Center for Orbital and Suborbital Observations (COSO)

- Establishment of an aircraft of observing system and implementation of aircraft observations
- Development of validation equipment for Earth observing satellites
- Development of ChubuSat and promotion of its applications
- Observation of polar ionosphere/magnetosphere by formation of flight satellites
- Climate system research at a virtual laboratory (VL)

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 FY2018

Promotion of aircraft observation

We have been promoting the establishment of a core base for aircraft observation in collaboration with an external research institute. We also aim to contribute to research using aircraft observation, such as studies of aerosol−cloud interactions and those on the development processes of typhoons.

Continuing from 2017, using the G-II jet of Diamond Air Service Co., Ltd., we conducted six penetrations to Typhoon T1824 (TRAMI) in four days from September 25 to 28, 2018 (Fig. 1). We obtained meteorological elements near the center of the typhoon through drop sonde observation. The data acquired from drop sonde were sent to the operational meteorological agencies via the Global Telecommunication System (GTS), and used to predict the track and intensity of this typhoon.

The cloud-aerosol process study using the CReSS is implemented based on the aircraft observation conducted in 2017 as part of the Advanced Study on Precipitation Enhancement in Arid and Semi-arid Regions of the United Arab Emirates. We conducted numerical experiments to investigate the impact on precipitation efficieny.

In addition, we held an aircraft observation session of JpGU in collaboration with the Meteorological Society of Japan (MSJ), to promote the aircraft mission of COSO. The research plan for aircraft observation in collaboration with MSJ was revised for the preparation of the master plan 2020 proposal.

Fig.1: The picture of eye of Typhoon T1824 from aircraft on September 27, 2018.

Investigation and development of the standard bus system for micro-satellite applicable to space missions

We have been conducting investigations and developing the standard bus system for compact (100–200 kg) satellite missions in the future demonstrative space science. In cooperation with a domestic manufacturer having substantial achievements of instrumental developments in the previous space missions, rather than well-known space companies requiring enormous cost for a new satellite system, and the science/engineering teams of ISAS/JAXA, we have completed the investigations regarding facilities and environment necessary to the development/operation for future space exploration missions using multiple satellites by assuming concrete conditions.

Promotion of international collaborative developments of onboard observational instruments applied to space exploration missions for the space-Earth coupling research

We are promoting the international collaborative developments of onboard science instruments for the future space observation missions, to stimulate and contribute to demonstrative research in the space-terrestrial upper atmosphere coupling system, by realizing the integrated measurements of space plasmas, neutral particles, fields, waves, and emissions in space. In particular, we initiated the discussion and investigations toward the international collaborative developments of the upper atmospheric neutral particle instrument together with overseas research institutes.

Solar observation mission by nano-satellites

We are developing a solar neutron and gamma-ray detector intended for nanosatellites weighing less than 10 kg, which have more launch opportunities than the 50-kg class satellite, ChubuSat-2, launched in 2016. With the goal of launch in FY2021, we have started the design of a 3U CubeSat with dimensions 30 × 10 × 10 cm^3 and a weight of 4 kg by the SERO members. We have designed and fabricated a signal processing board with ASICs for the mission instrument to achieve very low power consumption.

Space Exploration and Research Office (SERO)

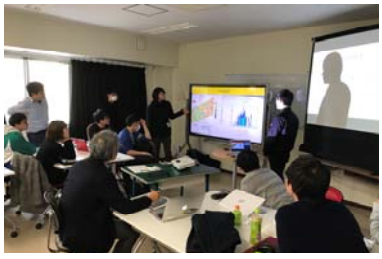

Fig.2: 2-week training course for space applications.

SERO is established as the first step toward forming a research center to consolidate all space-related activities in the university and promote hardware development and observational research for space exploration and science. Its main activities include development of micro- and nanosatellites, development of propulsion technologies, instrument development for satellite and/or space exploration projects at ISAS/JAXA, and administrations of training programs for space exploration. Staff members from the divisions of engineering, science and environmental studies, participated in these activities. We held a two-week training course for space applications in February (Fig.2).

Promotion of observations using Earth observing satellites

The concept of the future spaceborne precipitation radar was studied and DPR-2, upgraded from the dual-frequency precipitation radar onboard the GPM core satellite, was proposed as the mission proposal to the Grand Design of the Earth Observation Satellite. We participated in the discussion of the NASA's future cloud and precipitation observation mission.

Furthermore, we expanded J-OFURO3, the third-generation data set of heat, momentum and freshwater flux between the atmosphere and the ocean on the global basis, which is important for a precise understanding of the energy balance of the earth system and climate change. Research on the flux estimation under the severe weather conditions such as typhoons and bomb cyclones by using GNSS ocean reflection data from small satellites was started.