

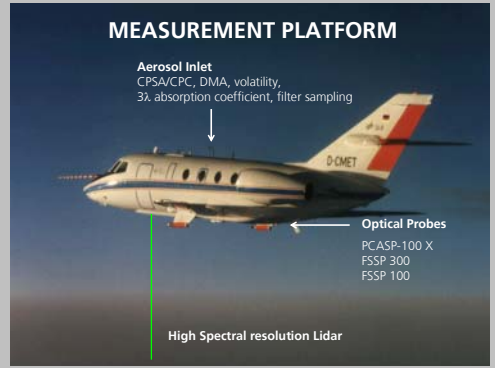
Airborne in situ and remote sensing studies on the vertical and areal distribution of microphysical and optical properties of Saharan dust

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CONTRIBUTIONS TO SAMUM OBJECTIVES	TOOLS AND METHODS
<p>Clear-column radiative closure for desert aerosol over a source region with respect to aerosol extinction from lidar and from particle size, shape and composition.</p> <p>Validation of active and passive space-borne and ground-based sensors by measuring vertical profiles of aerosol extinction, aerosol backscatter, aerosol microphysical properties and atmospheric thermodynamic properties during satellite overpasses.</p> <p>Intercomparison studies between airborne and spaceborne lidar and aerosol microphysics.</p> <p>Transformation of microphysical and optical dust properties during atmospheric transport and mixing with local pollution.</p>	<p>Full coverage of the tropospheric column:</p> <ul style="list-style-type: none"> - Operation of an airborne platform which can access altitudes up to 11 km above sea level (a.s.l.). - Nadir-looking lidar for full coverage of the boundary layer. - Medium to long-range capabilities of the platform for transport studies and satellite validations. <p>Calculation of aerosol optical properties from size distributions and spectral absorption coefficient data by inverse methods.</p> <p>Closure studies on aerosol optical depth AOD, the aerosol extinction coefficient σ_{ap} and the lidar backscatter coefficient σ_{bp}.</p> <p>Dust plume transport and transformation studies using vertical and horizontal profiles of aerosol microphysical properties, aerosol extinction profiles and air mass trajectories.</p>



CLOSURE STUDY CASE MAY 19, 2006 - MISR OVERPASS

Closure is investigated:

- between measured LIDAR extinction and backscatter coefficients and values calculated from particle size distributions,
- between measured aerosol optical thickness from HSRL, sun photometry and satellite instruments and values calculated from particle size distributions.

Extensive aerosol optical properties like extinction coefficient and backscatter coefficient are calculated from measured aerosol size distributions and refractive index information obtained from 3λ absorption coefficient data.

The combined analyses of vertical profiles of the lidar backscatter and extinction coefficient and aerosol microphysical properties provide vertically and horizontally resolved information on microphysical and optical properties of dust plumes.

Particle size distribution from multiple instrument data analysis

\tilde{A} exponent of σ_{ap} from 3λ absorption coefficient data

aerosol optical model
 $PM = \alpha SiO_2 + \beta Fe_2O_3 + \gamma BC$

INSTRUMENTATION

Aerosol Instrumentation

Aerosol instrumentation features

- full particle size spectrum from 4 nm to 100 μm
- size-resolved measurement of particle volatility
- 3λ measurement of the aerosol absorption coefficient
- inversion of optical particle spectrometer data for non-spherical particles
- sampling of sub 4 μm particles for chemical analyses

High Spectral Resolution Lidar

HSR LIDAR features

Parameter	Wavelength λ , nm
Backscatter coefficient	532, 925, 1064
Extinction coefficient	532
LIDAR ratio	532
Optical depth of elevated dust layers	532, 1064
Depolarization ratio	532, 1064
Water vapour	925

LONG-RANGE TRANSPORT AND TRANSFORMATION CASES MAY 27 AND JUNE 03

June 03: Dust plume extending from the Sahara to the Atlantic coast

May 27: Dust plume transported to Portugal

Effects of long-range transport and transformation

Mixing of pure dust and local pollution
 \Rightarrow modification of \tilde{A} - exponent of σ_{ap}

pure dust (Ouarzazate, Zagora)	3.1 - 5.0
Lab studies (Linke et al., ACP 2006)	4.2 - 5.3
aged dust (May 27, Portugal)	1.9 - 2.0
dust + urban poll. (Casablanca)	1.4 - 2.6
Casablanca urban pollution	1.0 - 1.2
combustion aerosol (Diesel)	1.0

Processing of aerosol \Rightarrow modification of dust size distribution and mixing state

P3/P4: no significant depletion of large dust particles during transport

P3: larger fraction of volatile compounds in the accumulation mode compared to pure dust (P0) close to the source: effect of long-range transport or dust origin?

P4: mixing of dust with urban pollution modifies Aitken mode, minor effects on dust mode