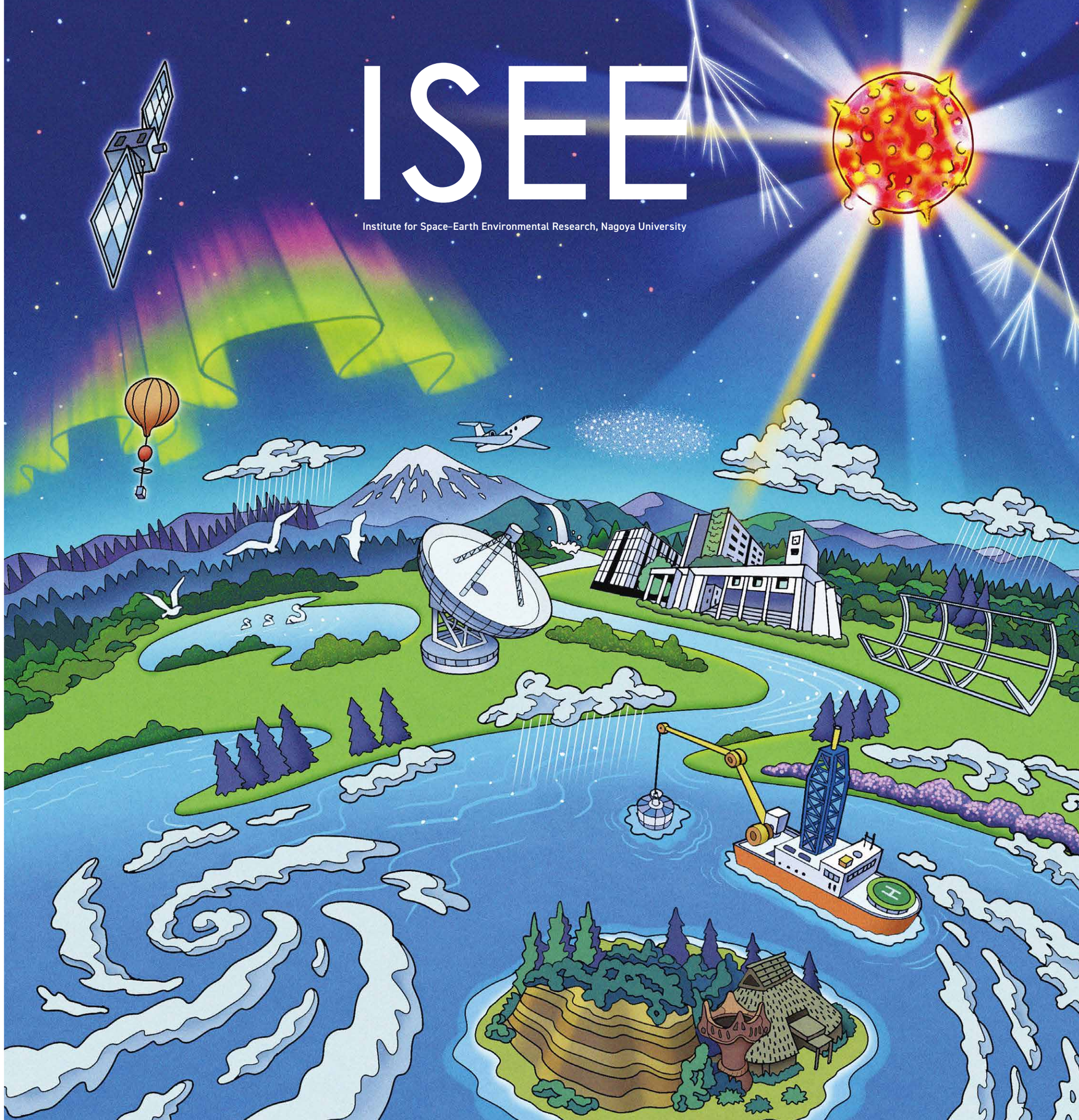

ISEE Institute for Space–Earth Environmental Research

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Dec. 2025

Contents

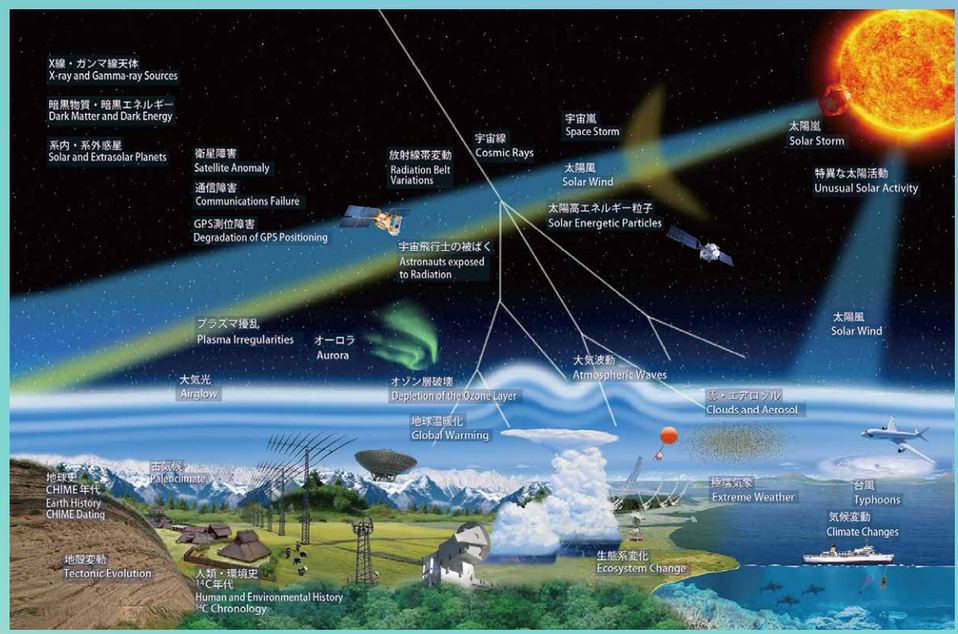
Message

Director of the Institute for Space–Earth Environmental Research
SHIOKAWA Kazuo

Rapid advances in society and science have expanded human activity into space, significantly affecting Earth's global environment. It is essential to reconsider our environment from a broader perspective, accounting for the relationship between Earth and space. In 2015, the Institute for Space–Earth Environmental Research (ISEE) was established at Nagoya University for this purpose. ISEE resulted from collaboration among researchers from various disciplines. Its mission is to clarify the mechanisms and relationships among Earth, the Sun, and cosmic space, treating them as a seamless system. The institute addresses issues related to the near-Earth environment and the expansion of human society into space. ISEE also supports international and domestic collaborative research projects as Japan's only International Joint Usage/Research Center connecting space and earth sciences.

Our living environment results from the interaction of various elements and changes over time. Variations in solar activity can significantly affect both our habitat and society. Solar flare explosions on the solar surface can severely disrupt Earth's radiation environment and upper atmosphere, leading to major disturbances in satellites, power systems, communications, aviation, and other infrastructure. Long-term changes in solar activity may also affect Earth's climate. Cosmic rays from distant parts of the universe can influence our ecosystem; for example, cosmogenic isotopes in tree rings provide valuable data for reconstructing past environments. Understanding the mechanisms of climate change and extreme weather phenomena is essential, as both can cause disasters on a global scale. This requires clarifying not only the greenhouse effect but also hydrological circulation, where aerosols, clouds, and precipitation interact. Additionally, it is necessary to understand the interaction between meteorological dynamics and the land–ocean ecosystem, as well as the role of solar influence.

Therefore, interdisciplinary research across various fields is necessary to explore the space–Earth environment. ISEE aims to play a central role in promoting domestic and international research collaboration among scientists and in developing new disciplines in space–Earth environmental research. To achieve this, we seek your support and cooperation to help establish a safer future for humankind.



We conduct joint research and interdisciplinary projects with domestic and international researchers to foster innovative fields of science exploring the Earth-Solar-Space system seamlessly.

Division for Integrated Studies

Sun | Earth / Planets | Magnetosphere | Systems Science | Space Weather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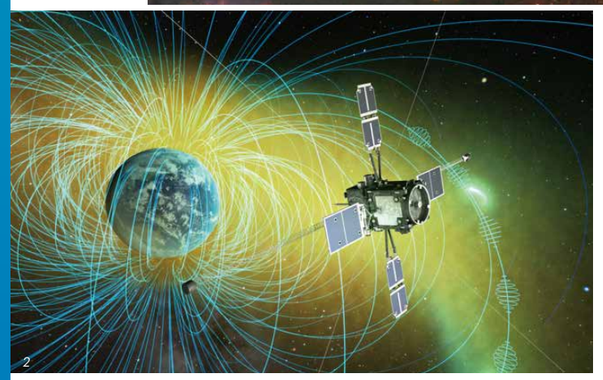
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The Division for Integrated Studies views the "solar–terrestrial–planetary environment," which includes the Sun, Earth, planets, and interplanetary space, as a unified "heliospheric system" and conducts research to understand its structure and dynamics. Research topics include sunspots, solar flares, auroras, geomagnetic storms, and their effects on Earth's atmosphere. The division also focuses on space-weather forecasting. Ground-based and satellite-based observations are integrated with advanced numerical simulations and AI, enabling comprehensive analytical studies in collaboration with researchers in Japan and other countries.

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MASUDA Satoshi Assoc. Prof. ▸ Solar physics
HARADA Yuki Assoc.Prof. ▸ Planetary plasma physics
IEDA Akimasa Asst. Prof. ▸ Auroral science, Space plasma physics

<Concurrent Members>
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IIJIMA Haruhisa Assoc. Prof. (Ctr. for Integrated Data Science)
HAYAKAWA Hisashi Asst. Prof. (Off. for the Promotion of Transdisciplinary Network)

More details are found on our webpage.
https://www.isee.nagoya-u.ac.jp/en/research/study06.html


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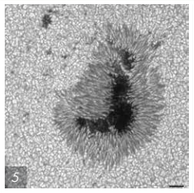
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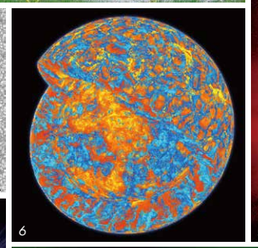
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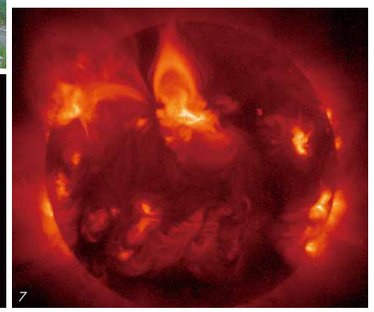
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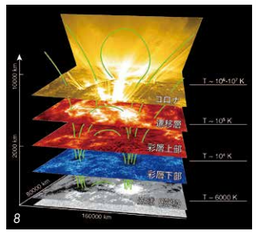

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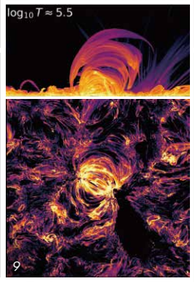

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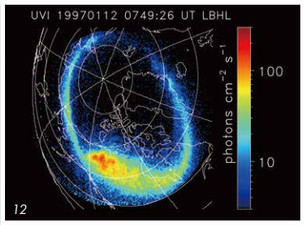

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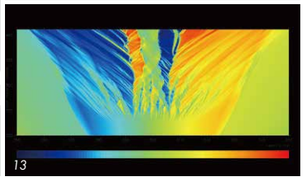
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1. The Division for Integrated Studies examined the solar–terrestrial system. 2. Conceptual illustration of the geospace exploration satellite "Arase" (©ERG Science Team). 3. Nobeyama Radioheliograph. 4. Solar observation satellite "Hinode" (©JAXA). 5. Sunspot observed by the "Hinode" satellite (©National Astronomical Observatory of Japan, JAXA). 6. Large-scale numerical simulation reproduced the entropy distribution inside the Sun. 7. X-ray image of solar flares. 8. Solar atmospheric layers connected by magnetic fields (©NAOJ/JAXA/NASA). 9. Numerical simulation of the solar active atmosphere. 10. Division for Integrated Studies members held a seminar. 11. Auroral breakup observed from the ground. 12. Auroral breakup observed from space (NASA). 13. Numerical simulation of plasma turbulence driven by magnetic reconnection.

Understanding the Solar-Terrestrial/Planetary System and Space Weather

The energy produced by nuclear fusion in the Sun's core requires a significant amount of time to reach the surface. Upon emerging, this energy appears in the solar atmosphere as dynamic phenomena, including sunspots, solar flares, solar wind, radiation, and high-energy particle generation. These phenomena provide the energy that drives the entire heliospheric system.

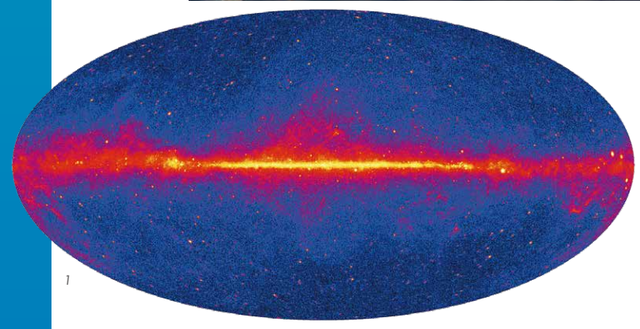
At the same time, geospace, other planets, and the surrounding space environments—the atmosphere, ionosphere, and magnetosphere—are continuously changing due to energy supplied by the Sun. Part of the solar-wind energy is absorbed by the magnetosphere as energetic particles and electromagnetic fields. This process initiates substorms and geospace storms, altering the distribution of high-energy particles in the radiation belts. These changes also affect the ionosphere, leading to aurora formation and strong electric currents, as well as modifications in the upper and middle atmosphere. Recent studies have shown that ions originating from the atmosphere can escape into space.

The Division for Integrated Studies aims to comprehensively understand the complex energy flows and transformation mechanisms within the heliospheric system, spanning from the Sun to the Earth and planetary systems. The Division seeks to accurately analyze phenomena across a wide range of temporal and spatial scales by integrating large-scale numerical simulations, analyses of diverse ground-based and satellite observations, and advanced data-science approaches, such as machine learning.

By integrating knowledge from these fields and clarifying their interactions, we aim to enhance understanding of the solar–terrestrial and planetary system. Additionally, advancing fundamental research on space-weather forecasting remains a key theme, as it is essential for the future of space development.

Division for Cosmic-Ray Research

Gamma-ray astrophysics | Neutrino | Dark matter | Cosmic-ray archeology | Cosmic-ray interactions



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Cosmic rays are radiations that contantly shower the Earch from outer space. They are composed of high-energy protons dominantly, but also include nuclei, electrons, gamma rays, and neutrinos. At the Division for the Cosmic-ray Research, we investigate the origin of cosmic rays and the physical processes of their acceleration and propagation. Furthermore, we conduct research into a range of advanced topics, such as ultra-high-energy particle phenomena beyond the reach of ground-based experiments, elementary particles like dark matter and their physical properties, fundamental physics utilizing cosmic rays, and the impact of cosmic rays on the Earth's environment.

TAJIMA Hiroyasu Prof. ▸ Cosmic-ray physics, gamma-ray astrophysics, dark-matter search
Masaki Yamashita Prof. ▸ Cosmic-ray physics, dark matter search, neutrino physics
OKUMURA Akira Lect. ▸ Cosmic-ray physics, gamma-ray astrophysics
MENJO Hiroaki Asst. Prof. ▸ Cosmic-ray physics, cosmic-ray interactions, neutrino physics

<Concurrent Members>
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KAZAMA Shingo Assoc. Prof. (KMI)

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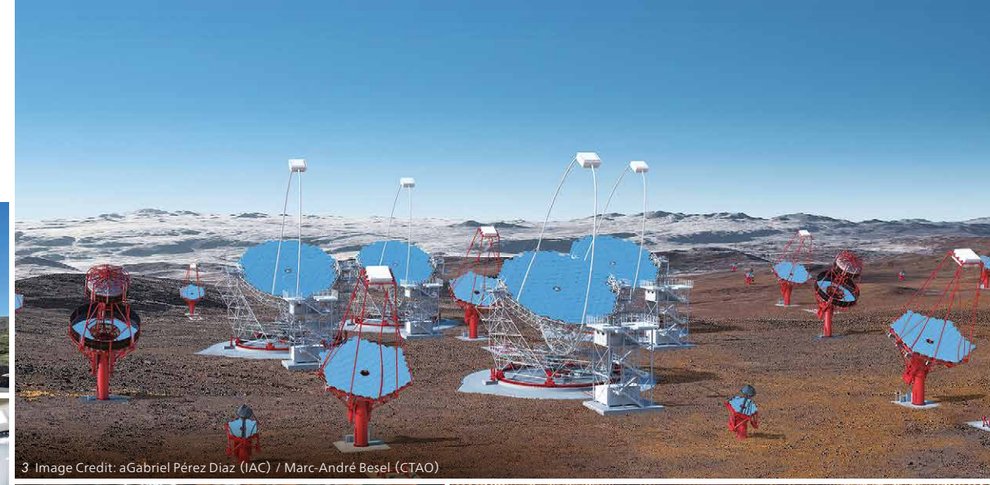
4 XENON Collaboration



3 Image Credit: aGabriel Pérez Diaz (IAC) / Marc-André Besel (CTAO)

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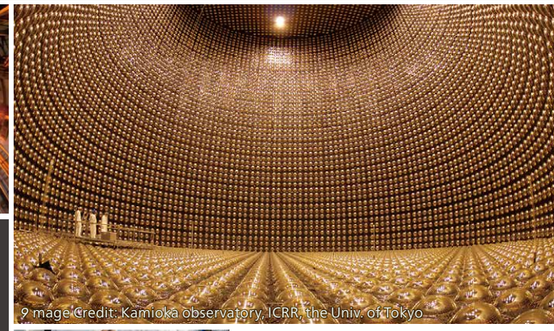

9 mage Credit: Kamioka observatory, ICRR, the Univ. of Tokyo

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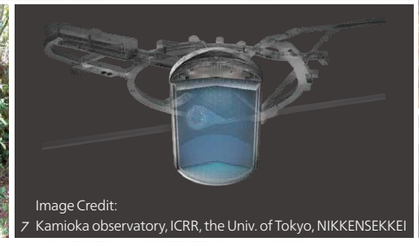

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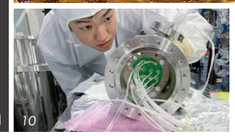
7 Kamioka observatory, ICRR, the Univ. of Tokyo, NIKKENSEKKEI



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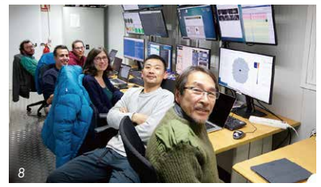

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1. All-sky gamma-ray map seen by the Fermi satellite. **2.** The first Large-Sized Telescope of the CTAO northern site in La Palma, Spain. **3.** A conceptual rendering of the Cherenkov Telescope Array Observatory (CTAO). **4.** The XENONnT detector. **5.** The LHCf detector installed in the LHC tunnel. **6.** A *Yakusugi* cedar tree, used to measure the Carbon-14 concentration in its tree rings. **7.** A conceptual drawing of the Hyper-Kamiokande detecto. **8.** The operation room of CTAO with international collaborators. **9.** Inside the Super-Kamiokande detetor. **10.** A graduate student at work on instrument development.

Bridging high-energy astrophysics and particle physics

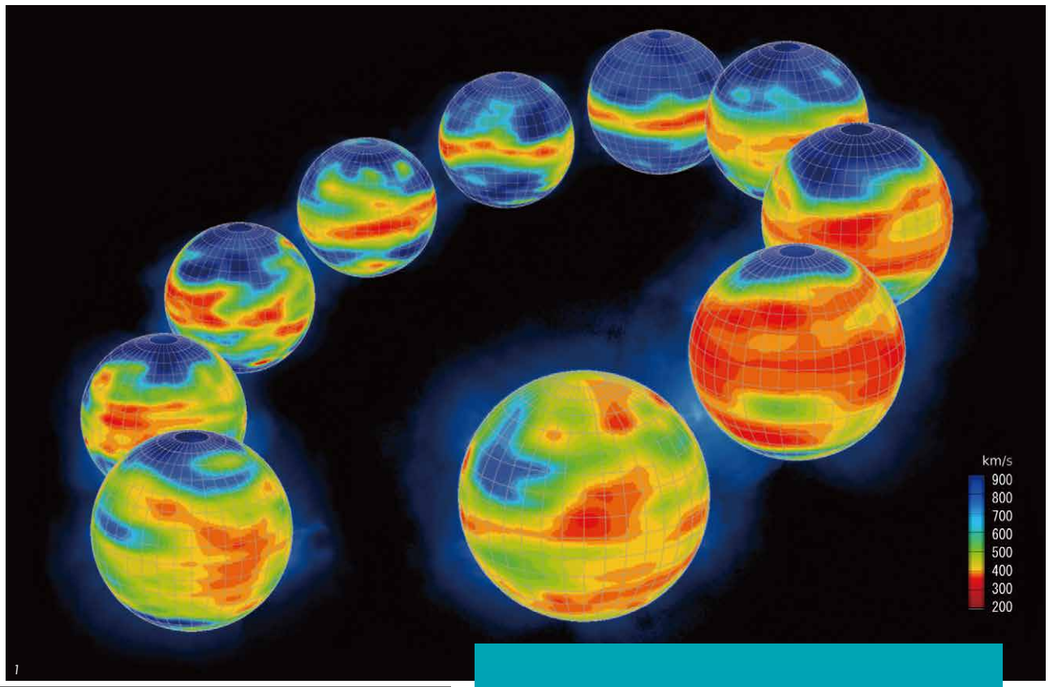
At the Division for the Cosmic-ray Research, we are advancing a range of projects to understand the origins of cosmic rays and those acceleration processes. To this end, we conduct gamma-ray observations using instruments like the Fermi satellite and MAGIC telescopes. We are also developing solar neutron detectors and a next-generation gamma-ray facility, the Cherenkov Telescope Array Observatory (CTAO). Understanding the hadronic interactions between cosmic rays and atmospheric nuclei is essential for accurately measuring their energy and elemental composition. We are therefore conducting an accelerator experiment, Large Hadron Collider forward (LHCf), to study such high energy intereactions.

In the field of neutrino research, we utilize the large number of neutrinos generated by cosmic ray interactions in the atmosphere for particle physics studies, as well as neutrinos from space for astrophysical research. We continue observations with the Super-Kamiokande detector, located underground in Kamioka, Gifu, and are proceeding with the construction of the next-generation Hyper-Kamiokande.To directly detect dark matter through its nuclear scattering , we are conducting the world's most sensitive dark matter search with the XENONnT experiment at the Gran Sasso National Laboratory in Italy. We are also engaged in developing XLZD, a next-generation liquid xenon experiment.

High-energy particles released during solar flares, when interacting with the Earth's atmosphere, produce cosmogenic isotopes such as carbon-14 and beryllium-10. By measuring these isotopes preserved in tree rings and ice cores, we investigate past sudden cosmic-ray enhancement events as well as the long-term history of variations in the solar and terrestrial magnetic fields.

Division for Heliospheric Research

Radio astronomy | IPS | Remote sensing | Solar wind | CME | Space weather | Instrumentation | AI



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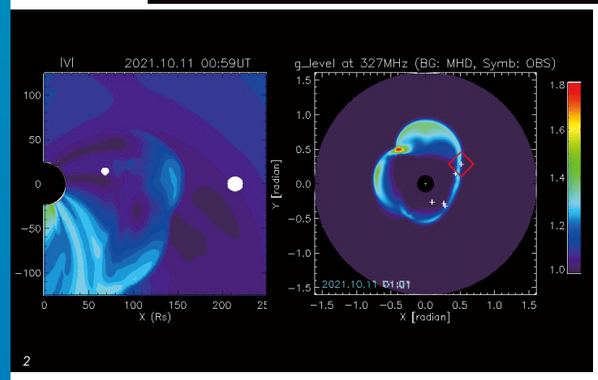

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The Division for Heliospheric Research develops unique observation equipment using radio astronomy techniques and conducts remote measurements of the solar wind by observing interplanetary scintillation (IPS). The Division pursues a wide range of research themes, including the three-dimensional structure of the solar wind and its variations, elucidation of the mechanisms of solar wind generation and acceleration, investigation of the propagation and forecasting of coronal mass ejections (CMEs), and the development of next-generation instruments based on digital technology. The Division also promotes joint observations and international research, serving as the core of the global IPS observation network.

IWAI Kazumasa Prof. ▸ Solar-Terrestrial Physics, Radio Astronomy, Space Weather
FUJIKI Ken-ichi Asst. Prof. ▸ Solar Wind Physics, Radio Astronomy, Space Climate

More details are found on our webpage.
https://www.isee.nagoya-u.ac.jp/en/research/study02.html

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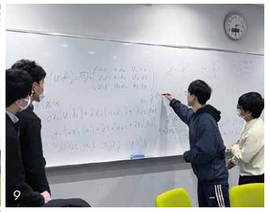

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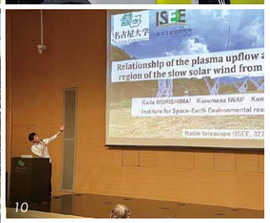

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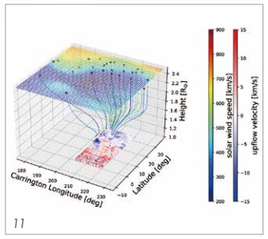

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1. Changes in solar wind structure over the solar cycle. The solar wind structure changes considerably depending on solar activity. **2.** An experiment reproducing the propagation of CMEs using IPS observations and magnetohydrodynamic (MHD) simulations. Simulation-based CME arrival forecast accuracy has been considerably improved through the use of information from IPS observations. **3.4 .**A performance evaluation experiment of the subarray for next-generation IPS observations. The next-generation device will extensively lay out these types of subarrays to create a large-diameter antenna. **5.** Digital backend developed by the Division. **6.** IPS antenna at Kiso Observatory (75 m E–W, 30 m N–S). **7.** IPS antenna at Fuji Observatory (100 m E–W, 20 m N–S). **8.** IPS antenna at Toyokawa Observatory (40 m E–W, 100 m N–S). These antennas are all among the largest in Japan. **9.** Discussion among students in the seminar. **10.** Oral presentation at an international conference by students. **11.** Research into the relationship between the source of the slow solar wind observed by IPS and the plasma upflow seen in the solar corona. This was a major advance toward the elucidation of the unknown origin of slow solar wind.

Exploring the solar wind that fills the heliosphere

Although the space between the Sun and the Earth may appear to be a vacuum, it is actually filled with a stream of super-hot charged particles (plasma) flowing outward from the Sun. This plasma stream is known as the solar wind. The space influenced by the solar wind (the heliosphere) constantly experiences violent fluctuations that reflect solar activity. These fluctuations have a major impact on the space environment around Earth and can sometimes disrupt artificial satellites, wireless communications, and power facilities. Forecasting this phenomenon, known as space weather forecasting, is therefore an important challenge.

Our division operates a network of large, independently developed radio telescopes to observe radio stars located hundreds of millions of light-years away. These observations allow us to detect a radio wave “twinkling” phenomenon called interplanetary scintillation (IPS). The twinkling is caused by density fluctuations in the solar wind, and by analyzing it in detail, we can obtain information about the wind speed and density. Observing radio stars in various directions enables us to effectively map the overall structure of the solar wind from the ground.

The solar wind speed and density information obtained from IPS observations is released immediately and used in space weather forecasts by research institutes both in Japan and abroad. The structure of the solar wind is also reconstructed using our independently developed IPS tomography method. This process has revealed the overall picture of the solar wind, which is in constant flux.

We also plan to commence construction of a next-generation IPS observation system that will have ten times the performance of existing equipment, aiming to achieve more precise observations. This is expected to significantly improve the accuracy of reconstructing the solar wind structure and space weather forecasts.

Division for Ionospheric and Magnetospheric Research

Upper atmosphere | Space plasma | Aurora | Airglow | Atmospheric wave/heating | Field observation | Instrumental development | Space/planetary exploration

The region from the Earth's upper atmosphere to the near-Earth space is collectively known as the ionosphere-magnetosphere system or the geospace. Solar wind energy entering this region drives auroras at high latitudes (polar regions) and space storms near geosynchronous orbit, while energy and waves from the lower atmosphere can also disturb the upper atmosphere. Our division is developing cutting-edge scientific observation instruments and conducting empirical researches using global ground-based observation networks and in-situ measurements by scientific exploration satellites to investigate the causes and mechanisms of these natural phenomena.

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NOZAWA Satonori Assoc. Prof. ▶ Upper atmospheric physics
OYAMA Shin-ichiro Lect. ▶ Upper atmospheric physics

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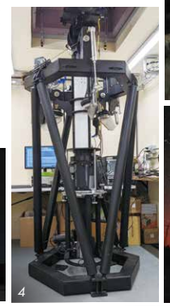
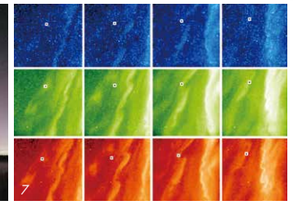
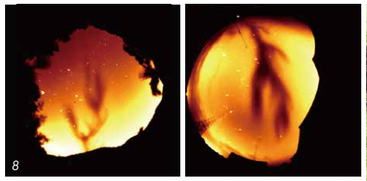
NISHITANI Nozomu Assoc. Prof. (Ctr. for International Collaborative Research)
MARTINEZ Claudia Assoc. Prof. (Ctr. for International Collaborative Research)

More details are found on our webpage.
https://www.isee.nagoya-u.ac.jp/en/research/study03.html

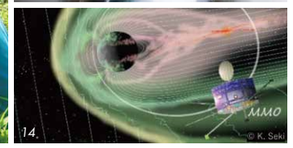
1. Auroras dancing in the Arctic night sky against a backdrop of stars (top right: satellite track; bottom center: EISCAT radar). **2.** EISCAT radar installed in Svalbard (EISCAT-ESR). **3.** Light trails of five-directional sodium LIDAR while observing against the backdrop of auroras. **4.** Scanning Doppler Imager measuring wide-area two-dimensional distribution of wind and temperature in the thermosphere. **5.6.** Fireball (October 18, 2018) and low-latitude aurora (January 1, 2025) observed at the SuperDARN Hokkaido-East Radar Site. **7.** A series of auroral images obtained at three wavelengths by satellite. **8.** Images of plasma bubbles with good symmetry in the northern and southern hemispheres observed in Sata, Kagoshima Prefecture (left), and Darwin, Australia (right). **9.** EISCAT_3D radar installed in Northern Europe enabling three-dimensional high-sampling measurement of the ionosphere. **10.** Experimental development of particle analyzers for space explorations using a charged particle beamline in a clean room. **11.**Scene from installation work on a magnetometer. **12.** Installation work for a very low frequency (VLF) radio waves receiver. **13.14.** A high-energy ion and electron analyzer mounted on the Mercury magnetospheric exploration orbiter. **15.16.** Global distribution of Total Electron Content (TEC) in the ionosphere (left) and change in TEC after "the 2011 off the Pacific Coast of Tohoku Earthquake" (right).

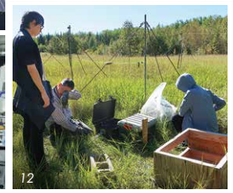
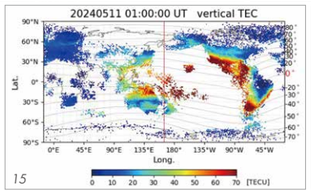


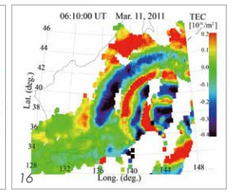








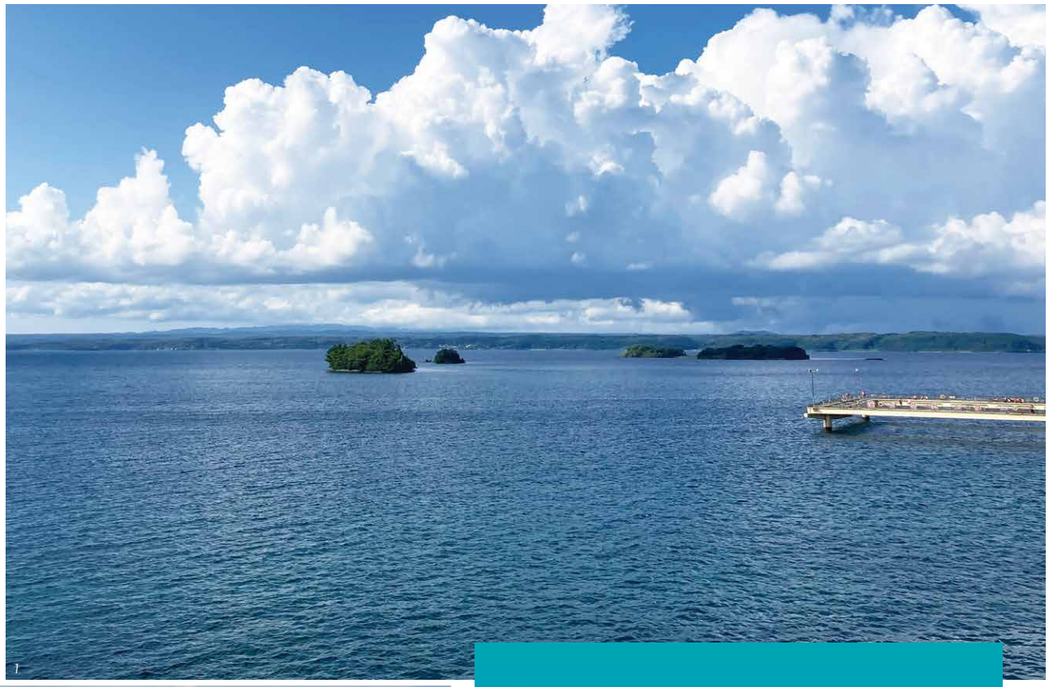
Exploring "geospace" spreading from Earth to the space

The energy, flowing into the Earth's ionosphere and magnetosphere from the solar wind, energizes the plasmas widely distributing in the space around the Earth (geospace). This reaction induces magnetic field fluctuations over various regions, triggering auroral emissions and atmospheric outflows in the Earth's polar regions and disturbances in the upper atmosphere. Meanwhile, atmospheric waves, propagating from the lower atmosphere and eventually reaching the thermosphere and ionosphere, release energy and momentum in the upper atmosphere. These waves have a major influence on the atmospheric and plasma dynamics in the mesosphere, thermosphere, and ionosphere. The interaction between the space plasmas, the magnetic fields, and the neutral atmospheres of the Earth and planets is a basic and universal process. The geospace hosts not only the international space station but also utility satellites for weather and communications, making it vital for modern society. Our society is developing essential infrastructure in space based on innovative satellite technologies.

The aim of the Division for Ionospheric and Magnetospheric Research (DIMR) is to elucidate the acceleration, transport, and loss mechanisms of the space plasma particles, the energy conversion processes from the solar wind to the magnetosphere, the ionosphere, and the upper atmosphere, and the interactions between these regions. To that end, the DIMR conducts ground-based observations of the neutral winds and magnetic field in the upper atmosphere, global-scale radio observations, and field observations of luminous phenomena such as auroras and airglow in Japan and abroad through international cooperation. our division is also leading the development of cutting-edge onboard instruments for scientific space explorations, as well as the development of ground-based experimental facilities and the analysis of observational data. In so doing, the DIMR is establishing the conceptual and technological foundations for future space explorations.

Division for Meteorological and Atmospheric Research

Remote Sensing | Clouds | Precipitation | Meteorology | Ozone layer science | Aerosol science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The careful monitoring of atmospheric states using various observational methods and a deeper understanding of the atmosphere and weather through theory and numerical models are crucial steps for solving global environmental problems. To achieve this, Division for Meteorological and Atmospheric Research is engaged in atmospheric research from a wide range of perspectives. The Division also cooperates with the Graduate Schools of Engineering, Science, and Environmental Studies and actively participates in graduate education.

MIZUNO Akira	**Prof.**	▸ Atmospheric science, radio astronomy
NAGAHAMA Tomoo	**Assoc. Prof.**	▸ Middle atmospheric physics, chemistry
MASUNAGA Hirohiko	**Assoc. Prof.**	▸ Clouds, precipitation, climatology, satellite remote sensing
OHATA Sho	**Asst. Prof.**	▸ Atmospheric materials science, atmospheric chemistry
<Concurrent Members>		
MOCHIDA Michihiro	**Prof.**	(Ctr. for International Collaborative Research)
TSUBOKI Kazuhisa	**Prof.**	(Ctr. for Integrated Data Science)
TAKAHASHI Nobuhiro	**Prof.**	(Ctr. for Orbital and Suborbital Observations)
SHINODA Taro	**Assoc. Prof.**	(Ctr. for Orbital and Suborbital Observations)

More details are found on our webpage.
https://www.isee.nagoya-u.ac.jp/en/research/study04.html


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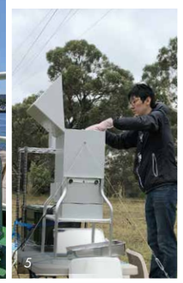
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Exploring the mysteries of the atmosphere through observations and numerical models

Our Earth is the only planet in the solar system that enjoys rich nature beauty filled with diverse life. Oxygen in the atmosphere has enabled countless organisms to thrive, and greenhouse gases such as water vapor and carbon dioxide help maintain today's warm climate. Water vapor also provides us with water, an essential benefit to all life on Earth, as condensed into clouds and precipitation. Ozone in the stratosphere protects terrestrial organisms from harmful ultraviolet rays from the Sun.

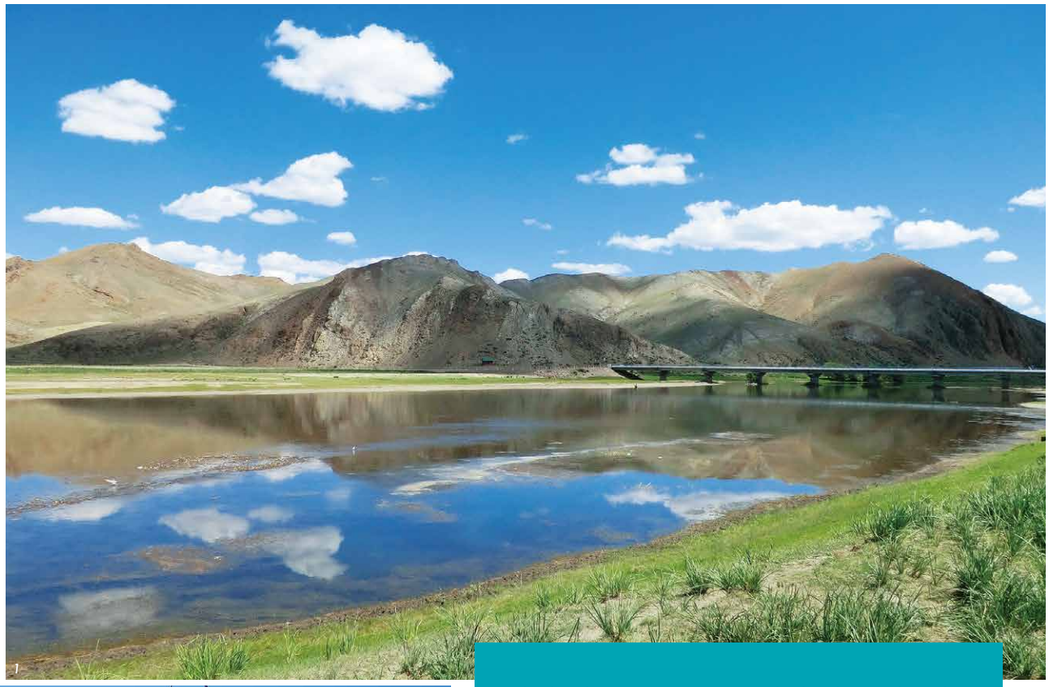
However, it is important to note that the atmosphere relies on a delicate balance of such elements. Global warming proceeds with an increase of greenhouse gases such as carbon dioxide and may also lead to more extreme weather. Aerosols are another important factor that affects the atmospheric environment and climate.

Research underway at the Division for Meteorological and Atmospheric Research includes the measurements of trace gases using millimeter-wave and infrared spectroscopy, observations of clouds and precipitation using polarimetric radar and hydrometeor sonde observations, analysis of the characteristics of atmospheric aerosols, and the development of basic technologies for observational equipment. The Division is also working on the analysis Earth observation satellite data to address unsolved problems in the atmospheric dynamics and studies combining observation data and numerical simulations.

1. Low clouds rising along the coast. **2.** Cumulonimbus clouds and rain columns captured from the roof of ISEE. **3.** Weather sonde just before launch. The sonde is equipped with various meteorological instruments and a parachute for recovery. **4.** Aerosol sampling observation at sea using a ship. **5.** Aerosol sampling observation in Australia. **6.** Aerosol sampler installed at the Ny-Ålesund observation facility in the Arctic. **7.** X-band polarimetric radar installed in the Republic of Palau X-band. **8.** Typhoon observation by aircraft. Entering the "eye of the storm" to drop in weather instruments. **9.** An anvil cloud spreading across the evening sky. **10.** Millimeter wave observation facility installed in Norway. **11.** Forest site in Finland observing organic aerosols.

Division for Land-Ocean Ecosystem Research

Global water cycle | Carbon cycle | Modeling | Remote sensing | Data analysis

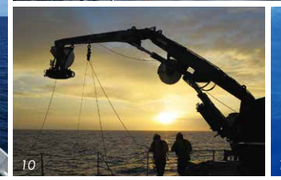


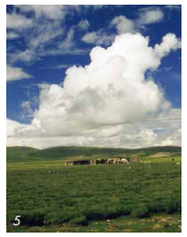
The land-ocean ecosystem, which is located on the Earth's surface, is a world of great diversity in terms of human activity and biological production. This ecosystem is driven by energy from the Sun and involves active exchange of thermal energy, water, and greenhouse gases between the ecosystem and the lower atmosphere. This ecosystem can thus be said to play an important role in the formation and maintenance of the Earth's climate system. The Division for Land-Ocean Ecosystem Research collaborates with climate, meteorology, hydrology, and oceanography researchers worldwide to study the past, present, and future of the Earth's surface system.

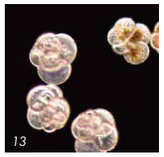
HIYAMA Tetsuya	ISEE Vice Dir./ Prof.	Climate change, global warming, Arctic, atmospheric water cycle, terrestrial water cycle/material cycle
AIKI Hidenori	Prof.	Ocean physics, numerical simulation, atmosphere-ocean boundary layer, atmosphere-ocean wave analysis
KURITA Naoyuki	Assoc. Prof.	Climate system, Antarctic warming, global water cycle, isotope geochemistry
FUJINAMI Hatsuki	Lect.	Meteorology, climatology, Asian Monsoon
MINO Yoshihisa	Asst. Prof.	Biogeochemistry, stable isotopes, marine organic matter

More details are found on our webpage.
https://www.isee.nagoya-u.ac.jp/en/research/study05.html

1. Example of a land-ocean ecosystem located on Earth's surface. **2.** Deployment of sinking particle collector at a depth of 4,900 m. **3.** Scenery of a glacial basin in the Nepalese Himalayas. **4.** Landscape and people of the Khangai Mountains in Mongolia. **5.** Vegetation and cumulus clouds on the Tibetan Plateau in summer. **6.** Weather station installed in the Antarctic ice sheet. **7.** View of the bow from the bridge. **8.** Work on an offshore observation tower. **9.** A shining halo in the Antarctic sky. **10.** Watching the sunset over the ocean from near the winch system. **11.** Deployment of 36 water samplers in the ocean. **12.** Icebreaker "Shirase" anchored off the coast of Showa Station. **13.** Planktic foraminifers from the Western Subarctic North Pacific. **14.** Bottom sediment sampling in Mikawa Bay. **15.** Aquarium experiment with high school students.







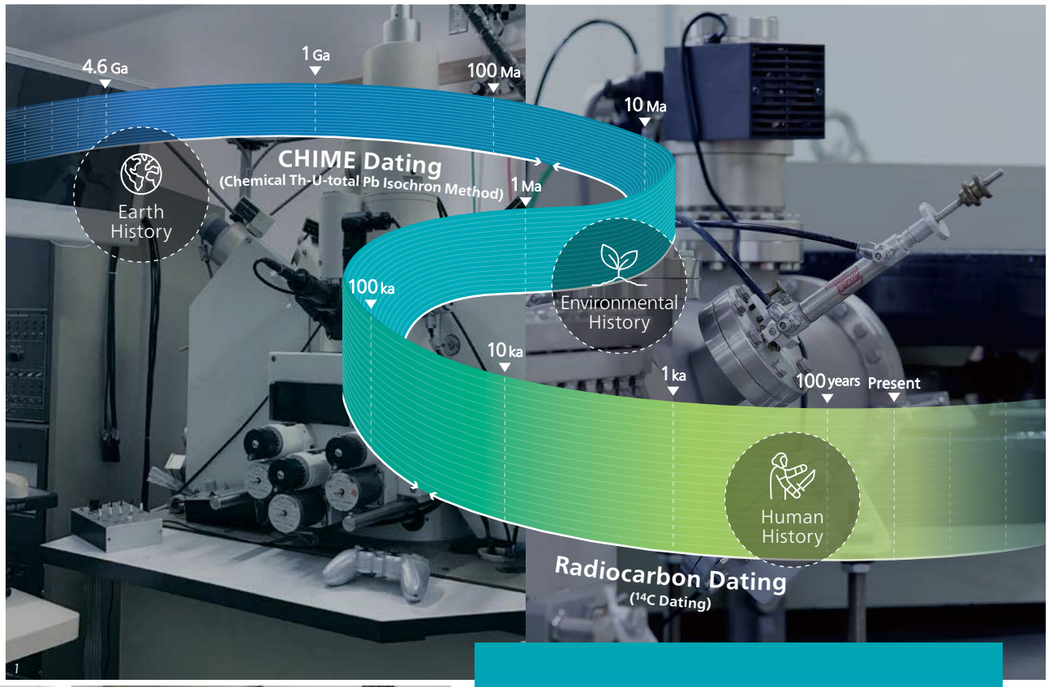
Conducting science on the past, present, and future of the Earth's surface system

We are conducting research on land, which is where humankind lives. Specifically, we are conducting research on changes in the water cycle (precipitation, evapotranspiration, groundwater flow, river runoff) associated with climate change and human activities around the world, from the tropics (Asia) to the polar regions (Arctic and Antarctic). Climate change includes global warming, and human activities include land use change. Therefore, we are also conducting research on the exchange of greenhouse gases (carbon dioxide and methane) (greenhouse gas balance), which determines the progress of global warming, as well as vegetation and land use change. We are combining field observations, laboratory experiments, data analysis, numerical models, and satellite remote sensing in an effort to work on a variety of research related to the water cycle and greenhouse gas balance.

The ocean and life together embody the Earth as a water planet, exerting major influences on climate and society. We aim to clarify the impacts of ocean acidification and marine heatwaves on the midlatitude climate, including Japan, by extracting valuable information from vast climate datasets and presenting a comprehensive picture of the Earth's surface system. Our work includes integrated studies on the influence of the ocean heat budget, currents, and waves on atmospheric environments such as typhoons, as well as the role of marine ecosystems in carbon sequestration. Theoretical analyses, together with data from orbital and suborbital platforms, research vessels, moored and drifting instruments, and underwater experiments, have evolved over time. In step with these advances, we seek to explore how new knowledge in the natural sciences can contribute to the challenges facing humanity, while fostering future generations of scientists.

Division for Chronological Research

Accelerator Mass Spectrometry (AMS) | Radiocarbon Dating | Electron Probe Microanalyzer (EPMA)
CHIME Method (Chemical Th-U-total Pb Isochron Method) | Geochronology | Earth History | Human History | Environmental History

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The Division for Chronological Research is committed to deepening our understanding of the Earth-Space Environmental System - a dynamic interplay of cosmic, solar, terrestrial, biological, and human processes. We achieve this through the application of cutting-edge dating technologies, including radiocarbon analysis using a Tandetron Accelerator Mass Spectrometer (AMS) and Chemical Th-U-Pb isochron dating (CHIME) via electron probe microanalysis. By fostering interdisciplinary collaboration across the natural sciences, engineering, and the humanities, our division generates transformative insights into Earth's history and the evolution of human civilization.

KITAGAWA Hiroyuki Prof. ▸ Environmental Change Analysis, Accelerator Mass Spectrometry (AMS)
ODA Hirotaka Asst. Prof. ▸ Radiocarbon Dating (^{14}C Dating), Ancient Documents and Calligraphy Fragment (Kobunsho, Kokugire) Analysis

<Concurrent Members>
MINAMI Masayo Prof. (Off. for the Promotion of Transdisciplinary Network)
KATO Takenori Assoc. Prof. (Ctr. for Integrated Data Science)

More details are found on our webpage.
https://www.isee.nagoya-u.ac.jp/en/research/study07.html


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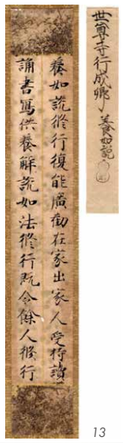
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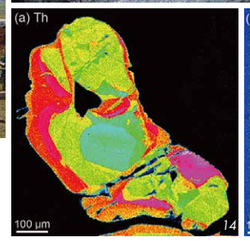

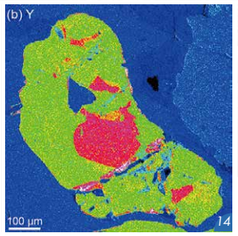

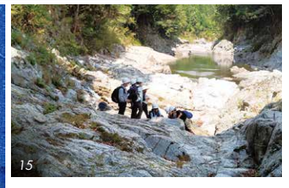
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Cutting-Edge Chronometry Unlocks Earth's 4.6-Billion-Year History

As a leading international center for research and education in chronometry, we are dedicated to unraveling the events that have shaped Earth's 4.6-billion-year history. Using advanced techniques such as the Chemical Th-U-total Pb Isochron Method (CHIME) and radiocarbon (^{14}C) dating via accelerator mass spectrometry (AMS), we deliver high-precision age determinations that illuminate the timeline of planetary, environmental, and human evolution.

The CHIME method enables precise dating of geological events spanning from ~10 million to 2.5 billion years ago by analyzing minerals such as zircon and monazite. Micro-scale analysis using an electron probe microanalyzer reveals previously inaccessible insights into the physical and chemical conditions of Earth materials and the mechanisms driving their formation - opening new frontiers in petrology and mineralogy.

^{14}C dating via AMS is essential for pinpointing the timing of environmental transitions, societal shifts, and cultural developments during the global expansion of Homo sapiens. Our 3 MV Tandetron accelerator mass spectrometer supports high-sensitivity ^{14}C analysis across diverse academic disciplines and public sectors, enabling new perspectives on the modern Earth system.

We are actively developing new dating methodologies, enhancing analytical precision, and expanding applications across a wide spectrum of research fields. Through state-of-the-art chronometric techniques, we aim to uncover the full story of Earth and humanity - illuminating the past and inspiring future scientific breakthroughs.

1. Second-generation CHIME dating system. **2.** Tandetron accelerator mass spectrometer for high-precision radiocarbon (^{14}C) measurements. **3.** XRF analyzer for elemental composition analysis of rocks and sediments. **4.** Stable isotope ratio mass spectrometer. **5.** Glass vacuum line for ^{14}C sample preparation. **6.** Drip water collection for paleoclimate reconstruction using stalagmites. **7.** Charcoal sample for evaluating chemical pretreatment methods. **8.** Radiocarbon dating of excavated artifacts and provenance analysis. **9.** Seafloor core sampling for the International Land Science Observation Program / Dead Sea Deep Drilling Project. **10.** Strontium isotope ratio mapping using river sediment samples. **11.** Geological survey of the Pleiku volcanic field (central Vietnam). **12.** Domestic rock sampling across Japan. **13.** Decorative sutra fragment attributed to Fujiwara no Yukinari. **14.** Thorium (Th)-Yttrium (Y) elemental mapping of monazite minerals. **15.** Hands-on learning for elementary students: Rock and mineral observation at Ayu Falls, Aichi Prefecture.

Center for International Collaborative Research

International joint research | International workshops | Overseas dispatch | Overseas researcher invitation | Observatories

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The Center for International Collaborative Research promotes a variety of international collaborative research projects in collaboration with researchers both in Japan and overseas to realize the mission of the Institute for Space–Earth Environmental Research. We are engaged in efforts such as the planning and promotion of international collaborative research programs, the promotion of ground-based and network observations, participation in satellite projects, hosting of international workshops, invitations of foreign researchers, dispatching of researchers and graduate students to overseas collaborative research institutes, and capacity development through training courses. In so doing, we are contributing to the development of the Institute's research fields.

Ctr. Dir.

MOCHIDA Michihiro	Prof.	Atmospheric chemistry, environmental chemistry, aerosol science
SHIOKAWA Kazuo	ISEE Dir./Prof.	Space physics, upper atmosphere physics
NISHITANI Nozomu	Assoc. Prof.	Magnetospheric physics, ionospheric physics, upper atmosphere physics
MARTINEZ Claudia	Assoc. Prof.	Magnetospheric physics, space plasma physics

<Concurrent Members>

IWAI Kazumasa	Prof.	(Div. for Heliospheric Research)
MIZUNO Akira	Prof.	(Div. for Meteorological and Atmospheric Research)
HIYAMA Tetsuya	Prof.	(Div. for Land–Ocean Ecosystem Research)
MINAMI Masayo	Prof.	(Off. for the Promotion of Transdisciplinary Network)
OTSUKA Yuichi	Assoc. Prof.	(Div. for Ionospheric and Magnetospheric Research)
NOZAWA Satonori	Assoc. Prof.	(Div. for Ionospheric and Magnetospheric Research)
KURITA Naoyuki	Assoc. Prof.	(Div. for Land–Ocean Ecosystem Research)
FUJINAMI Hatsuki	Lect.	(Div. for Land–Ocean Ecosystem Research)
MENJO Hiroaki	Asst. Prof.	(Div. for Cosmic-Ray Research)

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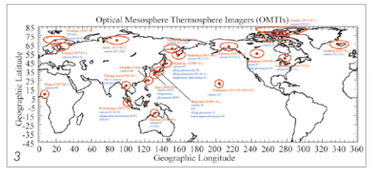
https://www.isee.nagoya-u.ac.jp/en/research/center01.html



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1. ISEE Award ceremony and commemorative lecture. **2.** Field observation of auroras in Canada by graduate students. **3.** Observation points of Optical Mesosphere Thermosphere Imagers (OMTI). **4.** Outreach activity at primary and junior high schools in Nigeria. **5.** Thirty-five students from five countries participated in the international school in Irkutsk, Russia. **6.** Installation of a magnetometer by graduate students at Athabasca Observatory in Canada. **7.** International workshop "Benchmarks for Operational Solar Flare Forecast" held at ISEE. **8.** Fuji Observatory at the foot of Mt. Fuji in Yamanashi Prefecture. **9.** Kagoshima Observatory located near Sakurajima Volcano. **10.** Moshiri Observatory. **11.** Rikubetsu Space and Earth Science Museum, with Rikubetsu Observatory on the second floor. **12.** SuperDARN radar at Rikubetsu Observatory. **13.** International school for African graduate students and young researchers held in Nigeria. **14.** Installation of a high-sensitivity camera in Nigeria. **15.** A visit to a domestic observation point by students from India. **16.** International school held in Indonesia, for graduate students and young researchers in Southeast Asia. **17.** EISCAT (European Incoherent Scatter Scientific Association) Tromso site.

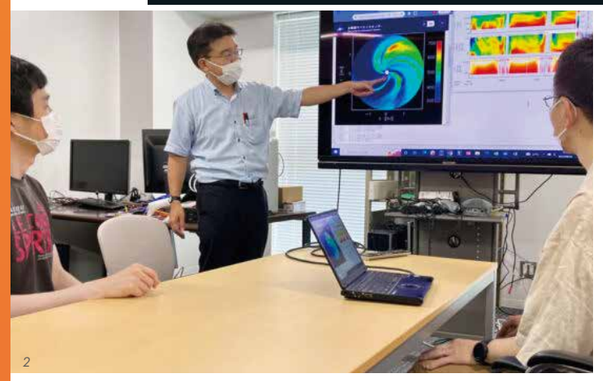
Promoting a variety of international collaborative research

We are a center for international collaboration located at the Institute for Space–Earth Environmental Research, which is Japan's only Joint Usage/Research Center for the space-Sun-Earth system. As part of this center, we are engaged in a variety of research activities to elucidate the mechanisms and interrelationships of various phenomena occurring in this system. Specifically, we contribute to international collaborative research programs, such as the publication of newsletters and hosting of online seminars as part of the international program of the Scientific Committee on Solar-Terrestrial Physics (SCOSTEP) under the International Council for Science (ISC). We also promote international projects based on ground-based and network observations. Examples of such work include observations using a LIDAR and an MF radar at the EISCAT radar site in Norway and global geomagnetic network observations using induction magnetometers and fluxgate magnetometers. Furthermore, the Center has observatories in Japan, which are the Moshiri Observatory, Rikubetsu Observatory, Fuji Observatory, Solar Wind Observatory, and Kagoshima Observatory. We use these observatories to conduct observational research on solar winds, geomagnetic variations, upper atmospheric variations, and atmospheric trace components.

We are also engaged in joint usage/research efforts of the Institute for Space–Earth Environmental Research. As part of those efforts, we support the implementation of international collaborative research, the invitation of foreign researchers, and the dispatch of graduate students overseas.

Center for Integrated Data Science

Data Science | High Performance Computing (HPCI) | DOI (Digital Object Identifier)
Large Data Base | Supercomputer | The Center for Heliospheric Science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The Center for Integrated Data Science was established to advance heliospheric system science research through large-scale data analysis and advanced computer simulations. The Center aims to expand scientific achievements by collaborating with other research institutions, improving research infrastructure, and developing a large-scale computing environment. This environment supports data release via large-scale databases, tool and software development, high-performance computing, and operation of the CIDAS supercomputer. The Center also promotes data management by minting data DOIs.

Ctr. Dir.

MIYOSHI Yoshizumi	Prof.	▶ Earth and planetary magnetospheric physics, space weather
TSUBOKI Kazuhisa	Prof.	▶ meteorology
KATO Takenori	Assoc. Prof.	▶ geochronology, petrology, EPMA, X-ray spectroscopy
IIJIMA Haruhisa	Assoc. Prof.	▶ solar physics

<Concurrent Members>

HOTTA Hideyuki	Prof.	(Div. for Integrated Studies)
AIKI Hidenori	Prof.	(Div. for Land–Ocean Ecosystem Research)
MASUDA Satoshi	Assoc. Prof.	(Div. for Integrated Studies)
HARADA Yuki	Assoc.Prof.	(Div. for Integrated Studies)
MASUNAGA Hirohiko	Assoc. Prof.	(Div. for Meteorological and Atmospheric Research)
IEDA Akimasa	Asst. Prof.	(Div. for Integrated Studies)

More details are found on our webpage.
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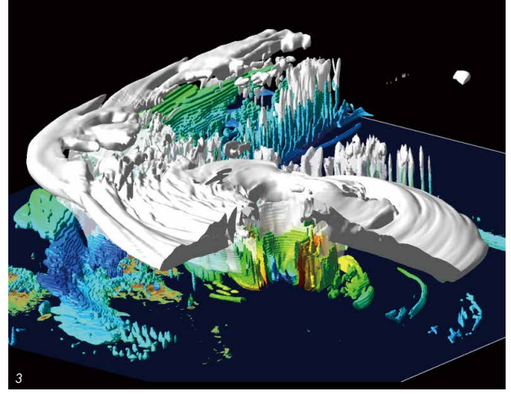
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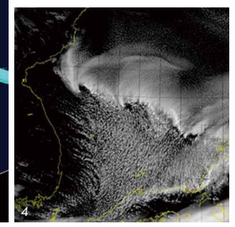
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1. Overview of the Center for Heliospheric Science (images provided by JAXA/ISAS, NAOJ). **2.** Meeting scene. **3.** Reproduction of the Ise Bay Typhoon. **4.** Snow clouds over the Sea of Japan causing heavy rain. **5.** 3D MHD simulation of solar flares. **6.** 2D Vlasov simulation of the KH vortex. **7.** 2D plot of global total electron content (TEC) fluctuations from approximately 9,000 GNSS receivers worldwide and Doppler velocity from the Hokkaido SuperDARN radar. **8.** Upper atmosphere image database. **9.** Mercury magnetospheric probe "Mio": International Mercury exploration mission "BepiColombo". **10.** Solar wind simulation. **11.12.** Example of analysis using UDAS. **13.** Th in monazite by Monte Carlo simulation M-ray emission region. **14.** CIDAS supercomputer system. **15.** Workshop.


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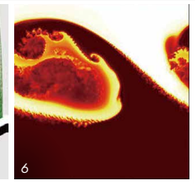
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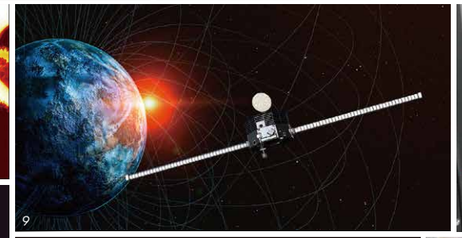
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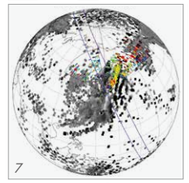
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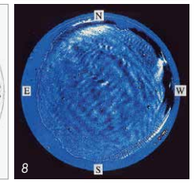

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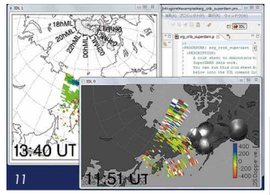

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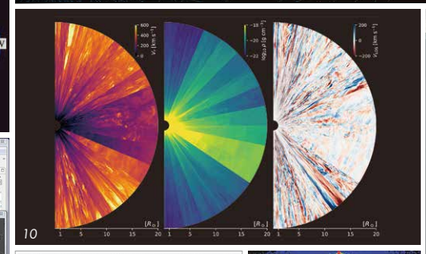
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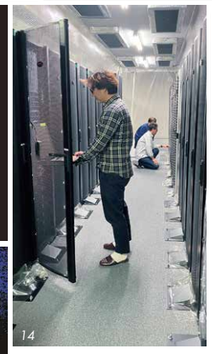
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Building Research Infrastructure for Advanced Space–Earth System Science

The Center for Integrated Data Science was established to advance research on the heliospheric system through large-scale data analysis and advanced computer simulations. Its mission is to establish a foundation for, and conduct, research and development that supports scientific progress in space–Earth science. The Center collaborates closely with ISEE research divisions, other centers, and domestic and international universities and research institutes to implement various projects. The Heliospheric Science Center, in partnership with JAXA and the National Astronomical Observatory of Japan, archives and distributes data from the satellites "Arase," "Mio," "Hinode," and the upcoming "SOLAR-C," as well as ground-based and simulation data. The Center develops and releases integrated analysis software widely used by researchers in Japan and abroad. CIDAS operates a dedicated supercomputer system that provides data analysis and simulation environments for researchers and students within and outside the university. This computing environment supports cutting-edge research and tool development. CIDAS also manages the Nagoya University High-Performance Computing Collaborative Research Project. Ongoing activities include developing solar wind models, cloud-resolving models, and research to improve geochronological method accuracy. The Center operates the Inter-university Upper Atmosphere Global Observation Network (IUGONET), the World Data Center for Cosmic Rays, and a radiation measurement database related to the 2011 Fukushima Daiichi nuclear accident. Additionally, the Center promotes long-term data accessibility by minting DOIs and conducts research on academic database development in cooperation with organizations inside and outside the university, including the Nagoya University Library.

Through these efforts, CIDAS strengthens the foundations of the scientific community, expands research outcomes, and promotes innovative interdisciplinary research.

Center for Orbital and Suborbital Observations

Remote Sensing | Cloud | Precipitation | Meteorology | Aerosol Science | X/gamma-ray astronomy | Microsatellite | Magnetospheric Science


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The Institute for Space–Earth Environmental Research investigates natural phenomena over an extremely wide range of areas, from the Earth's surface to outer space, and demand is high for empirical, cutting-edge research using measurements optimized for each area and phenomenon. The Center for Orbital and Suborbital Observations will maximize the use of its functions as a cross-disciplinary Joint Usage/Research Center based on a comprehensive perspective of the space-sun-earth system. To achieve this, the Center will build on the ground-based observation networks already developed by the Institute and the Center, while also formulating and implementing innovative observation programs in areas where orbital and suborbital observations are essential. At the same time, the Center will promote the development of the technologies needed to support these activities.

Ctr. Dir.

TAKAHASHI Nobuhiro	Prof.	▶ Cloud and precipitation remote sensing
SHINODA Taro	Assoc. Prof.	▶ Mesoscale meteorology, cloud physics
YAMAOKA Kazutaka	Assoc. Prof.	▶ X/gamma-ray astronomy, transient astronomical phenomena, microsatellite

<Concurrent Members>

TAJIMA Hiroyasu	Prof.	(Div. for Cosmic-Ray Research)
HIRAHARA Masafumi	Prof.	(Div. for Ionospheric and Magnetospheric Research)
AIKI Hidenori	Prof.	(Div. for Land–Ocean Ecosystem Research)
TSUBOKI Kazuhisa	Prof.	(Ctr. for Integrated Data Science)
MASUNAGA Hirohiko	Assoc. Prof.	(Div. for Meteorological and Atmospheric Research)
OHATA Sho	Asst. Prof.	(Div. for Meteorological and Atmospheric Research)

More details are found on our webpage.
https://www.isee.nagoya-u.ac.jp/en/research/center03.html


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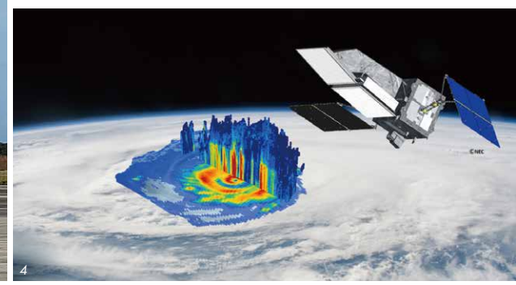
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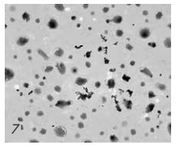
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1. Conceptual image of a typhoon viewed from space. **2.** Simulation of typhoon using cloud-resolving model CReSS. **3.** Gulfstream IV aircraft used in aircraft observation of typhoons (©Diamond Air Services). **4.** A 3D precipitation observation image from Precipitation Measuring Mission satellite (©JAXA). **5.** Newly developed dropsonde (Meisei Electric Co. and Nagoya University). **6.** Global Observing Satellite for Greenhouse Gases and Water Cycle(GOSAT-GW) launched in 2025 on H-IIA rocket No. 50 (©JAXA). **7.** Electron microscope image of atmospheric aerosols. Elucidation of the dynamics of aerosols in various environments using cutting-edge analytical methods. **8.** Airborne aerosol measuring device. **9.** Ka-band dual-polarization radar. **10.** X-band dual-polarized radar. **11.** Experience making insulation using film used in real artificial satellites. **12.** Rocket-mounted ChubuSat2 (provided by JAXA). **13.** Photograph of a sensor for a next-gaeneration gamma-ray satellite currently under development (provided by NASA).

Opening New Horizons in Space–Sun–Earth System Observations with Airborne and Spaceborne Platforms

Promotion of aircraft observations

This Center plays a central role in aircraft observations in Japan and is collaborating with other institutions to promote direct and remote observations of water and carbon cycles in the Earth's surface layer by aircraft. As part of this, we are collaborating with various academic societies to propose the promotion of aircraft observation-based Earth and planetary sciences in the Future Academic Advancement Initiative of the Science Council of Japan. We have established the Office for Aircraft Observation to promote aircraft observations. In the field of aircraft observation research, dropsonde observations from aircraft have had a major impact on typhoon research and research on the contribution of water vapor to linear precipitation bands. The Center has also established the Office for Earth Water Cycle Observation, and we are contributing to the promotion of aircraft and balloon observations in research on the water cycle on the Earth's surface and satellite observation research through using precipitation radars (2 X-band) and cloud radars (1 Ka-band) and numerical model.

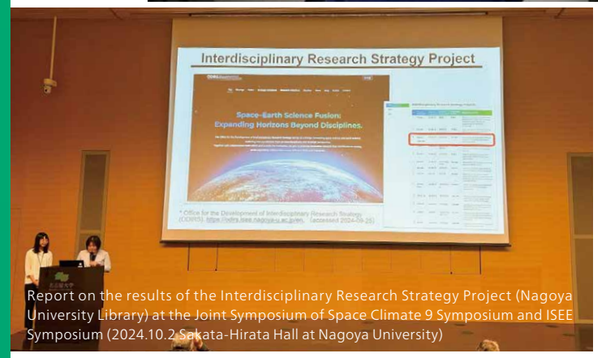
Observation of space phenomena affecting the terrestrial environment

Sudden or global-scale natural phenomena occurring on the surface of the Sun or in space around the Earth can cause major changes to the Earth's environment. Their examples are solar flares and space storms, which are also factors in the manifestation of aurora phenomena in the Earth's polar regions. These solar flares and space storms heat and expand the Earth's upper atmosphere, which is the outer boundary between the space and the Earth's environment, and change the atmospheric composition. The elucidation of such space phenomena is an important research subject for humanity whose activities are expanding into the space to build further space infrastructures. Cutting-edge observations using spacecraft (satellites, scientific probes, sounding rockets, etc.) are required for more accurately capturing complex space phenomena. This center is leading the development of small-size spacecraft and high-performance instruments for space observations and explorations based on rapid technological progresses. We will continuously contribute to the establishment of advanced and sustainable social infrastructures in the space around the Earth and the acquisition of academic knowledge.

Office for the Development of Interdisciplinary Research Strategy

Interdisciplinary fusion　Open-innovation　Industry-academia - government collaboration
Social implementation

Graphic recording-based group dialogue at "2024 Interdisciplinary Research Strategy Project Workshop – Aiming to create new interdisciplinary fusion and industry-academia-government collaboration" (TOIC NAGOYA, March 31, 2025)



Report on the results of the Interdisciplinary Research Strategy Project (Nagoya University Library) at the Joint Symposium of Space Climate 9 Symposium and ISEE Symposium (2024.10.2, Sakata-Hirata Hall at Nagoya University)

Promoting new research by integrating space science and earth science is a key role of the Institute for Space–Earth Environmental Research. The Office for the Development of Interdisciplinary Research Strategy was established to strategically advance interdisciplinary research, building on the Institute's established expertise in each field. This Office will lead the development of new research strategies, making use of the Institute's ongoing joint usage and research programs, as well as collaborative projects with related institutions.

Off. Mgr. <Concurrent Members>
SHIOKAWA Kazuo ISEE Dir./Prof. (Ctr. for International Collaborative Research)

ISHII Mamoru Desig. Prof. ▶ Space weather services
KUSANO Kanya Desig. Prof. ▶ Solar and space plasma physics, space weather prediction
KIKUCHI Ryota Desig. Associate Prof. ▶ Data assimilation, fluid science, aeronautical engineering
MORI Yasunori Lead Academic Specialist

<Concurrent Members>
HIYAMA Tetsuya Prof. (Div. for Land–Ocean Ecosystem Research)
MOCHIDA Michihiro Prof. (Ctr. for International Collaborative Research)
MIYOSHI Yoshizumi Prof. (Ctr. for Integrated Data Science)
TAKAHASHI Nobuhiro Prof. (Ctr. for Orbital and Suborbital Observations)
MINAMI Masayo Prof. (Off. for the Promotion of Transdisciplinary Network)
MARTINEZ Claudia Assoc. Prof. (Ctr. for International Collaborative Research)

More details are found on our webpage.
https://www.isee.nagoya-u.ac.jp/en/research/odirs.html

Interdisciplinary Research Strategy Projects 2025

※ Phase Sta : Start-up Phase　Fol: Follow-up Phase
※ Type Str: Strategy Type　See: Seeds Type

Principal Investigator	Affiliated Institution	Affiliated Department	Responsible Faculty	Phase/ Type	Research Project Title
UTSUMI Yukinori	GIFU Univ.	Faculty of Education	HIYAMA Tetsuya	Sta / See	Development of a climate change curriculum oriented to the development of decision-making skills to survive in an uncertain society
MATSUO Taro	NAGOYA Univ.	Graduate School of Science	MINO Yoshihisa	Sta / See	Green sea hypothesis: Measurement of light environment and phototrophs under water around Iwo island
MENDEZ Carlos	NAGOYA Univ.	Graduate School of International Development	TAKAHASHI Nobuhiro	Fol / -	Integrating satellite and socieconomic data for monitoring sustainable development
ITO Sanae	NAGOYA Univ.	Graduate school of humanities	HAYAKAWA Hisashi	Sta / Str	Feasibility Study of Data Rescue for Old Astronomical Records
MOCHIDA Michihiro	NAGOYA Univ.	ISEE	MOCHIDA Michihiro	Fol / -	Investigation of Air Pollution Associated with Space Developments
TANAKA Sachie	NAGOYA Univ.	University Library	MIYOSHI Yoshizumi	Sta / See	Investigation of the possibility of interdisciplinary research of humanities and sciences using digital data
KADOWAKI Seiji	NAGOYA Univ.	University Museum	MINAMI Masayo	Fol / -	Geochemical analysis and radiocarbon dating of metal weapons from Mongol invasions to Japan: Towards the establishment of "concretion archaeology"
NAKAZAWA Kazuhiro	NAGOYA Univ.	Kobayashi-Masukawa Institute	MIYOSHI Yoshizumi	Sta / See	Space-Earth Science fusion on Albedo X/Gamma rays and Neutrons observed from ISS
FUKUDA Tsutomu	NAGOYA Univ.	Institute for Advanced Research	KATO Takenori	Sta / See	Measurement of the spatial distribution of radioactive elements in rocks using ultra-high-resolution elementary particle microscopy technology
KANNO Satomi	NAGOYA Univ.	Institute for Advanced Research	TAJIMA Hiroyasu	Sta / See	Application of CMOS image sensors to element imaging systems in living cells
ICHIHARA Hiroshi	NAGOYA Univ.	Earthquake and Volcano Research Center	ISHII Mamoru	Sta / Str	Utilization of space weather information in underground exploration using magnetotelluric method
MURASE Takeru	GIFU Univ.	Faculty of Engineering	Mizuno Akira	Sta / Str	Establishing a cryogenic experiment facility at Gifu University and investigating high-precision millimeter and submillimeter-wave observations
HASHIGUCHI Minako	NAGOYA Univ.	Graduate School of Environmental Studies	KATO Takenori	Sta / Str	Understanding of the past and present space environment and solar activity using observation of meteorites and the search for dark matter

Interdisciplinary Research

Energetic Particle Chain
-Effects on the Middle/Lower Atmosphere from Energetic Particle Precipitations-

Data Rescues of the Analog Observational Records for the Past Solar-Terrestrial Environment

Direct Search for Dark Matter with Paleo-Detectors

Changes in Surface Temperature at Dome-Fuji in East Antarctica from the Mid-Twentieth Century and the Impact of Solar Activity

Exploring new possibilities from an interdisciplinary and strategic perspective

The Office for the Development of Interdisciplinary Research Strategy promotes new fusion research connecting space science, earth science, and other fields. The Office includes the institute's director, vice director, and affiliated center directors, who oversee joint usage and research. Additionally, the Office for the Development of Interdisciplinary Research Strategy Operation Committee, composed of faculty and staff from related departments within the Tokai National Higher Education and Research System and external members, is developing a new interdisciplinary research strategy covering a wide range of fields.

An example of a specific initiative is the call for proposals within the Tokai National Higher Education and Research System for "Interdisciplinary Research Strategy Projects," with 10 projects selected for FY2023 and 13 for FY2024. Beginning in FY2025, these projects will be classified into a "start-up phase," representing the early stage of research, and a "follow-up phase," representing the ongoing research period. The "start-up phase" will be further divided into "strategy type" and "seeds type." Following review, 13 projects have been selected for FY2025. In addition, four "interdisciplinary research projects" that span different fields are underway. These initiatives are expected to transform space–earth environmental research, establishing it as a significant project for the Institute for Space–Earth Environmental Research and as a new academic field.

Office for the Promotion of Transdisciplinary Network

Interdisciplinary Integration of Humanities and Sciences | Space–Earth Environmental Sciences | Carbon-14 | Archaeomagnetism | Metadata | History | Archaeology | Transdisciplinary Network

The Office for the Promotion of Transdisciplinary Network serves as a core hub for promoting the "Transdisciplinary Network linking Space–Earth Environmental Sciences, History, and Archaeology" under the MEXT Promotion of Development of a Joint Usage/Research System Project: Coalition of Universities for Research Excellence Program (CURE), in collaboration with five participating institutions. Its mission is to create a new transdisciplinary field that integrates space–earth environmental sciences with history and archaeology, and to establish a broad interdisciplinary research network. The Office also aims to foster the next generation of researchers with wide-ranging perspectives in science, engineering, and the humanities, who will contribute to the formation of a sustainable society extending into space.

Off. Mgr.

MINAMI Masayo ISEE Vice Dir./Prof. ▶ Isotope geochemistry, Radiocarbon dating, Environmental geochemistry

MIYAKE Fusa Assoc. Prof. ▶ Cosmic ray physics, Cosmogenic nuclide

HAYAKAWA Hisashi Asst. Prof. ▶ Solar-Terrestrial Physics, Extreme Space Weather, Historical Astronomy, Environmental History

<Concurrent Members>

SHIOKAWA Kazuo Prof. (Ctr. for International Collaborative Research)

KITAGAWA Hiroyuki Prof. (Div. for Chronological Research)

MIYOSHI Yoshizumi Prof. (Ctr. for Integrated Data Science)

OTSUKA Yuichi Assoc. Prof. (Div. for Ionospheric and Magnetospheric Research)

MORI Yasunori Lead Academic Specialist (Off. for the Development of Interdisciplinary Research Strategy)

MARTINEZ Claudia Assoc. Prof. (Ctr. for International Collaborative Research)

More details are found on our webpage.
https://www.isee.nagoya-u.ac.jp/en/research/optn.html

1. Promotion of transdisciplinary research linking space–earth environmental sciences with history and archaeology. **2.** Kick-off workshop of the Transdisciplinary Network Formation program (held in February 2025). **3.** Field survey of buried trees in Yakushima. **4.** Excavation of pottery at the archaeological site. **5.** Japanese pottery. **6.** Archaeological remains in Vietnam: Research on constructing archaeomagnetic secular variation curves in Vietnam and their application to dating. **7.** *Enkoan Zuikan Zue* (©National Diet Library). **8.** Solar storms reconstructed from historical documents (©Seiunji Temple). **9.** Survey of historical records at the *Thesaurus Linguae Latinae*, Munich. **10.** Large-scale storage system for the research and development of an integrated humanities and sciences database. **11.** Study of past solar activity and cosmic rays increase using ^{14}C in Yakusugi tree rings. **12.** Research meeting. **13.** Tandetron accelerator mass spectrometry system for high-precision ^{14}C measurement in archaeological artifacts and tree rings.

Creating a Transdisciplinary Network linking Space–Earth Environmental Sciences, History, and Archaeology

The Institute for Space–Earth Environmental Research serves as a core hub, collaborating with five participating institutions —the National Museum of Japanese History; the Center for Accelerator Mass Spectrometry, Yamagata University; the Advanced Asian Archaeological Research Center, Kyushu University; the Joint Support-Center for Data Science Research; and the Center for Digital Humanities and Social Sciences, Nagoya University — to launch the MEXT Promotion of Development of a Joint Usage/Research System Project: Coalition of Universities for Research Excellence Program (CURE), titled "*Transdisciplinary Network that linking Space–Earth Environmental Sciences, History, and Archaeology.*" This project is a 10-year initiative beginning in FY2024.

The Office will serve as the central hub for four main research groups: Cataclysmic Disasters and Dating, Archaeomagnetic Research, Solar-Terrestrial Environmental History, and Interdisciplinary Database Research and Development. In this capacity, it will work in collaboration with specially appointed faculty members, researchers, and students to promote the development of a new transdisciplinary network that integrates space–earth environmental science with history and archaeology.

These research activities aim to assess the impact of severe space storms on modern civilization and develop new fields in history and archaeology through accurate and precise dating. Achieving these goals will contribute to the formation of a sustainable, evolving society that expands into space, while also fostering the next generation of human resources.

An annual call for joint usage/research projects invites researchers from Japan and abroad to participate in this initiative, further expanding the transdisciplinary field. We also organize workshops to promote the integration of the humanities and sciences. This initiative will facilitate information exchange between researchers and users of research results across various fields, creating a transdisciplinary network that connects space–earth environmental science with history and archaeology.

Joint Research

In January 2016, our Institute was certified by the Ministry of Education, Culture, Sports, Science and Technology (MEXT) as a Joint Usage/Research Center for space-earth environmental research under the third mid-term plan. Since FY2016, it has served as the only Joint Usage/Research institute in Japan that integrates space science and earth science, promoting collaborative research on space-earth environment with related communities in Japan and abroad. On October 29, 2021, the Institute was recertified as a Joint Usage/Research Center under the fourth mid-term plan. Building on this recognition, it has aimed to further strengthen the integration of space and earth sciences, to establish an international joint research hub connecting diverse fields, to foster the development of related communities, and to create new academic frontiers. In FY2024, the Institute was selected for the Promotion of Development of a Joint Usage/Research System Project: Coalition of Universities for Research Excellence Program (CURE), and in FY2025, it was further certified as an International Joint Usage/Research Center. To date, the Institute has advanced space-earth environmental research by treating the Earth, the Sun, and space as a single system, and by elucidating the mechanisms and interrelationships of the diverse phenomena occurring within it. Through these efforts, it has contributed both to addressing global environmental challenges faced by humanity and to supporting the development of human society as it expands into space. Looking ahead, the Institute will continue these activities and further reinforce the integration of space and earth sciences. By doing so, it aims to establish an international joint research hub that links diverse fields, fosters community development, and promotes the creation of new academic disciplines. To this end, we promote joint usage and collaborative research under 17 frameworks, utilizing ground-based, ocean, aircraft, and satellite observations; laboratory experiments; data analysis; numerical simulations; and other approaches. Through these wide-ranging efforts, the Institute contributes to solving urgent issues such as global warming, extreme weather events including typhoons and torrential rains, and space weather hazards affecting satellites, communications, navigation, power systems, and aviation.

[Joint Research Category]

- 00 ISEE Symposium
- 01 Joint Research Program (International)
- 02 ISEE International Joint Research Program
- 03 ISEE International Workshop
- 04 Joint Research Program (General)
- 05 Joint Research Program (Student Encouragement)
- 06 Joint Research Program (Symposium)
- 07 Joint Research Program (Computing Infrastructure)
- 08 Joint Research Program (Database Management)
- 09 Joint Research Program (Accelerator Mass Spectrometry Analysis)
- 10 Carbon 14 Analysis Service
- 11 SCOSTEP Visiting Scholar(SVS) Program
- 12 Aircraft observation (Dropsonde)
- 13 International travel support for field and laboratory experiments by students and early-career scientists
- 14 International Technical Exchange Program
- 15 ISEE International School Support
- 16 International travel support for students (International presentation / Institutional stay)

Click here for assignment details

> International Activities and the Future of ISEE

On October 31, 2024, ISEE received a notice of certification as an International Joint Usage/Research Center from the Ministry of Education, Culture, Sports, Science and Technology. This honor was in recognition of its central role in the planning and implementation of large-scale research projects in international related communities and its activities that lead related communities. Only nine research institutes in Japan have been certified as this International Center. Going forward, we will promote seamless research on the universe, the sun, and the earth through international collaboration, while establishing an "International Center Collaboration Laboratory" that recruits young researchers from overseas, employing top-class foreign faculty and URAs to support research enhancement, and further expanding a variety of international joint usage/research programs. These initiatives will allow us to make international contributions to space science and earth science.

topics ISEE's advanced points in numbers ※FY2024 data

Research results

Approximately **200** papers

International co-authorship rate of papers **75** %
(2021-2024)

Joint usage/Research achievements

Implementation of open-call joint usage/research programs

17 types / approximately **250** cases per year

Development of international collaborations

Observation points **55**

Partner institutions **45**

including 27 institutions with academic exchange agreements

Number of databases held

International standard Approximately **7.6** million cases

International databases are available in ISEE, such as IPS Solar Wind Speed Data, SuperDARN Hokkaido Pair of (HOP) radars database, ERG database, MHD Simulation on the Magnetospheric Environment, and Database of the Optical Mesosphere Thermosphere Imagers.

Over 10 million pieces of data are provided each year

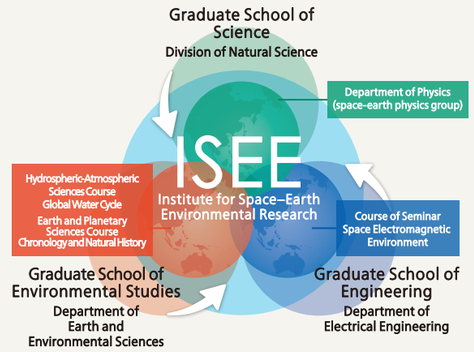
Education

The Institute continues the graduate education provided by the three parent research organizations (graduate school education at the Graduate Schools of Science and Engineering by the former Solar-Terrestrial Environment Laboratory, and graduate school education at the Graduate School of Environmental Studies by the former Hydrospheric Atmospheric Research Center and the former Center for Chronological Research). The Institute also provides graduate education through a cooperative program with the Graduate Schools of Science, Engineering, and Environmental Studies.

Graduate students are actively engaged in cutting-edge basic research in each field, taking full advantage of a variety of methods, including ground observation, fieldwork, laboratory experiments, chemical analysis, dating, development of observation equipment for launch vehicles, observation data analysis, numerical simulation/modeling, and theoretical research. The Institute also collaborates with researchers in Japan and abroad to develop new scientific fields through interdisciplinary research that views the Earth, Sun, and universe as a unified system. These results are documented in master's and doctoral theses and presented at domestic and international research meetings, conferences, and in academic journals. We aim to foster human resources in this environment, imparting a broad perspective and international sensibilities to ensure students can contribute back to society with their specialized knowledge. Graduate students can receive education and conduct research at the Institute by joining the following graduate schools and departments. Please refer to the websites of each graduate school and department for details.

Click here for details of the undergraduate and graduate education

Graduate School of Science Division of Natural Science・Department of Physics (space-earth physics group)	• Atmospheric and Environmental Science (AM) • Space Science-Experiment(SSE) • Solar and Space Physics-Theory(SST)	• Cosmic-Ray Physics(CR) • Heliospheric Plasma Physics (SW)
Graduate School of Engineering Department of Electrical Engineering	• Space Observation	• Space Information Engineering
Graduate School of Environmental Studies Department of Earth and Environmental Sciences	• Meteorology • Hydroclimatology • Cloud and Precipitation Sciences • Oceanography	• Atmospheric Chemistry • Geochronology • Environmental History



Outreach Activities

The outreach activities at ISEE include outreach publications, open laboratories, and public lectures.

Public outreach publications

We publish the following booklets, available on the ISEE website.

To view on the website

The "50 Whys…" series

A Japanese booklet series that answers 50 whys in the Q&A style for a variety of ISEE research topics.

■ Polar regions ■ Ozone ■ Cosmic rays ■ Planets ■ The Sun and solar winds ■ Weather ■ Auroras ■ Global warming ■ Top of the atmosphere ■ Geomagnetism ■ Radiation belt ■ Radio waves ■ Space weather ■ lanets (new version) ■ Oceans

"What is…!?" comic series

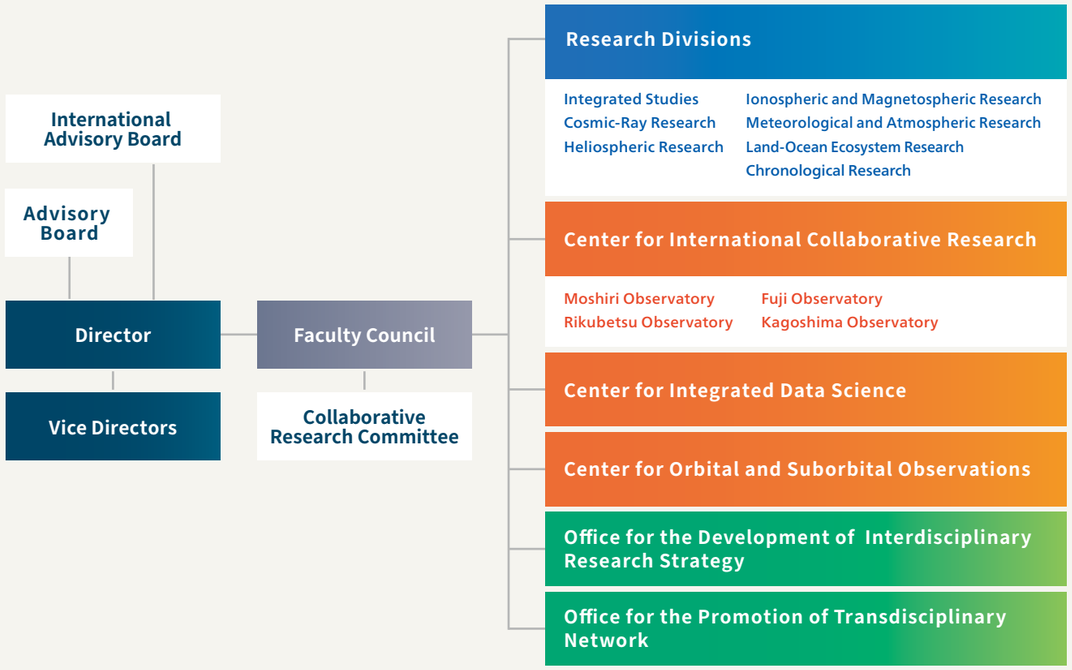
A science comic series. Translations to English, French, and Italian are underway by the Scientific Committee on Solar-Terrestrial Physics (SCOSTEP)

Open house and visiting lectures

We offer open laboratory events during the university festivals. Public lectures are given in Nagoya, Rikubetsu in Hokkaido, Kiso in Nagano, and Tarumizu in Kagoshima. We also provide special classes for local elementary, junior high, and high school students.

For more details

Organization



History

1949 Research Institute of Atmospherics, Nagoya University was established.

1957 The Water Research Laboratory, Faculty of Science,Nagoya University was established.

1958 Cosmic-ray Research Laboratory, Faculty of Science, Nagoya University was established.

1973 The Water Research Institute (WRI), Nagoya University was organized.

1981 The Tandetron Accelerator Laboratory was established in the Radioisotope Research Center of Nagoya University.

1982 Installation of the Tandetron Accelerator Mass Spectrometry (AMS) machine No.1 was completed.

1987 Inter-University Service of 14C measurements was started with the Tandetron AMS machine No.1.

1990 The Nagoya University Dating and Material Research Center was established.

1990 Solar-Terrestrial Environment Laboratory (STEL)
The Solar-Terrestrial Environment Laboratory (STEL) was established.

1993 The Institute for Hydrospheric-Atmospheric Sciences (IHAS), Nagoya University was organized.

1995 The Center for Joint Observations and Data Processing was organized.

1997 1997 The Tandetron AMS machine No. 2 was newly introduced.

2000 Center for Chronological Research (CCR)
The Center for Chronological Research was organized.
The CHIME dating system was transferred from the School of Science.

2001 Hydrospheric Atmospheric Research Center (HyARC)
The Hydrospheric Atmospheric Research Center(HyARC), Nagoya University was established.

2003 The Rikubetsu Observatory was organized.

2004 The Geospace Research Center was established.

2006 Laboratory was relocated to the Higashiyama Campus.

2010 Approved as one of the Joint Usage/Research Centers.

2010 Approved as one of the Joint Usage/Research Centers.

2015 Institute for Space–Earth Environmental Research (ISEE) was established.

2016 Approved as one of the Joint Usage/Research Centers.

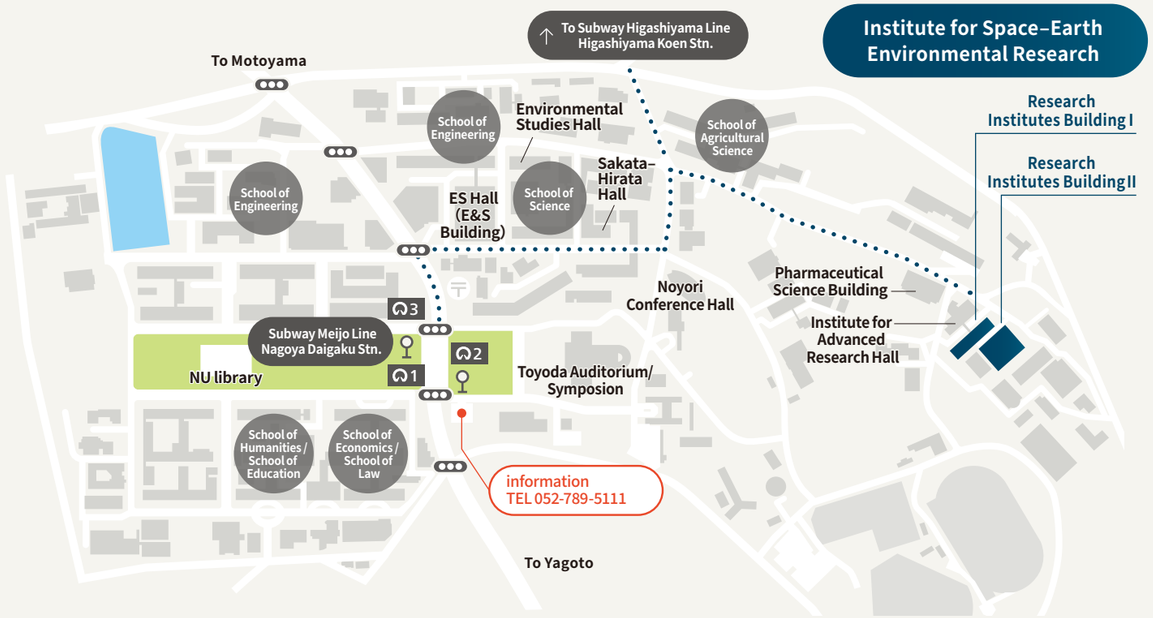
2025 Approved as an International Joint Usage/Research Center (as of April 1).

Higashiyama Campus Map

Institute for Space–Earth Environmental Research (Research Institutes Buildings I & II),
Nagoya University,Furo-cho, Chikusa-ku, Nagoya, Aichi 464-8601, Japan

Higashiyama Campus Interactive Map

Get off at “Nagoya Daigaku” station (Subway Meijo Line). About 15-minute walk from Exit 2 or 3.
Or get off at “Higashiyama Koen” station (Higashiyama Line). About 15-minute walk from Exit 3 or 4 (please carefully check the route in advance).



Research Institutes Buildings I (right) and II (left)