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FROM INSTANTANEOUS TO TIME INTEGRATED CHEMISTRY IN AN URBAN PLUME: PROCESSES, EFFICIENCIES, AND VOC AND NO_X LIMITATIONS TO OZONE FORMATION

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Analysis of aircraft and surface data of measurements of the Nashville urban plume is used to illustrate the power of combining observations and modeling. An observation driven box model is used to obtain a detailed mechanistic description of the instantaneous processing of urban emissions at several stages in the chemical evolution of the Nashville urban plume. Ozone production rates and efficiencies with respect to NO_x, and with respect to primary radicals are calculated. The box model is also used to investigate the sensitivity of instantaneous O_3 production rates to changes in NO_x or VOC emissions. It is found that O_3 production at the center of the urban plume is still under VOC sensitive conditions when half of the urban NO_x emissions have been processed. A 3-D Eulerian simulation is used to investigate the maximum O_3 concentrations produced in the plume under three hypothetical emission reduction scenarios. This analysis indicates that under present day emissions, maximum O_3 in the Nashville urban plume occurs under conditions of equal sensitivity to reduction, in either NO_x, or VOC. Empirical relationships between indicator ratios and the sensitivity of O_3 concentrations to emissions reductions is derived.

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