Center for Orbital and Suborbital Observations (COSO)

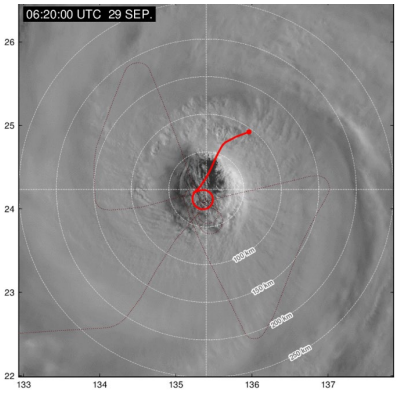
- Establishment of an aircraft observing system
- Aircraft observations of cloud, aerosol and typhoon
- Promotion of ERG mission
- Solar observation missions using micro satellites
- Study of the simultaneous development of multiple satellites for future space science
- Human resource development for space applications

Based on ISEE research objectives, 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 collaboration among industry, academia, and government, leading to remarkable technological developments for aircraft, balloons, sounding rockets, and spacecraft observations. COSO aims to be the core of aircraft observation in Japan and investigates and promotes future space exploration missions to obtain new knowledge of physical phenomena in cooperation with domestic and foreign research institutions. By promoting interdisciplinary activities and efficient common technology development, COSO can improve observation capabilities for future orbital and suborbital observations. The Hydrospheric Atmospheric Research Laboratory contributed to the Virtual Laboratory with four universities using X- and Ka-band radars, together with numerical model studies. The Space Exploration and Research Office (SERO) is undertaking nanosatellite and human resource development programs for space applications. The Aircraft Observation Promotion Office was newly established to promote aircraft observation in Japan.

Main Activities in FY2021

Promotion of aircraft observations

Thanks to Nagoya University President's Discretionary Funds, we were able to install drop-sonde observation equipment on a new jet plane, Gulfstream IV (G-IV). Test flight and drop-sonde experiments were conducted, and the drop-sonde ejection was filmed using a high-speed camera from another jet tracking the G-IV to confirm that the drop-sonde was ejected correctly from the shooter of the G-IV. Typhoon Mindulle, which approached Japan on September 29, 2021, was observed using this drop-sonde observation system, and three penetrating observations of the eye were made in a butterfly pattern at an altitude of 45,000 feet to observe the inner core region. A total of 31 drop-sondes were dropped around the eye and eye wall clouds. In addition, a real-time data-transmission experiment at Nagoya University was successful. This observation system allowed us to observe the warm-core structure of the eye, in addition to the central pressure and maximum wind speed.



Meteorological satellite image of Typhoon Mindulle in 2021 overlaid with the path of the observation flight.

In preparation for an aircraft observation project under the Ministry of Land, Infrastructure, Transport and Tourism, we investigated aerosol measurement equipment, CCN counters, and ice nuclei counts for use in NASA/DC-8, such as modifications to the aircraft, including aerosol inlets, for use in high-altitude operations.

A research paper based on the data analysis of aircraft observations in Greenland in 2018 was published and preparations were made for simultaneous aircraft and ship observations off the east coast of Hokkaido in the summer of 2022.

Hydrospheric Atmospheric Research Laboratory

To prepare for joint observations with the U.S. and Taiwan on Baiu fronts and typhoons from June to August 2022, a Ka-band radar was installed on Yonaguni Island in 2020 and an X-band radar was transported to Yonaguni Island. An ISEE symposium titled “Heavy Rainfall and Tropical Cyclone in East Asia” was held in March. During this symposium, details of the joint observations were also discussed with researchers from other countries.

Investigations on in-parallel manufacturing and cluster launch configuration for multiple 150–200 kg-class satellites developed for future space exploration

In cooperation with a Japanese satellite manufacturer, NEC, qualified by numerous satellite development experts for space missions of more than 300 kg, we have been investigating new types of system specifications and in-parallel development for future satellite exploration missions. Assuming the application of space-qualified components supplied by Airbus for simultaneous development and launch for almost equivalent satellites with a weight of less than 200 kg, we discussed the satellite structure with deployed subcomponents, launch configuration and separation sequence by a single rocket, and operation tasks in this fiscal year. Assuming that the launch service for multiple satellites is based on the Epsilon-S system by IHI-Aerospace, we investigated detailed satellite structures and concrete launch configurations for a case of vertically stacked satellites, which has not been realized in Japan.

Solar observation mission using nanosatellites

We are developing a solar neutron and gamma-ray detector intended for nanosatellites weighing less than 10 kg. Nanosatellites are chosen because they have more launch opportunities than 50-kg satellites, such as ChubuSat. We plan to launch an engineering prototype in FY2022 and a satellite with scientific instruments in FY2024 or later, in time for the next solar maximum. In FY2021, we established signal processing and calibration procedures for a plastic scintillator used for neutron detection and energy measurements. We achieved an energy resolution of 15% (full width at half maximum, FWHM) and angular resolution of 11° (FWHM) for 46 MeV protons. This corresponds to a 23% energy resolution for 56 MeV neutrons, which satisfies the mission requirement.

Space Exploration and Research Office (SERO)

SERO was established as the first step toward forming a research center to consolidate all space-related activities at the university and promote hardware development and observational research for space exploration and science. The development of nanosatellites is one of the most critical SERO processes. Educational activities are also important in SERO. We held a basic 2-week training course in August/September and an advanced 2-week training course in March. There were 72 applicants for the basic course and 42 for the advanced course. More than 80% of the applicants were from outside Nagoya University and approximately 40% of the applicants were from industries.

Promotion of observations using Earth-observing satellites

Activities were conducted to formulate a plan for Japanese Earth observation satellites under the TF remote sensing subcommittee. We contributed to the development of algorithms for spaceborne precipitation radar and studied future space-borne Doppler radars. We conducted validation activities for JAXA’s climate change mission (GCOM-C), validated the Northwest Pacific Action Plan (NOWPAP) marine eutrophication assessment protocol using satellite data, and studied the basic production of oligotrophic coastal areas in Japan. Quantity fluctuations were evaluated using Ise Bay as an example.