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Impacts of urban planning and regulations on the air quality and sustainable development of metropolitan cities

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Transportation-related emissions are of particular concern in large metropolitan areas as they are associated with adverse health outcomes. Therefore, mitigation strategies and accurate assessment of these emissions are essential in improving the air quality and understanding the effectiveness of regulations. To this end, extensive measurements were carried out in different micro-environments in the megalopolis of Los Angeles (LA). On-road measurements of fine-particulate matter (PM2.5) at three major roadways in LA (i.e. on two major freeways and surface streets) indicated substantially higher levels of carcinogenic including polycyclic aromatic hydrocarbons (PAHs) and redox active metals on freeways in comparison to surface streets. The observed $PM_{2.5}$-induced toxicity on freeways was 2 times higher than surface streets. However, comparison with previous studies in the past decade in LA suggested an overall reduction in the contribution of carbonaceous species to PM mass, indicating the effectiveness of targeted vehicle emissions control policies implemented in recent years in the state of California. In contrast, greater contributions of certain groups of metals and trace elements that are indicators of non-tailpipe (e.g. brake and tire wear) emissions to both PM mass and toxicity over the years provided evidence on the increasing importance of non-tailpipe emissions which are largely unregulated, as vehicular exhaust becomes cleaner. An extensive sampling campaign in two lines of the LA Metro system indicated that PAHs concentration were about 4 times higher on freeways than both Metro systems resulting in 3.8-fold higher lung cancer risk due to exposure to carcinogens based on a commuter lifetime. Additionally, studies conducted in the Port of Long Beach demonstrated that quasi-ultrafine particles ($PM_{0.25}$) concentration and its chemical constituents have decreased as the result of stringent regulations during the past decade. In another study conducted in the metropolitan area of Milan, Italy, we demonstrated that developing pedestrian zones in the city center is also effective in drastically reducing exposure to carcinogens emitted by traffic, signifying that in addition to mitigation strategies, developing alternative transportation means and urban planning are essential in improving the air quality for a sustainable city.

Biography

Constantinos Sioutas, ScD, is the first holder of the Fred Champion Professorship in Civil and Environmental Engineering at the University of Southern California (USC). His research has focused on investigations of the underlying mechanisms that produce the health effects associated with exposure to airborne ultrafine particulate pollutants generated by a variety of sources. He has developed many state-of-the-art technologies used by many academic institutions and national laboratories for aerosol sampling and characterization. He has authored over 300 peer-reviewed journal publications, and holds 13 US patents in the development of instrumentation for aerosol measurement and emissions control. His work has been cited in more than 15,000 scientific publications. He is the recipient of the American Association for Aerosol Research (AAAR) David Sinclair award in 2014 (AAAR's highest distinction), the Hagen Smit award of Atmospheric Environment for seminal publications, the 2010 Scientific and Technological Achievement Award by the US Environmental Protection Agency, and a Fulbright Fellow.

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