Studies on impacts of black carbon aerosol based on aircraft observations

Yutaka Kondo
(The University of Tokyo, Research Center for Advanced Science and Technology, Professor)

【Outline of survey】

Black carbon aerosol (BCA) is emitted by incomplete combustion of carbon based fuels. It strongly absorbs solar radiation and therefore contributes to global warming. This absorption heats the atmosphere and cools the surface, leading to increases in vertical stability of the atmosphere. As a result, convection is suppressed, leading to decreases in cloud formation and precipitation. In addition, BCA coated by non-refractory chemical components acts as cloud condensation nuclei (CCN) and affects cloud cover, cloud albedo, and precipitation. Emissions of BCA are largest in Asia and therefore can strongly impacts climate there. Heating rates of BCA depends on its mass concentration, size distribution, and coating thickness. Especially coated BCA strongly enhances photo-absorption. However, there are very limited direct measurements of these key physical parameters, leading to large uncertainties in assessments of climate change. In order to overcome this difficulty, we develop an instrument for the accurate and fast response measurements of these physical parameters. Aircraft observations by using the new instrument are conducted downstream of the Asian continent. By these observations, key processes critical in assessing BCA impacts on climate are understood. The processes include long-range transport, transformation, uptake into clouds, and removal of BCA. We improve the reliability of climate models based on understandings obtained by these observations. We assess impacts of BCA on radiation and climate (temperature, cloud cover, and precipitation) in Asia.

【Expected results】

Spatial and temporal variations of BCA and its physical properties in the outflow from the Asian continent are characterized. Key processes controlling these parameters are understood. These understandings on BCA processes will be used to improve aerosol schemes used in climate models. Impacts of BCA on climate (temperature, cloud cover, and precipitation) in Asia, are accurately assessed. In addition, we will improve reliability of the prediction of global climate change.

【References by the principal investigator】

・Kondo, Y., Y. Komazaki, Y. Miyazaki, N. Moteki, N. Takegawa, M. Nogami, S. Deguchi, M.Fukuda, T. Miyakawa, Y. Morino, D. Kodama, and M. Koike, Temporal variations of elemental carbon in Tokyo, *J. Geophys. Res.*, 111, D12205, doi:10.1029/2005JD006257, 2006.
・Moteki, N. and Y. Kondo, Effects of mixing state on black carbon measurements by Laser-Induced Incandescence, *Aerosol Sci. Technol.*, *41*, 398-417, 2007.

【Term of project】 FY2007－2011

【Budget allocation】 30,600,000 yen
(2007 direct cost)

【Homepage address】 http://www.atmos.rcast.u-tokyo.ac.jp/