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

Science and Engineering (Mathematical and Physical Sciences)

Title of Project : Analysis of cloud microphysics and vertical velocity by synergy use of next generation space-borne active sensors

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Research Project Number : 17H06139 Researcher Number : 10333783
Research Area : Atmospheric physics
Keyword : Meteorology, Earth observation, Remote sensing, Climate change

【Purpose and Background of the Research】

Cloud microphysics control Earth's radiation budget and the hydrological cycles. Comparisons of simulated cloud microphysics by general circulation models show large discrepancies among the models. Clouds are the major contributor (70%) to the total uncertainties in climate predictions. Cloud radar onboard CloudSat satellite and lidar onboard CALIPSO have started cloud and aerosol observation since 2006. ADM-Aeolus with Doppler lidar and EarthCARE with Doppler cloud radar and high spectral resolution lidar (HSRL) will be lunched after 2018. Retrieval of Vertical motion, cloud microphysics, mass fluxes of cloud/ precipitation, vertical profiles of horizontal wind velocity are expected from them, though the retrieval methods have not yet been established.

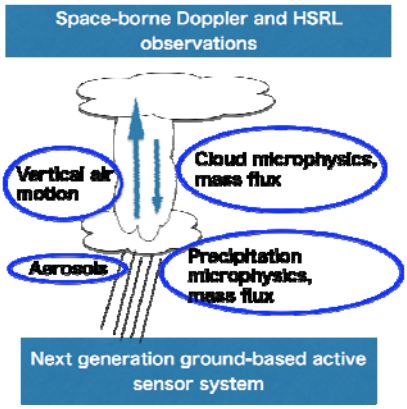
Main objectives of this project are to perform global analysis of cloud microphysics, mass flux, vertical air motion and their interactions, effect of horizontal wind shear on cloud formation.

【Research Methods】

We develop a next-generation-ground-based observation system including a multiple-scattering Doppler lidar and a multiple scattering multi-wavelength (355nm, 532nm and 1064nm) HSRL lidar systems that are based on the multi-field-of-view multiple-scattering polarization idar (MFMSPL) technique, which can overcome the observational limitation of existing ground-based conventional lidars. Cloud particle types, cloud and aerosol microphysics, as well as vertical air motion inside clouds will be retrieved. The next-generation system will be adopted to develop algorithms for EarthCARE and ADM-Aeolus satellites. These will further provide global analyses of cloud microphysics, mass fluxes of cloud/precipitations and vertical air-motion within 10km-horizontal scale and the effect of wind shear of horizontal wind velocity on cloud formation.

【Expected Research Achievements and Scientific Significance】

The next generation system is able to bridge the existing scale-gap between the ground-based and space-borne lidars and will be used to develop and improve algorithms for the satellites. Synergy use of Doppler cloud radar and the multiple-scattering Doppler lidar will provide dual Doppler information of clouds and simultaneous retrievals of particle fall velocity and vertical air-motion. The system gives the opportunity to evaluate and improve the cloud parameterization.



【Publications Relevant to the Project】

・H. Okamoto, K. Sato, Y, Hagihara, Global analysis of ice microphysics from CloudSat and CALIPSO: incorporation of specular reflection in lidar signals, J. Geophys. Res., 115, D22209 1-20, 2010.
・H. Okamoto, K. Sato, T. Nishizawa, N. Sugimoto et al., Development of a multiple-field-of-view multiple-scattering polarization lidar: comparison with cloud radar, Opt. Express, 24, 26, 30053-30067, 2016.

【Term of Project】

FY2017-2021

【Budget Allocation】

147,900 Thousand Yen

【Homepage Address and Other Contact Information】

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