

Residential emission and air-quality modeling in French cities under climate change and energy transition conditions

Framework

This research is part of the BATENQUE project (December 2020-December 2023) funded by the PRIMEQUAL program and the 2019 Call “QUALITÉ DE L’AIR, CHANGEMENT CLIMATIQUE, ÉNERGIE”. Researchers from three labs of the IPSL (LMD, LATMOS and LISA) and the CSTB (Centre Scientifique et Technique des Bâtiments) are involved in the project and will participate in the follow up of this research.

The duration of the contract is twelve months with the possibility to extend. The contract will be issued by the CNRS (DR4) and the salary will depend on the previous experience of the successful candidate.

General context

As a response to the climate change, the french building stock evolves. The “National Low-Carbon Strategy” (“Stratégie nationale bas carbone”) aims to near-zero green-house emissions by 2050. On one hand, the evolution in combustion techniques, installations and fuels used in households mainly for heating and cooking evolves modifying the emission of pollutants in the atmosphere. On the other hand, the energy demand of renovated or new buildings is lower due to a better thermal insulation. On the same time, climate change has a direct effect on the buildings’ energy demand. For example warmer weather reduces the need for heating in wintertime but increases the need for air-condition during summer months. These effects will not be uniform across France. Also, meteorological conditions will modify the rates of chemical reactions in the atmosphere as well as the dispersion patterns of atmospheric pollutants.

To study the complex interactions between climate, energy, buildings and atmospheric pollution in France the BATENQUE project sets up a multi-disciplinary modeling chain that includes regional scale meteorological modeling, energy demand simulations and air-quality modeling (outdoors and indoors) and exposure. The work proposed here will focus on the estimation of residential emissions and outdoor air-quality modeling.

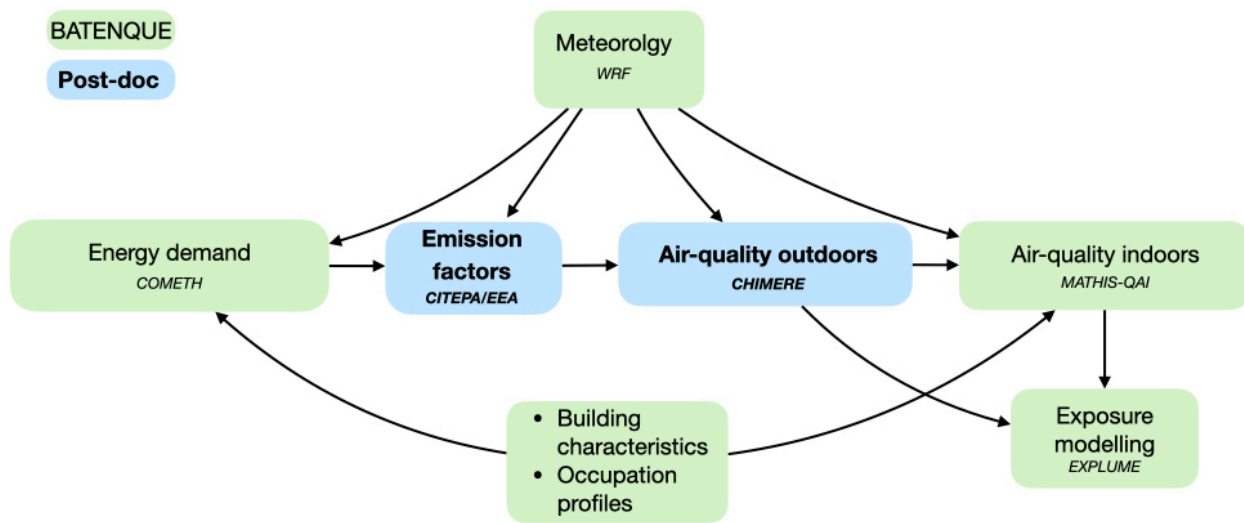


Figure 1 : The research work as part of the BATENQUE project

Aims of the study

The aim of the research proposed here is to i) estimate the evolution of residential emissions to a 2050 horizon over large French cities (Paris, Marseille, Lyon, Grenoble, Bordeaux) and for different meteorological conditions extracted from climate projections and ii) model the impact of these factors on air-quality.

Methods

The 2050-horizon climate projections have been conducted. We have already selected the study cases in order to represent on the same time **meteorological conditions bound to trigger an air-pollution episode** and **susceptible to become more frequent in the near future**. The energy demand of each region's buildings will be simulated with the COMETH model developed in the CSTB for the different combustion technologies encountered in the building stock (installation and fuel) and on meteorological conditions. We will also simulate a reference period.

- The first step is to carry out a literature search and chose the emission factors corresponding to each energy technology in the French building stock. These emission factors will be then applied on the energy demand simulated by the CSTB with the COMETH model to estimate emission fluxes for the different pollutants used in the CHIMERE air-quality model simulations (NO_x, NMCOV, SO₂, PM₁₀, PM_{2.5}, BC, OC, TSP...). This literature search will mainly focus on documents of the European Environmental Agency with refinements proposed by the CITEPA for France.
- The second stage consists of air-quality simulations with the CHIMERE model. These simulations will help understand i) the role of climate change in atmospheric chemistry and composition in French cities and ii) evaluate different scenarios of energy transition in the buildings' sector under an air-quality perspective, rather than a greenhouse gases perspective.

Perspectives

An additional funding may be available to complete this work with a study of the impact of building emissions (other than combustion) in atmospheric chemistry and composition.

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To apply for the job, please use the following link: <https://bit.ly/3fP0aHz>
In case of any technical issue with the platform please contact us directly.

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