Université de Lille

Area Cross Disciplinary Project Lille

Aerosol at the heaRt of the Earth/Atmosphere system

Master 2 - Research Training – 01/02 to 30/06/2026

Laboratory: CERI-EE-IMT-NE/LOA-UL

Supervisor: Hui Chen

E-mail : hui.chen@imt-nord-europe.fr Phone: 0782666425

AREA Work Package: 1

Application of Deep Learning Models to Predict Particle Number Size Distributions at the ATOLL Platform

Abstract.

This internship proposes to apply the open-source deep learning framework to the ATOLL platform (*ATmospheric Observations in liLLe*,). The model integrates air-parcel historical trajectories, meteorological and chemical reanalysis data into recurrent neural networks (Long Short-Term Memory, LSTM, and Bidirectional LSTM, BiLSTM) to predict aerosol Particle Number Size Distributions (PNSDs). At ATOLL, continuous *Scanning Mobility Particle Sizer (SMPS)*, *Aethalometer (AE33)*, and *Aerosol Chemical Speciation Monitor (ACSM)* observations, combined with *Modern-Era Retrospective analysis for Research and Applications, Version 2 (MERRA-2)* and *Hybrid Single-Particle Lagrangian Integrated Trajectory (HYSPLIT)* data, will provide the basis to test this approach in a continental urban/suburban environment in north France. The student will adapt the model to local datasets, fine-tune network parameters, and evaluate its transferability and interpretability using *SHapley Additive exPlanations (SHAP)* analysis. The work aims to identify the main meteorological and emission factors controlling ultrafine particle variability and to assess whether trajectory-aware deep learning can complement conventional source-apportionment and dispersion modelling. Expected outcomes include improved prediction of particle size dynamics, enhanced understanding of aerosol–meteorology interactions at ATOLL, and a demonstrator for integrating Artificial Intelligence (AI) into the AREA Work Package 1 program on advanced air-quality monitoring.

Keywords: deep learning, aerosol size distribution, ATOLL, ultrafine particles