9-2. Research Centers
Center for Orbital and Suborbital Observations (COSO)


Eyewall clouds of Typhoon LAN taken during the aircraft experiment on October 21, 2017.

Research topics and keywords

- 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 flight satellites
- Climate systems research at a virtual laboratory (VL)

Introduction to COSO

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 by observation, especially through collaborations between 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 X-and Ka-band radars, together with numerical model studies under VL activities.

Main Achievements in FY2017

1. Promotion of aircraft observation

We held a session at JpGU2017 entitled "Promotion of Climate and Earth System Science Research by Aircraft Observation". The aircraft observation of typhoon 21 (LAN) with newly developed dropsondes was conducted in the southeast of Okinawa in October. During the observation period, penetration to the eye wall of the typhoon was conducted three times and succeeded in observing the atmospheric pressure, temperature and airflow field in the eye of the typhoon. The data are extremely valuable for understanding the inner core structure of a typhoon and are assimilated to evaluate the track and intensity variation of LAN. As part of the Advanced Study on Precipitation Enhancement in Arid and Semi-arid Regions of the United Arab Emirates, seeding experiments were conducted to observe the number density and mass-mixing ratio of aerosols, cloud droplets and ice crystal particles in cumulus clouds.

2. Development of ground observation equipment for verification of satellite CO_2 observations

Ground validation for spaceborne sensors for CO_2 observation from space (GOSAT, GOSAT-2, OCO-2) has been conducted. New ground-based spectrometers to measure the column concentration of CO_2 using infrared around a wavelength of 1.6 microns from the Sun have been developed; one uses a high-resolution optical spectrometer and the other uses a small array spectrometer. Both are compact, lightweight and inexpensive compared with conventional equipment, and can be installed at a range of locations to conduct satellite validation. The high-resolution optical spectrometer has been operated for more than two years in the center of Tokyo and has demonstrated the causes of the

annual and seasonal fluctuation of the CO_2 column concentration. A less expensive spectrometer has been newly developed and demonstrated expected accuracy during continuous observation.

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

The center has been leading the investigation and development of a standard bus system for a 100–200 kg satellite applicable to future demonstrative space science and exploration missions. In cooperation with a domestic manufacturer with substantial successes in instrumental development in previous space missions, and the science/engineering teams at ISAS/JAXA, we have developed several conceptual designs for an onboard propulsion system for satellite altitude/orbit controls, rocket launch configuration into a targeted orbit by assuming a science mission model, and a feasibility check of the satellite bus system against the calculated space radiation dose.

4. Promotion of a multi-point/simultaneous observation mission with multi-satellites for geospace research

We are promoting a demonstrative space exploration mission performing integrated and many-sided observations of auroral emissions, atmospheric neutral and space plasma particles, plasma waves, and electric/magnetic fields with high-time/spatial resolutions using multiple (2–4) satellites with separation distances of 1–100 km in the geospace coupling system. We have discussed the observational importance and objectives at several typical altitudes of a modeled orbit, and also investigated the measurement principle/performance of the observational instruments, the control methods for satellite separation distances, and the propulsion system.

5. Solar and Earth observation mission by micro-satellites

We are developing a gamma-ray and neutron instrument for solar flare observations intended for 10-kg class satellites, which have more launch opportunities than 50-kg class satellites. Simulation studies verified that a twofold increase in the spatial and energy resolutions can be achieved by employing new integrated circuits with 1/20th of the power, which allows more electronic channels with less total power. We have also successfully read out signals and obtained spectra from integrated circuits coupled with a 4×4 array of inorganic scintillators (GAGG), used for gamma-ray spectroscopy.

6. Promotion of Earth Observation Satellite Missions

The vision of the Earth Observation Satellite was discussed with researchers and published as a “Meteorological Research Note”. A future precipitation observation mission was discussed within a Japan-US collaboration. The atmosphere-ocean flux database, J-OFURO3, extended its period and, using this database, the long-term fluctuation of the sea surface heat balance due to climate change was investigated. In addition, research using high frequency observation data from CYGNSS commenced.

7. 11th seminar on "Formation of a virtual laboratory for diagnosing the Earth’s climate system (VL)"

The 11th seminar of VL was conducted at Nagoya University in March 2018. 27 participants from 16 organizations and Universities including Hokkaido Univ., Niigata Univ., Tokyo Metropolitan Univ., Kochi Univ., and Fukuoka Univ., joined the seminar entitled “Analysis using XRAIN radar data”.