Global aerosol and cloud observation by space-borne multi-wavelength polarization high-spectral-resolution lidar

*Tomoaki Nishizawa[1], Hajime Okamoto[2], Syoken Ishii[3], Yoshitaka Jin[1]

1. National Institute for Environmental Studies, 2. Kyushu University, 3. National Institute of Information and Communication Technology

We propose global satellite measurements of vertical distributions of aerosols and clouds (particles) by multi-wavelength polarization high-spectral-resolution lidar (HSRL) using both HSRL and polarization measurement techniques. This proposal realizes polarization HSRL measurements in ultraviolet, visible, and near-infrared spectral regions (355, 532, and 1064nm) and conducts multi-wavelength and multi-parameter measurements of particles simultaneously.
The proposed lidar, which has twice or larger measurement channels than the previous space lidars, measures global, three-dimensional (vertical and horizontal) distributions of particles; this enables to observe various optical and microphysical properties (e.g., extinction, size distribution, chemical components) simultaneously and to obtain more reliable particle information in quantitative and qualitative than the past. Observational studies using both these global, three-dimensional data of particles and numerical models (e.g., aerosol chemical transport model, and cloud resolving model) will lead to understating preprocess on aerosol-cloud interaction better, reducing uncertainties on evaluation the particle effects on climate change, and improving prediction accuracy of the climate change. Furthermore, this space lidar observation can be used to monitor and forecast transport and diffusion of aerosols getting air quality worse (e.g., volcanic ash, mineral dust, smoke, and air pollution) and to evaluate the aerosol effects on atmospheric environment (e.g., human health, vegetation, and air quality). These improvements of the scientific knowledges contribute to internationally consensus building to solve global warming issues and improving environmental measures both within and outside Japan.
The proposed lidar should have a role to be a succession sensor of space lidar mission to observe global particle distributions such as CALIPSO satellite lidar (CALIOP) launched in 2006 and EarthCARE satellite lidar (ATLID) launched in 2021 and lead internationally particle observation mission by space lidar after EarthCARE mission. More advanced techniques on laser and lidar in space by improving the laser and lidar techniques established in vegetation lidar mission MOLI as well as HSRL techniques developed for ground-based lidars are established in this proposal. The developed techniques are also key techniques for lidars to measure meteorological parameters such as temperature, wind speed, and water vapor. Thus, this proposal is also a bridge for the technical development of the space lidar to measure meteorological parameters.

Keywords: Space-borne lidar, Aerosols, Clouds, HSRL, multi-wavelength

