

Postdoctoral position

Assimilation of mobile observations at city scale with application to pollution



February 2016

Context

A growing amount of observational data is collected in modern cities. New sensors are developed with various accuracies, costs and targets. There is a trend toward the use of mobile sensing devices, often based on low-cost sensors. At the same time, numerical simulation is a well established, sometimes regulated, tool to monitor the environmental state of a city. A key question is how to combine numerical simulations with existing and upcoming in situ measurements, in order to produce the best state estimate.

Objectives

The postdoctoral position aims to optimally assimilate observations, especially from mobile sensors, at urban scale. The objective is to devise data assimilation methods that (1) can deal with mobile observations, (2) properly take into account the uncertainties in the numerical simulations, and (3) are efficient enough to be applied in near real-time.

The assimilation of mobile observations raises interesting issues related to the assimilation of tracks instead of point observations. Also, the positions of the sensors are uncertain along those tracks.

The uncertainty quantification in the simulations is another key issue, especially at urban scale where the city geometry has strong influence on the error correlations. The numerical models are computationally intensive so that the propagation of the uncertainties requires to design surrogate models, e.g., based on Gaussian process emulators.

Applications

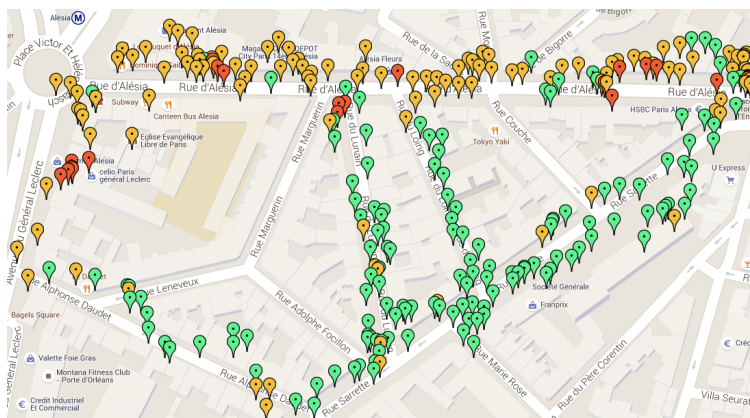


Figure 1: Example of a track along which noise levels are collected with the SoundCity mobile application. One objective of the postdoctoral position is to assimilate the data of such tracks.

The main application will be air quality at urban scale. The work will also be applied to noise

pollution. The target cities will be those of the European project Env&You, that is, Helsinki, Paris and a city in the San Francisco Bay Area.

As for noise pollution, the postdoctoral fellow will join the **SoundCity** team, which develops a mobile application for individual and collective observation of ambient noise. About one million observations are collected every four days by SoundCity users, which is a unique dataset to test new assimilation algorithms (Figure 1).

The air quality application will be carried out in the framework of the ANR project ESTIMAIR, which focuses on the propagation of uncertainties in traffic modeling, emission estimation and air quality simulation at urban scale (Figure 2).

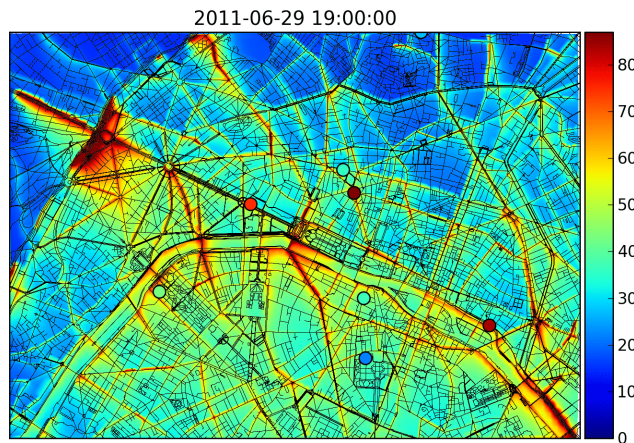


Figure 2: Map of concentrations of nitrogen dioxide ($\mu\text{g m}^{-3}$) as computed by an urban air quality model over part of Paris. The disks represent observations from a fixed monitoring network. One objective of the postdoctoral position is to quantify the uncertainties in such concentration map.

Hosting team

The hosting Inria team, Clime, works on uncertainty quantification and data assimilation for environmental applications. It leads the development of the data assimilation library **Verdandi**. It takes part to various projects connected to smart cities, in particular the **CityLab initiative**.

The work will be conducted in the frameworks of CityLab, the ANR project ESTIMAIR, the European project Env&You and the SoundCity project—all these projects are led by Inria. Many partners are involved, including the SME Numtech (urban air quality), École des Ponts ParisTech (traffic modeling), École centrale de Lyon (dispersion model), Forum Virium (Helsinki), Inria@SiliconValley and The Civic Engine (Bay Area).

Conditions and contacts

Expected profile: PhD in applied mathematics or geosciences, with interest in numerical simulation

Starting date: as soon as possible in 2016

Duration: 18 months

Salary: about 2120 euros net per month (health insurance included)

Localization: **Inria Paris**

- Address: 41 rue du Charolais, Paris (12e arrondissement)
- Within walking distance of gare de Lyon (RER A and D, subway 1 and 14), Montgallet (subway 8) et Dugommier (subway 6)

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