ACTRIS/AERONET Europe Newsletter

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Foreword. This is the second newsletter and we are happy to share with you some news about our activities. In 2017 and during the first semester of 2018, we (French and Spanish partners) were, as usual, very busy to provide you the best calibration, maintenance services and technical expertise but also to work on new instrumental developments, new calibration and aerosol retrieval techniques. New people came also on board. At the same time, we were all deeply involved in writing our concept paper for the future ACTRIS Research Infrastructure. This period was also quite rich in terms of atmospheric/aerosol events (Ophelia, stratospheric aerosols from Canada, ...) affecting, at least our European observation stations. To capture and study these phenomena we, you and us, must be ready, you by keeping eyes, time to time on your instrument and us, by providing the highest near real time aerosol data and services. This second newsletter will highlight some of these activities/events.

Infrastructure's Life

- *Activities*: During the last 18 month (second ACTRIS-2 period), the French-Spanish consortium provided close to 150 calibration accesses, very similarly to the first ACTRIS-2 period. Beside the regular users, about 25 new users applied for calibration, including 10 sites from the UK-Met Office photometer network. All components had, through various national (e. g ACTRIS-FR, CNRS, AEMET, MINECO[1]) and European (e.g ESA) supports, opportunities to fund a first series of upgrades of the calibration facilities. For example, the master calibration facility, located at AEMET/Izaña site has been upgraded from 8 to 20 units. In Spain again, national funding has supported the purchase of new instruments devoted to calibration and link with World Radiation Center (WRC) to maintain AERONET/CIMEL-GAW/PFR-traceability. At the same time, ACTRIS-France supported calibration facility upgrades (instruments and platform) since the French solar calibration platform operated in Carpentras (Meteo France) since 2004 will move to *Observatoire de Haute Provence* (CNRS) during Fall 2018. This year also, AERONET workshop was hold in Washington at NASA/GSFC and gathered US, French and Spanish experts from 19 to 23 March (figure 1).

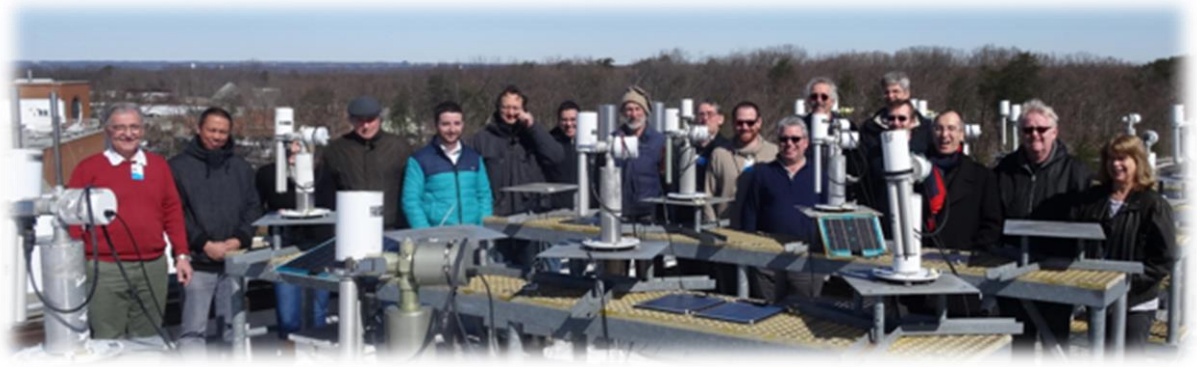

Figure 1: Group picture during the AERONET workshop at GSFC 19-23/03/2018.

Due to heavy snowstorm, NASA was temporarily closed but discussion went on thanks to Brent Holben hospitality! The agenda was very dense and addressed version 3 release (version 2 will be no more produced by the end of 2018), lunar AOD calibration and processing, normalization of radiance calibration protocols, including the so-called vicarious calibration, uncertainty of all retrieval products and many other exiting topics like mobile photometry.

- *People:* In France, Gael Dubois, engineer, supported by ACTRIS-2 project, joined us. He primarily addresses data quality control issue that is so important. Aliaksander Lapionak ("Sasha") got a position at CNRS as Assistant Engineer, contributing to maintenance. Fabrice Ducos (Engineer CNRS) will provide part time computer/software development support needed by our activity. Finally, Dr. Benjamin Torres got a position of Assistant Professor at Lille University and will contribute to our scientific activity.

- *Instrument:* upgrade issue. Since CE318T sun/sky/lunar/polarisation photometer, also called Model T, was validated and accepted in the network, upgrade phase has started on both sides of the Atlantic, however with different rates. The technical evolutions bring improved features and efficiency which are strategic for the objectives of the network, calibration and maintenance

[1] Financed by the State Research Agency of the Ministry of Economy, Industry and Competitiveness (MINECO), in the Call for projects of scientific equipment, co-financed with ERDF funds

managment: more accurate tracking system (sun and the moon), better control of the robot (microstepping technology), smoother robot movements, improved pointing resolution (0.003°), fully numerical control unit with high storage capacity, single powerful firmware (all usual scenarios for standard, polarized and/or sea prism, including new scenarios like the hybrid scenario and curvature cross to improve cloud screening); improved local interface, large backlight LCD display, new communication channels (GPS receiver and modern communication modes, USB, radio, GPRS, DCP…). In addition, meteorological parameters are measured which increases efficiency of the data processing. CE318T model opens new horizon, as you will read later in this newsletter. As recommended in the ACTRIS concept paper, previous CE318 model, older than 10 years, has to be replaced. Important investment efforts are therefore clearly needed to serve the ambition of the scientific community.

• *Application to Infrastructure call*: ACTRIS (*Aerosols, Clouds, and Trace gases Research Infrastructure*) was adopted to the ESFRI roadmap, 2 years ago, in 2016. During the ongoing *preparation phase* (2017-2019), ACTRIS shall achieve maturity at organizational, operational, and strategic levels. The preparation phase is supported by the European Commission (ACTRIS Preparatory Phase Project, PPP) and partner countries and organizations at the national level. The ACTRIS Central Facilities (CFs) host selection will be an essential outcome of ACTRIS PPP (Preparatory Phase Project). During the *implementation phase* (expected 2020-2024), the CFs are constructed and their services are tested. ACTRIS operations will start step-by-step by ramping up the service provision. After the necessary legal preparations, ACTRIS shall become a legal entity (ERIC, European Research Infrastructure Consortium) funded by the Member countries. The target is to launch ACTRIS ERIC in the beginning of 2021. It is foreseen that ACTRIS will be fully operational by 2025. The technical requirements and service provision of ACTRIS Central Facilities are detailed in the ACTRIS CF concept documents available in the call material.

AERONET Europe contribution to ACTRIS will be visible through the Central Facility "Center of Aerosol Remote Sensing" (CARS) in which both European photometry and LiDAR experts have merged. The reason of this 'wedding' is, undoubtedly, the great potential of combining passive and active remote sensing techniques to bring added-value parameters for better characterizing aerosols. Since summer 2017, we wrote the CARS concept paper and applied the ACTRIS Central Facilities (CFs) host selection call early August 2018. The goal of the selection process is to decide upon the undisputed host candidates for ACTRIS Central Facilities (CFs) - Head Office, Data Centre and six Topical Centres. The final decision is made by the Interim ACTRIS Council in September/October 2018.

Highlight on AERONET data processing version 3 release. During summer 2017, AERONET-NASA released version 3 AOD products (with several new improvements in the cloud screening procedure, gas transmission, data quality checks in real time (see AERONET Website for more information). In December 2017, the release of Version 3 "Inversion products" has been opened to public. At the moment, both version 2 and 3 are available. V3 Quality Assured Aerosol Optical Depth (AOD) including Angstrom Exponent and Water Vapor database is now available. V3 Quality Assured Spectral Deconvolution Algorithm (SDA) retrieval products (fine mode AOD, coarse mode AOD, and fine mode fraction of AOD) database is now available. V3 Level 1.5 and Level 2.0 Almucantar inversion database available 11 January 2018. Version 2 Level 2.0 AOD, SDA, and Inversion databases is expected to be maintained concurrently until end 2018. Polarization and nighttime AOD will be released later by end of 2018 (*paper in preparation*).

Highlight on publications. *In this letter, we highlight 3 papers.* The first one, by Torres et al. (AMT), is addressing an advanced aerosol characterization based on spectral extinction AOD inverted by GRASP algorithm. *The second one, by* Kazadzis et al. (ACP), is presenting the results of an intercomparison campaign between reference PFR sunphotometer and several other photometers like CIMEL CE318. The third one, from Popovici et al., (AMT), is focusing on mobile aerosol remote sensing observation and include photometer and LiDAR. Full references are listed below.

- Torres, B., et al., Advanced characterization of aerosol properties from measurements of spectral optical depth using the GRASP algorithm, *Atmos. Meas. Tech*., 10, 3743-3781, https://doi.org/10.5194/amt-10-3743-2017
- Kazadzis S. et al., Results from the Fourth WMO Filter Radiometer Comparison for aerosol optical depth measurements, *Atmos. Chem. Phys*., 18, 3185-3201, 2018, https://doi.org/10.5194/acp-18-3185-2018.
- Popovici, I. E. et al.: Description and applications of a mobile system performing on-road aerosol remote sensing and in situ measurements, *Atmos. Meas. Tech*., 11, 4671-4691, https://doi.org/10.5194/amt-11-4671-2018

Highlight on new instrumental development for mobile photometry. In the past, LOA (PHOTONS/AERONET) has developed instrumental concept to perform mobile photometry for airborne observation *(Karol et al., 2013, AMT)*. More recently, a second version has been built to address terrestrial observation *(Popovici et., 2018, AMT)*. Very recently, with the supports from ESA/IDEAS program (support to calibration facility), from CIMEL company and from CaPPA laboratory of Excellence, a first prototype of a marine version has been developed by ACTRIS-FR/PHOTONS service and setup on ships during 2 scientific campaigns. The first campaign, AQABA (*Air quality and climate change in the Arabian Basin*) was performed with the support of the Cyprus Institute (J. Sciare) on board the Iona Kommandor Ship during summer 2017 from Toulon (France) to Kuwait City. The second campaign was performed in the framework of the OCEANET-Atmosphere project led by TROPOS in collaboration with AWI (Alfred Wegener Institute), onboard the German research vessel Polarstern from Punta to Bremerhaven, Germany (figure 2).

Figure 2: OCEANET-Campaign, May 2018. Courtesy from M. Radenz, Z. Yin, C. J. and T. Kanitz from *TROPOS.*

During these two campaigns, the prototype photometer successfully provided, automatic spectral AOD and water vapor content. This first prototype, based on CIMEL CE318T, is a good candidate for future exploratory mobile platform and opens the way to automatic marine observation, providing a nice perspective for the ocean color community. A second campaign onboard the Polarstern will start in November 2018 from Bremerhaven (Germany) to Cape Town (South Africa). In France, a project to equip, permanently, the Marion Dufresne Vessel from IPEV (Institute Paul Emile Victor) with this automatic photometer is under preparation , in collaboration with La Réunion University.

Highlight on one extreme aerosol event: Saharan dust outbreak and Ophelia hurricane conjunction. In mid October, the West and North of France (Hauts-de-France region), was affected by both heavy mineral desert dust layer transported from Sahara and thick smoke particle layers originated from Portugal forest fires. This extreme aerosol event produced the highest AOD ever recorded in Lille, since AERONET station started operation in 1992 (AOD reached 2.7 at 440 nm).

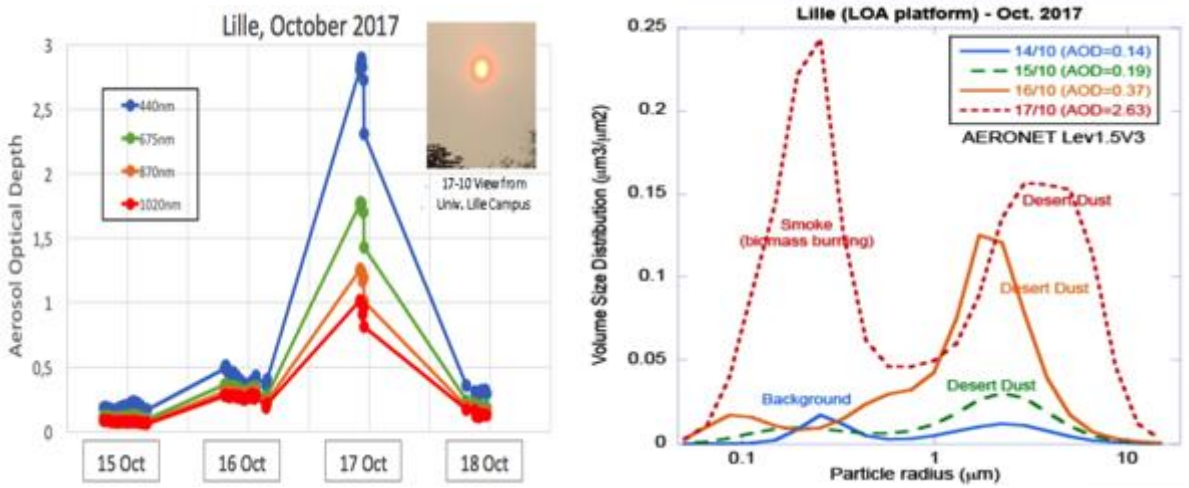

Figure 3: Aerosol Properties retrieved from sun/sky photometer in operation at Lille AERONET station during the extreme biomass burning-Dust event in October 2017. (a) AOD time series, (b) AERONET aerosol size distribution (version 3); Photography credits: Q. Hu, LOA.

Highlight on "Lunar photometry" workshop. Lunar photometer workshop organized at Izaña observatory in June 2017 with participants from several European countries (Spain, Italy, USA, France, Canada, …). One objective of the workshop was to improve the Moon irradiance model *(Barreto et al., 2017, AMT*) required to accurately compute night time AOD.

(a) (b)

Figure 4: (a) Lunar photometry workshop (Izaña, June 2017); (b) Stellar Photometer taking "flat field" images near the sunset time with the star photometer (EXCALIBUR; iTecAstronómica S.L.) of the Granada University, Izaña Atmospheric Research Center 2017.

Highlight on a new site: Chacaltaya Observatory (Bolivia, 5240 m a.s.l). The instrument is located at the roof of the Chacaltaya Observatory building. This Observatory is part of the Global Atmosphere Watch network and is located at the Bolivian Andes (16°21.014'S, 68:07.886'W, 5240m asl) at Mount Chacaltaya (5400 m asl) 150 m below the summit facing southward towards the metropolitan area of La Paz and El Alto. This urban conglomerate has 1.7 million inhabitants and its influence can be monitored almost on a daily basis at the station. The PI of the site is Dr. Marcos Andrade and the site manager is Fabricio Avila from the Laboratory for Atmospheric Physics, Cota Cota, Campus Universitario UMSA, La Paz-Bolivia

Figure 5: View of the instrument setup at the "Mount Chacaltaya" station. Part of the city of El Alto, 4000 m asl, can be seen in the background.

Technical Recommendations.

Quality Control issue: One very important service/activity is the regular quality control (QC) that has to be performed by AERONET actors in close cooperation with each site manager. Without this regular work, the data may be rejected and quality assurance level never reached. Figure 6 is a nice illustration of the detection of such problem.

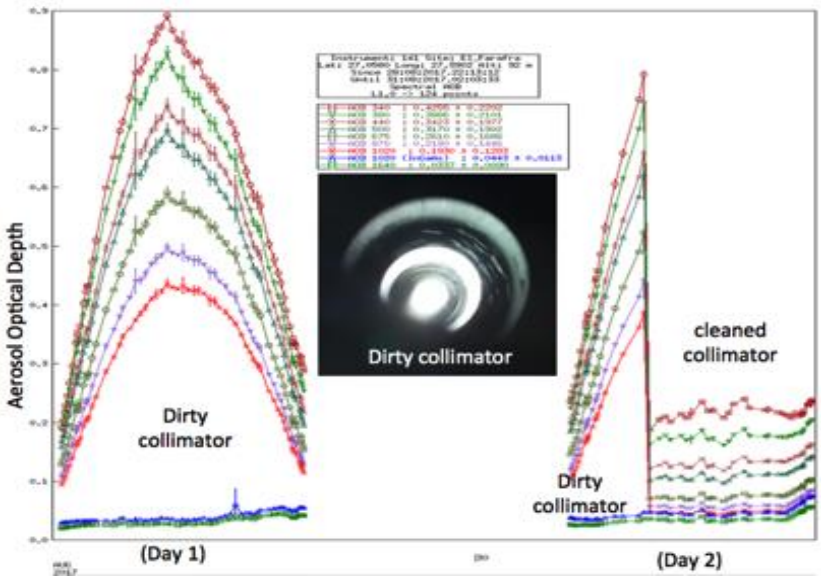

Figure 6: AOD time series when a photometer collimator is dirty (QC detection) and after cleaning the collimator by the local site manager.

It is very important to have a reactive site manager to respond to the persons in charge of the QC to solve quickly this type of problem. Users and site manager are encouraged to follow AERONET SOPs and to regularly clean external parts of the photometer (*see Newsletter n°1*). See our Bestof

Power supply issue: Statistically, about 80 % of the problem encountered came from the batteries. The 2 external black batteries (6 V, 8 Ah) plugged in serial (to give 12 V) are running the robot and the filter wheel in the photometer head. The internal 5.5V battery is located in the white white control unit. In general, a 5W solar panel (sp) can be used to charge external and internal batteries. The solar panel is plugged on the terminal CIMEL box, on the 'sp' connector. Inside the photometer, there are 2 regulators to charge the 5.5V battery and external 12V batteries.

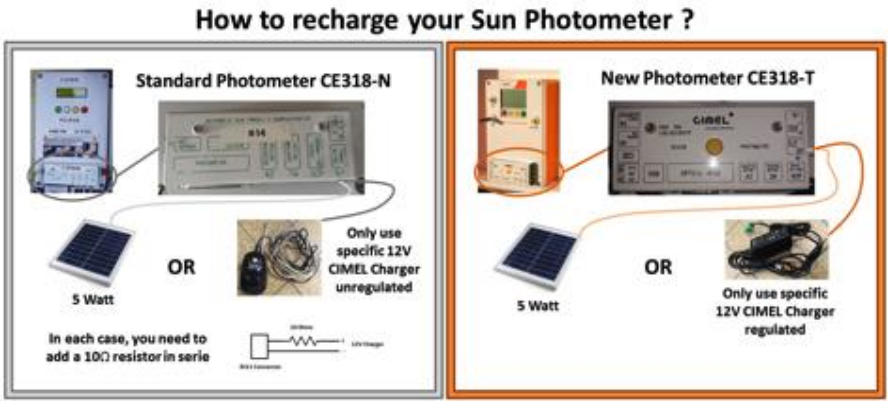

Figure 7: The right way to recharge your sunphotometer (old CE318 and new CE318T versions).

For any reason, if you do not or cannot use the solar panel, please use the unregulated CIMEL power supply 12V-500mA. If you do not have the 12V CIMEL power supply, buy one yourself but you have to carefully add a 10 Ohms resistance, in serial with the +12V battery. This resistance limits the intensity inside the regulator. If you forget to add it, you can/will burn the regulator or some components inside the CIMEL box (suggested list of spare elements: Timing Belt, External Battery, Radiospare Power supply 3/12 VDC 500mA , USB/RS232 Converter , Converter Cable Tie).

Important logistical recommendations. We remind you that, under the ACTRIS umbrella, the European branch of AERONET provides photometer calibration, Quality Control as well as standard maintenance for free. On the other hand, shipment and customs costs remain in responsibility and charge of the PI. Customs issue often arises when receiving parcels from outside the European Union. *We are not in position to manage photometers that are not sent in "Delivered, Duty paid" mode (DDP) because otherwise VAT and customs fees are charged to CNRS, University of Valladolid or AMET.* We kindly recommend you, PI from a non-European country, to be very careful and helpful, at this point, and send your photometers in DDP mode. Thanks ! *Last but not least important advice: in any case, to optimise custom tax, it is suggested to minimise the declared photometer value.*

Data policy and acknowledgment recommendations. We would like to remind how important it is to report to ACTRIS all the publications related to the use of instruments calibrated within AERONET-Europe. We kindly request every PI/user to send us your list of publications (full reference, and when/if possible the publications in pdf format). We also kindly remind to follow, in addition to AERONET acknowledgment, the recommendations for acknowledgement given below:
«Authors acknowledge AERONET-Europe/ACTRIS for calibration and maintenance services. The research leading to these results has received funding from European Union's Horizon 2020 research and innovation programme under grant agreement No 654109»

Low cost photometer: Calitoo story (cont'ed).

A new set of 100 handheld low cost photometers has been built by the TENUM company (Toulouse, France) and has got their initial calibration at Izana, in June 2018 (figure 8).

Figure 8: Calitoo absolute calibration setup, Izana observatory, 2018 (Picture credits, F. Bouchard)

In 2018, a new methodology to transfer the calibration in the laboratory has been investigated by LOA in order to simplify the re-calibration work.

A 4-wavelength version is currently under investigation in the near infrared, in order to improve the spectral information suitable for better deriving column integrated particle size distribution.

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