

Long-term measurements of black carbon concentrations in rainwater at a remote site in East Asia

Tatsuhiro Mori^{1*}, Sho Ohata¹, Yutaka Kondo¹, Nobuhiro Moteki¹, Hitoshi Matsui¹, Aya Iwasaki², Nobutaka Tomoyose², Hisashi Kadena²

¹Graduate School of Science, University of Tokyo, ²Okinawa Prefectural Institute of Health and Environment

Black carbon (BC) particles are mainly emitted into atmosphere by incomplete combustion of fossil fuels and biomass. BC particles emitted from these sources are generally hydrophobic, but they are gradually coated by hygroscopic species during transport and become hydrophilic particles with higher cloud condensation nuclei (CCN) activity, and they are finally removed from the atmosphere through wet removal processes. Therefore, wet deposition of BC is one of the most important processes controlling BC concentrations and their distribution. In order to understand the importance of wet removal processes of BC, BC mass concentrations both in the surface air (m_{air}) and in rainwater (m_{rain}) were measured simultaneously for two years (April 2010 - March 2012) at Cape Hedo in Okinawa. This study is the first attempt to conduct long-term measurements of m_{air} and m_{rain} at a remote site in East Asia. Seasonal variations of both concentrations and the wet deposition flux of BC are presented.

A Continuous Soot Monitoring System (COSMOS) was used to measure m_{air} . Rainwater samples were collected on a daily basis and m_{rain} was measured by an ultrasonic nebulizer (U-5000AT) and a Single Particle Soot Photometer (SP2).

The measured m_{air} and m_{rain} showed clear seasonal variations. The monthly mean m_{air} and m_{rain} were the highest during spring (March - May) with the values of 0.37 ug m^{-3} and 62.2 ug L^{-1} , and the lowest during summer (June - August) with the values of 0.07 ug m^{-3} and 5.82 ug L^{-1} . The correlation coefficient between the monthly mean m_{air} and m_{rain} was sufficiently high ($r^2 = 0.67$). The annual average amount of BC wet deposition, which was defined as the product of m_{rain} and precipitation amount, was 39.6 mg m^{-2} during the observation periods. The contribution to the total amounts of BC wet deposition was found to be 74.4% during spring. This is due to both higher m_{rain} and larger precipitation amount in spring. The values of m_{air} and m_{rain} in winter (December - February) and spring are the highest because polluted air masses are frequently transported from the Asian continent by strong north-westerly wind, East Asian monsoon in winter and cold front passages in spring. On the other hand, these values are the lowest in summer because clean air masses are transported from south to the measurement site by the Pacific high.

Keywords: Black Carbon, wet deposition