

Impacts of Biogenic and Anthropogenic Emissions on Summertime Ozone Formation in the Guanzhong Basin, China

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This study is the first attempt to understand the synergistic impact of anthropogenic and biogenic emissions on summertime ozone (O_3) formation in the Guanzhong (GZ) basin where Xi'an, the oldest and the most populous city (with a population of 9 million) in the northwest China, is located. Month-long (August 2011) WRF-Chem simulations with different sensitivity experiments were conducted and compared with near-surface measurements. Biogenic volatile organic compounds (VOCs) concentrations were characterized from 6 surface sites among the Qinling Mountains, and urban air composition was measured in the Xi'an city at a tower 100 m above the surface. The WRF-Chem control experiment reasonably reproduced the magnitudes and variations of observed O_3 , VOCs, NO_x , $PM_{2.5}$ and meteorological parameters, with normalized mean biases for each parameter within $\pm 21\%$. Subsequent analysis employed the factor separation approach (FSA) to quantitatively disentangle the pure and synergistic impacts of anthropogenic and/or biogenic sources on summertime O_3 formation. The impact of anthropogenic sources alone was found to be dominant for O_3 formation. Although anthropogenic particles reduced NO_2 photolysis by up to 60%, the anthropogenic sources contributed 19.1 ppb O_3 formation on average for urban Xi'an. The abundant biogenic VOCs from the nearby forests promoted O_3 formation in urban areas by interacting with the anthropogenic NO_x . The calculated synergistic contribution (from both biogenic and anthropogenic sources) was up to 14.4 ppb in urban Xi'an, peaking in the afternoon. Our study reveals that the synergistic impact of individual source contributions to O_3 formation should be considered in the formation of air pollution control strategies, especially for big cities in the vicinity of forests.

Keywords: ozone, biogenic volatile organic compounds, WRF-Chem