1.127 Impacts of the decadal urbanization on thermal circulations and ozone production in the Pearl River Delta region, China.

Early Career Scientist

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Abstract:

Thermal circulations induced by urbanization could exerts important effects on ozone (O_3) production through regulating the chemical transformations and transport of O_3 and its precursors. Previous studies lack a correct representation of urban vegetation abundance, and thus is difficult to accurately describe the land-atmosphere coupling. In this study, the Weather Research and Forecasting/Chemistry (WRF/Chem) model combined with Moderate Resolution Imaging Spectroradiometer (MODIS) remote sensing are used to investigate the urbanization impacts on thermal circulations and O_3 production in the Pearl River Delta (PRD) region, China. The assimilation of MODIS land-surface parameters (i.e., land-cover type, green vegetation fraction and leaf area index) provides a clear model improvement for near-surface meteorological variables. A typical urban heat island (UHI) is generated in PRD, which in turn modifies local circulation by initiating the UHI circulation and enhancing the sea breeze over the Pearl River Estuary. Overall, the modified urban meteorology cause a detectable decrease of daytime O_3 concentration (−1.3 ppb) and an increase of O_3 (+5.2 ppb) around the nocturnal rush-hours. The suppressed O_3 titration destruction due to NOx dilution into the deeper urban boundary layer (200−400 m) is the main reason for elevated nocturnal O_3 levels. In the daytime, however, the upward transport of O_3 precursors weakens near-surface O_3 photochemical production and conversely enhances upper-level O_3 generation. Furthermore, the surface UHI convergence flow and intensified sea breeze act to effectively trap O_3 at the suburban and coastal regions. This work may help understand the feedbacks between urban meteorology and air quality.