

AEROSAT initiative

Proposed contributions from LOA

P. Goloub

Main co-leaders : O. Dubovik, H. Herbin, D. Tanré, F. Waquet

Laboratoire d'Optique Atmosphérique
CNRS- Université de Lille 1
France

Current satellite aerosol activities & future priorities

Better address aerosol properties and gas over land, ocean and clouds using mainly satellite data in the solar spectrum (polarimetry), in the infrared with high spectral resolution sensors such as (IASI, GOSAT), and using geostationary satellites

3 main activities

Current satellite aerosol activities & future priorities

Activity 1 : Retrieval of aerosol over Land : Oleg DUBOVIK

GRASP Algorithm: Generalized Retrieval of **Aerosol** and **Surface** Properties (*Dubovik et al., 2011, AMT*)

(Accurate, Versatile, Fast)

- ✓ Inversion scheme: search in continuous space of solution, optimization as Multi-term LSM, simultaneous multi-pixel retrieval;
- ✓ Forward model: applicable to diverse remote sensing observations, accurate modeling using direct “on-line” computations;
- ✓ Software implementation : advanced highly parallelized programming, public, open source aerosol retrieval code;

First application to POLDER/PARASOL => Improve AEROSOL typing

Current satellite aerosol activities & future priorities

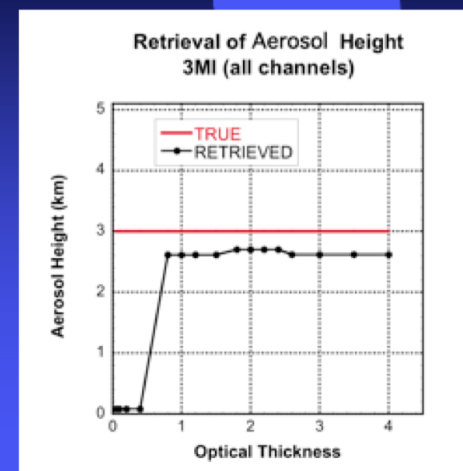
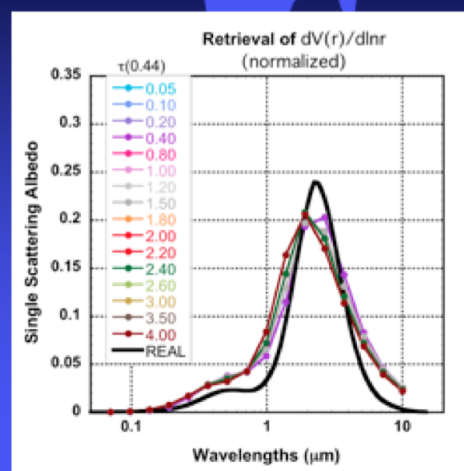
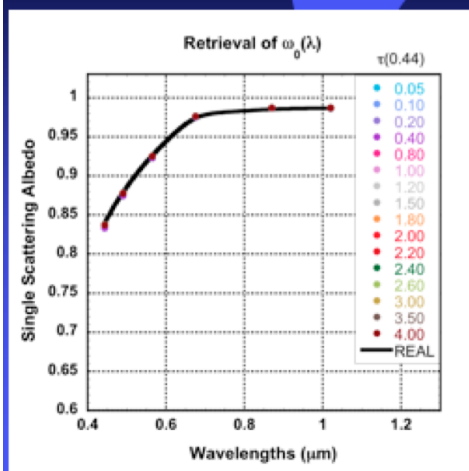
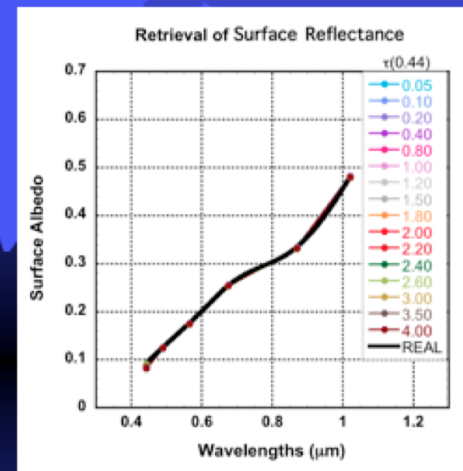
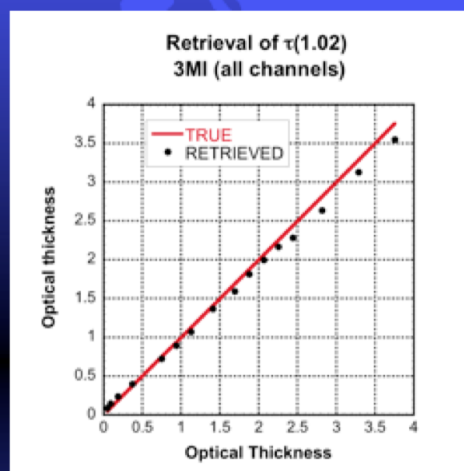
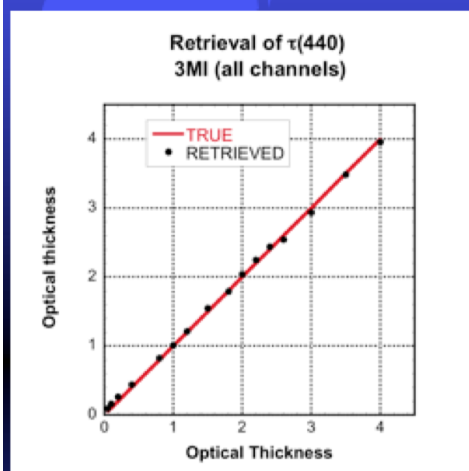
Sensitivity Study

PARASOL: 0.44, 0.49 (p+), 0.565, 0.675 (p+), 0.87(p+), 1.02 μm

NOISE ADDED: 1% for $I(\lambda)$. 0.005 for $Q(\lambda)/I(\lambda)$ and $U(\lambda)/I(\lambda)$!!!

Multi-Pixel Retrieval (i.e. temporal and spatial variability of surface and aerosol is limited)

Desert Dust aerosol (non-spherical!!!)



Current satellite aerosol activities & future priorities

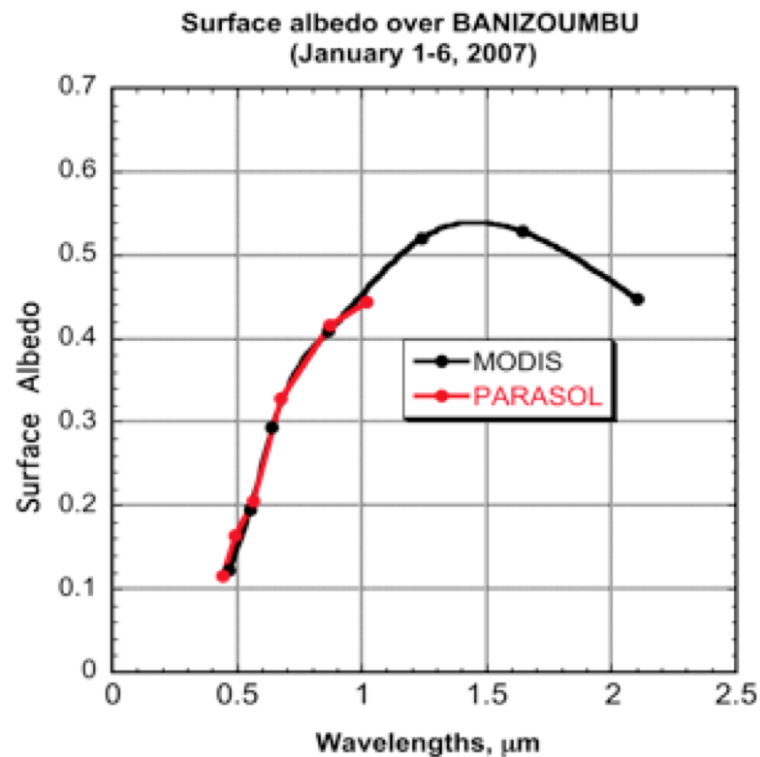
Test inversion of PARASOL data over bright desert surface:

LOCATION: AERONET site at BANIZOMBOU, NIGER
(North $13^{\circ}32'$, East $2^{\circ}39'$)

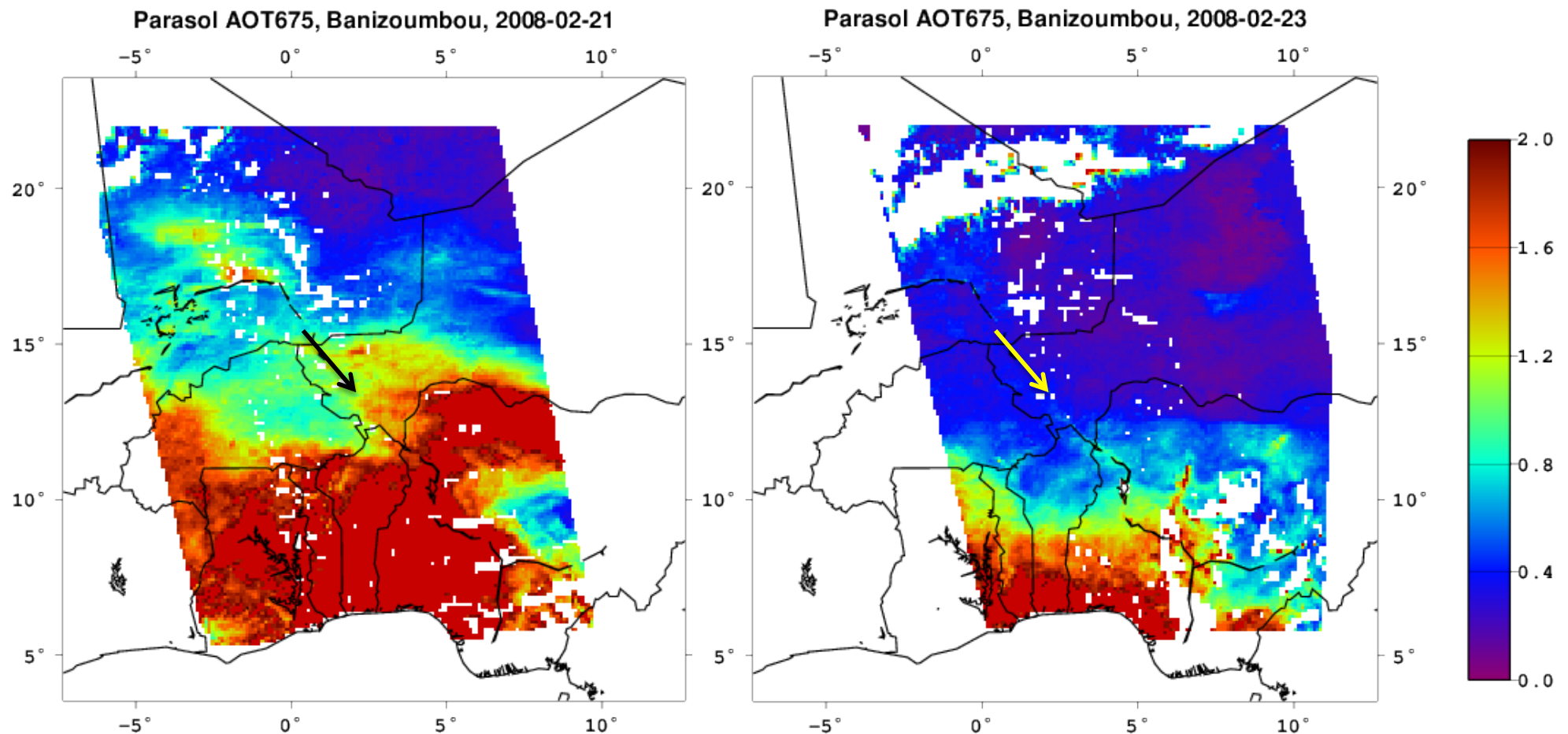
PERIOD: 2009

PARASOL 4 PIXELS: North $13^{\circ}30'$ · East $2^{\circ}36'$ · North $13^{\circ}30'$ · East $2^{\circ}43'$
North $13^{\circ}36'$ · East $2^{\circ}36'$ · North $13^{\circ}36'$ · East $2^{\circ}43'$

NOTE: Parameters of both bi-directional intensity and polarization reflectance are retrieved simultaneously with aerosol

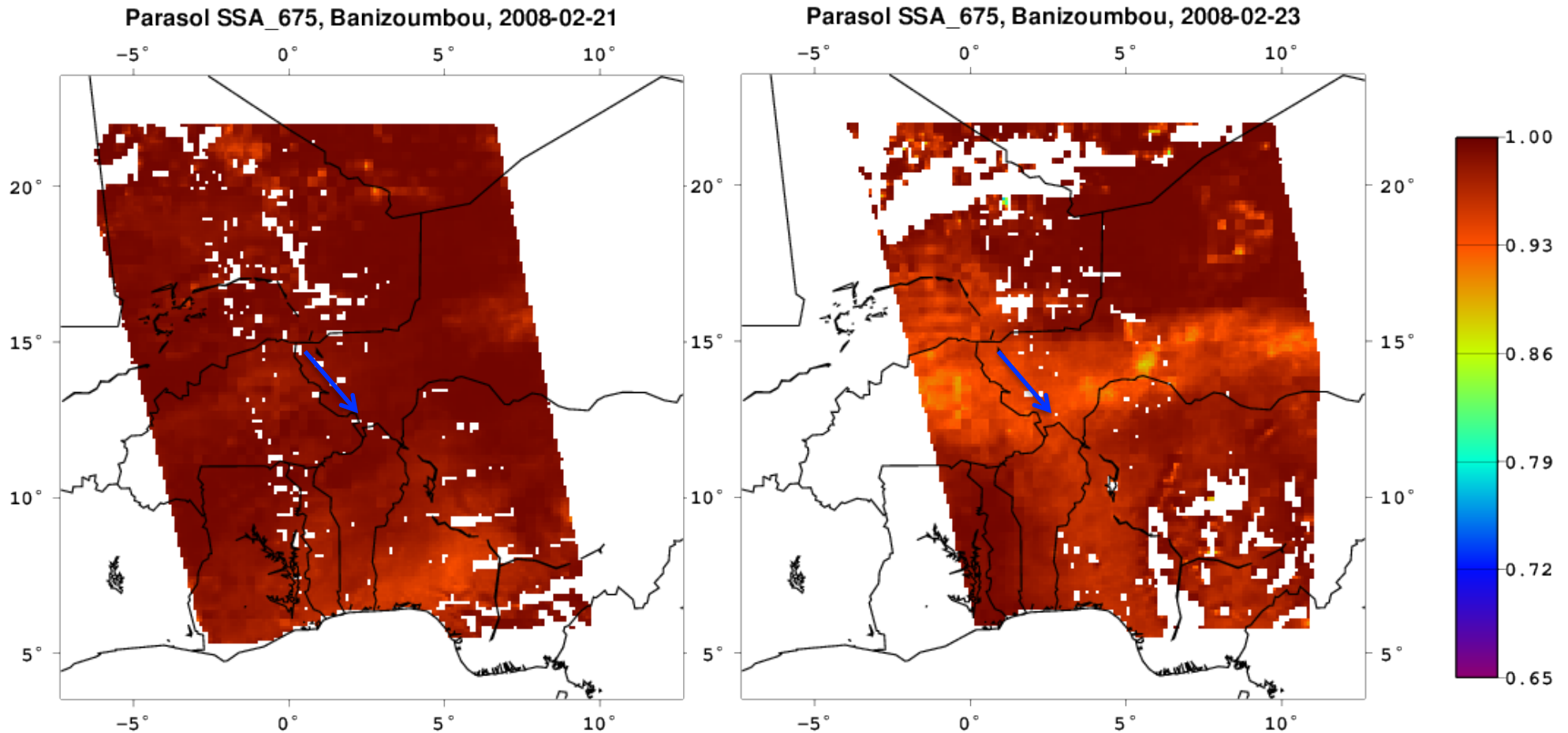


Regional maps (1800 x 1800 km). *Banizoumbou* (Niger, Bright Surface)



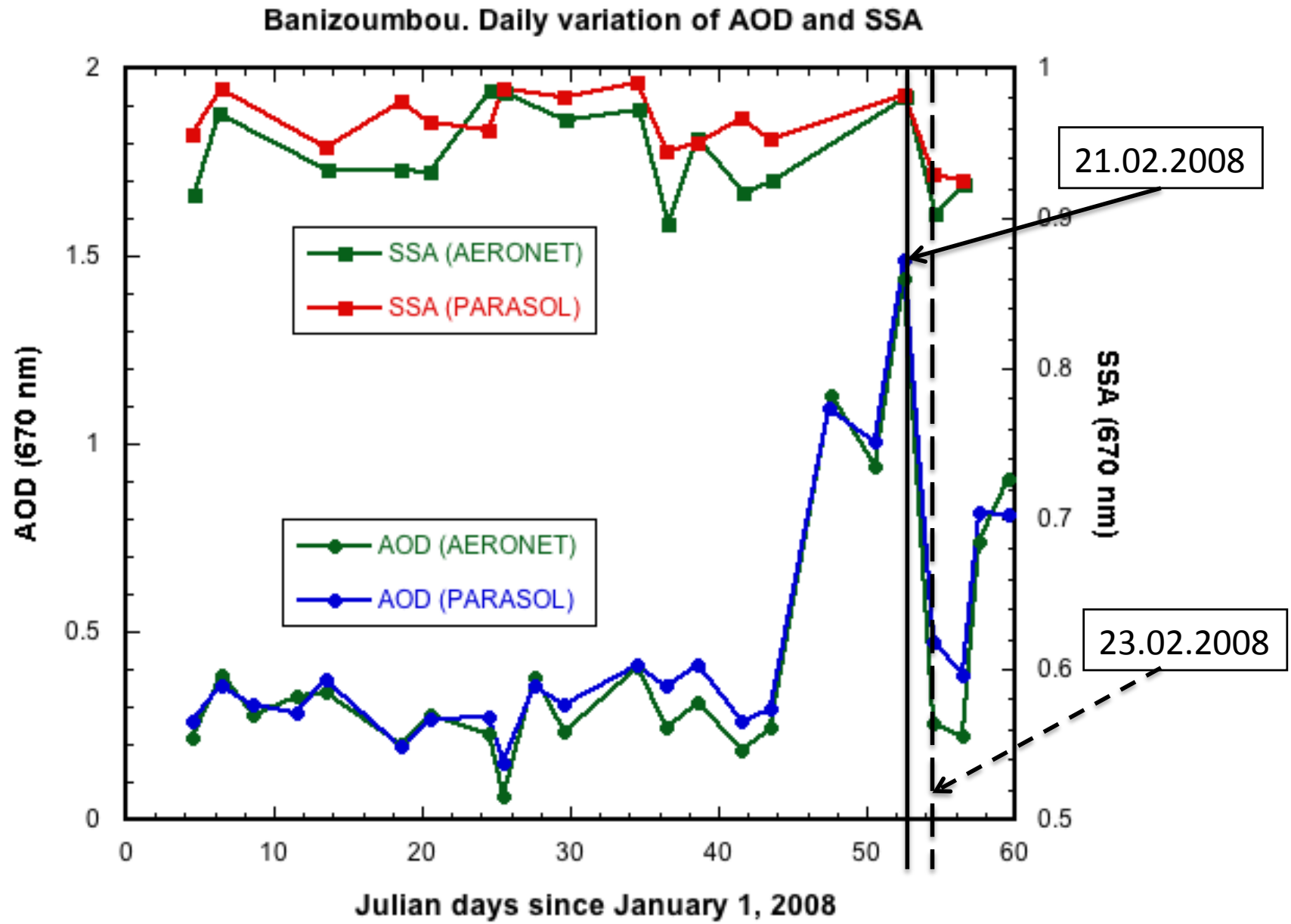
Strong spatial and temporal variation of AOD

Regional maps (1800 x 1800 km). *Banizoumbou*

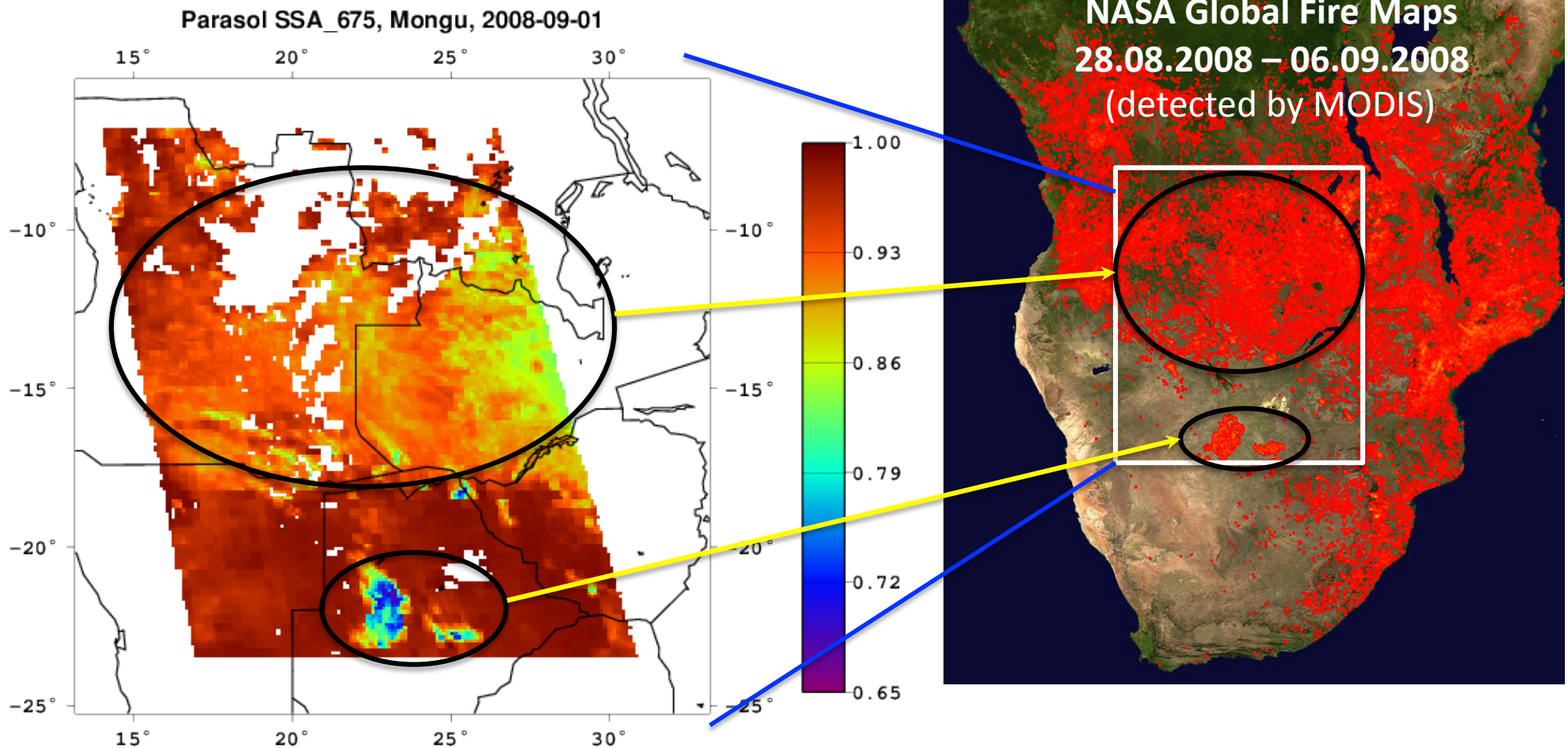


Essential temporal variation of SSA

GRASP vs AERONET site (*Banizoumbou*)



Regional maps. *Mongu, SSA 670 nm*



Small SSA correspond to biomass burning!

Current satellite aerosol activities & future priorities

Activity 2 : Retrieval of aerosol over very bright surfaces Clouds !

Fabien WAQUET



AEROSAT meeting - Hambourg - 27 sep.
2013

Current satellite aerosol activities & future priorities

Activity 2 : Retrieval of aerosol over very bright surfaces Clouds !

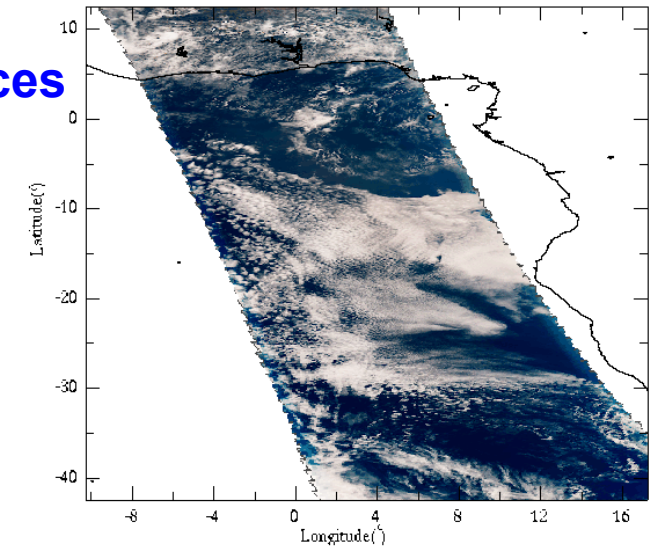
(Waquet et al., 2009; ...; GRL, 2013 submitted)

(see Fanny Peers presentation to AEROCOM)

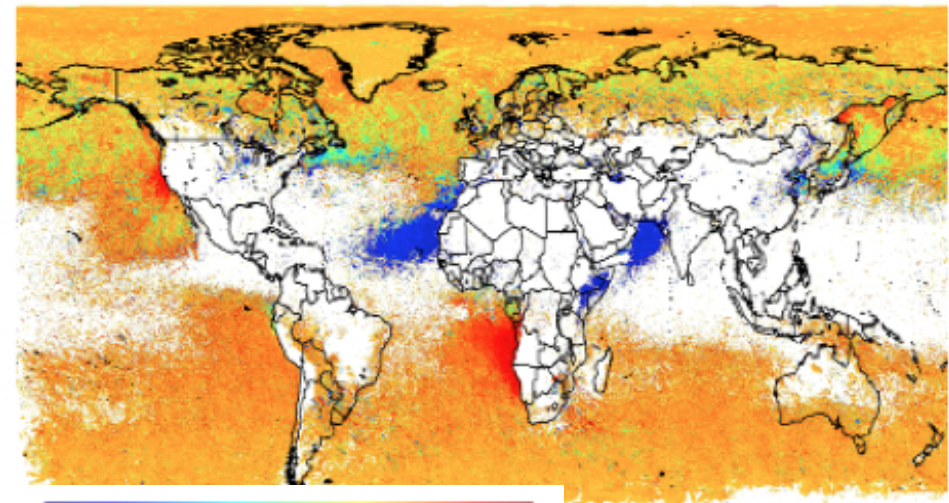
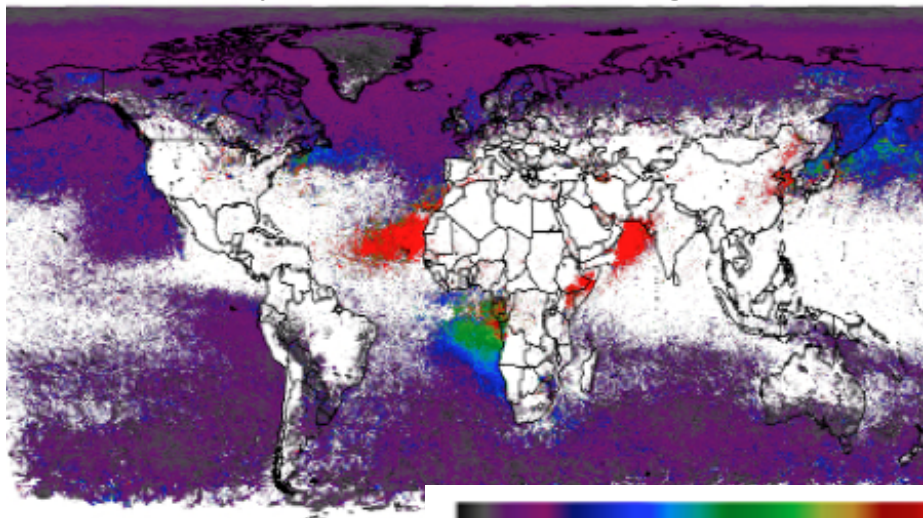
=> Access to AEROSOL typing over clouds

AOD, Alpha, absorption

Compute radiative forcing



Summer 2008



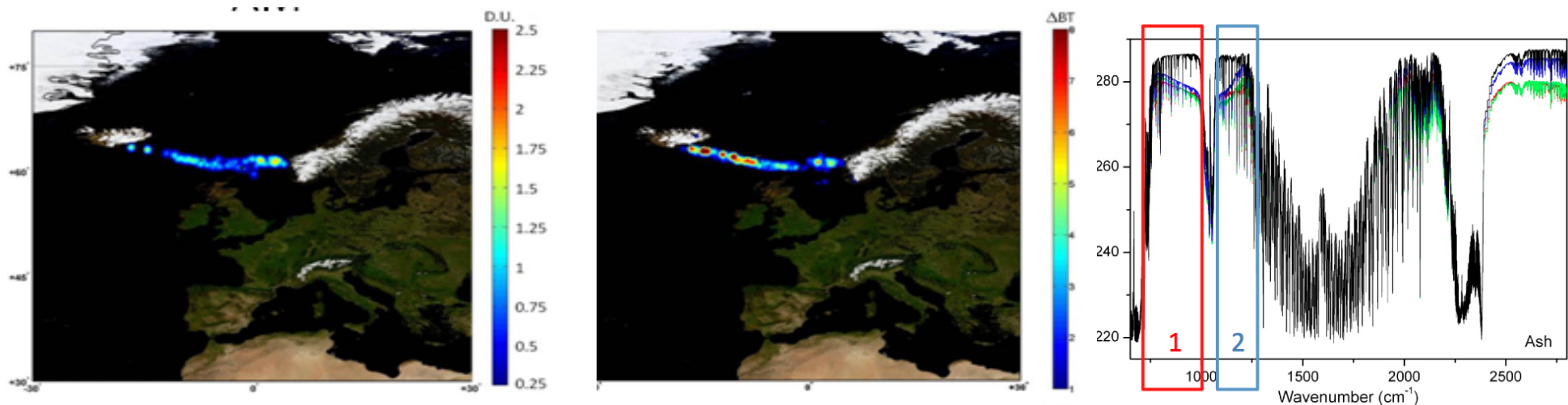
Current satellite aerosol activities & future priorities

Activity 3 : Simultaneous retrievals of gas and aerosols with infrared High Spectral resolution (main application to dust and volcanic aerosols)

Herbin et al., 2012; 2013 (submitted)

Hervé HERBIN

IASI/METOP : IR spectrometer



Herbin et al., LOA SO_2

Volcanic Ash

Detection and Characterization of extreme aerosols events

Current satellite aerosol activities & future priorities

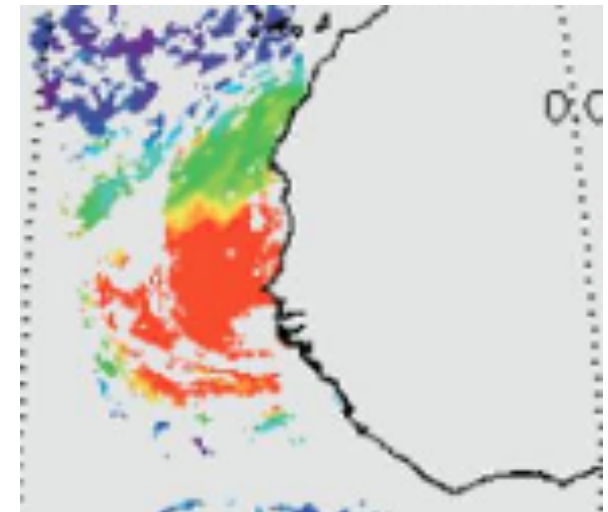
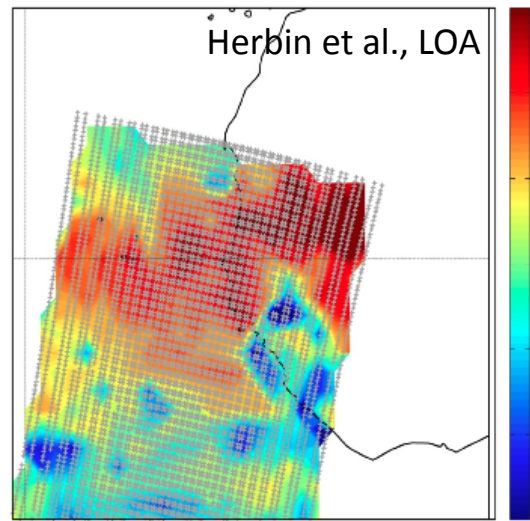
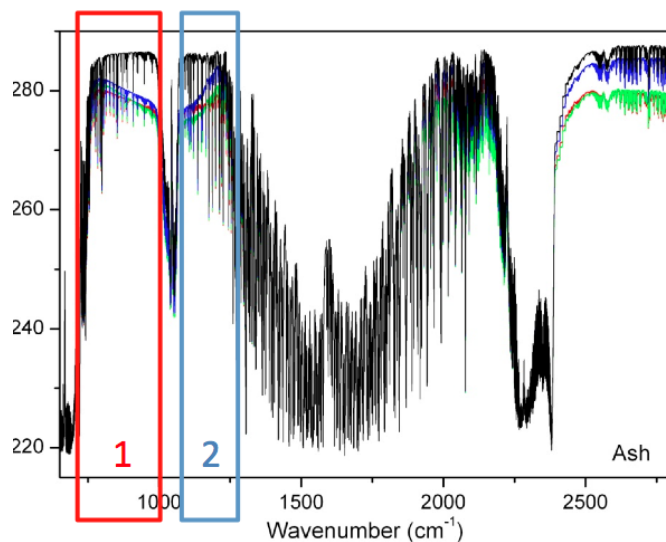
Activity 3 : Simultaneous retrievals of gas and aerosols with infrared High Spectral resolution (main application to dust and volcanic aerosols)

Herbin et al., 2012; 2013 (submitted)

•

IASI/METOP : IR spectrometer
(IR)

POLDER 3/ PARASOL
(solar spectrum)



Detection and Characterization of extreme aerosols events

Current satellite aerosol activities & **Future priorities**

Further develop Activities 1, 2, 3 :

Gas-aerosol simultaneous retrievals with IASI / GOSAT (profiles for gas, type for aerosols, size distribution)

Aerosols over clouds (improved characterization, including absorption => radiative forcing)
=> reprocessing of all PARASOL archive (2005-2013)

Aerosols over Land and ocean : Reprocessing all PARASOL data with GRASP to derive “AERONET-like” aerosol climatology at global scale and derive radiative impacts (see CCI project in collaboration with ICARE data center)

GRASP and its generalization (aerosol and cloud) simultaneous inversion -> Aerosol-cloud interaction

New missions preparation :

Preparation of (3 MI- Sentinel, MSG, MTG, IASI-NG) , synergies with spaceborne Lidar, ground-based networks (sun-photometer and lidar)

Involved OSIRIS (Vis-MIR) POLDER airborne version to fields campaigns

collaboration through AEROSAT:

Software GRASP :

public, open source aerosol retrieval code will be available at LOA (Université de Lille)

Data & products :

Processing of the archive and data Distribution by ICARE (Universite de Lille)

interest/expectations/opportunities/suggestions

Interest:

- To monitor the whole aerosol cycle (precursors, aerosol formation/evolution)
- Compute the aerosol radiative forcing

Expectations:

- Archive of PARASOL processed data available in 2015

Opportunities

- A-Train
- IASI / GOSAT

Suggestions:

- combining MSG with POLDER
- Select core stations (cf ACTRIS) with extensive ground-based instrumentation and combine data along the inversion for a full characterization