Geophysical Research Abstracts
Vol. 21, EGU2019-13145, 2019
EGU General Assembly 2019

Rethinking exposure modelling: no longer ignoring heterogeneity and mobility

Ines Makni, Isabelle Coll, Arthur Elessa Etuman, and Taos Benoussaid

Laboratoire Interuniversitaire des Systèmes Atmosphériques (LISA), IPSL, CNRS UMR 7583, Université Paris Est Créteil, Université Parie Diderot, France (ines.makni@lisa.u-pec.fr)

Air quality management strategies need to be assessed through their effect on improving public health. The parameter to be targeted as a success indicator is therefore the exposure of populations to pollutants, which results from the overlap between the time spent by city dwellers in different areas along the day, and the pollution levels that characterize them. Improving our knowledge about exposure, either in a current or prospective situation, requires tackling two major issues.
The first is the access to concentration gradients at street level. On this point, models have to face the dilemma between precision and applicability. The heterogeneity of built forms and emissions in urbanized areas, poorly represented in chemistry and transport models, still acts as a brake on their realism at local scales. On the contrary, Computational Fluid Dynamic models make it possible to study the impact of local urban development on air pollution. However, their computational cost limits their applications to very restricted spaces and their implementation on urban scenarios remains very complex. Urban gaussian models represent a good compromise but –depending on the study case– they can suffer from any of these two drawbacks.
The second issue is connecting individuals with the urban environments they frequent during the day. The so-called "geography of time" is obviously a crucial determinant of personal exposure. However, due to the lack of data on individual practices, exposure has traditionally been assessed by spatial interpolation of pollution monitoring data at individuals' places of residence.

In order to overcome these biases, and to propose a fast, innovative and more realistic estimate of exposure to NO_2 and particles, we developed an approach based on the exploitation and combination of urban model output data.
The first step is to apply a correction to the outputs of a CTM (CHIMERE), in order to recreate subgrid information. This approach consists of analyzing the structure of the CTM errors related to i) the heterogeneity of the emissions, ii) the confinement iii) the existence of vertical gradients and iv) the wind strength. Thus, by learning, we derive an equation able to correct the CTM error according to the local environment and meteorology. This approach has been tested on road traffic, urban and peri-urban sites, and shows quite satisfactory results. These results will be shown for the Paris region over an entire year. Such approach makes possible to obtain very high-resolution concentration maps for any of the scenarios simulated by the CTM without additional computational cost.
Secondly, we combine mobility data from the OLYMPUS model – an emission model centered on the activities of individuals – with city structure parameters and corrected CTM concentrations to produce a spatio-temporal analysis of the exposure of the people living in the city. The principles of this approach, described in a companion paper, will be presented and illustrated here. Ultimately, we aim at establishing an exposure value of individuals in urban areas, taking into account the time spent in polluted micro-environments, and likely to discriminate exposure inequalities according to the social classes of individuals.