Geophysical Research Abstracts
Vol. 20, EGU2018-18981, 2018
EGU General Assembly 2018

Impact of urban morphology on air quality: sprawl, compact, corridor and edge cities

Elessa Etuman Arthur and Coll Isabelle

LISA, Laboratoire Interuniversitaire des Systèmes Atmosphériques, UMR CNRS 7583, Université Paris Est Créteil, Université Paris Diderot, 94010 Créteil Cedex, France (arthur.elessa-etuman@lisa.u-pec.fr)

Urban pollution remains a major sanitary and economic concern. In France, particulate pollution is known to cause 48,000 premature deaths every year (French Public Health, 2016), while the economic cost of air pollution reaches 25 billion euros per year (CGDD, 2012). In the Greater Paris, despite the continuous strengthening of emission standards, the introduction of traffic restrictions, car-sharing development and incentives for electric vehicle use, road transport continues to play a critical role in the exposure of inhabitants to high levels of gaseous and particulate pollutants. In this context, new integrated solutions for health-friendly cities rely on urban planning, which could be an innovative strategy to reduce transport demand and to decrease average commuting distances, to promote modal shift to more sustainable modes (public transport, cycling, walking ...) but also to help limit containment and proximity to emissions.

We have studied the sensitivity of pollutant emission to different urban morphologies using the OLYMPUS tool. OLYMPUS is a modeling platform that calculates pollutant emissions related to energy consumption over a territory. It relies first on the generation of a synthetic population of individuals living in a given urban structure. The tool then defines the mobility of each individual via a travel demand approach based on algorithms simulating professional and leisure activities, as well as hypotheses about urban practices. Then, OLYMPUS models traffic flows, considering a given fleet of vehicles and congestion on the road network. In parallel, OLYMPUS estimates the regional energy demand for building heating, based on surveys and unit consumption data. Emissions of pollutants from all these activities are then calculated using the EEA methodology, spatialized and distributed over time.
The IPCC has established four key variables underlying the urban structure and functionality: density, mixed land use, connectivity and accessibility. Each of them has a specific impact on mobility and energy consumption and, ultimately, on air quality. To study their impact on pollutant emissions from energy use, 4 contrasting urban structure scenarios were simulated with OLYMPUS: COMPACT (classical monocentric city), CORRIDOR (city based on privileged directions for transport), SPRAWL (extended city) and STARS (polycentric city).

Our results show that urban density is strongly correlated with the intensity of the emitting urban fabric. However, while densification was expected to promote proximity and energy savings, very little reduction of the energy consumption is observed for compact cities. Furthermore, the different scenarios show little variability in the respective attractiveness of public transport and private vehicles. This result opens a debate on the rationality of individuals' choices regarding their mobility. So, the question of modal shift must be addressed through new scenarios that vary urban shape and structure. The objective would be to identify the degree of transformation of urban spaces, as well as the changes in practices - or even the nudges - required to move to a preferential use of sustainable travel modes. Our results allow to discuss such elements, as a guide for the design of new cities and for the evolution of existing cities.