Modelling new forms of exposure to air pollution: Application to Paris megacity

Taos Benoussaïd, Inès Makni, Isabelle Coll, and Arthur Elessa Etuman

LISA/IPSL, CNRS UMR 7583, Université Paris-Est Créteil et Université Paris Diderot, Créteil, France
(taos.benoussaid@lisa.u-pec.fr)

Summary

The aim of this project is to implement an innovative method of estimating the exposure of individuals to air pollution by taking into account their mobility within the city. To do this, we rely on an urban modelling chain involving the OLYMPUS mobility/emission model (Elessa et al., 2018) and the CHIMERE Chemistry-Transport Model (Mailler et al., 2017). The originality of this work is to create refined and socially-discriminating forms of representation of the exposure parameter.

Keywords: Air pollution, exposure, city, transport, decision-making.

Methodology and results

First, we will describe the type of data used for exposure modelling. Finally, we will propose a way to represent population's exposure.

Olympus is a model designed for environmental decision support. It uses an activity-based travel demand approach to create a daily mobility matrix for each individual of a selected urban area (whether in current or prospective situation). Mobility emissions, as well as household emissions for heating are modelled by OLYMPUS following the European Environmental Agency methodologies. These emissions are used as forcing into CHIMERE to produce 3D concentration fields for air pollutants at the kilometric scale over the simulated area.

The originality of this work is to overlay CHIMERE output concentration fields, urban building density, local traffic and wind strength. All these data will be integrated in an empirical formula to estimate hourly street-level concentrations for any pixel of the simulation domain. The second stage of our work consists in associating local and temporal descriptors of people mobility to these pixelated concentrations to provide individual-dependent exposure, integrated over a day. We can thus quantify the exposure of individuals and produce graphical representations of the risk of exposure by categories of individual or dwelling area. We have implemented these calculations for the Paris area for the year 2009. Several examples of calculation of the pixelated concentrations, and estimation of the exposure, will be presented.

Conclusion

Our results give us a much more precise look at the actual exposure of individuals, allow us to identify differences in exposure that can be simulated between different categories of people, and points out the role that mobility practices have in people's exposure to air pollutants.

References

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