Title : **BouLOn - Boundary Layer Composition and Dynamics at the Observatoire de Haute-Provence**

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Co-funding : ACTRIS-Fr (AEROS-OHP project, 2019) ; OHP-GEO (Atmospheric component of OHP, INSU).

Main results :

Lidar* measurements as to quantify the Planetary Boundary Layer Height (PBLH) and, in a second step, to describe aerosols of various origins in the vertical profile of the troposphere, have been identified to be of great interest for an interdisciplinary research perspective for the research community at the observatory 'Observatoire de Haute Provence' (OHP), which hosts stations of ecosystem and atmospheric research of major Research Infrastructures (AnaEE, ICOS, NDACC, ACTRIS).

The ICOS-Lidar (CIMEL Electronique S.A.S., France), dedicated to analyses of the troposphere (installed at the ICOS station in July 2012), needed to be validated for its instrumental performance. This was approached by the possibility for instrument inter-comparison with 2 other Lidars during a three day PBLH campaign at the OHP in the framework of the ACTRIS-Fr research infrastructure.

An alignment problem of the Lidars optics was diagnosed and subsequently repaired by CIMEL, just in time as that the instrument was fully performant for the FLEXSense campaign (ESA Earth mission Eplorer FLEX) on the 10th Jul 2018, and for which the Lidar data are essential.

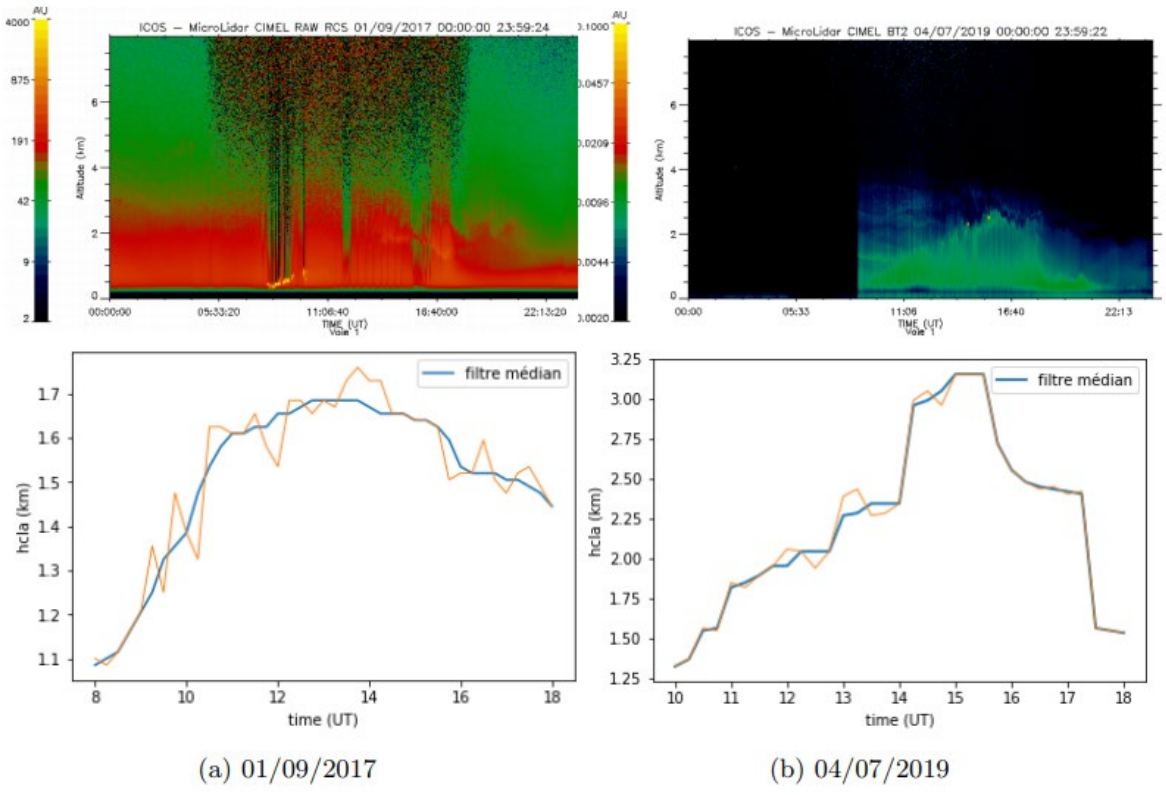

Fig.1 Extraction of the PBLH (here noted hcla) from the ICOS LIdar for two case studies (Sept.1st, 2017 and July 4th, 2019) – source : Rey et al, 2019.

In general, the performance of the Lidar was good, producing exploitable data up to a height of about 3 km during daylight hours (clear sky), thus allowing to identify the PBLH (as confirmed by balloon sounding and the other Lidars). Volatile organic compound air samples were taken at ground level at the O3HP, as to interpret in the future potential abundance of secondary organic aerosols in the vertical column. A new promising, reasonably priced gas chromatograph prototype (GC Maverick)

for detecting VOC (here tuned for isoprene, toluol, benzene) had been deployed by LATMOS for this campaign. However, this instrument has shown to need further amendments.

With the functionality of the instrument being approved, the operational exploitation of the data was launched in the framework of the OHP-GEO project in collaboration with the ACTRIS-Fr community and the Laboratoire Optique de Lille, coordinator of the French tropospheric aerosols Lidar National Service of Observation. PBLH datasets are now produced on a daily basis and are accessible from the AERIS national atmospheric database on demand to the PI of the ICOS-Lidar (I. Xueref-Remy). Their quality control is under development.

Furthermore, within a summer grant (July 2019, 3 weeks), Zoé Rey, a Master 1 level student (superv. I. Xueref-Remy, F. Ravetta, S. Khaykin) funded by Actris-Fr performed a manual treatment on two 1-day case studies (Sept.1st, 2017 and July 4th, 2019). The PBLH could be extracted and shows that the ICOS Lidar is able to follow the diurnal cycle of the PBLH (Fig.1 ; Rey et al, 2019). For these two case studies, a comparison of the ICOS Lidar datasets with the NDACC Lidar datasets on the range of altitude from 5 to 12 km. A good agreement between the two instruments was found. In the second case study, large stratospheric aerosols plumes could be detected on both datasets, likely originating from the eruption of the Raikoke volcano (Russia). This will be further inferred by using the depolarisation channel of the Lidars.

Follow-ups of the project

- Contribution to and Co-financing from ACTRIS-Fr for the Lidar intercomparison campaign ABLH.
- Incorporation of the OHP Lidar datasets into the national atmospheric database AERIS.

Perspectives:

- Contractual Contribution to the FLEXsense and AtmoFLEX subprojects in the FLEX program (ESA, Earth mission Explorer), 60 k€
- Further Lidar data treatment and analysis is planned through the Master 2 training period of Zoé Rey early 2020.
- A deeper valorisation of the Lidar datasets is programmed in the framework of a phD project starting in 2020, if the phD-grant can be obtained.

Communications – Publications :

Goloub, P., I. Xueref-Remy, F. Ravetta et al, Summary of the Actris-Fr tropospheric aerosols Lidars, Actris-Fr annual users meeting, Fréjus, Mai 2018, France

Rey, Z., Xueref-Remy, S. Khaykin and F. Ravetta, Calibration du lidar ICOS et comparaison avec le lidar LTA, en synergie avec les photomètres. Cas d'étude le 1er Septembre 2017 et le 4 Juillet 2019, July 2019, LATMOS, Zoé REY summer contract report, under the supervision of I. Xueref-Remy, S. Khaykin and F. Ravetta, funding : AEROS-OHP Actris-Fr grant, Paris, France, 2019.

*Lidar means Light Detection And Ranging.