

ACTRIS-France proposal for EarthCare Cal/Val

**Bonn
June 2018**

ACTRIS-France Contribution to EC Cal/Val

Proposal from
P. Goloub and many french collaborators

Presented by B. Torres, LOA

Laboratoire d'Optique Atmosphérique, Univ. Lille / CNRS, France

*Structuration efforts in Europe through ACTRIS-1/2 I3 projects (**Aerosol Cloud and Trace gas Research Infra Structure**) to improve our knowledge **on aerosols and clouds properties** and their impacts on Climate and Air Quality by a wide community **expert in ground-based remote sensing (photometry, lidar, radar, radiometer) and in situ observations.***

Objectives : ACTRIS-France contribution to EarthCARE Cal/Val.

- ACTRIS-FRANCE is the French component of the European Research Infrastructure.
- Activities focusing on:
 - Aerosol Remote Sensing (Working Group 1).
 - Clouds and Precipitation 3D (Working Group 3)
- French stations or stations co-operated by France (in the Tropics, in the Arctic, in France) are part of European and International networks (AERONET, EARLINET, NDACC, etc.) contributing to aerosol, cloud studies (climatology, process study, satellite Cal/Val,...)



	T	UTLS	S		TYPE
EUROPE :					
LILLE(*, **)	X	X		LOA	H+L
PALaiseau(*)	X	X		LMD	H +C
PARIS	x			LATMOS	L
CLERMONT	X	X		LaMP	H+L
OHP	x	X	X	LATMOS	H+L
MOBILE	X	x		LOA (MAMS)	L
TROPICS :					
DAKAR	X			LOA/IRD	L
LA REUNION	X	X		LACY/OPAR	H+L
RUSSIE :					
TOMSK	X			LATMOS/IAO	L
ARCTIC :					
ALOMAR	X	X	X	LATMOS	H

(*) co-located with Meteo France operationnal LiDAR network
 (**) transportable system (e.g. Field campaign in China, Spring 2019)

US Dept of State Geographer

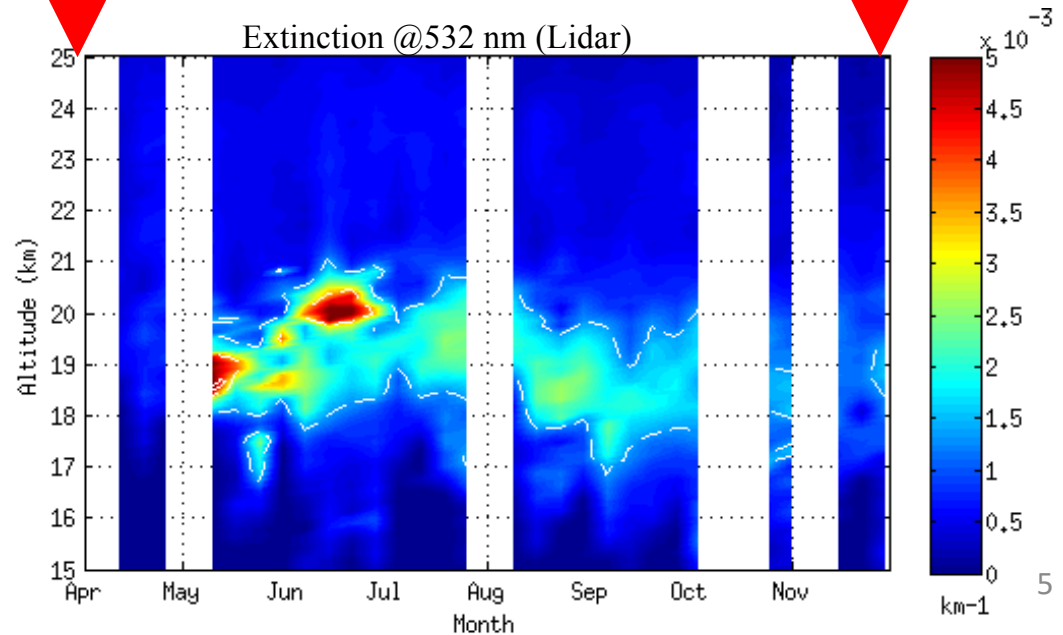
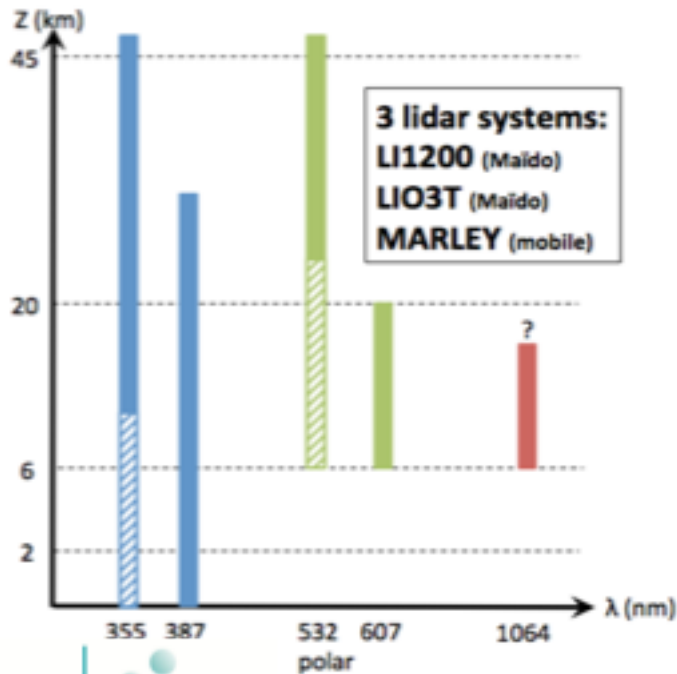
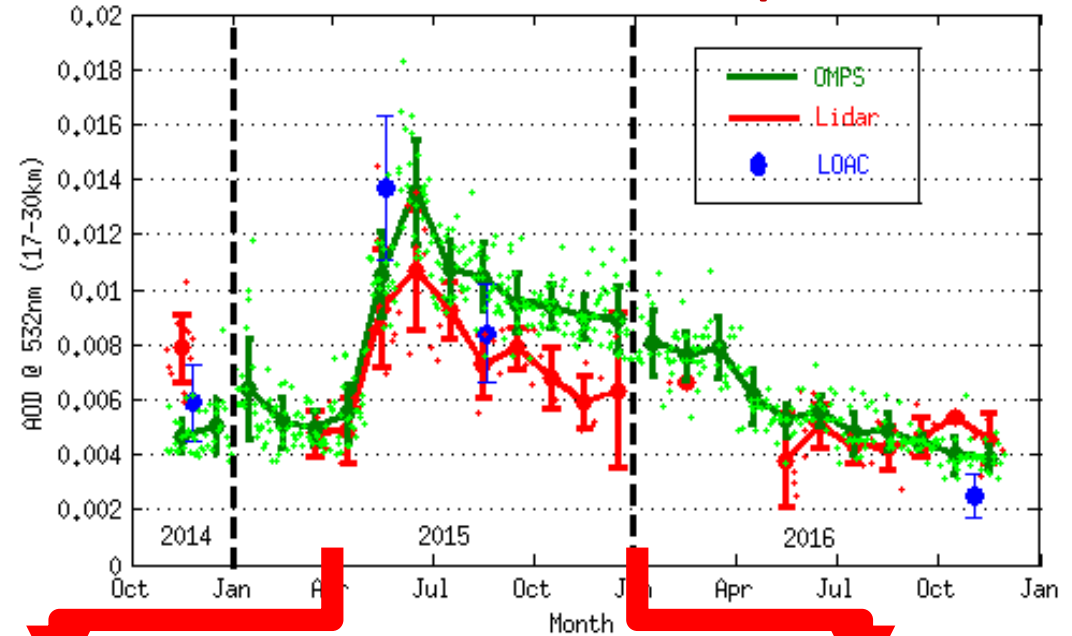
Ground-based stations with French LiDAR and photometer

Examples of French observing systems capability

- LA REUNION ISLAND (Bègue et al., ACP, 2017)
- DAKAR (Mortier et al., 2016, JGR)
- OHP (*Khaykin et al, GRL, 2018*)
- LILLE / PALAISEAU (and mobile) (*Hu et al., ACP submitted, 2018*)

La Reunion Island – Aerosol observation in Tropical Tropopause Layer (TTL)

2015: the Calbuco eruption



IRD M'Bour station (near Dakar)

- Abundant aerosol content
- Aerosol type variability (marine, dust, smoke, local pollution)
- Seasonal features
- Permanent AERONET obs. (22 yrs),
- Routine LiDAR obs. (12 yrs),
- Great Potential for Field Campaigns (... , 2013, 2015, 2016,..)

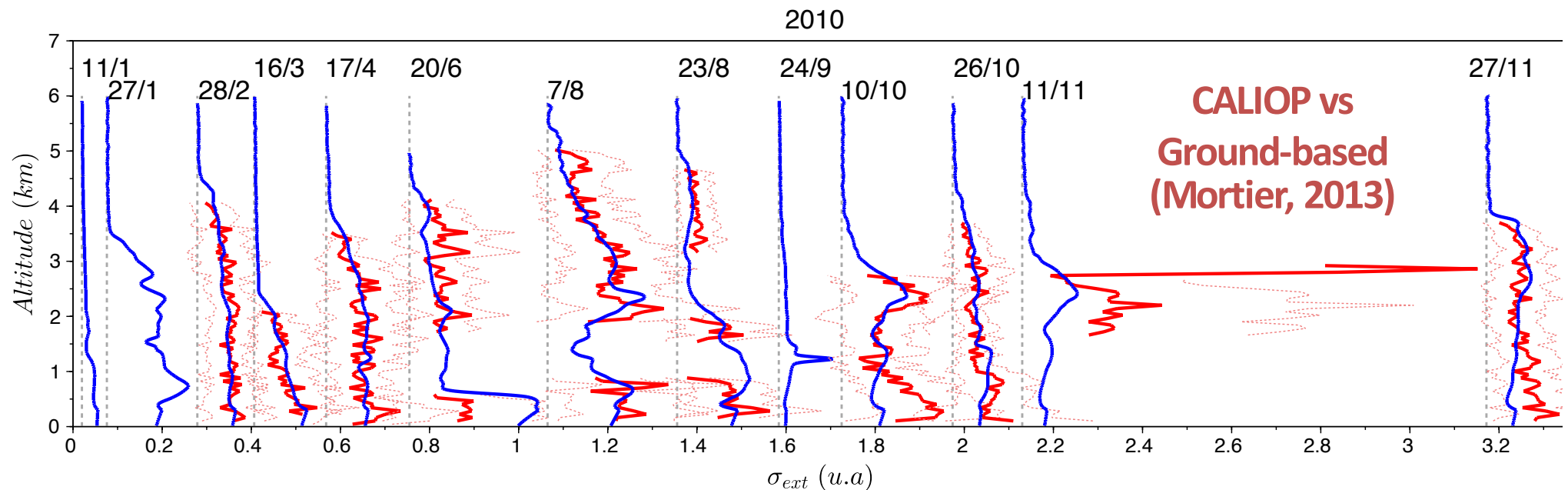


M'bour

IRD Station of geophysics and oceanography (IMAGO), with qualified technical staff

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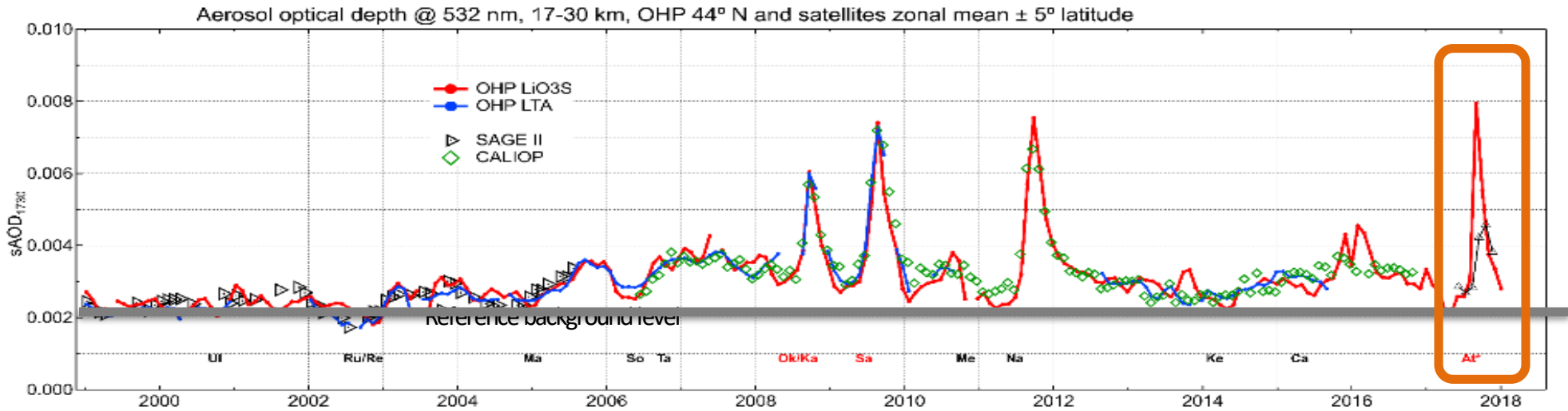


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**Adequate weather situation, frequent observations, aerosol variability
(dust, dust & biomass burning smoke mixture, marine)**

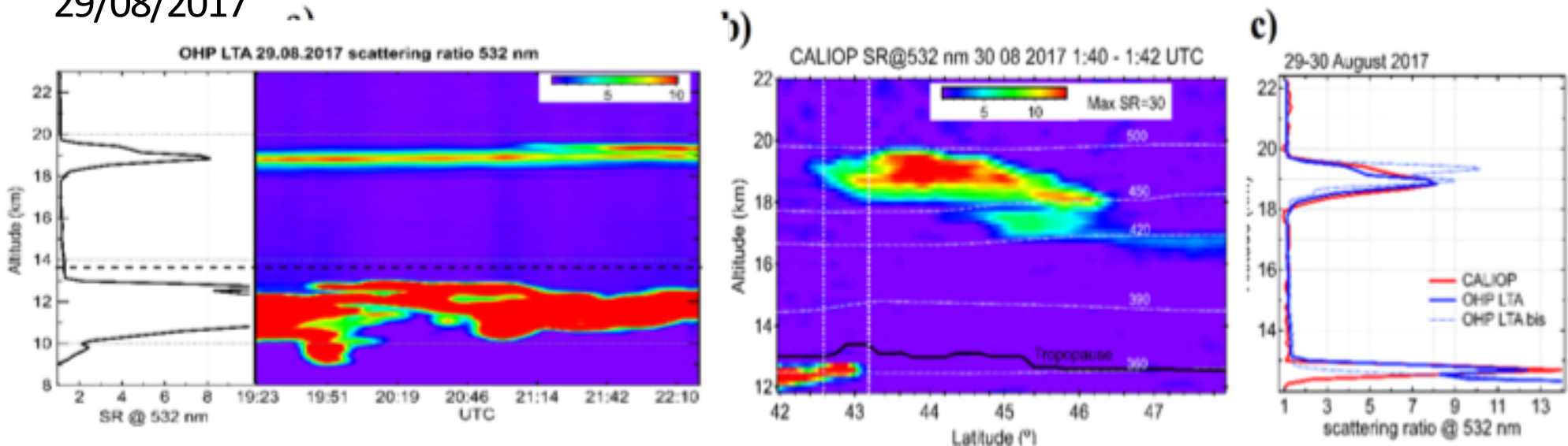
**Currently 532 nm but AERONET can be used day and night to compute at 355 nm
(dust case, at least)**

Stratospheric Aerosol Optical Depth 17-30 km @ 532 nm (OHP and satellites)



Stratospheric smoke layer with unprecedentedly high backscatter at OHP

29/08/2017



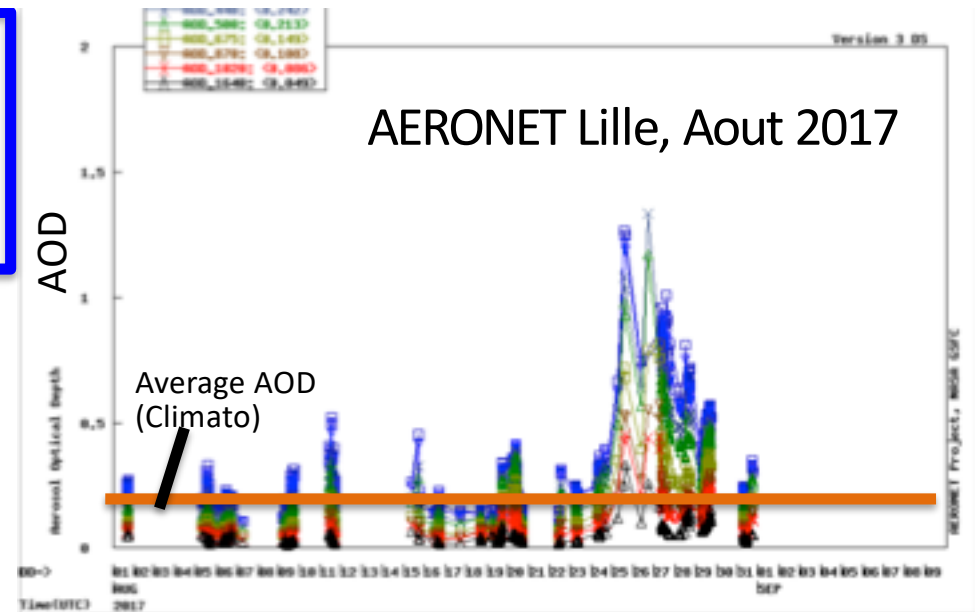
S.M. Khaykin et al., GRL, 2018 published. Stratospheric smoke layer with unprecedentedly high backscatter observed by lidars above Southern France.

Analysis of an Extreme aerosol event at Lille, Palaiseau and in between

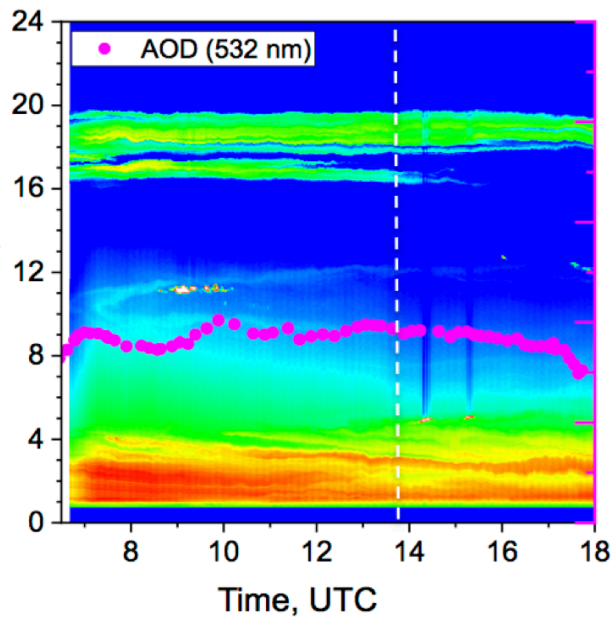
Août 2017

Hu et al., ACP, 2018, submitted

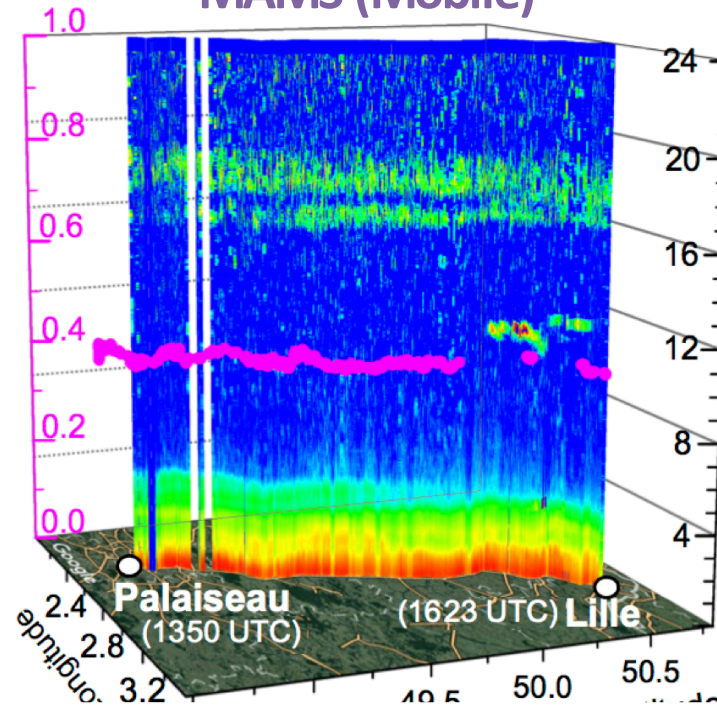
Popovici et al., AMTD, 2018



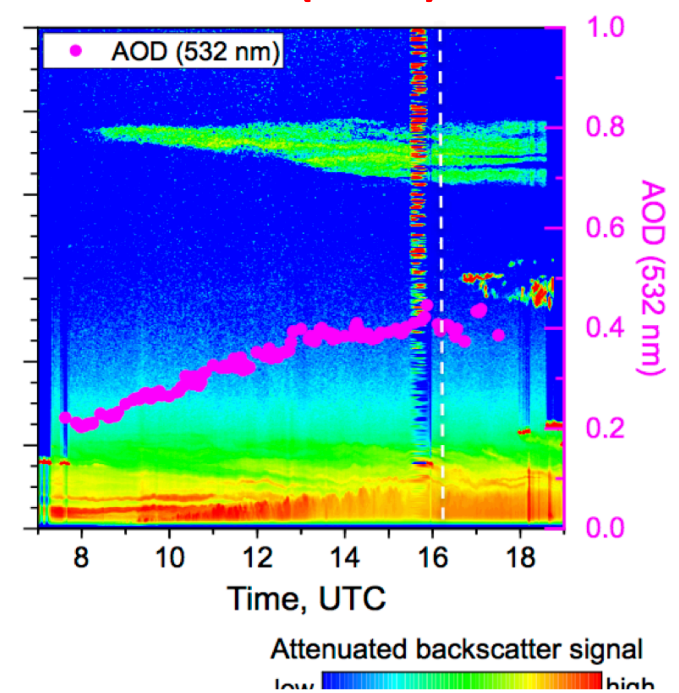
Palaiseau (IPRAL)



MAMS (Mobile)



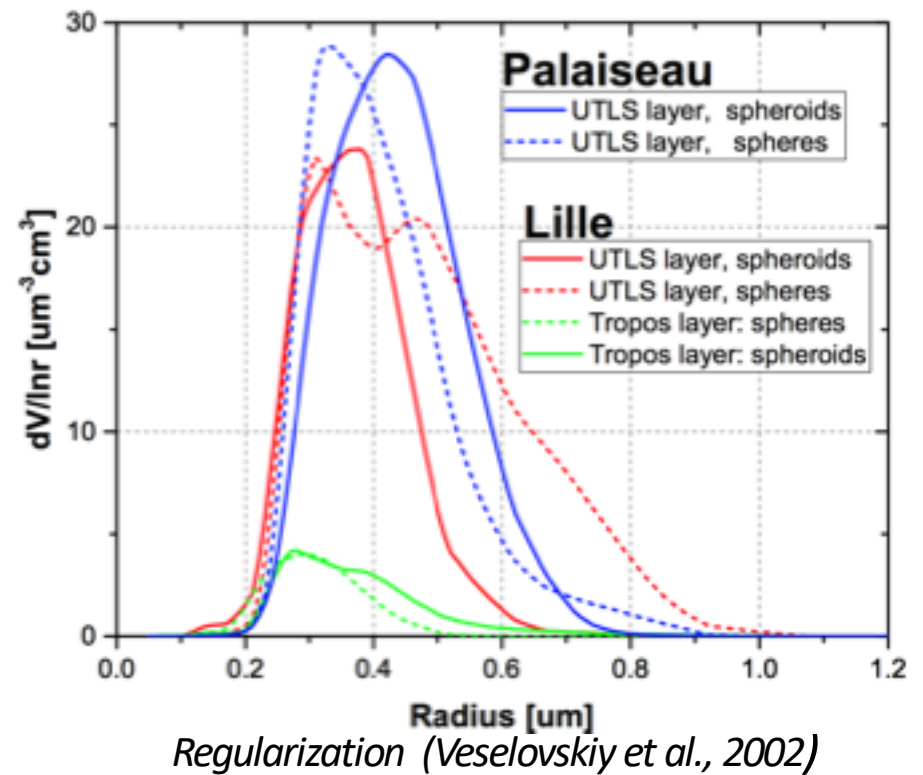
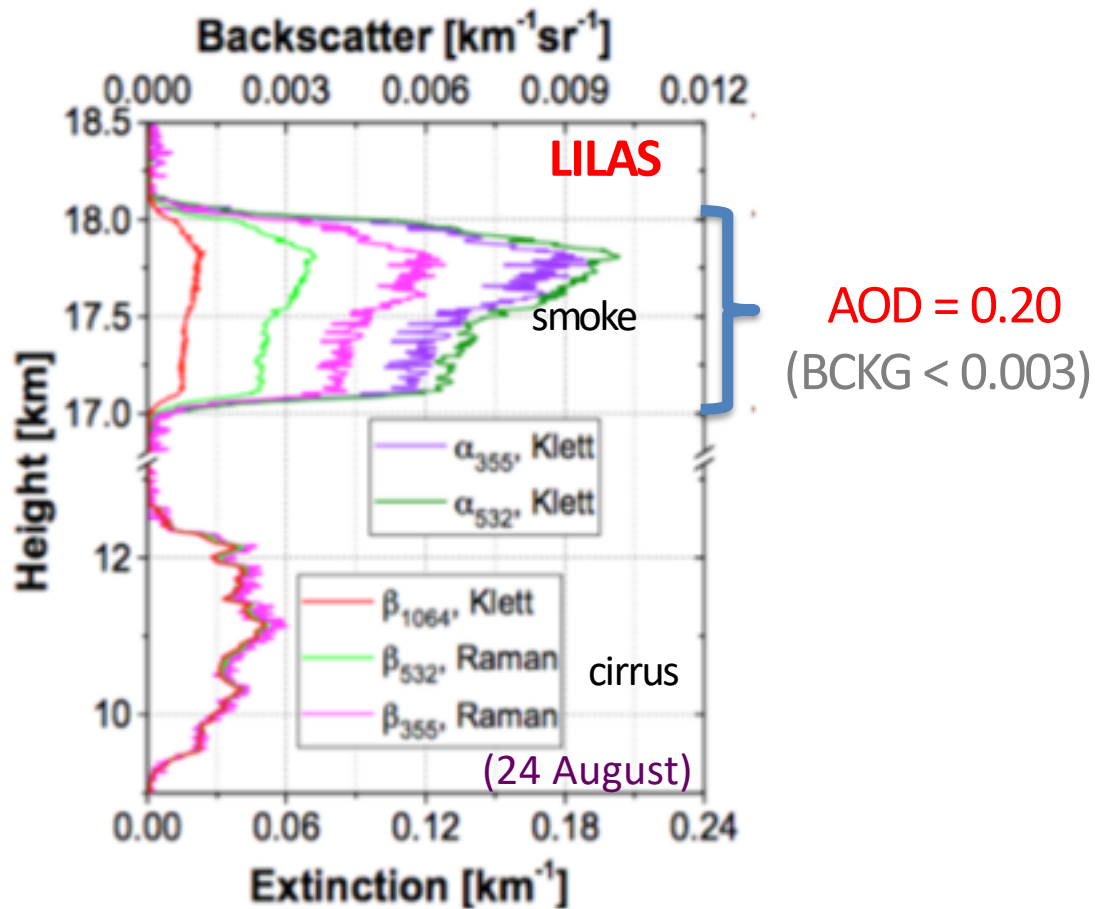
Lille (LILAS)



Observations and analysis of UTLS aerosols detected over North France (Hu et al., ACP, 2018, submitted).

Description and applications of a mobile system performing on-road aerosol remote sensing and in situ measurements (Popovici., AMTD, 2018)

Size Distribution



- High refractive index
(smoke)

Q. Hu (EGU, 2018, ACP, 2018 (submitted))

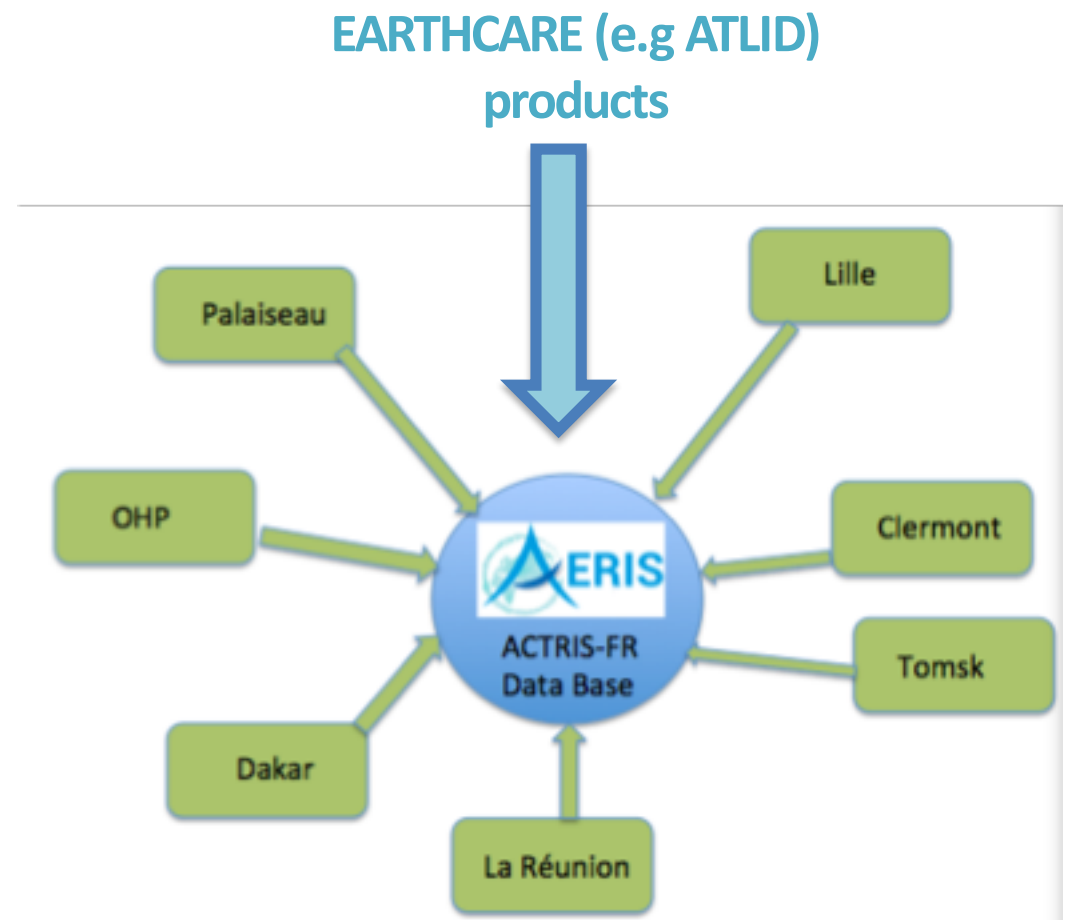
Lidar system	LILAS, 24 August	
Model	Spheres	Spheroids
$R_{eff}, \mu\text{m}$	0.33 ± 0.10	0.32 ± 0.10
$V_c, \mu\text{m}^{-3}\text{cm}^3$	24 ± 7	19 ± 6
m_R	1.61 ± 0.05	1.60 ± 0.05

National Organisation (ACTRIS-FR)

- **Observation (stations)**
- **Submission to ACTRIS-FR Data Center (AERIS)**
 - satellite archive (AERIS/ICARE-Lille) : Extraction tools over stations
 - ground-based archive and processing (AERIS/ICARE-Lille)

LiDAR, Ceilometer, photometer,
AERONET,, Level 0, 1 data products
(aerosol products, cloud products)

- **Data Processing**
- **Link with CNR Data Center (Italy, for SCC)**



Examples of data processing for aerosols (algorithms used)

- **Profile** : Standard Stand-alone LiDAR techniques for aerosol optical properties
(from $1\alpha/\beta$ to $3\beta+2\alpha+1/2/3\delta$) – Profiles + integral
Status : both at stations level (SCC, owner) and Centralized
(in progress within ACTRIS-2 and ACTRIS-FR projects)

- **Column** : Standard Photometer-alone techniques (AERONET)
Status : Centralized Processing (in the USA and in France/AERIS)

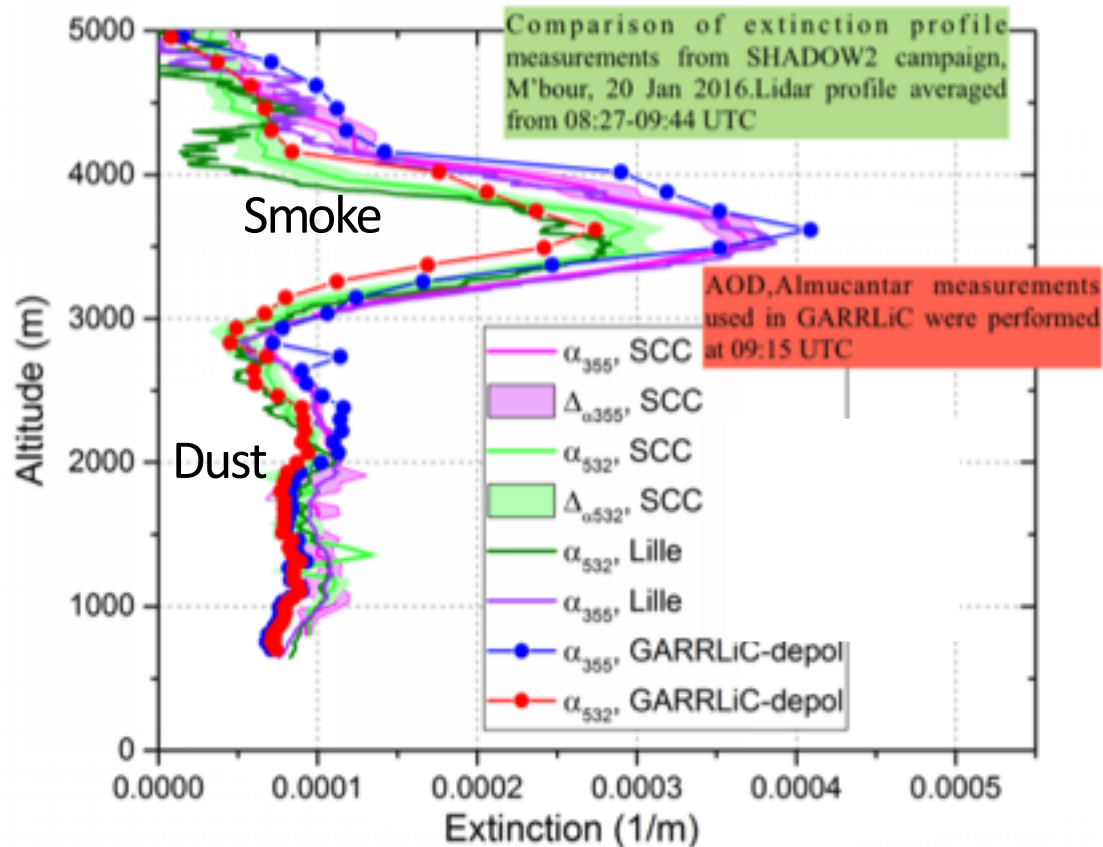
$$\text{Day and night time} = AOD = \int \sigma_{\text{ext}}(z) dz$$

- **Both** : Joint photometer-LiDAR techniques (Basic & Advanced techniques)
 - * simple AOD-constrained Klett technique (day and night) –
 - * advanced synergy with GARRLIC/GRASP retrievals (optical and microphys.)

Status : Centralized Processing (France/AERIS)

Advanced Aerosols retrieval (LiDAR+ photometer) GRASP/GARRLIC, U. Lille

GRASP Extinction against Raman techniques extinction (supposed as reference, but at night), Rotational Raman (Daytime) with LiDAR and comparison with GRASP/GARRLIC daytime (Qiaoyun Hu, PhD thesis, 2018)



Day time : complementary to Raman

Reference : Raman Inversion ($3\beta+2\alpha$)

- SCC : Extinction (532 & 355)
- LOA : Extinction (532 & 355)

New method (GRASP/GARRLIC)

- 355+532+1064 + depol. + photometer + Error bars



Proposal for EARTH CARE Cal/Val : “multi-site calibration/validation based on reference ground-based active (LiDAR/Radar) and passive (photometer, radiometer) remote sensing observations”

- Measure aerosol / cloud properties using state-of-the-art instrumentation and algorithms and following QC/QA SOPs to offer reference data for cal/val activities (extinction/backscatter/depolarization/LiDAR ratio)
- Evaluate the optical signature of volcanic aerosols and stratospheric clouds

