

Evolution of organic aerosol in polluted air exported from Tokyo urban area

Nobuyuki Takegawa[1]; Takuma Miyakawa[2]; Yutaka Kondo[3]; Yugo Kanaya[4]; Masato Fukuda[2]; Yuichi Komazaki[5]; Yuzo Miyazaki[6]; Makoto Koike[2]

[1] RCAST, Univ of Tokyo; [2] Earth and Planetary Sci., Univ. of Tokyo; [3] RCAST, Univ. of Tokyo; [4] FRCGC/JAMSTEC; [5] none; [6] Earth and Planetary Physics, Univ. of Tokyo

Organic compounds often constitute a major fraction of total fine particle mass in urban air. Recent model simulations have shown that export of polluted air from urban areas, combined with emissions of volatile organic compounds (VOCs) from biogenic sources, can significantly affect the distributions of organic aerosol (OA) in surrounding regions. Current understanding of the emission of primary organic aerosol (POA) and the formation of secondary organic aerosol (SOA) is increasing but is still limited, causing significant uncertainty in estimating the effects of OA on regional/global climate change.

Ground-based measurements of aerosols and trace gases were conducted at an urban site in Tokyo (Komaba) and a site 50 km north (Kisai) during the summer of 2004. The major purpose of this study is to investigate the chemical evolution of OA in polluted air. Size-resolved chemical composition of submicron aerosol was measured using an Aerodyne Aerosol Mass Spectrometer (AMS) with a time resolution of 10 min both at the Komaba and Kisai sites. Ozone (O₃), reactive nitrogen (NO_x and NO_y), and volatile organic compounds (VOCs) were also measured at both sites. The mass concentrations of OA at the Kisai site were systematically higher than those at the Komaba site and correlated well with O₃ under southerly wind conditions. This result indicates that polluted air masses were exported from Tokyo to the surrounding regions and significant formation of O₃ and OA took place in those air masses.

The rate of increase of OA at the Kisai site is investigated using the photochemical age derived from the ratio of alkyl nitrates to their parent hydrocarbons. We estimate that OA increased by a factor of ~4 within 10-20 hours, suggesting that the chemical properties of OA can be significantly altered within 0.5-1 day under conditions of high photochemical activity. This study provides some insights into the characteristic time of photochemical processing of OA in urban air and could be useful for improving SOA formation schemes in chemical transport models.