 –Flamant)

In SOP1-a the F/F20 flying above the PBL (with the nadir looking LEANDRE 2 lidar) at a level around 500 hPa to enable the documentation of the atmospheric reflectivity and moisture fields in the lower troposphere.

Combining the in situ aerosol measurements and laser remote sensing measurements will enable to retrieve two-dimensional fields of aerosol extinction at high horizontal and vertical resolution.

During SOP2-a1, the same basic pattern is proposed. D/F20 (equipped with the nadir looking Doppler lidar WIND) flights will be coordinated with the French aircraft flights.

Characterizing the SAL and IFT structural parameters and radiative properties at the seasonal and interannual time scales in the Sahel and the Sahara using continuous *in situ* (e.g. mass concentration, size distribution) and remote sensing (e.g. lidar and sunphotometer derived aerosol optical depth) measurements at the two Sahelian Dust Transect stations of Banizoumbou (Niger) and IER-Cinzana (Mali) as well as in Niamey (Niger) and Tamanrasset (Algeria).

Scientific objectives from AMMA Implementation Plan

TT8 **IOP**

Aircraft deployment strategy - SOP Monsoon

I1.2: Surface-atmosphere-aerosol: Squall-line related aerosol emissions surveys (SOP1-a – Formenti)

The F/F20 will be equipped with the water vapor lidar LEANDRE 2 and will provide with aerosol and water vapor distribution up to ~12 km msl.

The vertical resolved concentrations and properties are obtained by ground-based lidar (Banizoumbou) and in-situ and remote sensing aircraft measurements. Combining lidar backscatter measurements on the F/F20 and at the ground with in situ measurements made on board the F/ATR-42 will enable to derive aerosol extinction coefficient 2D fields.

…

In addition, the 2D moisture field measured with LEANDRE 2 will also enable to assess how water vapor vertical is redistributed in the vertical by the passage of squall lines.

Scientific objectives from AMMA Implementation Plan

TT8 **IOP**

Aircraft deployment strategy - SOP Monsoon

I1.3 Surface-atmosphere: North-South 'land-ocean-atmosphere interactions' surveys (SOP1-a, SOP2-a2, Flamant, Parker)

During SOP1-a, the exploration of the monsoon flux south of Niamey (and over the CATCH window), will be made using 2 aircraft: the F/ATR in the PBL and the F/F20 flying above the PBL (with the nadir looking LEANDRE 2 lidar) at a level around 500 hPa to enable the documentation of the moisture field in the monsoon flow as it penetrates over the continent.

Scientific objectives from AMMA Implementation Plan

TT8 **IOP**

Aircraft deployment strategy - SOP Monsoon

Coordinated MCS flights I2: Dynamics and chemistry of MCSs (SOP1-a, SOP2-a1, SOP2-a2 – Mari, Flamant, Reeves, Hoeller)

Flight patterns for SOP2-a1 (1-15 July)
During this period, the exploration of the mesoscale dynamics of MCSs and their environment will be made with 3 aircraft: the ATR42 in the PBL, the F/F20 as well as the D/F20. The two last aircraft will sample the environmental conditions around a MCS by means of dropsondes and lidar 2D fields (water vapour and wind along with flight level measurements.
…
optimum flight level is 40 kft, but it could be lowered to 35 or 30 kft, to avoid commercial traffic or to fly below cloud cover (for LEANDRE-2 and WIND operations during SOP-B2 (= 2a1))

during SOP2-a1, the D/F20 equipped with WIND Doppler lidar should fly at same altitude and close distance from the French F20. Lidar measurements are not possible within cloudy air, so the upstream (1-2-3-4-5-6 7-8) and the far downstream (13-14-15-16) parts of the flight must be in clear air.

The combination of LEANDRE 2 and WIND measurements around the MCSs will enable detailed, high spatio-temporal resolution analysis of the moisture inflow into MCSs for the first time.

Scientific objectives from AMMA Implementation Plan

TT8 **IOP**

Aircraft deployment strategy - SOP Monsoon

I4.1: Horizontal microphysical variability of MCS anvils (SOP2-a3 – Bouniol)

The “mesoscale structure flight” will be performed with a single aircraft, the F/F20, equipped both with RALI (Radar-LIdar combination) and a set of standard in-situ microphysical sensors (FSSP/2D-C/2D-P). The main goal is to obtain a three dimensional description of the internal structure of the MCS anvil and thus to derive physical properties at the scale of the anvil.

…

, with one overpass of ground based facility (ARM Mobile facility, Ronsard or Xport for instance).

I4.2: Vertical microphysical variability of MCS anvils (SOP2-a3 – Bouniol)

… the F/F20, equipped with RALI (LNG/Rasta) …

Observation for SOP and EOP

EOP-type: long-term variability of aerosol distribution and properties; long-term variability of PBL height and thin cloud properties and coverage.

- ISAC-CNR micro-lidars at three super sites

SOP-type: aerosol optical properties as a function of aerosol type and season, and radiative calculations

- ISAC-CNR micro-lidars at three super sites
- POLIS at Banizoumbou (SOP 0)
- Ceilometer and Cimel lidar IPSL at Djougou (SOP 0,1,2,3)
- Cimel LOA at M'bour (SOP 0,1,2)
- LNG, LAUVA

Lidar intercomparison studies:

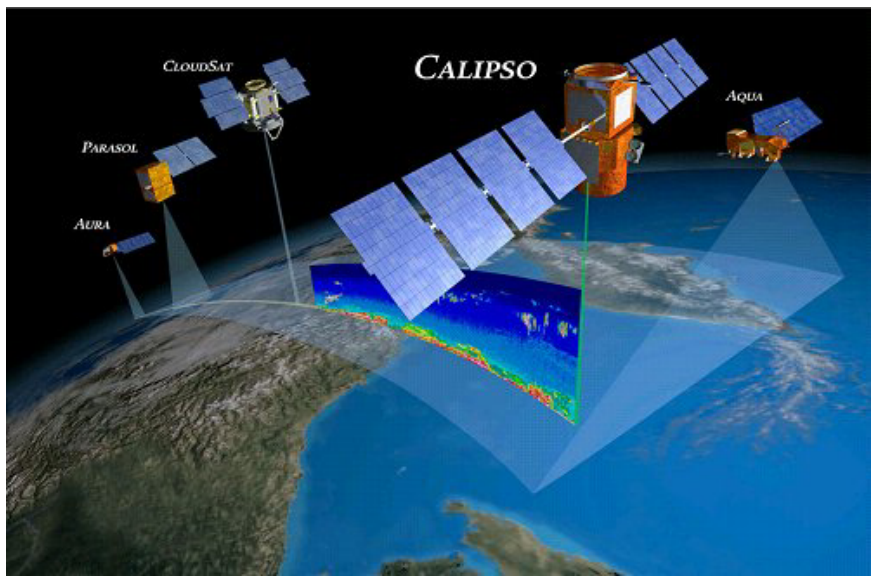
- at Banizoumbou during SOP 0: ISAC-CNR and the Munich lidar POLIS and LAUVA onboard ULM
- at M'bour during EOP: ISAC_CNR micro-lidar and Cimel Lidar

Satellite instruments

The Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observation CALIPSO satellite is planned to be launched at the end of October 2005.

Validation of CALIPSO measurements (Lidar 532 nm,1064 nm, wide field camera and 3 wavelength IR imager) will take place until 2007, level 2 products) by

Lidar activity:
all ground based lidars



Preparation of the field campaign – Retrieval Algorithms

M12 - 1. January 2006 D2.4.1a:

A report on algorithms to be used for optical modelling of aerosols

Coordination: Bernard Vogel, FZK

- review uncertainties on in situ AND COLUMN (addition) optical properties (single scattering albedo, mass scattering and mass absorption efficiency) for mineral dust, biogenic aerosols, and particles issued by biomass/domestic burning and urban pollution.
  This work could be split between UP12 for mineral dust, and the partner CNRS for the other aerosol types. Cathy Liousse, Paola Formenti

- A second group will work on "define which algorithms to be used for":

  (1) Computation of optical properties from in situ µ-physical data Coordination: FZK

  (2) Inversion of lidar data (LMU/ISAC/ENEA) Coordination: Birgit Heese, LMU

  (3) Radiative transfer calculations Coordination: Jean Francois Leon, Jacques Pelon, CNRS

Questions:

Ground based:

- which is the measurement frequency required for EOP objectives ?
- is it worth to have 2 lidar systems in M'bour ?
  (compatibility between SOP and EOP mode)
- possible redeployment (Micro-Lidar from M'bour to Ouaga –
  depends also on the M55 campaign)?

Airborne:

- funding for LAUVA?