

Urban compaction vs city sprawl: impact of road traffic on air quality in the greater Paris

Elessa Etuman Arthur (1), Coll Isabelle (1), Viguie Vincent (2), Coulombel Nicolas (3), and Prud'homme Julie ()
(1) LISA (Laboratoire Interuniversitaire des Systèmes Atmosphériques), (2) CIRED (Centre International de Recherche sur l'Environnement et le Développement), (3) LVMT (Laboratoire Ville Mobilité Transport)

Urban pollution remains a major sanitary and economic concern. In France, particulate pollution is known to cause 48,000 premature deaths every year (Santé Publique France, 2016), while the economic cost of air pollution reaches almost 25 billion euros per year (CGDD, 2012).

In the Greater Paris, despite strengthened emission standards, restricted traffic areas, car-sharing and incentives for electric vehicle use, road transport plays a substantial role in the exposure of inhabitants to high levels of pollutants. In this context, urban planning could possibly constitute an innovative strategy to reduce emissions from road traffic, through its actions on transport demand, travel distances, modal shift (public transportation, cycling, walking...) or even proximity to emitters.

We have developed a multi-scalar modeling of urban pollution by coupling an urban economic growth model NEDUM (CIRED), a model for urban mobility (LISA), a traffic emission model (LISA) and the CHIMERE Chemistry-Transport model (CTM) for air quality simulation (LISA). The innovative aspect of this modeling system is to integrate into a classic CTM the mechanisms underlying the dynamics of an urban system. This way, we establish a quantitative and comprehensive link between a given urban scenario, the associated public and individual transport matrix, and local air quality. We then make it possible to highlight the levers of energy consumption reductions inside compact or sprawled cities.

We have been working on the Ile de France region (centered on the Paris agglomeration) which relies on a broad urban structure of megacity, a high density of housing and an expanding urban peripheral zone, clearly raising the issue of transport demand, mobility and traffic congestion.

Two scenarios, considering opposite urban development policies from the 1960s to 2010, have been simulated over the whole modelling chain. The first one promotes a dense and compact city while the second favors city spread, though restricted by a green belt. In our results, we compare the local air quality simulated in these scenarios with our reference situation (the current 2010 situation).

The spreading or densification of the city contribute a little to the air quality and therefore a reflection on a real mix of the urban canvas is probably an influencing factor for the reduction of the motorized mobility. We should also consider more advanced scenarios (in the course of production) for the reduction of individual transport like encouraging car-pooling, which has a maximum daily trip reduction potential of 16% in urban areas (CGDD, 2014).