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Assessment of the impact of emissions reductions on air quality over North China Plain

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The production rate of secondary pollutants was highly non-linear with the emission intensity of their precursors. In this study, the air quality modeling system RAMS-CMAQ with zero-out sensitivity test was applied to conduct source sensitivity approaches of PM2.5 for four source categories (industry, power plants, transport, and residential) over the North China Plain (NCP) in January and July of 2013. The results show that the residential and industry emission sector were the greatest contributors to domain-wide PM2.5 in January and July, respectively. The largest variation could exceed 200 μg m-3 attributed to the residential sector in January when a heavy pollution period appeared, and could reach 40-60 μg m-3 attributed to the industry sector in July in the heavy pollution area, respectively. The nonlinear relationship between the secondary pollutant formation and its precursors was reflected by this source sensitivity approaches, as the summation of the secondary pollutant variations attributed to the four sources was obviously different from the simulated baseline concentration and the mass burden of nitrate would increase upon removal of the power plants or transport emission sector in the heavy pollution regions in January. Further analysis indicated that the improvement of atmospheric oxidation capacity due to emission sector removal coupled with the sufficient precursor nitrogen oxide under severe pollution background should be the main reason of the negative variation of nitrate appeared in the sensitivity test. This feature indicates that the atmospheric oxidation capacity is an important impact factor in determining the production rate of nitrate formation, and could further influence the variation feature of PM2.5 mass burden during the pollution episode. Thus, it is suggested that the comprehensive pollution control strategies should be implemented based on the specific pollution condition. Additionally, the nonlinearity of secondary pollutants formation should be reasonably considered for developing effective emission control strategies.