Quality Assurance for Earth Observation

Traceability for AERONET network, Aerosol field campaigns validation & related I/A developments

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Since last workshop in Roma ...

1. Business As Usual Activity (photometry, operational) :
   - Sun calibration platform at OHP, France (operational, 60 calibrations)
   - Operational during COVID-19 lockdown period (20 calibrations)
   - Absolute calibration at Mauna Loa (operational)

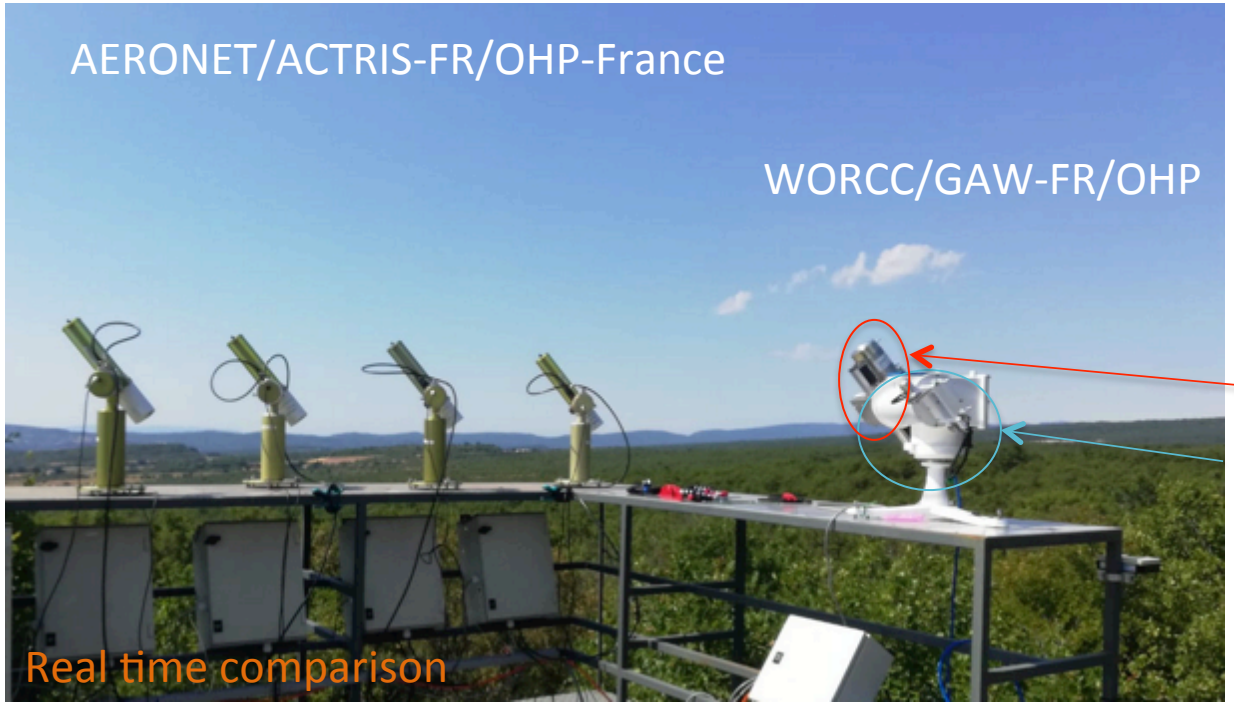
2. Day time AERONET Europe AOD Traceability to WORCC/PMOD at OHP (in progress)

3. Comparison NASA / CNRS / PMOD (started)

4. Campaigns / Intensive Observation (organization + analysis)

5. Instrumental/Algorithm (I/A) Developments

2. Day time AERONET AOD Traceability to WORCC/PMOD at OHP, campaign since July 2020

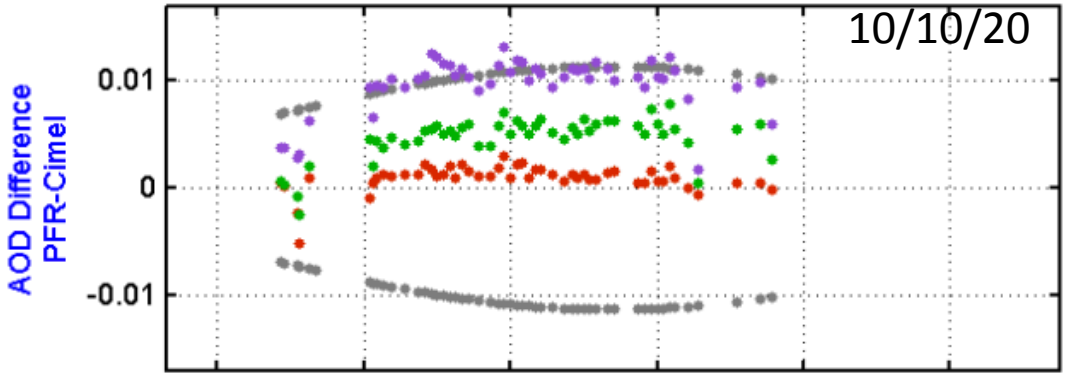


2 Cimel reference instruments
1 PFR instrument

ACTRIS-FR/ QA4EO / ESA

PFR (provided by PMOD)

PFR Robot (funded by ACTRIS-FR)



Comparison Results (points=52):
Differnces PFR - Cimel

862 nm: 1.03± 1.23 (x10^{-3})
100% within WMO limits

500 nm: 5.15± 2.07 (x10^{-3})
100% within WMO limits

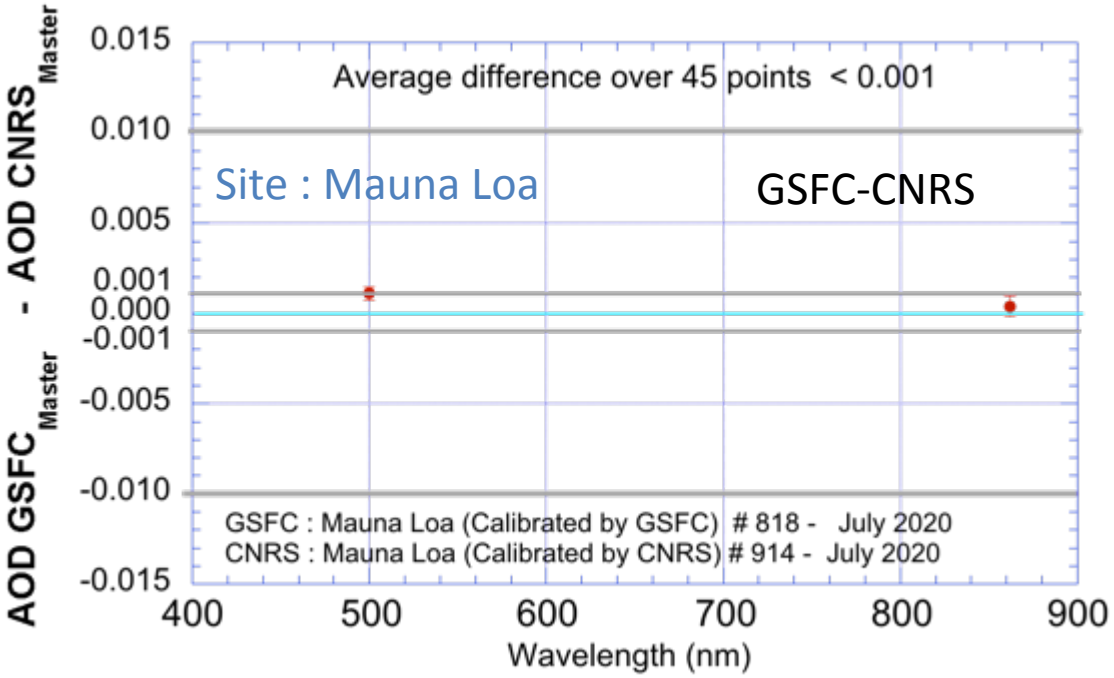
Angstrom exp.
368-862nm & 440-870nm:
-0.08± 0.04

https://www.pmodwrc.ch/en/world-radiation-center-2/worcc/gaw-pfr/OHP/

3. Comparison NASA / CNRS / PMOD

NASA reference vs CNRS reference vs PMOD-PFR reference
Frequency : every 3 months

Mauna Loa : same location, same software, different instrument, different dataset and different 'calibrator'



1. Same CNRS instrument at OHP & Mauna Loa

2. July 2020 exercise :
GSFC and CNRS < 0.001

3. October 2020 exercise: similar results

Conclusions / Future actions

- Traceability procedure for the campaign: setup ok
- First comparison looks quite good, analysis under progress
- Traceability of AERONET NASA
- Information to be mentioned on ACTRIS Calibration Certificate
- Archive and publish results
- Calibration platform at OHP/Lille needs to refresh Cimel robots (CCN 2021, Spring, 22 kE).

(coll. with PMOD)

4. Campaigns / Intensive Observation (organization + analysis)

4.1 MOBILE (ship photometer or PLASMA; Lidar)

- FIREX-AQ (USA- 2019, *done, 2 months of data*)
- MOABAI (China, 2017), 1 month of data, May, *paper submitted to ACP, Popovici et al., 2021*
- MOSAIC (North Pole, *few night time data, technical problem*)
- SEA2CLOUD (2020, March 2020, *shortened due to COVID-19*)

Permanent operation :

- NORTHSEA/CHANNEL (since May 2020, **see this presentation**)

Scheduled for January 2021:

- **MAP-IO (Indian ocean), see this presentation**

Expected in 2021 or later :

- Autralian mobile GAW station (CSIRO, Investigator)
- Romania : Black Sea (project)
- Other opportunities / needs for Cal/Val ?

4.2 STATIONARY (photometer; Lidar)

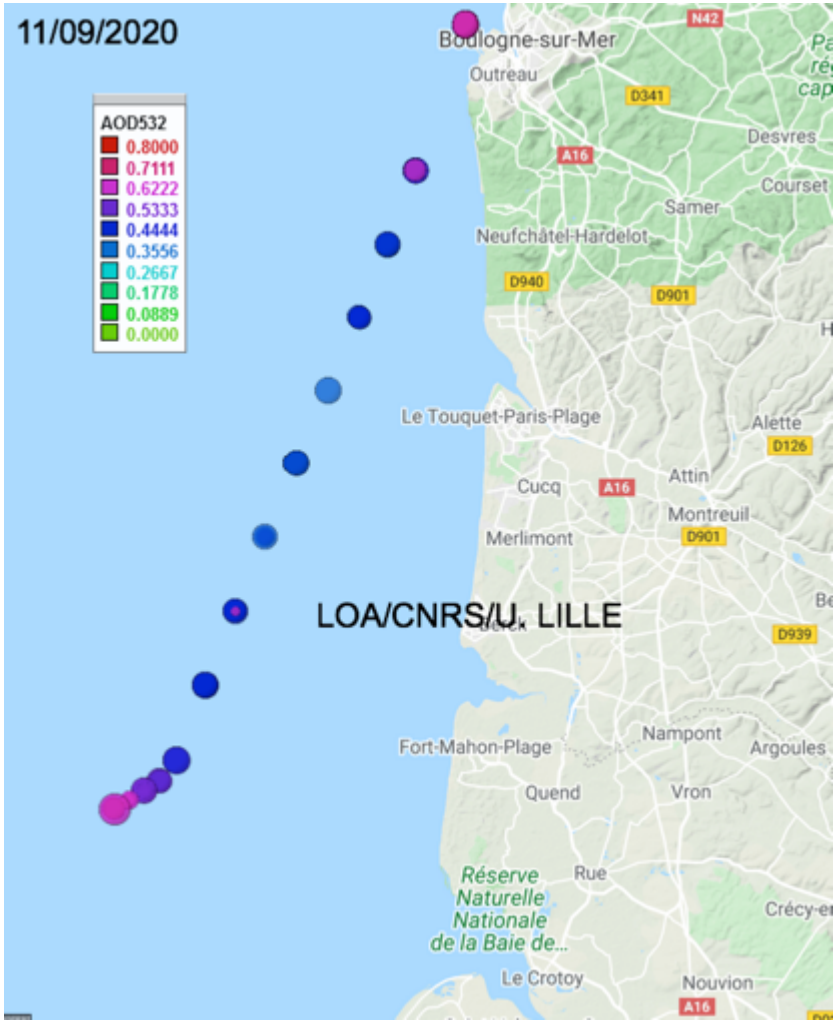
- COBIACC, done, France, 2019, *2 month, bioaerosols + in situ gas, North of France Summer, 1 paper soon submitted*
- DOA, done, China, *1 paper in ACP, Hu et al. -> 1 month (Unique dust profiles close to Taklamakhan)*
- Dakar-LOA/IRD facility, Senegal, permanent observation

- **LOA national facility** *: continuous observation with LILAS (unique Lidar system)*
  Lille : fluorescence + Californian smoke…, **see this presentation**
  1 publication in AMT (Veselovskii, Hu et al.,2020) + 2 publications in preparation

NORTHSEA/CHANNEL campaign
Preparation and operation

on a **small fishing boat**, Boulogne/mer, France

(credits: Luc Blarel, CNRS)



Observation during « Californian Smoke »
(AOD and Sky radiance)

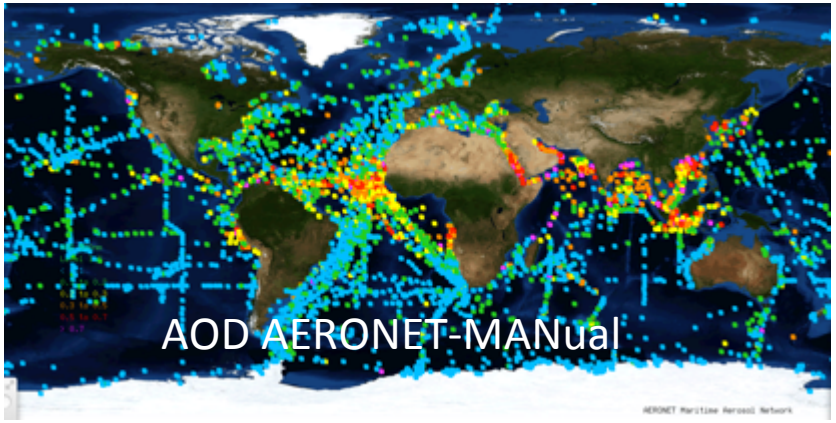
Last tests by CNRS off Boulogne/mer coast before setup in Marion Dufresne in January 2021

5. I/A (**Instrument** / Algorithm) developments (**photometers**, lidar and combination)

Marion Dufresne Atmospheric Program Indian Ocean (MAP-IO)

Université de la Réunion + several universities + Meteo France + IPEV

Monitoring and scientific analysis of atmospheric and oceanic parameters in the India Ocean



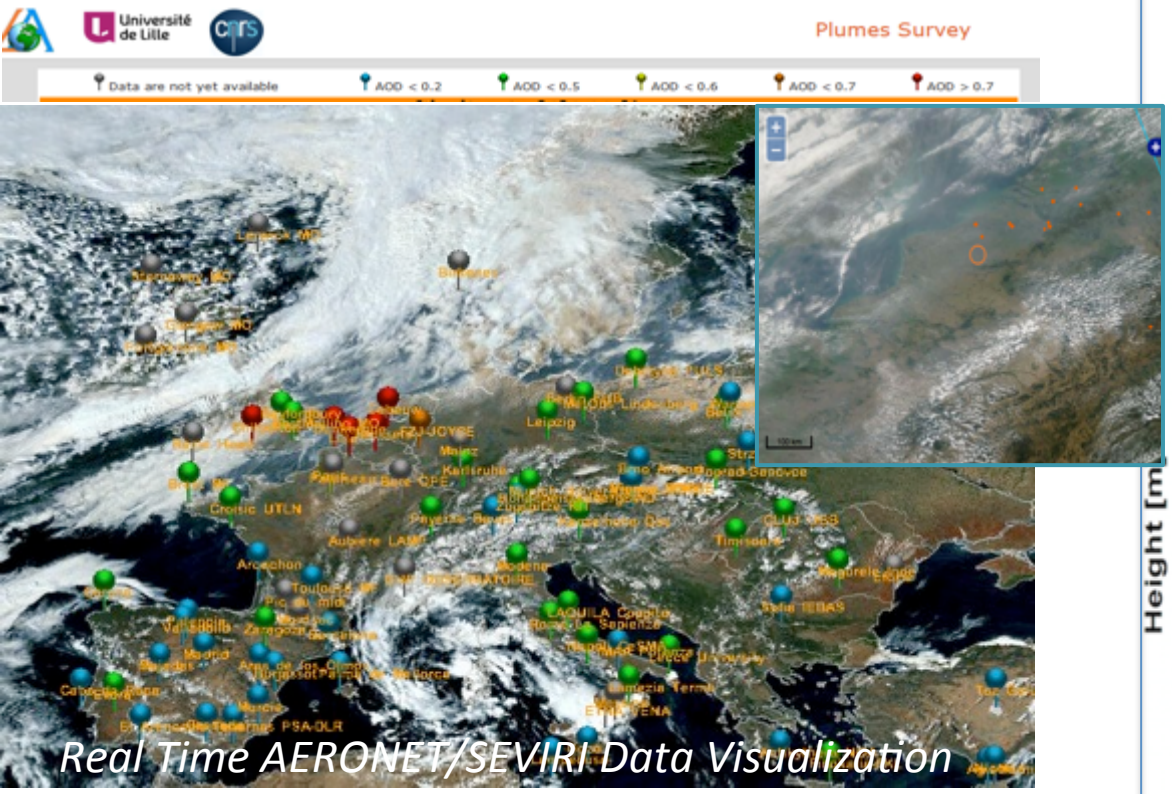
A new era is starting with mobile Automatic CE318T observations

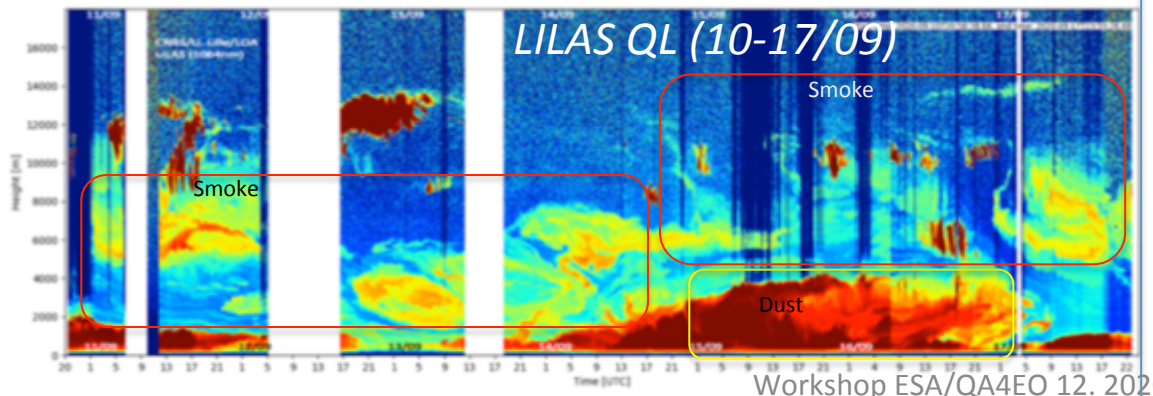
1 automatic ship-photometer will be setup and will start operation in january 2021
A Master 2 internship will analyze the data (Feb 2021-> June 2021).

5. I/A (**Instrument / Algorithm**) developments (photometers, **lidar** and combination)

LOA Facility : Investigation of Californian Smoke Episode

2 weeks of continuous observation, in September 2020

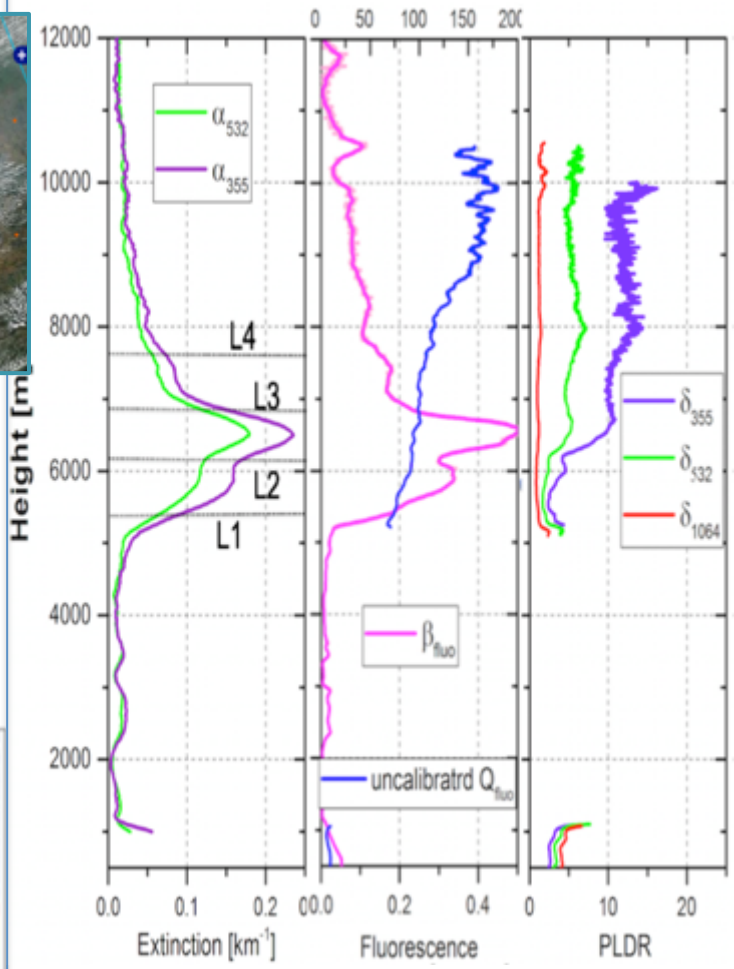




Fluorescence Lidar prototype

Veselovski & Hu

Veselovskii et al., 2020, AMT (invited . Professor, LOA)



Hu et al., ACP, *in preparation*

Ph.D Thesis started (2020-2023), Y. Chang
(new algorithmic development)

5. I/A (Instrument / Algorithm) developments (photometers, lidar and combination)

- ***SUN/SKY/MOON-PHOTOMETER***

  - **Ship-photometer**, CIMEL-based (AERONET/ACTRIS compatible)
    - Close to commercial version
    - Master 2 Internship (February to June 2020)

  - **Advanced mobile photometer** (all type of vector/platform), AERONET/ACTRIS-compatible.
    New concept combining CIMEL and CNRS developments - Under prototype phase.
    Looking for supports for building a first series (min 5)
    Applications :
    - Aircraft (atmospheric research aircraft from SAFIRE (CNES + CNRS), DLR ? ESA ? … ?
    - Ship : France, may be IFREMER, METEO France ? Australia (CSIRO, Yes), Romania (?), NASA ? ESA ? EUMETSAT ? ..
    - Van/car (mobile platforms), ….

- ***LIDAR***

  - **Fluorescence Lidar:**
    - prototype (LabEx CaPPA, U. Lille/CNRS, *Ph.D Thesis n°1. started 2020-2023, Yuyang Chang*.
    - new system, national program of investment (EquipEx, under evaluation)

- ***INTEGRATED SYSTEM***
  - Compact or not compact combination of photometer and lidar including:
    - Data processing and aerosol retrievals
    - 2 operation modes : off line processing and real time on board processing
      Ph.D Thesis n°2, just started 2020-2023, LOA/CIMEL, M.F Sanchez-Barrero

5. I/A (Instrument / **Algorithm**) developments (**photometers, lidar and combination**)

- Instrument compatible with AERONET/ACTRIS calibration / processing
- Data processing and preprocessing (QC/QA, geometric corrections,..)
- Aerosol retrievals :
  - AOD : done in AERONET and CNRS/ACTRIS processing chains
  - Volume Size Distribution : from spectral AOD inversion, day and night, GRASP-AOD *(Torres et al., 2017; 2021)*
  - All column properties (AOD and sky radiance, AERONET/GRASP)
  - Lidar alone and Lidar+Photometer : new information, new algorithms (Post-doc + Thesis n°1 + Thesis n°2)

Conclusions / Futures actions

- Looking for supports to built first serie of AMP (Advanced Mobile Photometers)
- Searching for campaign opportunities (contributions to Cal/Val)
- Data are available for space mission validations
- Developing automatic integrated system for stationary / mobile needs/applications
- Preparation of new services associated to mobile observations (framework for preparation, ACTRIS-IMP, QA4EO)
- MAP-IO project (Phase 1) – Phase 2, in 2022, will include automatic Lidar on board Marion Dufresne

- Lille supersite labelled as “Aerosol Remote Sensing platform” by University of Lille, July 2020
- Lille is candidate to be ACTRIS NF for Aerosol Remote Sensing – *decision in december 2020*

Thank you for you support !

2020 scientific production related to field or specific campaigns involving photometer & Lidar

Publications

- Veselovskii, I., Hu, Q., Goloub, P., Podvin, T., Korenskiy, M., Derimian, Y., Legrand, M. & Castellanos, P. (2020). Variability in lidar-derived particle properties over West Africa due to changes in absorption: towards an understanding. *Atmos. Chem. Phys.*, 20(11), 6563-6581. 10.5194/acp-20-6563-2020
- Hu, Q., Wang, H., Goloub, P., Li, Z., Veselovskii, I., Podvin, T., Li, K. & Korenskiy, M. (2020). The characterization of Taklamakan dust properties using a multiwavelength Raman polarization lidar in Kashi, China. *Atmos. Chem. Phys.*, 20(22), 13817-13834. 10.5194/acp-20-13817-2020
- Veselovskii, I., Hu, Q., Goloub, P., Podvin, T., Korenskiy, M., Pujol, O., Dubovik, O., and Lopatin, A.: Combined use of Mie-Raman and fluorescence lidar observations for improving aerosol characterization: feasibility experiment, Atmos. Meas. Tech. Discuss., https://doi.org/10.5194/amt-2020-291, 2020 (accepted).

Submitted publications

- De Brito J.F. et al., Extreme heat wave impacts on northern France's atmospheric dynamics, reactivity and composition: Overview of COBIACC field campaign", soon submitted to ACP, 2021
- Ioana E. Popovici, Philippe Goloub, Luc Blarel, Thierry Podvin, Xia Xiangao, Hongbin Chen, Zhaoze Deng, Yitian Hao, Hongyan Chen, Disong Fu, Nan Yin, Benjamin Torres, Stéphane Victori, Spatial and vertical variability of aerosol optical properties during MOABAI mobile campaign in North China Plain, soon submitted to ACP, 2021

Conference / workshop

- Popovici I.E , M. F. Sanchez Barrero P. Goloub, T. Podvin, L. Blarel, G. Dubois, A. Lapionak, L. Proniewski, S. Victori, B. Holben, D. Giles, A. LaRosa, T. Eck, M. Sorokin, J. Schafer, A. Smirnov, A. Sinyuk, I. Slutsker, J. Kraft, J. Campbell, E. Welton, Smoke Observations by LIDAR and Sun Photometer Mobile Measurements during FIREX-AQ Campaign in summer 2019, Smoke symposium, Virtual, Avril 2020
- Popovici I.E , M. F. Sanchez Barrero P. Goloub, T. Podvin, L. Blarel, G. Dubois, A. Lapionak, L. Proniewski, S. Victori, B. Holben, D. Giles, A. LaRosa, T. Eck, M. Sorokin, J. Schafer, A. Smirnov, A. Sinyuk, I. Slutsker, J. Kraft, J. Campbell, E. Welton , Smoke Observations by Lidar and Sun Photometer Mobile Measurements during FIREX-AQ campaign in summer 2019, European Lidar Conference, Virtual, 2020.
- Giles David, Brent Holben, Tom Eck, Ilya Slutsker, Anthony LaRosa, Mikhail Sorokin, Alexander Smirnov, Alexander Sinyuk, Joel Schafer, Jason Kraft, Amy Scully, Philippe Goloub, Thierry Podvin, Luc Blarel, Lelia Proniewski, Ioana Popovici, Gael Dubois, Aliaksandr Lapyonok, FIREX-AQ ER2 – 23 June 2020, AERONET DRAGON Mobile Observations during FIREX-AQ, Williams Flats Fire, Smoke symposium, Virtual, Avril 2020
- Veselovski I., P. Goloub, Hu Q., T. Podvin, Aerosol characterization from Raman and fluorescence lidar measurements, European Lidar Conference, 2020
- Hu Q., P. Goloub, I. Veselovski, T. Podvin, Transported Californian smoke layers over Lille, workshop ACTRIS, November 2020, France

Internal reporting

- Hu Q., P. Goloub et al. June 2020, Pre-analysis of some column integrated aerosol optical properties, with focus on Spring 2020 COVID-19 period, internal report, LOA.

Internships 2020, LOA

- Chang Y., Hu Q., Goloub P., Dust Aerosol Observation (DAO) campaign: Analysis of aerosol events observed at Kashi site, Master 2 internship, 2020. University de Lille
- Maria Fernanda SANCHEZ BARRERO, Analysis of the Mobile Remote Sensing data from North American FIREX-AQ intensive field campaign, Master 2 internship, 2020. University de Lille