LOA LABORATOIRE D'OPTIQUE ATMOSPHÉRIQUE

Université de Lille cnrs

Doctoral thesis topic (2025-2028)

Multi-Scale Synergies for the Optical, Microphysical, and Chemical Characterization of Aerosols Using Lidar Fluorescence and In Situ Measurements from the ATOLL Platform

The Hauts-de-France region, located at a crossroads where air masses from various origins converge, is particularly exposed to the long-range transport of aerosols. The ATOLL observatory leverages this diversity, as well as local and regional sources, by maintaining a unique dataset that facilitates the in-depth study of complex interactions between local and transported aerosols, while evaluating their impact on air quality and climate.

Through continuous and multi-parameter measurements, ATOLL plays a significant role in enhancing the analysis and understanding of atmospheric processes, improving models, and developing strategies for air quality management. The data collected are integrated into national, European, and international databases, further establishing ATOLL as a key player in research on aerosols and their influence on the environment and climate.

In this project, the Ph.D. candidate will utilize the potential of the LIFE lidar (Laser-Induced Fluorescence Explorer), which introduces a new dimension of observation through multi-spectral fluorescence detection. Successfully tested with a prototype since 2020, this technology provides discriminative information on the chemical composition and properties of particles (in both clear and cloudy atmospheres), surpassing conventional lidars. This approach will also integrate advanced in situ observations, including fluorescence measurements at the particle scale using a WIBS sensor (in collaboration with the University of Clermont-Ferrand and DMT company) and potentially particle imaging and holography. These will help develop improved tools for interpreting lidar data, enabling a better understanding of aerosols impacting the region.

The work will involve creating a database of aerosol characteristics from LIFE and in situ measurements, which requires precise identification of aerosol sources (local or long-range transport) and their penetration into the planetary boundary layer (PBL) down to the surface. This will enhance aerosol characterization through remote sensing by integrating lidar and in situ measurements, supported by a lidar classification method validated with coincident data. Outcomes will include strengthened remote sensing/in situ synergies within ATOLL, the development of algorithms for improved classification, and the dissemination of results within the ACTRIS community and through collaborations with CIMEL (AGORA-Lab) and DMT companies (technological applications). This project aligns with the scientific priorities of the LOA, CaPPA, OBS4CLIM, and AREA projects.

Keywords: Climate, air quality, aerosols, lidar, fluorescence, in situFundings : CaPPA/AREA (accepted) + U-Lille (expected); Related-papers

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Candidature/Application : best before April 2025 (send CV and motivation letter)