High resolution urban air quality modeling using a multi-scale approach

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Abstract

Air pollution is one of the global menaces which is causing nearly 6-9 million premature deaths, and more than 90% of children across the globe are getting affected. Urban centers and particularly mega cities are grappled with poor air quality owing to their high energy requirements, which significantly contributes to higher levels of toxic exposure. Understanding the dispersion of pollutants within the urban canopy is crucial in devising the mitigation measures. Modeling of urban systems requires a hybrid approach, where the benefit of high resolution spatio-temporal pollution profiling is achieved by using OpenFOAM toolbox in compliment with the meso-scale weather forecasting model inputs. One such framework is proposed in this work, using the 3D topography of any urban center and solving the flow fields and dispersion of the pollutants, by considering the appropriate initial and boundary conditions derived from the regional meteorological model. The effect of urban topography in determining the wind fields and its role in development of pollution hotspots can be better understood with the proposed framework. Plugging-in realistic emission inventory and the photochemical transformations of the pollutants provides better insights in planning urban air sheds. The proposed framework with integrated multi-scale approach provides an opportunity for the urban planners and environmental modelers to build environmentally resilient and sustainable cities.

Keywords: Urban centers, air pollution, air quality modeling, OpenFOAM, Urban resilience.