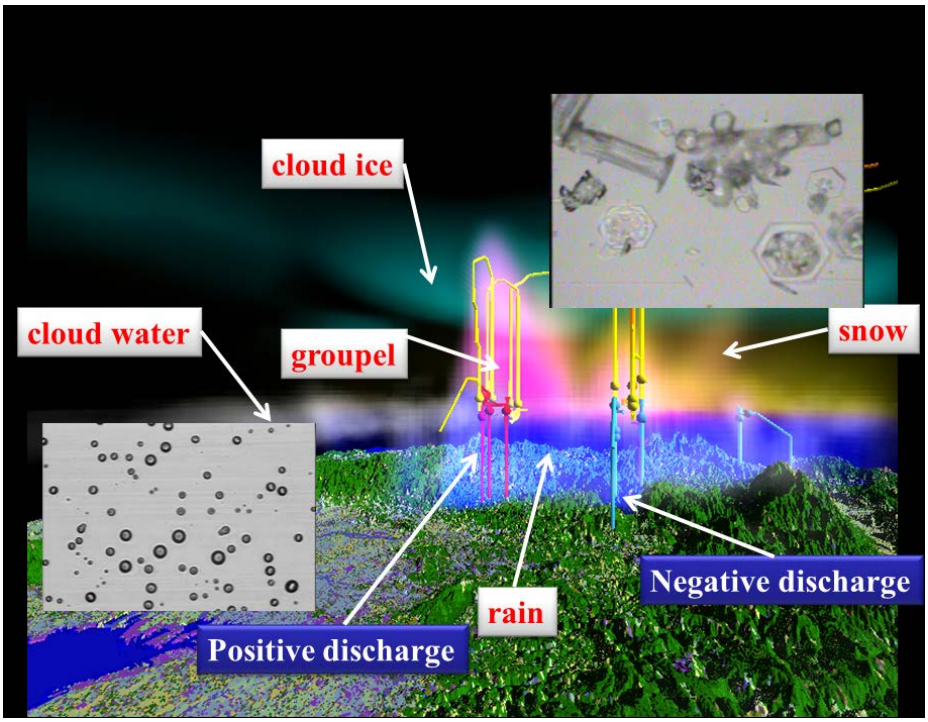
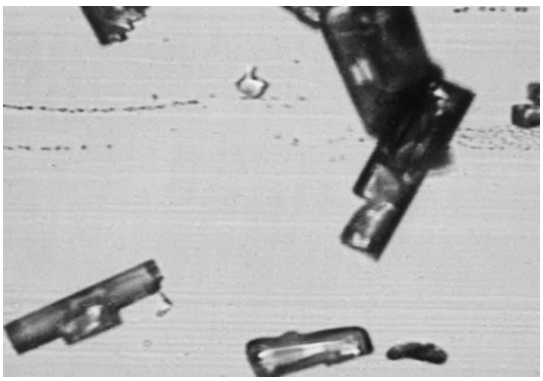
9-3. Interdisciplinary Researches
Project for Aerosol and Cloud Formation

Introduction to Project for Aerosol and Cloud Formation

Hydrometeors and aerosols closely interact with each other in their generation and dissipation, and play important roles in atmospheric water circulation, formation of convective clouds and typhoons as well as in the Earth radiation budget. They are, however, some of the most unknown quantities in the atmosphere. So far, hydrometeors and cloud-precipitation systems have been studied in the Hydrospheric Atmospheric Research Center, whereas aerosols and related processes have been studied in the Solar-Terrestrial Environmental Laboratory. In the joint research program, researchers from both centers will cooperate to study the interaction between aerosols and hydrometeors, their variations in the formation of precipitation, and cloud-aerosol-radiation interactions by field observations and numerical simulations. On the basis of field observations, the numerical model will be improved for quantitative simulation of cloud and aerosol processes. In cooperation with the Center for Orbital and Suborbital Observations, we will conduct *in situ* observations of typhoons using an aircraft, balloons, and drones. This research will improve the cloud-resolving model (CReSS), and the impact of aerosols on typhoon clouds will be studied.



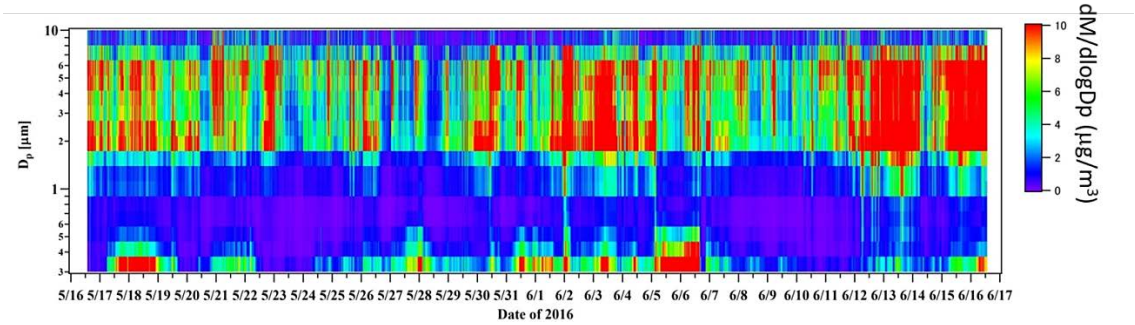


Upper: A mesoscale convective system and hydrometeors simulated by the CReSS model.
Lower: The superimposed images show hydrometeors expected to be present in the convective system. Balloon observation of typhoon clouds. Launching balloon (left) and observed hydrometeors (right).

Main Achievements in FY2017

1. Cloud and aerosol observation in the Okinawa region

Aerosol observation and numerical simulations of clouds and precipitation were performed to clarify the effect of aerosols on cloud formation, and typhoon-related cloud and precipitation. Typhoons often approach the Okinawa region. Oceanic precipitation often occurs there. An optical particle sizer (OPS) was utilized to observe aerosol in the central part of the main island of Okinawa for about one month. The figure shows the weights of aerosol particles in a unit mass of air as a function of particle size. Since the observation point was close to the sea, larger particles are dominant. This indicates that the air was clean and that large particles such as sea salt are the main component of aerosol. Although no typhoon was observed during the observation period, aerosol observations will be conducted in the future to investigate aerosol characteristics during a typhoon.



Time-series of aerosol size distribution observed by OPS at the Okinawa Electromagnetic Technology Center, National Institute of Information and Communication Technology in Onna village, Okinawa.

2 . Cloud and aerosol observation in United Arab Emirates (UAE) and aerosol modeling

Using an aircraft (Super King Air, B200T) equipped with an aerosol-cloud-precipitation observation system, aerosol observation was conducted over the UAE to clarify the physical and chemical characteristics of aerosols. Cloud micro-physical observations were also conducted in the UAE as well as along the flight path between Japan and UAE: over the Okinawa region, the Philippines, Thailand, Vietnam, India, and Oman. The effect of aerosols on cloud and precipitation was studied using the data. In the modeling study, the activation process of aerosols was investigated using CReSS, based on observed data. A unified model of aerosol, cloud and precipitation is now in development, and the observed data will contribute to the verification of the model.

Aerosol observation using B200T (left panel), observed diurnal convective clouds (central panel), and precipitation distribution caused by the diurnal convective clouds simulated by CReSS (right panel).