Center for Orbital and Suborbital Observations (COSO)

- Establishment of an aircraft observing system
- Aircraft observations of cloud, aerosol and typhoon
- Development of validation equipment for Earth observing satellites
- Promotion of Exploration of energization and Radiation in Geospace (ERG) mission
- Solar observation missions using micro satellites
- Study for simultaneous development of multiple satellites for future space science

Based on ISEE research subjects, which encompass natural phenomena ranging from the Earth's surface to outer space, COSO is expected to perform empirical and advanced research through observation, especially through collaborations among industry, academia, and government, leading to remarkable technological developments for aircraft, balloons, sounding rockets, and spacecraft observations. COSO plays a key role in, and promotes, aircraft observations in Japan. We also investigate and promote future space exploration missions in collaboration with institutions in Japan and overseas to gain new insights into physical phenomena. We assist in advancing observation capabilities for future orbital and suborbital observations by developing an efficient common technological and development environment via interdisciplinary activities. The Hydrospheric Atmospheric Research Laboratory contributes to COSO's activities by using X-and Ka-band radars, together with numerical model studies under VL activities. The Space Exploration and Research Office (SERO) was newly established in 2018.

Main Activities in FY2019

Promotion of aircraft observations

Aircraft observations of water vapor on the upstream side of heavy rainfall was implemented, in collaboration with DOTSTAR in Taiwan. In addition, ground-based observation equipment such as radar was installed on Yonagunijima island to carry out joint observations with the US, Taiwan, and Korea, targeting typhoons in 2021.

Ka-band radar installed on Yonagunijima.

In the United Arab Emirates Precipitation Intensification Science Program "Advanced Research on Precipitation Intensification in Arid and Semi-arid Regions," the investigation of the effects of cloud-aerosol processes on cumulus development and precipitation efficiency using a numerical cloud-resolution model has continued. The Ministry of Land, Infrastructure, Transport, and Tourism's Transport Technology Development Promotion System research project, "Basic study on understanding high ice water content clouds causing jet engine power loss and air data probe failures and development of their detection and prediction methods," has started. We are also preparing for ice cloud observations conducted jointly with the US, which are scheduled in 2021.

The proposal "Promotion of Climate and Earth System Science Research by Aircraft Observation," jointly proposed by the Meteorological Society of Japan, the Japan Society of Atmospheric Chemistry, and the Japan Aeronautics and Astronautics Society for the Master Plan 2020 of the Science Council of Japan, was selected as a high priority project. In this proposal, COSO is the core base for the aircraft observations.

Promotion of international collaboration in satellite missions for terrestrial upper atmospheric exploration

Regarding future space exploration missions, we investigated integrated observational methodologies for space plasmas, upper atmospheric particles, plasma waves, electric/magnetic fields, and auroral emissions in the terrestrial magnetosphere/ionosphere/thermosphere, collaborating mostly with Swedish research institutes. Centering around specialty Swedish scientific instruments, we discussed concrete measurement techniques, based on collaborative research and development on the Japanese side, through on-site science meetings and remote discussions via email.

Solar observation mission using nano-satellites

We are developing a solar neutron and gamma-ray detector, weighing less than 10 kg, intended for nano-satellites weighing less than 10 kg. The nano-satellitesare chosen because they have more launch opportunities than 50-kg satellites like ChubuSat. We plan to launch an engineering prototype in 2021 and a satellite with scientific instruments in 2022 or later, in time for the next solar maximum. In FY2019, we designed components specifically required for the scientific satellite. We also developed a signal processing board for low-power integrated circuits.

Space Exploration and Research Office

The Space Exploration and Research Office (SERO) has been established as the first step toward forming a research center to consolidate all space-related activities at the university, and to promote hardware development and observational research for space exploration and science. The development of nano-satellites is one of SERO's most crucial activities. Educational activities are also important to SERO. We held two-week basic training courses for space applications in August and February. We also held a two-week advanced training course in March. All the courses drew close to 30 applicants. About 40% of the applicants were from outside Nagoya University.

Investigation on the simultaneous development of multiple satellites for future space exploration missions

2-week training course for space applications.

Cooperating with a domestic manufacturer with substantial achievements in spaceborne component development for previous space missions, we have been designing a standard bus system for the compact (150–200 kg) satellite missions applicable to future demonstrative space exploration. We have also been investigating the technical issues required for the simultaneous development, cluster launch, and operation of multiple satellites to realize multi-point observations. We discussed electric/mechanical interfaces, simultaneous ground-based test configuration/subjects, mechanical structures and electronics for launch and separation, and satellite–satellite communication operations, including time synchronization methods.

Promotion of observations using Earth-observing satellites

Regarding the future concept of an Earth-observation satellite, studies on the future spaceborne precipitation radar were implemented. A new radar called DPR2, which is an upgraded version of the dual frequency precipitation radar onboard the GPM core observatory, was proposed in the grand design of the Earth-observation satellite program, as a key sensor for the cloud-precipitation observation mission. In cooperation with JAXA, we participated in discussions on the NASA cloud-precipitation observation mission.

Using J-OFURO3, the third-generation dataset of heat–momentum–freshwater flux between the atmosphere and the ocean, which is important for accurately understanding the energy balance and climate change of the Earth system, long-term (30 years) global heat flux fluctuations were analyzed. Furthermore, a new algorithm applicable to severe weather conditions, such as typhoons, was developed.