LIDAR INNOVATION: CIMEL CE376 AND CE710 LIDARS

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PROJECT AND METHODS

CIMEL is well known for its photometers equipping AERONET and has a long time cooperation with LOA, which now materialized in a joint laboratory AGORA-Lab. In the frame of AGORA-Lab, development of innovating CIMEL lidar is also considered, which aims to enhance the capacity of atmospheric research infrastructure in support of the space-based observing system and to extend spatial coverage of operations and completeness of existing observation platforms. The LIDAR characterization and validation is done at ATOLL (ATmospheric Observatory of liLLE) platform operated by LOA, University of Lille/CNRS, France, where EARLINET QC/QA procedures are followed. AUSTRAL (AUtomated Server for the TReatment of Atmospheric Lidars) processing framework allows the treatment, retrieval and visualization of both CE710 and CE376 LIDAR data (**Fig. 2**, **Fig. 4**). It was developed by LOA in the framework of AGORA-Lab.

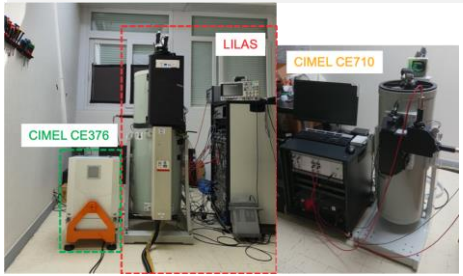

Fig. 1. CIMEL CE376 micro-pulse lidar, LILAS high-power lidar and CE710 high-power CIMEL lidar at ATOLL platform

LIDAR	CE376	CE710	LILAS
Laser energy	6 µJ	55 mJ	100 mJ
Repetition rate	4.7 kHz	20 Hz	20 Hz
Telescope diameter	10 cm	30 cm	40 cm
Eye-safe	yes	no	no
Wavelengths (nm)	532, 808	532 modulable	355, 532, 1064
Depolarization	yes (532)	yes	yes (355, 532, 1064)
Raman channels	no	modulable	yes (387, 408, 530)

RESULTS

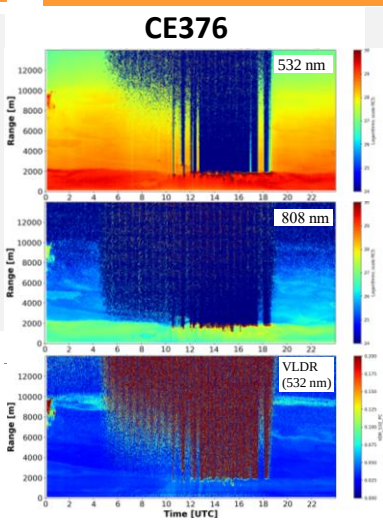

Fig. 2. CE376 lidar measurements at ATOLL platform Lille, France, 16 April 2021, AUSTRAL processing

CE376 micro-pulse lidar allows continuous monitoring of the PBL and of transported aerosol layers in the free troposphere. The depolarization channel at 532 nm allows to identify low-depolarizing particles such as aged smoke from Siberian wildfires at 8-10 km and below (**Fig. 2**). The comparison with LILAS EARLINET/ACTRIS lidar (**Fig. 3**) shows the quality of the CE376 lidar (extinction derived from Klett inversion with lidar ratio of 50 sr): 10% differences for extinction (EXT) and backscatter (BSC) profiles and 7% for VLDR and PLDR.

The new CE710 CIMEL lidar operated alongside LILAS lidar at ATOLL and allowed observations of Saharan dust up to 10 km on the night of 2-3 March 2021 (**Fig. 4**). Extinction profiles were derived using Klett method constrained by nighttime AOD. The results showed excellent agreement between the two systems, with differences of 2% for EXT, 0.5% for BSC, 1% for VLDR and 4% for PLDR. The extinction (70 ± 35 Mm^{-1}), the PLDR (0.3 ± 0.03) and the retrieved lidar ratio (52 sr) for the main dust layers between 2.5 km and 7 km are consistent with the values observed in Germany for the same dust event (Haarig et al., 2022)

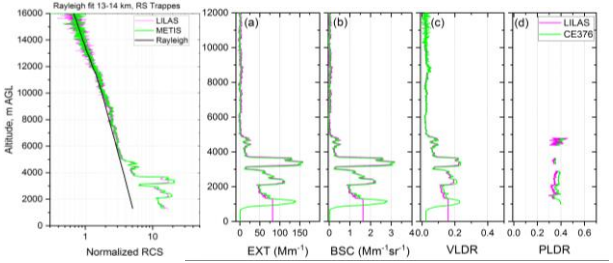

Fig. 3. Comparison of CE376 and LILAS lidars, 1 April 2021 (19:50-20:00 UTC), Lille, France

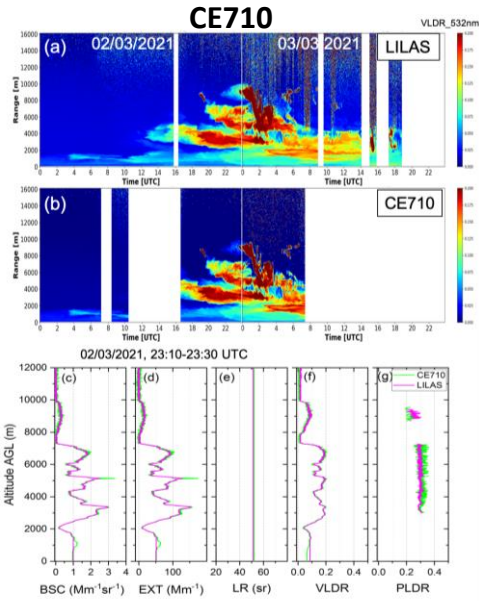

Fig. 4. Saharan dust observations at ATOLL platform (LOA/CNRS), Lille, France on 2-3 March 2021 by LILAS and CE710 lidars

PERSPECTIVES

The current effort being made on the CE376 micro-pulse lidar is to develop a robust (mechanical and thermally) version to be operated on various mobile supports. On the CE710 the future will be the enhanced automation and remote control of the system. The OBS4CLIM project (2022-2028) will fund 4 such CE376 lidars and CE710 high-power lidar. A new project ATMO-TECH (recently submitted to INFRA-TECH) is now considered to foster on "mobile technology for atmospheric monitoring" to develop innovative technologies, more efficient and cheaper.