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NIES ライダーネットワークデータを用いたエアロゾル・雲解析
Aerosol and cloud analyses using NIES lidar network observation data

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We have established a ground-based lidar network (NIES lidar network) covering a wide area in East Asia since 2001 in order to monitor and understand the movements and the optical properties of Asian dust, air-pollution aerosols, and clouds. As part of the NIES lidar network observation, we have conducted shipborne lidar measurements using the research vessel MIRAI of JAMSTEC since 1999 in order to understand the optical properties of aerosols and clouds over ocean and provide vertical distribution data of aerosols and clouds for validation of numerical models and satellite-borne measurements. A compact two-wavelength (532 and 1064nm) backscatter (b) and one-wavelength (532nm) polarization (d) Mie-scattering lidar system (i.e., 2b+1d lidar system) with automatic measurement capability is used in the ground-based and shipborne observations. To better understand the optical properties of aerosols and clouds, we improved some lidars used in the ground-based lidar network observation by adding a channel measuring Raman scattering light from nitrogen gas. These improved lidars (Mie-Raman lidar system) can provide particle (i.e., aerosols and clouds) extinction data (a) at 532nm without assuming an extinction-to-backscatter ratio (i.e., 1a+2b+1d lidar system), unlike Mie-scattering lidar. We also constructed a new lidar system using High spectral resolution lidar (HSRL) technique; this lidar provides 1a (532nm), 2b (532 and 1064nm), and 1d (532nm) data like the Mie-Raman lidar. We installed the developed HSRL system on the vessel MIRAI and conducted the shipborne measurements over Indian ocean last year. To analyze the ground-based and shipborne 2b+1d lidar data, we developed algorithms to retrieve aerosol optical properties. The algorithms identify several main aerosol components in the atmosphere (e.g., dust, sea-salt, and air-pollution particles) and retrieve their extinction coefficients at each slab layer. These algorithms assume an external mixture of the aerosol components; mode radii, standard deviations and refractive indexes for each aerosol component are prescribed based on the literatures such as the Optical Properties of Aerosols and Clouds (OPAC) database; the optical properties for each aerosol component are computed from Mie theory on the assumption that their particles are spherical, except for dust. To consider the effect of nonsphericity, the dust optical properties are theoretically computed on the assumption that the particles are spheroidal. In these algorithm developments, we found that particle extinction data are useful to classify strongly light absorption particles. We are then developing an algorithm to identify black carbon particles as well as dust, sea-salt, and air-pollution particles with weak light absorption (e.g., sulfate and nitrate) using the ground-based and shipborne 1a+2b+1d lidar data. In the conference, we introduce the lidar systems used in the NIES lidar network observation and the observed data. We also present the outlines of the aerosol classification and retrieval algorithms and report the results of the application of the algorithms to the observed lidar data to demonstrate their abilities.

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