Sensitivity of nitrate aerosol production to vehicular emissions in an urban street

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This study investigated the sensitivity of nitrate aerosols to vehicular emissions in urban streets using a coupled computational fluid dynamics (CFD)-chemistry model. Nitrate concentrations were highest at the street surface level following NH3 emissions from vehicles, indicating that ammonium nitrate formation occurs under NH3-limited conditions in street canyons. Sensitivity simulations revealed that the nitrate concentration has no clear relationship with the NOx emission rate, showing nitrate changes of only 2% across among 16 time differences in NOx emissions. NOx emissions show a conflicting effect on nitrate production via decreasing O3 and increasing NO2 concentrations under a volatile organic compound (VOC)-limited regime for O3 production. The sensitivity simulations also show that nitrate aerosol is proportional to vehicular VOC and NH3 emissions in the street canyon. Changes of VOC emissions act the nitrate aerosol and HNO3 concentrations through changes in the O3 concentration under a VOC-limited regime for O3 production. Nitrate aerosol concentration is influenced by vehicular NH3 emissions, which produce ammonium nitrate effectively under an NH3-limited regime for nitrate production. This research suggests that, when vehicular emissions are dominant in winter, the control of vehicular VOC and NH3 emissions might be a more effective way to degrade PM2.5 problems than the control of NOx.

Key words: Urban pollution, Street canyon, Nitrate aerosol, CFD, Air quality

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