Investigation of Physical and Chemical Properties of Aerosol by Advanced Technologies for Improvement of Prediction of Climate Change

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[Abstract]

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This study is aimed at investigating impacts of aerosol on climate by combining observations using advanced technologies and climate models. For this purpose, we have made improved understanding on microphysical processes of scattering and absorption of solar radiation by aerosol by ground-based and aircraft observations. We have made an accurate estimate of BC emission from China by combining ground based observations and 3-D models. We have also quantified transport processes of aerosol from the boundary later to the free troposphere by aircraft observations. Updated knowledge on aerosol optical properties has been included in climate prediction models. Estimations and predictions of aerosol radiative effects on global and regional scales have been greatly improved. Changes in radiation and cloud cover are predicted by performing numerical experiments using improved models. These results are being included in the IPCC 5th assessment report. We describe important items conducted by this study, and discuss key findings and implications to the strategies for earth environmental policy.

The items of the research made by this study are listed below.

Physics, chemistry, and optical properties of aerosol

(1) Field measurements of mixing state and optical properties of aerosol at a remote site
(2) Microphysical modeling of mixing state of BC
(3) Ground based and aircraft measurements of aerosol chemical composition
(4) Interpretation of the field data by 3-D models

Measurements of optical parameters and radiation

(5) Ground based measurements of optical parameters (optical depth, single scattering albedo, and asymmetry factor) by sky radiometers and spectral irradiances at Hedo, Fukue, and Miyako stations)

Global modeling of aerosol and radiative forcing

(1) Update of inorganic aerosol chemical module of MIROC+ SPRINTARS general circulation model (GCM)
(2) Estimate of aerosol radiative forcing by the updated GCM

(3) Investigation of stratification of aerosol and clouds using ESSP/CALIPSO satellite data
(4) Estimate the effect of stratification of aerosol and clouds on radiative forcing