RI-URBANS

Why RI-URBANS? – extended

Changes in emissions in the last decades prompted new urban pollution patterns to be considered in new policy developments and health impact studies.

Below, we summarize what we believe are the key developments:

- In the last 15 years, the European Union and national Air Quality (AQ) policies have favoured not only the abatement of particulate matter (PM) levels but also a shift on PM chemical composition, from high loads of sulphate ($SO4^{2-}$), nitrate (NO_3^-), ammonium (NH_4^+), and equivalent black carbon (BC) in PM2.5, to secondary organic aerosols (SOA). SOA are the most complex components of PM, which have now become the major components of PM2.5.
- Domestic (and in some countries agricultural) biomass burning now represents the main source of BC and primary PM2.5 in EU-28. Biomass burning is also a very important source of organic aerosols (OA) and SOA formed from volatile organic compounds (VOCs). SOA formation (including enhanced biogenic SOA, or eBSOA) has also been enhanced by a generally increasing trend in urban O_3. Furthermore, VOCs, being precursors of PM, nanoparticles and O_3, have undergone a marked changing source origin due to new vehicle engine technologies, an increased use of urban chemicals and the abatement of large industrial VOC emissions.
- Vehicle-exhaust emissions of PM have decreased in the last decades, but much less in the case of vehicle-non-exhaust emissions related to brake, tyre and road wear. The source contributions of the latter have increased relative to bulk traffic urban PM and have a high oxidative potential. Therefore, there is an urgent **need for improving capacity to quantify source contributions** in this new situation.
- Furthermore, as urban PM contributions have been decreasing, numerous studies have shown that regional and continental PM is contributing more significantly to urban PM in many cities of Europe. Thus, to appropriately devise cost effective AQ policies, it is very relevant to **quantify the origin of such contributions**.
- Although the main origin of nanoparticles in urban areas is road traffic, a marked decrease of urban fine and coarse PM levels in Europe over the last decades may account for a consequent decrease in the condensation sink capacity of gaseous precursors. This observed reduction in PM may favour higher frequency and more intense urban nucleation of nanoparticles, which currently contributes considerably to urban levels of nanoparticles in Europe. Hence, there is a strong **need to improve capacity to monitor the specific fraction that constitutes very small particles in urban areas**.

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- The source contributions of nanoparticles are also relevant because epidemiological and toxicological studies suggest that negative health effects may be enhanced with exposure to decreasing particle size. However, the association between exposure to nanoparticles and health outcomes is inconsistent in literature, probably due to the small number of studies (compared to studies on fine PM), the differences in health effects of nanoparticles for different cities, the lack of representativeness of the few existing nanoparticle-measuring sites for whole cities, and the differences in nanoparticle measurement instruments. Therefore, to implement adequate policies, there is a **need for Europe to engage Air Quality Monitoring Networks (AQMNs)** in more harmonised and thorough initiatives **to clarify the relationship between nanoparticle sources, ambient nanoparticle exposures and health effects**.
- **Mapping the spatial variability in urban environments**, specifically the need for high-resolution data for proper exposure assessment, which is highly relevant for nanoparticles.
- There is limited empirical evidence that oxidative potential is more closely associated with health than particle mass, and there is a strong **need to further investigate new AQ metrics for the health-related impact of particulate pollution**.

RI-URBANS is organized within the framework of 2 European Strategy Forum on Research Infrastructures (ESFRI) Research Infrastructures of the Atmospheric domain: the ESFRI Project **ACTRIS** and the ESFRI Landmark **IAGOS**. ACTRIS and IAGOS are organized long-term Research Infrastructures (RIs) that document the trends and variability of short-lived atmospheric species relevant to AQ. While IAGOS's most relevant AQ data are acquired within the vicinity of several large European airports, ACTRIS data originate from approximately 60 observation platforms located in different environments in Europe, including some in urban and peri-urban areas; some of the data also contribute to the European Monitoring and Evaluation Program (EMEP).

The **challenge of RI-URBANS** is therefore to develop innovative urban AQ service tools, in clear complementarity with the AQMNs, and provide innovative tools to better quantify the impact of atmospheric species most deleterious to human health. Under the complex and changing AQ situation of urban pollution as described above, obtaining monitoring data on PM composition, source contributions to PM, nanoparticles, and gaseous precursors, as well as spatially resolved exposure maps of urban pollutants, will contribute to enhanced AQ policy assessment and evaluation of health effects in Europe. For such assessment both urban scale modelling (for nanoparticles, and other pollutants such as exhaust and non-exhaust vehicles PM emissions, and BC) and regional ones (for SOA and Secondary Inorganic Aerosols (SIA) and for the background levels of all the other pollutants) are also needed. RI-URBANS is based on the premise that advanced monitoring and modelling tools developed by RIs and science teams can be used to supplement current AQMNs of regulated pollutants.

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