【Grant-in-Aid for Scientific Research(S)】

Integrated Science and Innovative Science (New multidisciplinary fields)

Title of Project : Composition, origin, transformation and hydroscopic properties of organic aerosols in East Asia and the North Pacific

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Research Area : Environmental Science, Atmospheric Chemistry
Keyword : Changes in atmospheric environment, Organic aerosols

【Purpose and Background of the Research】

Atmospheric particles (aerosols) influence on Earth climate system by absorbing and reflecting solar radiation and by acting as cloud condensation nuclei (CCN) and forming clouds. Organic compounds comprise up to 70% of fine atmospheric particles (< 1 μm). They are primarily derived from incomplete combustion of fossil fuels and biomass burning and more importantly from secondary photochemical oxidation of biogenic and anthropogenic volatile organic compounds (VOC). Organic aerosols are enriched with polar and thus water-soluble species and can participate in cloud formation as CCN affecting on Earth climate.

To better understand the aerosol composition in East Asia and the western North Pacific, we study organic molecular composition, their sources and photochemical transformation as well as hygroscopic properties of aerosols.

【Research Methods】

Various organic species ranging from water-soluble (low molecular weight dicarboxylic acids, isoprene/monoterpene-oxidation products) to water-insoluble species such as n-alkanes and hopanoid hydrocarbons will be analyzed in aerosol samples collected from East Asia and the Pacific Ocean using gas chromatography/mass spectrometry. Stable carbon isotopic compositions will be measured in biomarkers and low molecular weight carboxylic acids such as oxalic acid to understand the sources and photochemical aging in the atmosphere.

Organic aerosols still contain many unknown structures that are possibly produced by atmospheric photochemical processes. We will identify those unknown compounds using gas chromatography/time-of-flight high resolution mass spectrometry and develop the new compounds as new tracers to better understand the atmospheric processes. Radiocarbon (^{14}C) will be measured in aerosol samples to evaluate relative contributions from biogenic and fossil fuel sources.

【Expected Research Achievements and Scientific Significance】

Although aerosol composition and their hygroscopic properties have not been studied simultaneously, both chemical and physical (hygroscopicity) properties will be investigated here. The combination of two approaches will provide achievements on better understanding of the role of aerosols in changing atmosphere and earth system. Using a Tandem DMA system, the hygroscopicity of aerosols and their growth factors will be clarified for various aerosol types.

We will apply these techniques to the aerosol samples collected at Chichijima Island in the western North Pacific, an outflow region of Asian polluted aerosols and their precursors. By analyzing the marine aerosols collected for last 20 years, we can reconstruct the past changes in the atmospheric composition and their hygroscopic properties in the Asian Pacific region.

【Publications Relevant to the Project】

Kawamura K., H. Kasukabe and L. A. Barrie, Secondary formation of water-soluble organic acids and α-dicarbonyls and their contributions to total carbon and water-soluble organic carbon: Photochemical aging of organic aerosols in the Arctic spring, *J. Geophys. Res.*, 115, D21306, doi: 10.1029/2010D014299, 2010.

Jung J., Y. J. Kim, S, G. Aggarwal, K. Kawamura, Hygroscopic property of water-soluble organic-enriched aerosols in Ulaanbaatar, Mongolia during the cold winter of 2007, *Atmos. Environ.* 45, 2722-2729, 2011.

【Term of Project】 FY2012-2016

【Budget Allocation】 167,900 Thousand Yen

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