

## PhD offer

# Use of microsensor data for urban-scale air quality modeling and mapping

Location: Verneuil-en-Halatte, 60 km from Paris Nord

Contract: PhD

Contact: [alicia.gressent@ineris.fr](mailto:alicia.gressent@ineris.fr) - 03.44.55.61.08

Address: Rue Jacques Taffanel, BP 2, 60550 Verneuil-en-Halatte

### Key words \*

Air quality modeling and mapping, microsensors, urban scale, geostatistics, Machine Learning, big data, algorithmic calibration.

### Abstract \*

The recent technological developments and the strong increased interest for public information lead to a fast-growing use of microsensors for air quality monitoring. Measurement campaigns are conducted to assess the potential of these new low-cost devices by deploying fixed sensors (on top of buildings, on street lights, or on reference stations) and/or mobile sensors (on top of cars, bikes, or carried by citizens). Unlike conventional station networks, microsensor allow for the first time to measure pollutant concentrations with high spatial coverage. The large amount of collected data offers new opportunities of developments in air quality modeling and mapping at urban scale.

The PhD aims to i) develop a data fusion methodology based on a geostatistical technique (universal kriging, spatiotemporal statistics) by using reference station and sensor observations combined with dispersion model calculations and other potential auxiliary variables, ii) use the high spatial and temporal density of the sensor data and make the connection with the calibration algorithms, iii) apply the approach to improve emission inventories and air quality modeling, iv) and estimate the ambient air pollution exposure. The performance of the geostatistical methods for pollutant concentration field estimate is well established, but modeling must be adapted for using micro-sensor data. In addition, the feasibility and the benefit of the Machine Learning techniques, that allow to use more complex models capable to converge towards an optimal solution using historical data, will be investigated.

These developments must overcome many challenges related to the heterogeneity and the large amount of the collected data, the quick change of the sensor position if it is mobile, the temporal variability of observations, the spatial representativeness of observations, and the measurement uncertainty. In this context, it will be necessary to work with the metrologist team at INERIS to better understand the data. In fact, calibration can alter the spatial representativeness of the measurement processes. The methodology will be applied to the French and European urban areas in close collaboration with the AASQA (the French Associations for Air Quality Monitoring), laboratories and startup companies.

## PhD planning \*

The first phase of the PhD will consist in analyzing the existing methodologies in geostatistics (universal kriging, spatiotemporal statistics etc.) and adjusting those methods to the microsensor issues. Machine Learning techniques will also be evaluated by investigating the limit between calibration and mapping. The methodology will then be applied to real data to be validated. Eventually, the last phase of the PhD will aim to define potential applications for air quality monitoring and determine the added-value of sensor data compared to conventional approaches. Especially, the calculation of the individual exposure and the estimate of emission inventories will be considered. The PhD is in collaboration with Mine ParisTech. It will take place at INERIS but the candidate will work from Mine ParisTech for several months.

## Institutional context \*

INERIS ([www.ineris.fr](http://www.ineris.fr)) is a public establishment of an industrial and commercial nature under the tutelage of the Ministry of the Environment. Its research activities supporting public policy and its services supporting businesses contribute to the evaluation and prevention of the risks that economic activities induce for the environment, health and safety of people. INERIS has 600 employees approximately and the institute is in Verneuil-en-Halatte (Oise).

In air quality, INERIS is involved in different angles of risk control: emissions, air quality monitoring, forecast, standard developments, and make available its expertise to the public and the Public powers. In addition, INERIS is one of the three partners (with LNE and IMT/Lille Douai) which constitutes to the LCSQA (Laboratoire Central de Surveillance de la Qualité de l'Air) in charge of the technical coordination of the air quality monitoring in France. The use of micro-sensors in air quality is an important topic for the LCSQA.

The PhD will take place in the MOCA unit, Atmospheric Modeling and environmental Mapping. The unit is composed of ten engineer scientists working on national and international projects on modeling and air quality mapping. The unit develops and manages the national platform of air quality forecast PREV'AIR which gives daily forecast maps at different spatial scales via its website (<http://www.prevoir.org/>).

## Profile and required skills \*

Ideally, the candidate must have completed a Master 2 with skills in air quality and environmental mapping, statistics and/or geostatistics, GIS and R programming language. He/She has good writing skills.