Regional model calculation of secondary organic aerosols in Tokyo urban area

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Although organic aerosol contributes to a total fine aerosol mass by 20˜50% and secondary organic aerosol (SOA) is considered to be a dominant form of organic aerosol, formation processes of SOA are still highly uncertain as compared with those of inorganic aerosols. As a consequence, an understanding of processes controlling SOA amount in the atmosphere is one of the most important issues in the present aerosol study.

The purpose of this study is to evaluate an ability of the three-dimensional mechanistic SOA model to reproduce SOA levels and its temporal variation observed in Tokyo metropolitan area in Japan. Various factors which control diurnal and day-to-day variations of SOA amount are presented, and important precursor volatile organic compounds (VOCs) are identified. Because accurate SOA data become available only recently and accurate meteorological data and emission inventories of precursor gasses are generally available in Tokyo area, a comparison between model calculations and measurements provides a good opportunity to test our current understandings.

In this study, MM5 and CMAQ-MADRID were used as a regional meteorological model and three-dimensional chemical transport model, respectively. To evaluate the performance of model calculations, measurements made at Komaba, which is close to the center of Tokyo, in July and August 2003 and the regional network measurement in and around Tokyo metropolitan area (Soramame) were used. In this study, meteorological field in Tokyo metropolitan area and behaviors of various gaseous (ozone, VOCs, and others) and inorganic aerosol species were generally well reproduced by model calculations. Various observed features of temporal SOA variations, such as diurnal, day-to-day, and seasonal variations were also reproduced by model calculations reasonably well, however, model calculations severely underestimated observed SOA amounts by a factor of 3 to 6. Possible causes for this underestimation will be discussed.