PHD OFFER

Long-term trend study of fine particle datasets and organic aerosol sources at different urban sites in France (part of the CARA program)

Type of contract: Doctoral contract (2025-2028)

Main location: INERIS at Verneuil-en-Halatte (60), 40 mn north of Paris

Access: A free private bus provides the connection between Creil station and the INERIS site in Verneuil-en-Halatte.

CONTEXT AND OBJECTIVES OF THE THESIS

Particulate matter (PM) plays a significant role in air quality and human health. Composed of a complex mixture of particles from diverse emission sources and transformation pathways in the atmosphere, PM remains a major environmental concern. Effectively addressing ambient PM levels requires a deeper understanding of the sources and temporal behavior of pollutants generated by human activities. Studying atmospheric aerosols is therefore crucial for improving air quality and mitigating their impacts on human health and climate.

Organic aerosols (OA) represent a substantial fraction of the fine particulate mass in the atmosphere. However, their complex composition and formation processes make it challenging to fully comprehend their environmental and health effects. Along with OA, secondary inorganic aerosols (SIA) and black carbon (BC) are the dominant fractions of submicron aerosols, originating mainly from anthropogenic activities. To monitor the chemical composition and optical properties of these fine particles over long periods of time, a combination of advanced instrumentation, such as the Aerosol Chemical Speciation Monitor (ACSM) and multi-wavelength Aethalometer (AE33), is employed. In addition, receptor models such as Positive Matrix Factorization (PMF) and air mass trajectory analysis help to identify the key sources responsible for the observed PM concentrations in ambient air.

This thesis will focus on the study of long-term trends (~10 years) and their inter-seasonal and inter-annual variability to monitor the composition and origin of fine particles (PM_1) at French urban sites within the CARA program. The databases analyzed come from monitoring stations within the French regional air quality networks. Several instruments, including the ACSM, provide the chemical composition of non-refractory PM_1 components such as OA, nitrate (NO_3^-), sulfate (SO_4^{2-}), ammonium (NH_4^+), and chloride (Cl^-). Source apportionment studies have been conducted to identify the origin of OA, a major contributor to PM_1. The objective is to apply statistical analysis methods to assess temporal trends, analyze changes in OA sources, and better understand their formation mechanisms. The findings will also contribute to the validation of numerical atmospheric composition models and/or satellite measurements.

This PhD research aims to conduct long-term trend analyses for continuous monitoring of fine particle sources and composition at CARA program sites, with the following key sub-objectives:

- Investigate the evolution of fine particle sources and their formation mechanisms;
- Improve characterization and understanding of OA sources and associated chemical processes;
- Develop and test new robust statistical methods for aerosol data analysis;
- Implement these methodologies at national (CARA program) and European (ACTRIS) scales.

The candidate will have the opportunity to interact with collaborative research infrastructures (e.g., the ACTRIS European research infrastructure) as well as regional/national air quality monitoring networks, which are currently implementing a growing number of in-situ and real-time aerosol observation facilities around the world.

WORK ENVIRONMENT / PHD LOCATION

The fellowship is a fixed-term position available for a total duration of 36 months.
The successful candidate will be mainly based at Ineris in Verneuil-en-Halatte (Oise, France), with regular work sessions at IMT Nord Europe in Douai (Nord, France), both locations being located at about 100 km from each other.

EXPECTED PROFILE

- Master in Environmental Engineering and/or Atmospheric Chemistry
- Strong skills in data analysis and statistics
- Autonomy, adaptability, communication, and writing abilities
- Good proficiency in English and French
- Programming skills (Python, Igor, MATLAB, R, …)
- Knowledge in online aerosol in situ measurements (Aerosol Mass Spectrometer, Aerosol Chemical Speciation Monitor, Multi-wavelength Aethalometer, …)

GENERAL INFORMATION
Start: 01/10/2025
Duration: The fellowship is a fixed-term position available for a total duration of 36 months
Salary: Remuneration in accordance with current collective agreement
Type of contract: Ineris doctoral contract

DOSSIER DE CANDIDATURE

To apply: Send CV, cover letter and academic transcripts by April 30, 2025, to:
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SUPERVISION / CONTACT

Doctoral school concerned : Materials, Radiation and Environmental Sciences (ED SMRE)
Thesis director: Prof. V. Riffault, IMT Nord Europe
Co-supervision: Drs. Hasna Chebaicheb & Olivier Favez, INERIS

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2 / 2