

7A.5 - Weather and the City: The Scales and Drivers of Urban Air Quality Variability (Invited Presentation)



Tuesday, January 27, 2026



2:45 PM - 3:00 PM

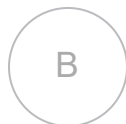


342E (George R. Brown Convention Center)

Abstract

Urban pollutant emissions remain a critical global concern due to their oversized contribution to global emission inventories, their role in modulating regional atmospheric chemistry and hydrometeorology, and their severe health implications. However, accurate understanding and forecasting of urban air quality are hindered by its strong dependence on urban and meteorological conditions. Understanding the interplay between these urban and meteorology drivers of pollutant concentrations, at various scales, is essential for designing effective interventions. In this talk, we examine the spatial scales at which urban attributes modulate air quality, defining the concept of an environmental neighborhood as the surrounding area that shapes air quality at a given location. We measure the extent of these neighborhoods in New York city, using high-resolution datasets, by searching for the scale that maximizes the correlations between air quality and urban parameters across variable footprint sizes (from 25 m × 25 m to 5000 m × 5000 m). These neighborhoods, we find, range from ~ 200 to 1000 m, depending on the pollutant and urban attribute in questions. This scale is then used to further analyze the drivers of air pollution, using gradient boosting regression (GBR). We show that traffic-dominated pollutants are strongly influenced by urban parameters, while pollutants with more varied sources are more sensitive to the meteorological conditions. The resulting spatial model, using only meteorological and urban inputs, achieves mean absolute errors of 8–32% and reliably maps temporal variability in pollutant distributions from a limited set of sensors.

Co-Authors

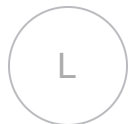
**Elie Bou-Zeid (Presenter)**

Princeton Univ.
Princeton, NJ
USA



Firas Gerges
Princeton University
Princeton, NJ
USA

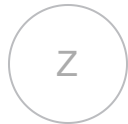
Princeton University
Princeton, NJ
USA



Maidier Llaguno-Munitxa
Université Catholique de Louvain
Tournai, 7500
Belgium



Michel Boufadel
New Jersey Institute of Technology
Newark, NJ
USA



Mark Zondlo
Princeton University
Princeton, NJ
USA