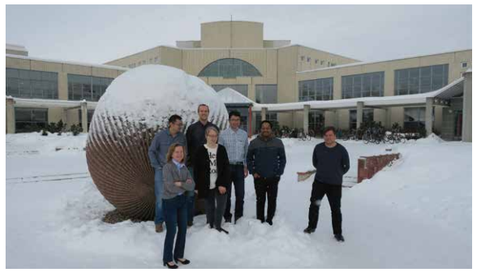
PSTEP (Project for Solar-Terrestrial Environment Prediction) Summer School RIKUBETSU

The optical counter part of a gravitational-wave event (left) imaged by the MOA II telescope

Aerial photography of the IPS radio telescope at the Kiso observatory



Began cross appointment with the University of Oulu, Finland

Ka-band polarization radar

Estimating permafrost thawing rate at Mongolia using a drone and spring water analyses

A graduate student (joint researcher) making a sample preparation for ^{14}C measurement

ISEE introduction video has been created

Institute for Space–Earth Environmental Research, Nagoya University

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NAGOYA UNIVERSITY

Institute for Space–Earth Environmental Research, Nagoya University

Institute for Space–Earth Environmental Research Nagoya University

Annual Report

FY2017

Institute for Space–Earth Environmental Research, Nagoya University Annual Report FY2017

Institute for Space–Earth Environmental Research Nagoya University

Annual Report

April 2017–March 2018

Contents

1. Foreword

The Institute for Space–Earth Environmental Research (ISEE) was launched in October 2015 by merging three institutes of Nagoya University: the Solar Terrestrial Environment Laboratory, the Center for Hydrospheric Atmospheric Research, and the Center for Chronological Research. These research institutes have been at the forefront of scientific research in their specific research disciplines. With the merging of the three institutes, the ISEE functions as a new center for interdisciplinary space–Earth research. The mission of the ISEE is to clarify the mechanisms and mutual relationships of the Earth, the Sun, and cosmic space, treating them as a seamless system and to benefit humanity by resolving issues in the global environment and contributing to the advances of space exploration. To this end, the institute has pursued collaborative research efforts with related facilities to develop integrated research opportunities. In particular, the ISEE plays an important role as the Joint Usage and Joint Research Centers in Japan through the following various programs, the International Research Program, the ISEE International Joint Research Program, and the ISEE/CICR International Workshop. We also engage in broader efforts such as general collaboration, student encouragement, symposiums, computing infrastructure, database management, accelerator mass spectrometry analysis, and carbon 14 analysis service research. In FY 2017, 270 research projects were conducted under this framework, with many exciting outcomes and new results.

The ISEE continues to actively promote international collaborative research. This year, 219 foreign researchers were invited to carry out joint research and seminars both inside and outside of the institute. The ISEE hosted international workshops in which experts from around the world were invited to intensively discuss topical issues and publish international coauthored papers. In FY 2017, the ISEE hosted two international workshops on the Benchmarks for Operational Solar Flare Forecasts and the Prediction of Solar Cycle 25. International joint research activity is expected to be a valuable step in future research development.

This year, we established the ISEE Award to foster a new type of interdisciplinary research. The ISEE Award recognizes excellent ISEE collaborative research. Nominations are accepted regardless of affiliation or nationality. Based on a wide range of recommendations from many related communities, the first winner of the ISEE Award will be determined based on strict selection guidelines. It is our hope that the ISEE Award will encourage the development of future space–Earth environmental research.

The ISEE is organized by basic research divisions, consisting of seven research groups and three centers: the Center for International Collaborative Research, the Center for Integrated Data Science, and the Center for Orbital and Suborbital Observation. The ISEE is currently promoting four interdisciplinary research projects: the Project for Solar-Terrestrial Climate Research, the Project for Space–Earth Environmental Prediction, the Project for the Interaction of Neutral and Plasma Atmosphere, and the Project for Aerosol and Cloud Formation. These projects are being carried out in cooperation with nationwide collaborative research supported by the Grant-in-Aid for Scientific Research program of the Ministry of

Education, Culture, Sports, Science and Technology (MEXT). For example, the Aerosol and Cloud Formation group completed Japan's first typhoon measurement using an aircraft; they flew over Typhoon No. 21, directly entering the eye of the typhoon to acquire valuable data. In addition to interdisciplinary research projects, the ISEE has contributed to significant progress in science. For instance, the Microlensing Observations in Astrophysics (MOA) II telescope, operated by the ISEE and the University of Canterbury Mount John Observatory in New Zealand succeeded in observing the visible afterglow of a neutron star merger, first detected by gravitational wave measurements on 17 August 2017. We were very pleased that the ISEE was able to contribute to this historic discovery.

The ISEE strives to nurture young minds through new perspectives and integrated and international partnerships. In particular, the ISEE cooperates with the Graduate School of Science, Graduate School of Engineering, and Graduate School of Environmental Studies of Nagoya University to offer a unique educational opportunity in which graduate students from the three graduate schools collaborate on research of mutual interest. Through the ISEE, these students also participate in international research activities.

At the ISEE, we are actively working on outreach programs to promote public awareness of our research and contribute to science education. In FY 2017, we held an open lecture on the theme of "New Measurement of the Earth" in December and conducted an open laboratory at the University Festival (Meidai-Sai) in June. In August, we also carried out an open seminar "Explosive Phenomena in Space" in conjunction with the Graduate School of Science, a summer school for elementary school students in the Tokai region to learn about the history of the Earth, as well as an open house at the Kiso Observatory. We made a presentation at the Nagoya University Homecoming Day event in October. We also cooperated with organizers in presenting the Science Festival for Young People in the city of Tarumizu, Kagoshima prefecture (the location of the ISEE Observatory) in December. We created a video to explain ISEE research in an easy-to-understand manner for the ISEE homepage and YouTube viewing. Future efforts will include the distribution of postcards providing information about video access to ISEE research, as well as scientific booklets for high school students in Aichi prefecture.

Modern society is undergoing drastic changes and civilization is rapidly evolving in an unprecedented manner at the global scale. The ISEE views the Sun, Earth, and space as a seamless system and it is crucial that people understand the delicate balance and mechanisms of this system and their role in its protection and sustainable development as mankind spreads throughout the solar system. The ISEE will therefore continue with its mission to help resolve global environmental issues and advance space exploration by elucidating the mechanisms and interactions of various phenomena occurring therein. It is our hope that this annual report has highlighted some of the more recent ISEE activities. We look forward to your continued support and cooperation in future research efforts.

Kanya Kusano

Director

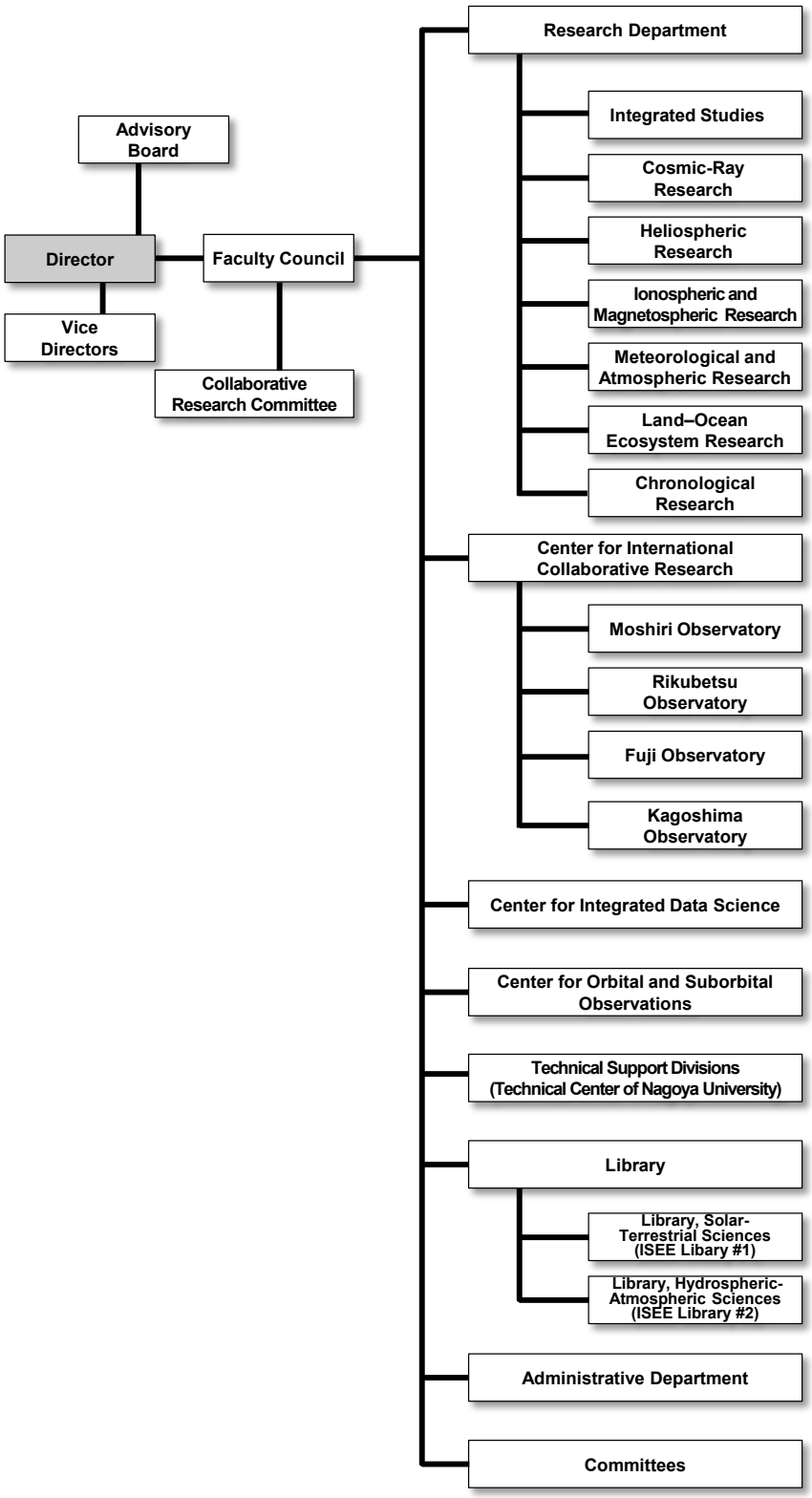
2. History

Solar-Terrestrial Environment Laboratory	Hydrospheric Atmospheric Research Center (HyARC)	The Nagoya University Center for Chronological Research
May, 1949 Research Institute of Atmospherics, Nagoya University was established.	**April, 1957** The Water Research Laboratory, Faculty of Science, Nagoya University was established.	
April, 1958 Cosmic-ray Research Laboratory, Faculty of Science, Nagoya University was established.	**September, 1973** The Water Research Institute (WRI), Nagoya University was organized.	**February, 1981** The Tandetron Accelerator Laboratory was established in the Radioisotope Research Center of Nagoya University.
		March, 1982 Installation of the Tandetron Accelerator Mass Spectrometry (AMS) machine No.1 was completed.
		January, 1987 Inter-University Service of ^{14}C measurements was started with the Tandetron AMS machine No.1.
June, 1990 The Solar-Terrestrial Environment Laboratory (STEL) was established.	**April, 1993** The Institute for Hydrospheric-Atmospheric Sciences (IHAS), Nagoya University was organized.	**June, 1990** The Nagoya University Dating and Material Research Center was established.
April, 1995 The Center for Joint Observations and Data Processing was organized.		
		March, 1997 The Tandetron AMS machine No. 2 was newly introduced.
	April, 2001 The Hydrospheric Atmospheric Research Center (HyARC), Nagoya University was established.	**April, 2000** The Nagoya University Center for Chronological Research was organized.The CHIME dating system was transferred from the School of Science.
April, 2003 The Rikubetsu Observatory was organized.		
April, 2004 The Geospace Research Center was established.		
March, 2006 Laboratory was relocated to the Higashiyama Campus.		
April, 2010 Approved as one of the Joint Usage/Research Centers.	**April, 2010** Approved as one of the Joint Usage/Research Centers.	

October, 2015,
Institute for Space–Earth Environmental Research (ISEE), merging the laboratory and two centers, was established.

January, 2016
ISEE was approved as one of the Joint Usage/Research Centers.

3. Organization



4. Staff

April 1, 2017–March 31, 2018
✱ : Concurrent post
▲: Left the Institute in the 2017 academic year
○: Joined the Institute in the 2017 academic year

Director	Kanya Kusano
Vice Directors	Joji Ishizaka
Vice Directors	Kazuo Shiokawa

Division for Integrated Studies

Professor	Shinobu Machida ▲
Professor	Kanya Kusano (✱)
Associate Professor	Satoshi Masuda
Associate Professor	Yoshizumi Miyoshi (✱)
Designated Associate Professor	Shinji Saito *1
Lecturer	Takayuki Umeda (✱)
Assistant Professor	Akimasa Ieda
Assistant Professor	Shinsuke Imada *2
Researcher	Haruhisa Iijima
Research Institution Researcher	Yasunori Tsugawa ▲
Research Institution Researcher	Takuma Matsumoto ○▲
Vsiting Academic Staff/Visiting Faculty Members	
Visiting Professor	Kiyoto Shibasaki

*1 Belongs to Graduate School of Science
*2 Lecturer after February 2018

Division for Cosmic-Ray Research

Professor	Yoshitaka Itow
Professor	Hiroyasu Tajima (✱)
Associate Professor	Kimiaki Masuda ▲
Associate Professor	Yutaka Matsubara
Associate Professor	Fumio Abe (✱)
Associate Professor	Fusa Miyake ○
Designated Associate Professor	Kazutaka Yamaoka *1
Lecturer	Takashi Sako ▲
Assistant Professor	Akira Okumura *2
Designated Assistant Professor	Hiroaki Menjo *1
Researcher	Yoshinori Sasai ○
Technical Assistant	Kinji Morikawa
Technical Assistant	Nobuhito Yamane ○▲

*1 Belongs to Graduate School of Science
*2 Lecturer after March 2018

Division for Heliospheric Research

Professor	Munetoshi Tokumaru
Associate Professor	Kazumasa Iwai ○
Assistant Professor	Ken-ichi Fujiki

Division for Ionospheric and Magnetospheric Research

Professor	Masafumi Hirahara
Professor	Kazuo Shiokawa (✱)
Associate Professor	Yuichi Otsuka
Associate Professor	Satonori Nozawa
Associate Professor	Nozomu Nishitani (✱)
Lecturer	Shin-ichiro Oyama
Designated Assistant Professor	Atsuki Shinbori ○
Researcher	Mitsuru Matsumura
Research Institution Researcher	Neethal Thomas ○
Vsiting Academic Staff/Visiting Faculty Members	
Visiting Associate Professor	Yasunobu Ogawa
Visiting Associate Professor	Yoshifumi Saito
Visiting Associate Professor	Ayako Matsuoka
JSPS Postdoctral Fellowship for Research in Japan	Cai Lei ▲

Division for Meteorological and Atmospheric Research

Professor	Akira Mizuno
Professor	Nobuhiro Takahashi (✱)
Professor	Kazuhisa Tsuboki (✱)
Professor	Yutaka Matsumi (✱) ▲
Associate Professor	Tomoo Nagahama
Associate Professor	Hirohiko Masunaga
Associate Professor	Taro Shinoda (✱)
Lecturer	Tomoki Nakayama ▲
Assistant Professor	Taku Nakajima
Designated Assistant Professor	Tadayasu Ohigashi ▲
Researcher	Yoshiki Fukutomi ▲
Researcher	Fumie Furuzawa
Technical Assistant	Kazuji Suzuki ▲
Technical Assistant	Seina Ishida ○▲

Division for Land–Ocean Ecosystem Research

Professor	Joji Ishizaka
Professor	Tetsuya Hiyama (∗)
Associate Professor	Hidenori Aiki
Associate Professor	Naoyuki Kurita ○
Lecturer	Hatsuki Fujinami
Assistant Professor	Yoshihisa Mino
Researcher	Shun Ohishi ○
Research Institution Researcher	Zhu Yuanli ○

Divison for Chronological Research

Professor	Masaki Enami
Professor	Hiroyuki Kitagawa
Associate Professor	Masayo Minami
Associate Professor	Takenori Kato (∗)
Associate Professor	Kimiaki Masuda (∗)▲
Assistant Professor	Hirotaka Oda
Research Institution Researcher	Naoyuki Kurita ▲
Research Institution Researcher	Fumiko W. Nara ▲
Research Institution Researcher	Masako Yamane ○
Technical Assistant	Masami Nishida
Technical Assistant	Yuriko Hibi
Technical Assistant	Miyo Yoshida ▲

Vsiting Academic Staff/Visiting Faculty Members

Toshio Nakamura

Center for International Collaborative Research

Director • Professor	Kazuo Shiokawa
Professor	Tetsuya Hiyama
Professor	Masaki Enami (∗)
Professor	Akira Mizuno (∗)
Designated Professor	Ioannis Daglis ○▲
Designated Professor	Joaquim Ignacio Goes ○▲
Designated Professor	Joseph Benjamin Harold Baker ▲
Designated Professor	K. D. Leka ○
Designated Professor	Lee Zhongping ○
Designated Professor	Lynn Marie Kisteler ○
Designated Professor	Martin Gerard Connors ▲
Designated Professor	Maria Fatima Helga Do Rosario Gomes ○▲
Designated Professor	Stephen Michael Playfer ○
Designated Professor	Sergey Anatolievich Tyul'bashev ○▲
Associate Professor	Nozomu Nishitani
Associate Professor	Naoyuki Kurita (∗)○
Associate Professor	Satonori Nozawa (∗)
Designated Associate Professor	Bich Thuy Ly ○▲
Designated Associate Professor	Surendra Kumar Dhaka ○▲
Lecturer	Takashi Sako (∗)▲
Lecturer	Hatsuki Fujinami (∗)
Designated Assistant Professor	Masaki Nishino *1
Designated Assistant Professor	Taro Nakai ○
Researcher	Hironari Kanamori
Researcher	Park Sung-Hong ○

Vsiting Academic Staff/Visiting Faculty Members

Visiting Professor	Hiroyuki Shinagawa
Visiting Professor	Yoshinobu Harazono
Visiting Professor	Park Hotaek
Visiting Professor	Tomoomi Kumagai ○

Moshiri Observatory

Technical Assistant	Yuuji Ikegami ▲
Technical Assistant	Masayuki Sera ▲

Foreign Visiting Research Fellow (Visiting Professor)

March 1 – May 31, 2017	Bernhard Kliem
May 1 – June 10, 2017	Sarma Venkata Subrahmanya Srinivasa Vedula

*1 Belongs to Graduate School of Engineering, Designated Lecturer after August 2017

Center for Integrated Data Science

Director • Professor	Kazuhisa Tsuboki ○
Professor	Kanya Kusano
Professor	Joji Ishizaka (∗)
Professor	Shinobu Machida (∗)▲
Associate Professor	Fumio Abe
Associate Professor	Takenori Kato
Associate Professor	Yoshizumi Miyoshi
Associate Professor	Satoshi Masuda (∗)
Associate Professor	Hirohiko Masunaga (∗)
Designated Associate Professor	Tomoaki Hori ○
Lecturer	Takayuki Umeda
Assistant Professor	Akimasa Ieda (∗)
Assistant Professor	Shinsuke Imada (∗)[*1]
Designated Assistant Professor	Sachie Kanada
Designated Assistant Professor	Masafumi Shoji ▲
Designated Assistant Professor	Satoshi Inoue
Designated Assistant Professor	Mariko Teramoto
Designated Assistant Professor	Tzu-Fang Chang ○
Designated Assistant Professor	Takuma Matsumoto ○
Researcher	Norio Umemura
Researcher	Masaya Kato ○
Researcher	Mayumi Yoshioka ▲
Researcher	Yukie Moroda
Researcher	Satoshi Kurita ○
Researcher	Takafumi Kaneko ○
JSPS Research Fellowship	Shoya Matsuda ○
JSPS Research Fellowship	Hidetaka Hirata ○
Technical Assistant	Tomoya Iju ▲[*2]
Technical Assistant	Mariko Kayaba
Technical Assistant	Asayo Maeda
Technical Assistant	Takahiro Tsukamoto
JSPS Postdoctoral Fellowship for Research in Japan (Summer Program)	Magnus Morton Woods ○▲
JSPS Bridge Fellow Program	Savani Patel Neel Prakash ○▲

Vsiting Academic Staff/Visiting Faculty Members

Visiting Professor	Yoshiya Kasahara
Visiting Professor	Kanako Seki
Visiting Associate Professor	Ryouhei Kano
Visiting Associate Professor	Iku Shinohara
Visiting Associate Professor	Hirohisa Hara
Visiting Associate Professor	Daiko Shiota ○

*1 Lecturer from February 2018
*2 Researcher from November 2017

Center for Orbital and Suborbital Observations

Director • Professor	Nobuhiro Takahashi
Professor	Hiroyasu Tajima
Professor	Yutaka Matsumi ▲
Designated Professor	Masataka Murakami
Professor	Joji Ishizaka (∗)
Professor	Kazuhisa Tsuboki (∗)
Professor	Masafumi Hirahara (∗)
Associate Professor	Taro Shinoda
Designated Assistant Professor	Hiroyuki Tomita
Researcher	Woonseon Jung
Technical Assistant	Hiroshi Sasago ▲
Technical Assistant	Tomoko Tanaka

Vsiting Academic Staff/Visiting Faculty Members

Visiting Professor	Masahiro Kawasaki
Visiting Professor	Kunihiko Kodera
Visiting Professor	Yoshikatsu Kuroda
Visiting Associate Professor	Yasutaka Narusawa

Cooperating Research Fellow

Keiji Hayashi

Akiko Mizuno

Claudia Maria Martinez Calderon ▲

Technical Center of Nagoya University

Senior Technician	Akiko Ikeda *1
Senior Technician	Yasusuke Kojima *1
Senior Technician	Haruya Minda *1
Technician	Tetsuya Kawabata *2
Technician	Tomonori Segawa *2
Technician	Yoshiyuki Hamaguchi *2
Technician	Yasushi Maruyama *2
Technician	Takayuki Yamasaki *2
Technician	Yuka Yamamoto *2
Assistant Technician	Takumi Adachi *3
Assistant Technician	Moeto Kyushima *3
Assistant Technician	Ryuji Fujimori *3

*1 Changed from Senior Technical Specialist after October 2017
*2 Changed from Technical Specialist after October 2017
*3 Changed from Technical Staff after October 2017

Foreign Visiting Cooperation Researcher

September 1, 2016 – August 31, 2017	Anglu Shen
October 1, 2016 – January 31, 2018	Jie Ren
May 12 – August 10, 2017	Ngoc Hanh Tam Dao
June 1 – August 31, 2017	Daniel Izuikedinachi Okoh
July 20 – October 20, 2017	Devanaboyina Venkata Ratnam
July 30 – September 30, 2017	Sergii Panasenko
November 13 – December 30, 2017	Das Uma

Administration Department

Director, Administration Department	Sumio Murai
Manager, General Affairs Division	Kazuhiko Tsukazaki ○
Office Manager, Research Support Office	Tohru Kawai ▲
Specialist, General Affairs Section	Norishi Sugiyama
Section Head, General Affairs Section 1	Seiji Tsuruta ○
Section Head, General Affairs Section 2	Sayuri Morino ▲
Section Head, Personnel Affairs Section	Shoji Asano
Section Head, Research Support Office	Tadayosi Ito
Leader, General Affairs Section 1	Yumi Matsubara ▲
Administrator	Yoko Nokura ○
Administrator	Harumi Morishita
Administrator	Anna Kato
Administrator	Yori Sato ▲
Administrator	Yuka Suzuki ○
Manager, Accounting Division	Hiroyuki Ichioka ○
Specialist, Maintenance Section	Yoshiyuki Nakano
Section Head, Supplies Section	Noriaki Hiroi
Section Head, Supplies Section	Kiyoko Hasegawa
Section Head, Maintenance Section	Shinichi Nakagawa
Leader, Accounting Section	Youko Yasui ○
Leader, Supplies Section	Yuka Matsuoka
Administrator	Mio Kato ▲
Administrator	Yuka Ito ○
Administrator	Ayaka Nakamura ▲
Administrator	Kyohei Yamaguchi ○
Designated Supervisor	Tadashi Tsuboi ○

Toyokawa Branch

Technical Assistant	Kayoko Asano
Technical Assistant	Yasuo Kato

5. Committee of Other Organizations

Committee of Other Organizations

Contact Post	Job Title	Organizations	Name of Committee / Title
Kanya Kusano	Professor	International Astronomical Union (IAU)	Organizing Committee Member of Commission E3 Solar Impact throughout the Heliosphere
Kanya Kusano	Professor	Solar Physics	Editorial Board member
Yoshizumi Miyoshi	Associate Professor	Committee on Space Research (COSPAR)	Vice-chair of the Panel on Radiation Belt Environment Modeling (PRBEM)
Yoshizumi Miyoshi	Associate Professor	Scientific Committee on Solar-Terrestrial Physics (SCOSTEP)	Campaign coordinator of VarSITI/SPeCIMEN
Yoshizumi Miyoshi	Associate Professor	Scientific Committee on Solar-Terrestrial Physics (SCOSTEP)	Co-leader of the SCOSTEP VarSITI (Variability of the Sun and Its Terrestrial Impact)/SPeCIMEN (Specification and Prediction of the Coupled Inner-Magnetospheric Environment)
Yoshizumi Miyoshi	Associate Professor	Annales Geophysicae	Editor
Yoshizumi Miyoshi	Associate Professor	Earth and Planetary Physics	Editor
Yoshitaka Itow	Professor	Telescope Array collaboration	Telescope Array External Advisory committee
Hiroyasu Tajima	Professor	B-factory Programme Advisory Committee	Committee member
Hiroyasu Tajima	Professor	Progress of Theoretical and Experimental Physics	Editor
Hiroyasu Tajima	Professor	The Scientific World Journal	Editorial Board member
Kazuo Shiokawa	Professor	Earth, Planets and Space (EPS)	Guest Editor for the special issue of Global Data Systems for the Study of Solar-Terrestrial Variability
Kazuo Shiokawa	Professor	Committee on Space Research (COSPAR)	Chair of the COSPAR Sub-Commission C1 (The Earth's Upper Atmosphere and Ionosphere)
Kazuo Shiokawa	Professor	Scientific Committee on Solar-Terrestrial Physics (SCOSTEP)	Co-chair of the SCOSTEP VarSITI (Variability of the Sun and Its Terrestrial Impact)
Kazuo Shiokawa	Professor	Journal of Atmosphere and Solar-Terrestrial Physics	Guest editor for the special issue of the 1st VarSITI General Symposium (VarSITI2016)
Nozomu Nishitani	Associate Professor	Super Dual Auroral Radar Network	Executive Council
Nozomu Nishitani	Associate Professor	Earth, Planets and Space (EPS)	Guest Editor for the special issue of Global Data Systems for the Study of Solar-Terrestrial Variability
Nozomu Nishitani	Associate Professor	Earth, Planets and Space (EPS)	Guest Editor for the special issue of Recent Advances in MST and EISCAT/Ionospheric Studies - Special Issue of the Joint MST15 and EISCAT18 Meetings, May 2017
Nozomu Nishitani	Associate Professor	Earth, Planets and Space (EPS)	Vice Editors-in-Chief

Contact Post	Job Title	Organizations	Name of Committee / Title
Yuichi Otsuka	Associate Professor	Journal of Astronomy and Space Sciences	Editor
Satonori Nozawa	Associate Professor	EISCAT Scientific Association	Council member
Satonori Nozawa	Associate Professor	Earth, Planets and Space (EPS)	Guest editor for the special issue of Recent Advances in MST and EISCAT/Ionospheric Studies - Special Issue of the Joint MST15 and EISCAT18 Meetings, May 2017
Shin-ichiro Oyama	Lecturer	Committee on Space Research (COSPAR)	Science Organizing Committee
Masataka Murakami	Designated Professor	World Meteorological Organization (WMO)	Member of Weather Modification Expert Team
Masataka Murakami	Designated Professor	AMS	Chair, Ccommittee on Planned and Inadvertent Weather Modification
Hirohiko Masunaga	Associate Professor	World Climate Research Programme (WCRP) Global Energy and Water cycle Exchanges (GEWEX)	GEWEX Data and Assessments Panel (GDAP) member
Joji Ishizaka	Professor	North Pacific Marine Science Organization (PICES)	Co-Chair of Advisory Panel for a CREAMS/PICES Program in East Asian Marginal Seas
Joji Ishizaka	Professor	North Pacific Marine Science Organization (PICES)	Member of Working Group 35: Third North Pacific Ecosystem Report
Joji Ishizaka	Professor	Northwest Pacific Action Plan (NOWPAP)	Focal Point of Center for Special Monitoring and Coastal Environmental Assessment Regional Active Center (CEARAC)
Joji Ishizaka	Professor	Journal of Oceanography	Editor-in-Chief
Tetsuya Hiyama	Professor	Integrated Land Ecosystem - Atmosphere Processes Study (iLEAPS), one of the Global Research Projects (GRPs) of the Future Earth	Scientific Steering Committee (SSC) member
Hidenori Aiki	Associate Professor	American Meteorological Society (AMS)	Associate Editor of Journal of Atmospheric and Oceanic Technology (JAOT)
Toshio Nakamura	Vsiting Academic Staff/Visiting Faculty Members	Radiocarbon	Member of Editorial Board

6. Joint Research Programs

One of the major functions of the ISEE is to promote and conduct collaborative research on Space–Earth Environmental Science together with researchers from universities and institutes outside the ISEE. On January 14, 2016, the ISEE was certified as a core research institution of Space–Earth Environmental Science, which is a "Joint Usage/ Research Center" as defined by MEXT of Japan. We prepared application forms for joint research programs focusing on the following two research issues. One is the "Study of coupling processes in the solar–terrestrial system using ground-based observation network," and the other is the "Establishment of an international collaborative research hub to solve research issues in the global (terrestrial) environment and space applications based on comprehensive studies of the space–Sun–Earth system." The former focuses on coupling processes in the solar–terrestrial system and the interactions of neutral and plasma components in the Earth's atmosphere by establishing an international ground-based observation network ranging from low to high latitude regions, especially in Asia and Africa. The latter aims to establish an international collaborative research hub for comprehensive studies of the space–Sun–Earth system, space applications, space weather forecasting, and environmental problems, such as global warming. The following ten research programs were prepared for the application during the 2017 Japanese fiscal year.

01) Joint Research Program (International)
02) ISEE International Joint Research Program (*)
03) ISEE/CICR 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

(*) Applicable only to foreign researchers

These collaborative research programs will be executed using the instruments, software/databases, and facilities of the ISEE. Joint research programs from 01) to 03), described above, will be managed by the Center for International Collaborative Research (CICR). Those of 07) and 08) will be managed by the Center for Integrated Data Science (CIDAS), and 09) –10) will be managed by the Division for Chronological Research.

Lists of Accepted Proposals

■ ISEE International Joint Research Program

Proposer	Affiliation*	Job title*	Corresponding ISEE researcher	Title of the research program
Okoh, D.	Centre for Atmospheric Research, National Space Research and Development Agency, Nigeria	Principal Scientific Officer	Shiokawa, K.	Investigating plasma bubble propagations using the all-sky airglow images and GNSS Data
Lee, J.	Seoul National University	BK21 Associate Professor	Masuda, S.	Comparative Study of NoRH microwave maps and SDO/AIA EUV DEM maps
Chonokhuu, S.	National University of Mongolia	Associate Professor	Matsumi, Y.	Development of PM2.5 instruments and observation in Mongolia and Japan
Teh, W.-L.	Space Science Centre, Institute of Climate Change	Lecturer	Umeda, T.	Study on the formation of small-scale magnetic flux ropes in the reconnection diffusion region
Panasenko, S. V.	Institute of ionosphere of NAS and MES of Ukraine	Head of Department	Otsuka, Y.	Joint observations of travelling ionospheric disturbances using radar and GPS techniques
Huang, J.	National Astronomical Observatories, Chinese Academy of Sciences	Associated Professor	Masuda, S.	Joint study of particle acceleration in solar flares with MUSER and NoRH
Mann, I.	UiT the Arctic University of Norway	Professor	Nozawa, S.	Combining PMSE and wind observations to study coupling processes in the mesosphere
Padmanabhan, J.	Physical Research Laboratory, Ahmedabad	Senior Professor and Dean	Fujiki, K.	The Role of flow angle in determining geo-effectiveness of non-radial solar wind outflows associated with Corotating Interaction Region (CIR) like events
Vourlidas, A.	The Johns Hopkins University Applied Physics Laboratory	Section Supervisor	Kusano, K.	Investigating heliospheric data assimilation to improve the CME arrival predictions of MHD codes
Kupriyanova, E.	Central Astronomical Observatory (CAO) at Pulkovo of the RAS	Senior Researcher	Masuda, S.	Diagnostics of mechanism of quasi-periodic pulsations in the multi-wavelength emission of solar flares
Savcheva, A.	Harvard-Smithsonian Center for Astrophysics	Astrophysicist	Kusano, K.	Data-driven and MHD simulations of space-weather-effective quiet-sun filament eruptions
Vichare, G.	Indian Institute of Geomagnetism	Associate Professor	Shiokawa, K.	Study of the propagation of substorm associated Pi2 pulsations in different local time sectors
Venkata Ratnam, D.	KL University	Professor	Otsuka, Y.	Development of Ionospheric Weather Forecasting Algorithms for GNSS Users
Dao, N. H. T.	Ho Chi Minh Institute of Physics	Researcher	Otsuka, Y.	Study of the causes of post-midnight field-aligned irregularity at magnetically low latitudes using simulations
Manoharan, P. K.	National Centre for Radio Astrophysics (NCRA), Tata Institute of Fundamental Research	Professor and Head of Radio Astronomy Centre	Tokumaru, M.	Inter-calibration of IPS data sets from ISEE and Ooty Observatories

* Proposer's affiliation and job title are as of the proposal submission date.

■ ISEE/CICR International Workshop

Proposer	Affiliation*	Job title*	Corresponding ISEE researcher	Title of the research program
Leka, K. D.	NorthWest Research Associates	Associates Senior Research Scientist	Kusano, K.	Operational Flare Forecasts: a systematic community comparison
Imada, S.	Nagoya University	Assistant Professor	Imada, S.	Solar Cycle 25 Prediction Workshop

* Proposer's affiliation and job title are as of the proposal submission date.

List of Collaboration Resources

■ Instruments

Name	Contact Person
UV/Visible Spectrometer for Atmospheric Composition Measurements (Rikubetsu)	T. Nagahama
Carbon Dioxide (CO_2) Isotope Measurement Instrument (^{13}C, ^{18}O) Using a Laser Spectroscopic Technique in the Mid-Infrared Region (Nagoya)	Y. Matsumi
Optical Mesosphere Thermosphere Imagers	K. Shiokawa
Magnetometer Network	K. Shiokawa
ELF/VLF Network	K. Shiokawa
Sodium LIDAR (Tromsø)	S. Nozawa
MF Radar (Tromsø)	S. Nozawa
Meteor Radar (Alta)	S. Nozawa
Solar Neutron Telescope (Norikura Observatory, Institute for Cosmic Ray Research, the University of Tokyo)	Y. Matsubara
Low-Background Beta-Ray Counter	K. Masuda
Multi-Station IPS Solar Wind Observation System (Toyokawa, Fuji, and Kiso)	M. Tokumaru
Nobeyama Radioheliograph	S. Masuda
Multi-Directional Cosmic Ray Muon Telescope (Nagoya)	F. Abe
SuperDARN Hokkaido Radar (Rikubetsu)	N. Nishitani
Upper Air Sounding Systems (two sets)	K. Tsuboki
Polarimetric Radar Systems (two sets)	K. Tsuboki
Ka-band Polarimetric Radar	K. Tsuboki
Hydrometeor Video Sonde (HYVIS) System	K. Tsuboki

■ Software/Databases

Name	Contact Person
Atmospheric Composition Data by FT-IR Measurements (Moshiri and Rikubetsu)	T. Nagahama
NO_2 and O_3 Data by UV/Visible Spectrometer Measurements (Moshiri and Rikubetsu)	T. Nagahama
Coordinated Magnetic Data Along 210° Magnetic Meridian (Moshiri, Rikubetsu, Kagoshima, and Overseas MM Stations)	K. Shiokawa
All-Sky Auroral Data (Canada, Alaska, and Siberia)	K. Shiokawa, Y. Miyoshi

Name	Contact Person
Database of the Optical Mesosphere Thermosphere Imagers	K. Shiokawa
VHF Radar/GPS Scintillation (Indonesia)	Y. Otsuka
EISCAT Database	S. Nozawa, S. Oyama
ELF/VLF Wave Data	K. Shiokawa
Interplanetary Scintillation Data	M. Tokumaru
Solar Wind Speed Data	M. Tokumaru
Cosmic Ray Intensity Database	F. Abe
MHD Simulation on the Magnetospheric Environment	T. Umeda
S-RAMP Database	F. Abe
CAWSES Database	F. Abe
Hinode Science Center, Nagoya University	K. Kusano
ERG Science Center	Y. Miyoshi
QL Plot Archive of Satellite Data for Integrated Studies	Y. Miyoshi
Remei Satellite Observation Database	M. Hirahara
MOA Database	F. Abe
SuperDARN Hokkaido Radar Database	N. Nishitani
Numerical Simulation Codes for Plasma Kinetics	T. Umeda
Cloud Resolving Strom Simulator (CReSS)	K. Tsuboki
Satellite Data Simulator Unit (SDSU)	H. Masunaga

■ Facilities

Name	Contact Person
Computer System for Solar-Terrestrial Environmental Research (Supercomputer System)	F. Abe, T. Umeda
CHN Analyzer, Isotope Ratio Mass Spectrometer	Y. Mino
Tandetron Accelerator Mass Spectrometry	H. Kitagawa, M. Minami
Electron Probe Microanalyzer (EPMA)	T. Kato
Ion/Electron Beamline and Calibration Facility	M. Hirahara
Clean Room Facility for Instrument Development	M. Hirahara
Facilities at Moshiri Observatory	Y. Matsumi
Facilities at Rikubetsu Observatory	A. Mizuno
Facilities at Kiso Station	M. Tokumaru
Facilities at Fuji Observatory	M. Tokumaru
Facilities at Kagoshima Observatory	K. Shiokawa

7. Governance

As of Mar 31, 2018

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Yutaka Matsumi	Institute for Space–Earth Environmental Research, Nagoya University

8. Finance

External Funding and Industry–Academia–Government Collaborations

Researches of ISEE members as principle investigator were supported by the following external funds.

Kakenhi category	Number of subjects	Total amount (JPY)
Grant-in-Aid for Scientific Research on Innovative Areas	3	85,410,000
Grant-in-Aid for Scientific Research (S)	2	88,790,000
Grant-in-Aid for Scientific Research (A)	6	54,677,143
Grant-in-Aid for Scientific Research (B)	10	45,890,000
Grant-in-Aid for Scientific Research (C)	10	15,860,000
Grant-in-Aid for Challenging Exploratory Research	7	8,288,000
Grant-in-Aid for JSPS Research Fellow	1	2,470,000
Grant-in-Aid for Young Scientists (A)	2	24,570,000
Grant-in-Aid for Young Scientists (B)	4	6,411,453
Fund for the Promotion of Joint International Research	2	14,300,000
Grant-in-Aid for Specially Promoted Research	1	99,710,000
Grant-in-Aid for JSPS Research Fellow	2	2,860,000
Total	50	449,236,596

- fifty research subjects listed in the table were supported by the JSPS Kakenhi.
- Thirty-two research subjects received total 203,709,742 JPY from governmental funds except KAKENHI, and from other universities and companies. Fifteen of them were collaborative researches between ISEE and companies, or national institutes.
- Six research subjects received total 4,340,000 JPY of donation.

Library

■ Library, Solar-Terrestrial Sciences (ISEE Libary #1)

Book

Japanese	3,037
Foreign	11,148

Journals

Japanese	4
Foreign	132

■ Library, Hydrospheric-Atmospheric Sciences (ISEE Library #2)

Book

Japanese	4,620
Foreign	8,869

Journals

Japanese	171
Foreign	191

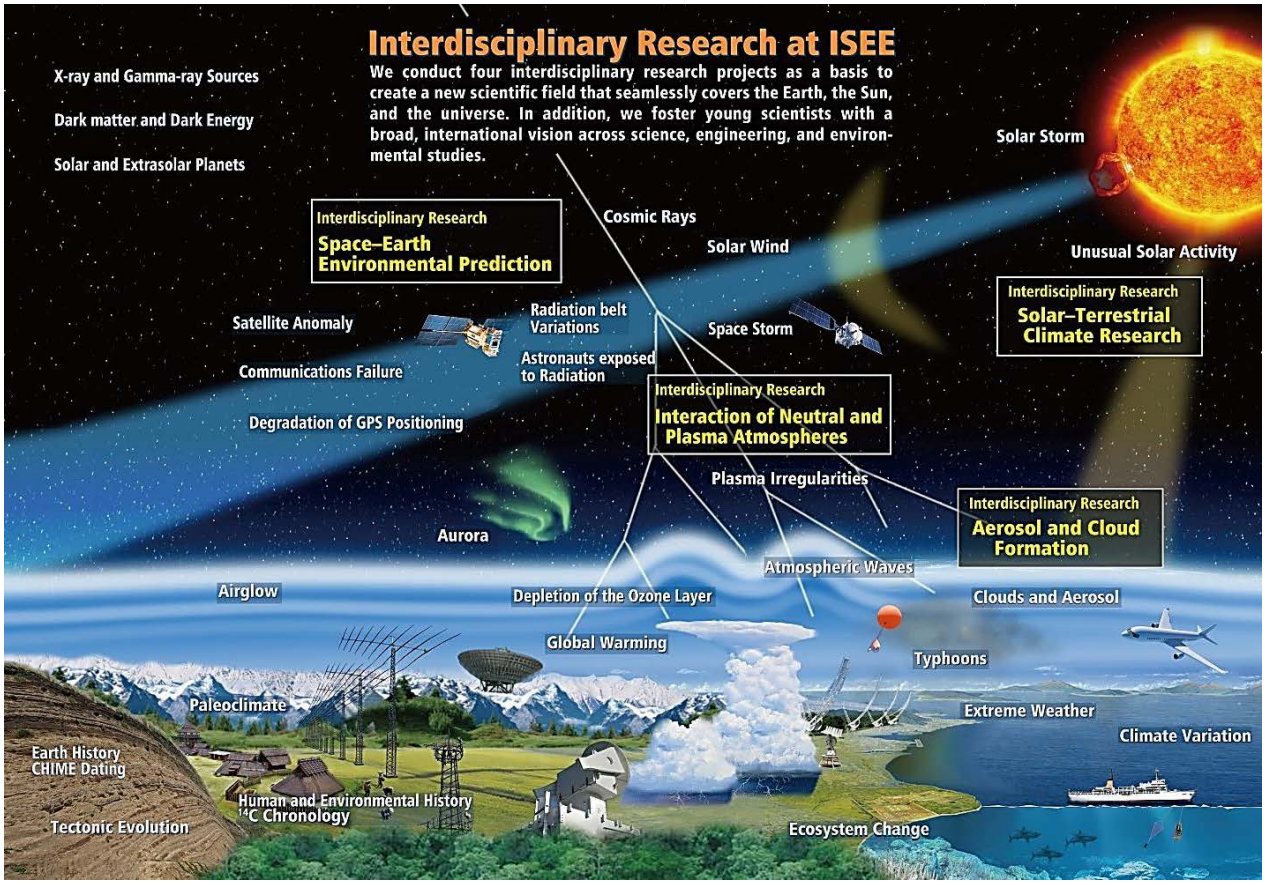
Properties

	Site (m^2)	Bulidings (m^2)	Location
Higashiyama Campus (Main campus of Nagoya University)	-	9,005	Nagoya
Toyokawa Campus	158,002	7,189	Toyokawa
Moshiri Observatory	110,534	325	Hokkaido
Rikubetsu Observatory	24,580	167	Hokkaido
Kagoshima Observatory	13,449	287	Kagoshima
Fuji Observatory	19,926	174	Yamanashi
Sugadaira Station	3,300	0	Nagano
Kiso Station	6,240	66	Nagano
Total	336,031	17,213	

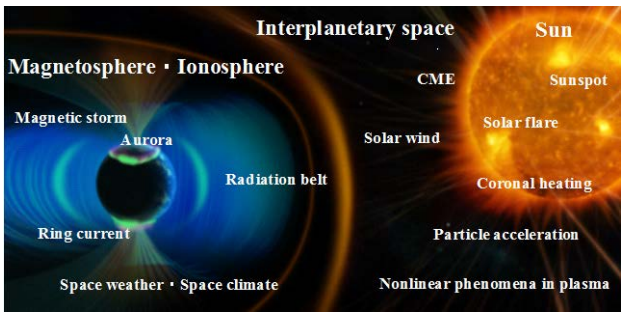
9. Research Topics

The mission of the Institute for Space–Earth Environmental Research (ISEE) is to understand the mechanisms and interactions of diverse processes occurring in the integrated space–Sun–Earth system to deal with global environmental problems and to contribute to human society in the space age. To develop this new research field, four subjects of Interdisciplinary Research are being conducted with strong collaborations from seven Research Divisions (Divisions for Integrated Studies, Cosmic Ray Research, Heliospheric Research, Ionospheric and Magnetospheric Research, Meteorological and Atmospheric Research, Land–Ocean Ecosystem Research, and Chronological Research). The “Project for Space–Earth Environmental Prediction” aims to develop our understanding and predictive capabilities of the influences of solar dynamics and atmosphere–ocean activities on the global environment. The “Project for the Interaction of Neutral and Plasma Atmospheres” aims to improve our understanding of the connection between the Earth’s atmosphere and space using a global observation network of interactions between the upper plasma and middle atmosphere. The “Project for Solar–Terrestrial Climate Research” aims to observe the long-term variability in the solar activity over more than several thousands of years via radioisotopes and to examine the influences of the solar activity on the atmosphere using observations and models to understand the influence of solar activity on global climate variability. The “Project for Aerosol and Cloud Formation” aims to understand the processes that form cloud and precipitation particles from aerosol particles with regard to the influence of cosmic rays and the processes of scattering and absorption of radiation by clouds and aerosol particles using experiments, field observations, and simulations.

ISEE has also organized three Research Centers to contribute to national and international research development of the relevant disciplines in cooperation with the Research Divisions. The Center for International Collaborative Research (CICR) conducts extensive observations with four domestic observatories (Moshiri, Rikubetsu, Fuji, and Kagoshima) and a global observation network and enhances collaboration and joint research with domestic and international researchers and institutions. The Center for Integrated Data Science (CIDAS) conducts infrastructure and research development of intensive studies of the space–Sun–Earth system through the analysis of big data and advanced computer simulations. The Center for Orbital and Suborbital Observation (COSO) conducts planning and technological development of research using orbital and suborbital observation vehicles, such as aircraft, balloons, rockets, and satellites, with national and international networks.



9-1. Research Divisions
Division for Integrated Studies



Research topics and keywords

- Solar flare · CME
- Inner-magnetosphere · Radiation belt
- Aurora substorm
- Space weather · Space storm
- Space climate · Long-term variations of the Sun
- Space plasma
- Computer simulation
- Data assimilation

Introduction to Division for Integrated Studies

The solar–terrestrial environment is a complex system that consists of nonlinear, non-equilibrium, and multi-scale interacting processes. The research activities in the Division for Integrated Studies are aimed at understanding the mechanisms and predicting the dynamics of various phenomena in the solar–terrestrial environment through data analyses and modeling studies. Some of the major results are introduced below.

Main Achievements in FY2017

1. Nonlinear dynamics of a solar eruptive flux rope

A magnetohydrodynamic (MHD) simulation was conducted to investigate the nonlinear dynamics of a solar eruptive flux rope. The simulation showed that the eruptive flux tube accelerates rapidly even though it passes through a region predicted from a theoretical model where the evolution of a flux rope should be suppressed. We found that the nonlinear interaction of the flux rope evolution and reconnection, which is not taken into account in the theoretical model, plays an important role in accelerating the flux rope. These results were summarized in Inoue et al. *Nature Communications* 9, 174 (2018).

2. Numerical study of prominence eruptions with radiative cooling condensation

As part of the Project for Solar-Terrestrial Environment Prediction (PSTEP), we reproduced solar prominence eruption, a progenitor of coronal mass ejection, using a MHD simulation including thermal conduction and radiative cooling. In this study, we combined a prominence formation model (Kaneko & Yokoyama, 2017) and a flare trigger model (Kusano et al., 2012), and investigated the impact of radiative condensation on prominence eruption. We found that momentum in the corona as well as mass is condensed into prominence, facilitating initiation of the MHD instability responsible for eruptions. We also found that prominence oscillates before eruption, as suggested by previous observations.

3. Study on the onset mechanism and prediction of solar explosions

To understand the mechanism of solar explosions, i.e., solar flares and coronal mass emissions, and devise a new scheme to predict these, we analyzed the evolution of the parameter κ^*, which is a proxy for the critical parameter for the double-arc instability (DAI) that was recently predicted to be the initial driver of solar eruptions by Ishiguro and Kusano (2017). We calculated κ^* for solar active region NOAA 11158 using vector magnetic field data observed by the Solar Dynamics Observatory (SDO) satellite and the nonlinear force-free field model. We found that κ^* increased to greater than a certain level before the two major flares and decreased drastically just after the flares. These results support the

theoretical model in that the DAI plays a crucial role in triggering solar eruptions, and suggests the applicability of the nonlinear force-free model for predicting the onset of solar eruptions.

4. Statistical study of the relationship between flare activity and magnetic structure in solar active regions

Study of the magnetic field in solar active regions is important for understanding the physics of solar flares. At present, the relationship between flare occurrence and energy storage in the coronal magnetic field in active regions is not well understood because coronal field observations are difficult. We reconstructed configurations of the coronal magnetic field from observational data of the surface magnetic field using a non-linear force free field model for a number of active regions from June 2010 to February 2016, and conducted a statistical study on flare activity and energy storage in the coronal magnetic field. The analysis showed that flare activity has a better correlation with the magnetic twist than with the energy excess from the potential energy state in the active region magnetic field. We also created a catalogue of coronal magnetic parameters for more than 100 active regions.

5. Statistical study of active-region microflares observed with Hinode/XRT

The solar corona, the outermost atmosphere of the Sun, is very hot (~ 1 MK) compared with its surface (~6,000 K) ; this is one of the major unsolved problems in solar physics. Small solar flares such as microflares and nanoflares are one possible source of the heating mechanism in the solar corona. Using X-ray Telescope (XRT) on board Hinode, we succeeded in detecting a very large number of microflares in an active region, and found that the energy distribution of microflares can be described by a power-law ($dN/dE\ A \times E^{-\alpha}$), with α greater than 2. This result means that the total energy of very small flares is sufficient to heat the active-region corona if the distribution extends to the lower energy range with the same α value.

6. Investigation of thermal response in wave-heated corona loops

We conducted 3D MHD simulations to investigate the thermal response in wave-heated corona loops. As a result of random forces on the foot point of the loop, MHD waves are excited to transport their energy to the upper atmosphere, and the resultant MHD waves become non-linear to transport their energy to smaller spatial scales. As a natural consequence of energy dissipation, we demonstrated that a 1 MK corona would be produced and, in addition, collision between counter propagating Alfven waves in the corona causes an impulsive temperature increase. These facts demonstrate that wave-heating mechanisms are able to produce nano-flare like events, as the heating is spatially localized and temporally intermittent.

7. Numerical study on the regional difference of solar chromospheric jets

We investigate the regional difference of solar chromospheric jets using the numerical simulation. The MHD equations with the effects of gravity, radiative energy transport, latent heat of ionization, and field-aligned thermal conduction are numerically solved for the realistic modeling of the solar chromosphere. We assume that the regional difference is characterized by two parameters: the photospheric magnetic field imbalance and the coronal temperature. We mimic the quiet and active regions on the Sun by choosing the two parameters of the simulation. The simulated thermal convection self-consistently excites various MHD waves, which are the energy sources of the chromospheric jets. The resultant numerical simulation shows the regional difference of simulated chromospheric jets quantitatively consistent with the observation. This regional difference of the simulation is naturally explained by the nonlinear amplification of the Alfven wave. Our results indicate that the Alfven wave plays a crucial role in the formation process of solar spicules.

8. Next solar cycle prediction study

We developed a surface flux transport (SFT) model and conducted calculations to predict activity in the next solar cycle. We obtained the result that the next cycle will be weaker than the current solar cycle by a few 10% (Iijima et al. 2017, *Astron. Astrophys.*). To achieve a more precise prediction, the long-term variation of the solar surface velocity was analyzed from the observations, and we also clarified the relationship between the observed velocities and the magnetic field strength.

9. Simultaneous observation of auroral substorm onset in Polar satellite global images and ground-based all-sky images

Substorm onset was originally defined as a longitudinally extended sudden auroral brightening ("Akasofu initial brightening"), which is followed a few minutes later by an auroral poleward expansion in ground-based all-sky images. In satellite-based global images, however, this clearly marked two-stage development has not been evident and, instead, substorm onsets have been identified as localized sudden brightenings, which immediately expand poleward. To resolve these differences, optical substorm onset signatures in global images and all-sky images were compared for a substorm that occurred on December 7, 1999. The all-sky images revealed the two-stage Akasofu initial brightening (2124:50 UT) and the subsequent poleward expansion (2127:50 UT), whereas the global images revealed only an onset brightening that started at 2127:49 UT. Thus, the onset in global images was delayed relative to the Akasofu initial brightening and, in fact, agreed with the poleward expansion in the all-sky images. The fact that the Akasofu initial brightening was not evident in the global images may possibly be attributed to the limited spatial resolution of global images for thin auroral arc brightenings. The implications of these results for the definition of substorm onset are discussed herein.

10. Study of the dayside magnetic reconnection with MMS spacecraft data

We analyzed the structure and physical processes near the magnetic neutral line for the magnetic reconnection at the Earth's dayside magnetopause by applying the two fluid equations to the data obtained by MMS spacecraft. It was shown that there is a strong correlation between the magnitude of the electron collision term resulting from the electron-wave interactions and the intensity of the low frequency hybrid waves in the ion diffusion region that surrounds the magnetic neutral line. This strongly suggests the presence of anomalous resistivity due to excited waves.

11. Direct evidence of the pitch angle scattering of energetic electrons observed by ERG (Arase)

The ERG (Arase) satellite that was launched in December 2016 has an electron detector with high-angular resolution. In March 2017, there was a good conjugate observation between ERG and ground-based optical imagers in Canada, and active pulsating aurora was observed. During the period, ERG observed intense chorus emissions near the magnetic equator and identified for the first time the flux modulation inside the loss concurrently with the chorus variations. The pitch angle scattering by plasma waves in space has not been identified until this observation. The amplitude modulation of the pulsating aurora shows good correspondence with the flux modulation of electrons inside the loss cone, which shows the definitive evidence on the origin of the pulsating aurora. This result was reported in Nature as the first observational result of the ERG project.

12. Rapid acceleration of MeV electrons associated with sudden commencement

We investigated relativistic electron accelerations associated with SC with a code coupling simulation of global MHD and test-particle simulations. Results indicate wide energy electron accelerations through interactions between the fast mode waves and drifted electrons.

13. Quasi-periodic modulations in energetic electrons without corresponding ULF waves observed by ERG satellite

ULF waves affect energetic electrons in the radiation belt. To understand the spatial properties of energetic electrons, we compared the energetic electron flux modulations observed by the Radiation Belt Storm Probes (RBSP) and ERG satellites with the longitudinal distance. RBSP and ERG simultaneously observed relativistic electron flux modulations with frequency in the dusk and dawn sectors, respectively. From the dispersion signature, we estimated the source regions of the flux modulations and found that the source regions were located in the dusk-noon sector. ULF waves observed in the dusk sector did not appear in the dawn sector and these ULF waves might generate electron modulations in the dusk-noon sector, which may then drift eastward and be observed by ERG.

14. Direct evidence of the nonlinear interactions of electromagnetic ion cyclotron waves by spacecraft observation

Nonlinear interactions by electromagnetic ion cyclotron (EMIC) waves have an impact over a wide energy range of ions and relativistic electrons. We developed a method to detect these interactions directly from THEMIS spacecraft data. Calculating the phase difference between the wave electromagnetic fields and particle velocities, we obtained the distribution of the ions over phase angle, and the values indicating the nonlinear resonant currents. We obtained evidence of energy transfer from the energetic ions to the EMIC waves with increasing frequency.

15. Statistical analysis of EMIC waves observed by Plasma Wave Experiment aboard Arase

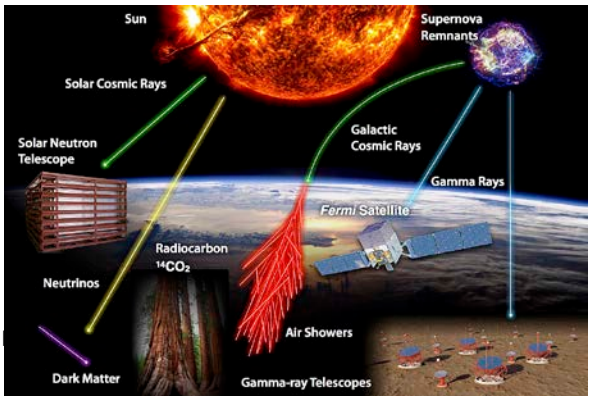
The Plasma Wave Experiment (PWE) is one of the scientific instruments onboard the ERG satellite that measures the electric and magnetic fields in the inner magnetosphere. One significant advantage of ERG observations is the broad latitudinal coverage because of the orbital inclination of ERG is 31 degrees, and the observations in both around the geomagnetic equatorial region and around the mid-latitude region are possible.

We successfully obtained 166 EMIC waves during the first 9 months after the satellite was launched, and found that 37% of observed EMIC waves obtained by the PWE had fine structures. Our statistical analyses showed that the spatial distributions of the unstructured EMIC waves and of the fine-structured EMIC waves were significantly different. The wide latitudinal coverage of Arase's orbit enabled this unique analysis.

16. Non-MHD effects in the Rayleigh-Taylor instability

The nonlinear evolution of the Rayleigh-Taylor instability (RTI) at a density shear layer transverse to the magnetic field in a collisionless plasma was investigated using a fully kinetic Vlasov simulation with two spatial and two velocity dimensions. The primary RTI in the MHD regime develops symmetrically in a coordinate axis parallel to gravity, as seen in the previous MHD simulations. The primary RTI in the Hall-MHD regime develops asymmetrically in a coordinate axis parallel to gravity. A compressible flow is formed at the secondary density shear layer by the Hall effect, which generates a strong scalar pressure gradient of ions, and a Hall electric field due to the diamagnetic current results in an asymmetric flow at the tip of the finger structure. In the primary RTI with the ion gyro kinetic effect, a secondary RTI with a wavelength shorter than the wavelength of the primary RTI is generated at the saturation stage of the primary RTI. A seed perturbation for the secondary RTI is excited by another secondary instability due to the coupling between the electron stress tensor and the Hall electric field. The heat flux term plays an important role in the time development of the total pressure. In contrast, the contribution of the ion stress tensor to both the electric current and the total pressure is small.

9-1. Research Divisions
Division for Cosmic-Ray Research



Research topics and keywords

- Acceleration and propagation of cosmic rays
  - Cosmic gamma-ray observations
  - Solar neutron observations
- Cosmic-ray interactions with the Earth's atmosphere
  - Hadron interactions of very-high-energy cosmic rays
  - Past solar activities probed by cosmogenic nuclides
- Particle astrophysics and non-accelerator physics
- Wide-field transient survey by an optical telescope

Introduction to Division for Cosmic-Ray Research

Cosmic rays (CRs), which are mostly protons with small amounts of charged particles such as electrons or nuclei and neutral particles such as gamma rays or neutrinos, are produced in space and propagate through interstellar and interplanetary magnetic fields before reaching the Earth. The Division for Cosmic-Ray Research performs cosmic gamma-ray observations using the *Fermi* Gamma-ray Space Telescope (*Fermi* satellite) and the Cherenkov Telescope Array (CTA), and high-altitude solar neutron observations to reveal the CR acceleration mechanisms as common space-plasma phenomena.

CRs also provide hints for ultra-high energy phenomena and unknown particles that cannot be explored in a laboratory. We conduct Large Hadron Collider forward (LHCf) and Relativistic Heavy Ion Collider forward (RHICf) experiments to study hadronic interactions of ultra-high energy CRs using the Large Hadron Collider (LHC) and Relativistic Heavy Ion Collider (RHIC) accelerators, respectively. This division also conducts neutrino physics research with the Super-Kamiokande experiment, and promotes the Hyper-Kamiokande project as a future project. We intensively work for direct dark matter searches in the XMASS liquid xenon experiment at the Kamioka Observatory, and recently started new commitment to the XENONnT experiment in LNGS in Italy.

CRs deeply penetrate the atmosphere, producing ionization and cosmogenic nuclides. Our division studies past solar activities and sudden changes of the CR flux that are recorded in the carbon-14 (^{14}C) concentration of ancient tree rings and other cosmogenic nuclides from Antarctic ice cores.

In addition, this division conducts the MOA project with a dedicated 1.8-m wide-field optical telescope at Mt. John University Observatory in Tekapo, New Zealand. It conducts surveys of gravitational microlensing caused by massive astrophysical compact halo objects (MACHOs) or exoplanets, and optical follow-up observations of gamma-ray bursts, supernova neutrino detections and gravitational wave events.

Main Achievements in FY2017

1. Search for the origin of cosmic rays with gamma-ray observations

Cosmic gamma rays are good probes for investigating the properties and distributions of CRs and the interstellar medium, since gamma rays are produced by their interactions. Supernova remnants (SNRs) are the leading candidate for the origin of Galactic CRs. Past gamma-ray observations from the Fermi satellite confirmed that CR protons are accelerated to GeV energies in SNRs with ages older than 10,000 years. However, we have not resolved the mechanism of particle acceleration or obtained the maximum energy of particles accelerated by SNRs.

We are developing the Gamma-ray Cherenkov Telescope (GCT), which is one of the telescopes for the next

generation of the gamma-ray observatory, the CTA, to address these questions. We are in charge of the development of silicon photomultipliers (SiPMs) for GCT. We found that the resin coating for SiPM surface protection was causing degradation of optical crosstalk, one of the key parameters of the SiPMs. We are now improving the handling of the SiPMs during camera assembly so that the protection resin can be removed; we are also re-optimizing the geometry of the SiPM internal structure to take advantage of better crosstalk.

Gamma rays are also useful for studying the distribution of interstellar gas, since gamma-ray intensity is well correlated with gas density. Recent observations by the *Planck* satellite have provided unprecedented measurements of all-sky dust distributions with 10-arcminute resolution using the attenuation coefficient for 353-GHz microwaves. The amount of dust is correlated with the amount of gas, which can be verified by measurement of the correlation between the dust and gamma rays. We found that the attenuation coefficient for 353-GHz microwaves correlated well with the gamma-ray intensity in the MBM 53–55, Pegasus Loop and Chameleon regions. In these studies, we found nonlinearity between those correlations. Further studies are ongoing to model the nonlinearity in the Orion region, since this region contains a wide range of matter density, which is suitable for the nonlinearity study.

We have improved the image restoration technique used for the *Fermi* gamma-ray data to account for the Galactic diffuse gamma-ray background, which enables image analysis of faint gamma-ray sources. By applying this technique in the Galactic center region, we found possible new gamma-ray sources that have not been previously detected. Further analysis is in progress.

2. Research on the acceleration mechanism of solar energetic particles

Study of the acceleration mechanism of solar energetic particles is expected to provide key information for understanding the origin of CRs. To understand particle acceleration at the Sun, it is necessary to know the moment and duration of particle acceleration at the solar surface. Solar neutrons produced at the solar surface through the interaction of accelerated ions with the solar atmosphere are studied at ISEE. Neutrons are not reflected by the interplanetary magnetic field, and are thought to be preferable to accelerated particles themselves for studying the acceleration mechanism of solar energetic particles. The emission timing of neutrons can be determined from the neutron energies. ISEE has developed a worldwide network of solar neutron telescopes to detect solar neutrons (> 100 MeV) over an entire day. In fiscal year (FY) 2017, operation at Gornergrat in Switzerland ceased.

Besides this network, a new solar neutron telescope was installed in Sierra Negra, Mexico (97°W, 4600 m) in 2013. The new detector was previously used for accelerator experiments, and uses 15,000 scintillator bars to measure particle tracks, providing much higher energy resolution and better particle discrimination than previous solar neutron telescopes. The new telescope was built with the support of Kyoto University, High Energy Accelerator Research Organization (KEK), and the National Autonomous University of Mexico, and the experiment is called the SciBar Cosmic Ray Telescope (SciCRT). Our Monte Carlo simulation study predicted that the power-law index of the solar-neutron energy spectrum can be determined to an accuracy of 0:1 if we know the duration of neutron production at the solar surface. Moreover, if an ambiguity of up to 1:0 of the power-law index is permitted, it is possible to discriminate between an instant emission and a continuous emission of longer than 5 minutes.

The activity of solar cycle 24 reached a maximum in February 2014, and has since decreased. No solar-neutron events have been detected in FY 2017. Significantly, two large solar flares occurred in September 2017, and their soft X-ray fluxes measured by the GOES satellite were the two highest values in solar cycle 24. Unfortunately, solar neutrons were not recorded in these flares, but we may have detected solar neutrons if these flares had occurred at noon in Mexico.

This work was performed in collaboration with Chubu University, Shinshu University, the National Astronomical Observatory of Japan, RIKEN, the Institute for Cosmic Ray Research (ICRR) of the University of Tokyo, Institute of Space and Astronautical Science/Japan Aerospace Exploration Agency (ISAS/JAXA), the Japan Atomic Energy Agency (JAEA), the National Defense Academy, the Aichi Institute of Technology, and many other institutions around the world.

3. Study of cosmic neutrinos and dark matter

The neutrino is a neutral elementary particle with an infinitesimal mass, which is scattered only via weak interaction, and its strong penetrating power can provide physical information from the center of celestial bodies such as the Sun and the Earth. In addition, by observing neutrino oscillations, which occur because of quantum state mixing between the three neutrino species, we can explore unknown properties of neutrinos, such as their masses, and hidden information, such as the material density of celestial bodies. In addition to neutrinos, which only weakly interact with other particles, particle dark matter (weakly interacting massive particles, or WIMPs) are thought to exist in space and many projects are working on first detection.

In 2017, a new technique to separate muon neutrinos and muon anti-neutrinos was developed through use of decay-electrons from muon decays, and neutron emission from neutrino interactions. The separation performance has been evaluated and looks promising. Further application to atmospheric neutrino oscillations in matter is now being considered. We have been promoting a next-generation ultralarge water Cherenkov detector, Hyper-Kamiokande, which has a volume 20 times greater than that of Super-Kamiokande. We have made substantial and continuous efforts toward organization of the project, as one of the main stakeholders.

We have conducted the XMASS experiment for direct WIMP searching using an ultra-low background liquid-xenon detector. We have studied a new scheme for nuclear recoil detection by electron emission via the Migdal effect, and an intensive study of neutron calibration data has been made to detect the possible Migdal effect. In addition, for application to future largescale dark-matter-search experiments, we have developed a liquid-xenon single-phase TPC. Some XMASS members have become new participants in the XENONnT experiment, the world's largest liquid-xenon dark-matter detector, foreseen to be operational by 2019. Contribution to the neutron-veto system and purification of xenon has been discussed.

4. Cosmic-ray interaction-focused accelerator experiment

Hadronic interactions of CRs play many important roles in cosmic-ray physics. CRs interact with the interstellar medium and produce cosmic gamma rays or neutrinos through which a range of CR astrophysics can be studied. High-energy CRs undergo repeat interactions in the atmosphere that are observed as particle clusters called "air showers" at the ground. To extract CR information from air showers, precise knowledge of hadronic interactions is required, which can be studied through accelerator-based experiments; for example, hadron collider machines such as the LHC at the European Organization for Nuclear Research (CERN) or the RHIC at Brookhaven National Laboratory (BNL) provide an opportunity to study hadronic interactions equivalent to CR energies of 10^{14}–10^{17} eV.

In June 2017, the RHICf experiment successfully collected data during radially polarized proton–proton collisions with a collision energy of 0.51 TeV. In a quick analysis, we observed a clear peak of neutral pions in the invariant mass of two photons hitting the detector. A range of other analyses is now in development. The first combined analysis of the LHCf experiment with the ATLAS detector has been conducted using data for proton–proton collisions at $\sqrt{s}$ = 13 TeV collected at the LHC in 2015. This is an important milestone for study of diffractive interaction in the very-high-energy range, which is highly relevant to air-shower physics of very-high-energy CRs.

5. Historic cosmic-ray intensity variation with cosmogenic radioisotopes

Radiocarbon (^{14}C) concentrations in tree rings are a good proxy for historic CR intensity reaching the Earth. The CR flux may reflect short-term ($\leq$ 1 year) high-energy phenomena such as supernova explosions near the solar system or arrival of solar CRs by extreme solar proton events (SPEs). Although the CR flux variation in the past has been investigated by ^{14}C concentration measurements in tree rings with time resolutions of more than 10 years over the Holocene (the last 12,000 years), variations at 1 or 2-year resolutions have not been investigated for most periods. Several

CR increase events have been detected by ^{14}C measurements, e.g., the AD 775 and the AD 994 events published by our group in 2012 and 2013, respectively. This suggests a relationship between these CR events and extreme SPEs.

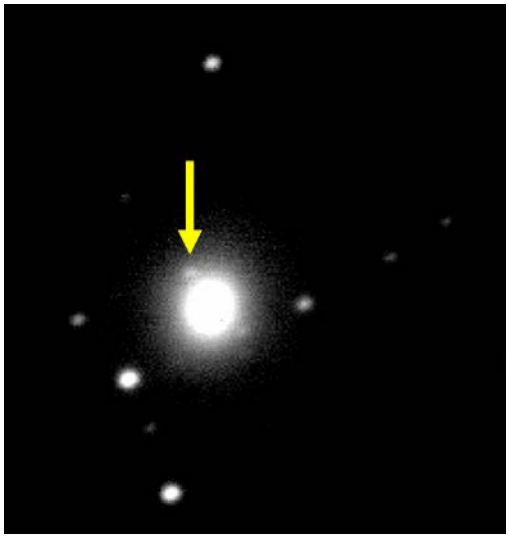
To investigate similar CR increase events occurring in the past 3,000 years, we measured ^{14}C contents in annual rings at biennial intervals using accelerator mass spectrometers (AMSs) at Nagoya University and Yamagata University, for the periods covering the 2nd–3rd AD centuries, the 1st–4th BC centuries, and the 9th–12th BC centuries. We obtained continuous ^{14}C data with annual resolution for most of the past 3,000 years, and found that the AD 775 event had the largest ^{14}C increment in the period. We also found two other events in AD 994 and 660 BC with scales almost half that of the AD 775 event. Although there are other small ^{14}C increases in the data, it is necessary to conduct additional verification to distinguish these small events from background variations.

6. Verification of the cosmic-ray-induced cloud formation hypothesis

We aimed to verify the increase in cloud condensation nuclei due to galactic CRs, as one hypothesis for the correlation mechanism between solar activity and the global climate. We investigated the relationship between the ionization density and the production efficiency of cloud nuclei formation with an atmospheric reaction chamber, by irradiation of high-energy protons, nitrogen, and xenon ions at the Heavy Ion Medical Accelerator in Chiba (HIMAC) at the National Institute of Radiological Sciences (NIRS). The experimental data were carefully analyzed and showed that the particle density at the nanometer level in the atmosphere varies, corresponding to the ion density produced by high-energy heavy ions, and that they are possibly independent of the incident ion species, that is, the ionization density along the track. On the other hand, relatively high production efficiency was obtained for protons. For further discussion of the relationship between lower cloud amounts and the CR flux in the lower atmosphere, more precise experiments are necessary.

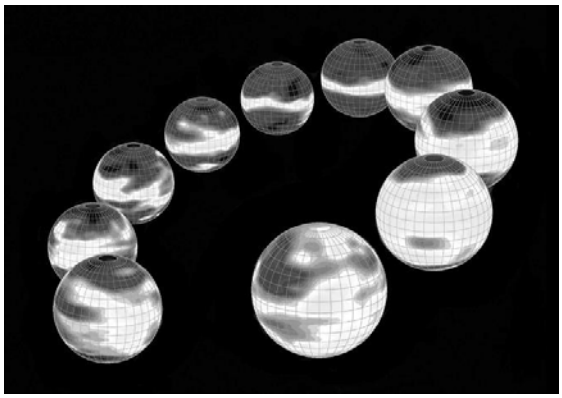
7. Wide-field optical surveys for gravitational microlensing and gravitational sources

In 2017, we detected 511 microlensing events and issued real-time alerts to follow-up groups. Analyses of the events are in progress. Discovery of the merger of a neutron star binary was conducted by the LIGO and Virgo detectors on August 17, 2017 (GW170817). We succeeded in observing its optical counterpart from the MOA II telescope 1.78 days after detection of the gravitational wave.



Left: The domes of the MOA II 1.8-m (left) and the B&C 61-cm telescopes.
Right: The optical counter part of the gravitational-wave event and its host galaxy NGC 4993 imaged by the MOA II telescope.

9-1. Research Divisions
Division for Heliospheric Research



Research topics and keywords

- Solar wind
- CME
- Radio astronomy
- Interplanetary scintillation
- Global heliospheric structure
- Space weather forecast
- Development of instruments
- Pulsar

Introduction to Division for Heliospheric Research

A supersonic (with a speed of 300–800 km/s) plasma flow known as the solar wind emanates from the Sun, and permanently engulfs the Earth. While the magnetic field of the Earth acts as a barrier to protect the atmosphere from a direct interaction with the solar wind, a considerable fraction of its vast energy enters the near-surface layer via various processes. Thus, the solar wind acts as a carrier to transfer the Sun's energy to the Earth.

The solar wind varies dramatically with solar activity. In association with eruptive phenomena on the Sun's surface, a high-speed stream of the solar wind sometimes arrives at the Earth, and generates intense disturbances in geospace and the upper atmosphere. Space environment conditions that significantly change with the solar activity are known as "space weather", and are currently a topic of significant interest. An accurate understanding of the solar wind is needed to make reliable predictions of space weather disturbances.

We have observed solar wind velocity and density irregularities for several decades using three large antennas to investigate unsolved important issues such as acceleration and propagation mechanisms of the solar wind, space weather forecasting, the global structure of the heliosphere, and its variation. Also, laboratory and fieldwork experiments are performed for improving data quality and upgrading the instruments.

Main Achievements in FY2017

1. Solar wind observations using the IPS system

We have performed remote-sensing observations of the solar wind since the 1980s using the multi-station Interplanetary Scintillation (IPS) system. Tomographic analysis of IPS observations enables accurate determination of the global distribution of the solar wind speed and density fluctuations. IPS observations provide valuable information, particularly for high-latitude solar wind, where *in situ* observations are currently unavailable. The IPS system currently consists of three large antennas at Toyokawa, Fuji, and Kiso. The Toyokawa antenna (called the Solar Wind Imaging Facility Telescope, SWIFT) has the largest aperture and the highest sensitivity among our three antennas, and started daily observations in 2008. The Fuji and Kiso antennas were upgraded in 2013–2014 by installing new low-noise amplifiers (LNAs), which led to a great improvement in their sensitivity. These two antennas are located in mountainous areas, and are not used for observations during winter due to heavy snowfall. Solar wind density fluctuations were derived from IPS observations at Toyokawa and measured throughout the year. The IPS data were made available to the public in real time via an ftp server, and were used for various international collaborations, as described below.

2. International collaboration for space weather forecast

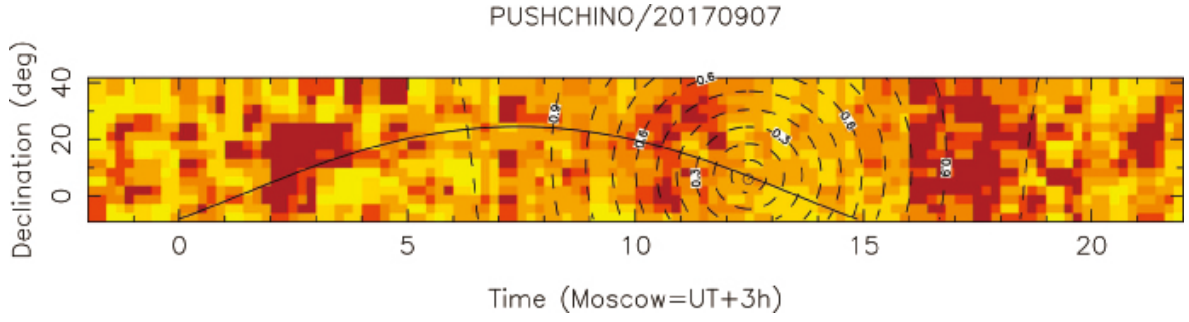
We have performed collaborative research with Dr. B. V. Jackson and his colleagues at the University of California, San Diego (UCSD) on 3D reconstruction of the time-varying heliosphere using tomographic analysis of IPS observations over a long period. The time-dependent tomography (TDT) program was developed through this collaborative research, and this program is now available on the web server of the NASA Community Coordinated Modeling Center (CCMC), and is running in realtime at the Korean Space Weather Center (KSWC) to predict the solar wind at the Earth. A prediction system for the solar wind and IMF at the Earth was also developed at KSWC combining TDT analysis of IPS data with the ENLIL solar wind model (Dr. D. Odstrcil of GMU/NASA). The ISEE signed an agreement on research exchange and cooperation with KSWC in 2012, and renewed this in 2016. In this FY, several people including the KSWC Director visited the Toyokawa observatory and discussed further collaboration.

3. World-wide IPS Stations (WIPSS) Project

As awareness grows of the utility of IPS observations for space weather forecasting, an increasing number of IPS observations have been conducted around the world. In addition to Japan, Russia, and India, where IPS observations have been conducted for a long time, new dedicated antennas for IPS observations have been constructed in Mexico and Korea, and IPS observations using low-frequency large radio array systems such as the Low-Frequency Array (LoFAR) and the Murchison Widefield Array (MWA) have been conducted on a campaign basis. An integrated analysis using IPS data from these stations enables higher-resolution 3D reconstructions of the solar wind rapidly varying with solar activity. Establishment of World-wide IPS Stations (WIPSS) was proposed at the IPS workshop held at Morelia, Mexico, in 2015, and research activities on IPS observations at each WIPSS station were reported at the IPS workshop in Cardiff in December 2017. Our IPS data are in the IPSDCF V1.1 format, which is a revision of the common data format defined at the UCSD IPS workshop in December 2016, and was made available via the ISEE ftp server. Comparison between IPS data at different stations is key to realisation of WIPSS. We invited Dr. Sergey Tyul'bashev from the Pushchino Radio Astronomy Observatory (PRAO) in Russia to our laboratory for the period September 10–December 9, 2017, and compared IPS data obtained from the Big Scanning Array at PRAOP with those from ISEE. In addition, Dr. P. K. Manoharan of the Ooty Radio Astronomy Center (India) visited our laboratory from March 11–30, 2018, and compared Ooty and ISEE IPS data.

4. Coordinated Observations of interplanetary disturbances in Japan and Russia

A marked enhancement in solar flare activity occurred in early September 2017, leading to two halo coronal mass ejections (CMEs). Travelling interplanetary disturbances associated with the halo CME events on September 4 and 6, 2017, were clearly detected in IPS observations at ISEE, Japan, and PRAO, Russia. We compared ISEE and PRAO IPS data for these events, considering the longitudinal difference between the two stations. We found that both data sets were consistently explained by disturbances propagating toward the Earth at high speed. The IPS data for the CME



All-sky map of the solar wind density disturbance index derived from IPS observations at PRAO, Russia, on September 7, 2017.

events on September 4 and 6 show that the average transit speeds of disturbances were as high as >1000 km/s. This is higher than the average speed of the IPS shocks arriving at the Earth, suggesting that the disturbances decelerated during the propagation. Slowly (~700 km/s) moving disturbances were also observed in the September 6 event, following the fast disturbances. The slowly moving disturbances can be explained by a flank of the disturbances that propagated more slowly than the central portion. The result obtained here demonstrates the utility of the world-wide IPS observation network for space weather forecasting.

5. Long-term variation of very-slow solar wind with low density

Solar wind with a speed less than 350 km/s is called very slow solar wind (VSSW), and our past study showed that its source corresponds to the region near the active region, where the magnetic field is connected to interplanetary space: the so called open region. The efficiency of the acceleration mechanism for the VSSW is considered to be less than that for the ordinary slow wind owing to the extremely large expansion factor of the magnetic flux of the open region. We investigated the long-term variation of the solar wind density fluctuation level ΔNe using ISEE IPS observations obtained over many years. We found that the occurrence rate of the VSSW associated with low ΔNe increases markedly during the period between Cycles 23 and 24. Since ΔNe is roughly proportional to the solar wind density, our finding suggests that the VSSW of Cycle 24 is significantly rarefied. We also investigated *in situ* observations made from the ACE spacecraft, and found that the occurrence rate of the low density VSSW increases in Cycle 24, consistent with the IPS observations. We investigated the properties of the magnetic field at the source region of the VSSW associated with ΔNe using the potential field model, and found that the source region of the low ΔNe VSSW is associated with smaller expansion factors and weaker magnetic fields than that of the high ΔNe VSSW. This suggests that the low density VSSW that increased in occurrence frequency in Cycle 24 corresponds to the pseudo-streamer formed in the quiet Sun region.

6. On the origin of extremely non-radial solar wind outflows

The solar wind is primarily radial in nature with the azimuthal component of the flow typically being between 10–30 km/sec. However, non-radial flows (azimuthal flow angle > 60) are observed on many occasions. Although non-radial flow associated with solar wind disappearance events has been noted previously, the causes of the non-radial flow have not been addressed. The degree of deviation from the radial direction also has consequences for geo-effectiveness and space weather, and we have therefore investigated a large number of such cases in Cycles 23–24, covering the period 1995–2017. In all the cases, the azimuthal angle of the solar wind flow exceeded more than 6o for a period of 1 day or more in the absence of any solar phenomena such as CME and/or co-rotating interaction regions (CIRs). For most of the events, the solar wind density at 1 AU was < 5 cm^{-3} for periods of more than 1 day, similar to the well-known ‘‘solar wind disappearance events’’, which show unusual drops in solar wind density at 1 AU (< 1 cm^{-3}) for prolonged periods (> 1 day). The significant changes in the charge state ratio of O^{7+}/O^{6+} at 1 AU, for most of the events, suggest fast and dynamic evolutions taking place at the source regions. We thus traced the events back to the Sun, using a velocity trace-back technique combined with a potential field source surface extrapolation, to pinpoint their solar sources. Strikingly, this exercise revealed that the events are associated with characteristic pairings of active regions (AR) and coronal holes (CH) located at the central meridian. The dynamical evolution taking place at the AR-CH complex regions was examined, using the Extreme Ultraviolet Imaging Telescope and the Michelson Doppler Imager images, and shows new emerging magnetic flux regions and coronal loops during the trace-back dates, disturbing the stable CH configurations and leading to the extreme non-radial events. Therefore, this investigation showed for the first time the causative mechanism of non-radial solar wind flows that are not associated with CME or CIR. This work was carried out in collaboration with the Physical Research Laboratory, India, under the ISEE International Collaborative Research Program.

7. Estimation of magnetic flux rope axis orientation at 1 AU using the cylinder and the toroidal model

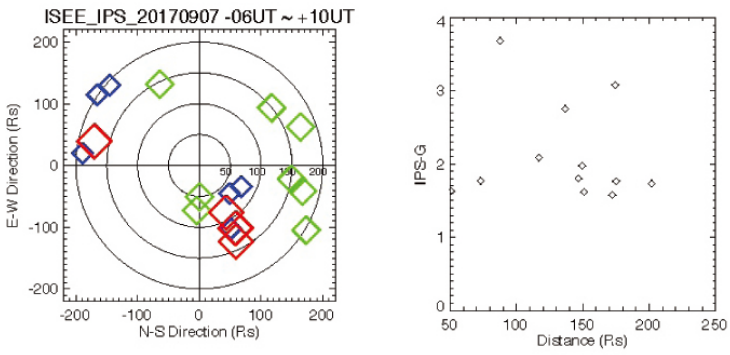
CMEs are large expulsions of magnetized plasma from the Sun. The magnetic field structure inside CMEs consists of a bundle of helical magnetic field lines around the central axis, known as the magnetic flux rope (MFR). The axis orientation of MFRs is an important factor in space weather forecasting. Estimation methods for the axis orientation include the cylinder and the toroidal model fittings. The cylinder model is characterized by a straight axis surrounded by helical magnetic field lines and the toroidal model is characterized by a curved axis. We analyzed five MFR events observed by the ACE spacecraft during 2006 and 2007, and used both the cylinder and toroidal models to investigate the possibility of curvature of the MFR axis. The toroidal model yielded an axis orientation similar to (less than 11 deg) that of the cylinder model for two MC events, a little different (near 30 deg) for one event, and significantly different (greater than 90 deg) for one event; the remaining event could be fitted well only by the toroidal model.

8. Measurement of coronal density using the Crab pulsar

In recent years, the decrease in solar wind density due to declining solar activity has been highlighted from IPS and *in situ* observations. Coronal observations, which provide the source of the solar wind, are important for investigating solar activity. We aimed to estimate the coronal density using the dispersion measure (DM) of the Crab pulsar. The DM is the frequency dispersion observed in the pulsar signal, which gives the integrated plasma density along the line-of-sight (los). The los of the Crab approaches the Sun in mid-June, to as close as 5 solar radii over the South Pole. By taking the difference between the DMs when the los of the Crab is located close to and far from the Sun, it is possible to determine the (integrated) coronal density over the South Pole. Crab observation has been conducted at the Toyokawa observatory since November 2016. The Crab is also known to emit exceptionally bright pulses called giant pulses, and these enable rapid DM estimation. We detected tens to hundreds of giant pulses each day, many more than previous studies, which indicates the high sensitivity of the radio telescope at Toyokawa (SWIFT). We are working on development of further pulsar observations using SWIFT.

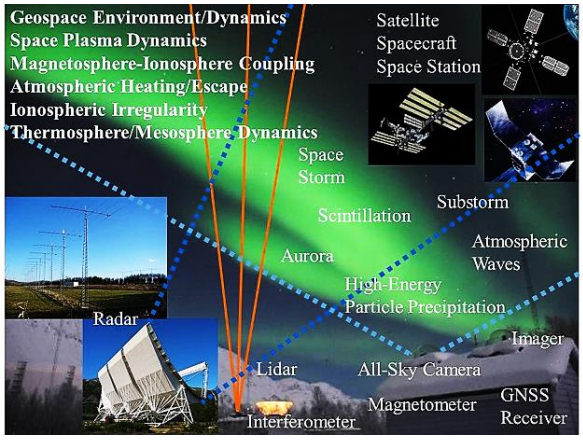
9. IPS data driven simulation for real-time space weather forecasting

The solar wind and CMEs sometimes cause disturbances in geospace that are closely related to the social life such as radio telecommunications, spacecraft and airplane operation, and GPS navigation. Forecasting of geospace disturbances, i.e., space weather, has therefore become increasingly important. The IPS observations at ISEE detect CMEs and high-speed solar winds from stable ground-based radio observations. We have begun development of an IPS data-driven MHD simulation system under a joint research program with the National Institute of Information and Communications Technology (NICT), which organizes the Japanese space weather forecasting center. MHD simulation by NICT can estimate CME propagation in interplanetary space using initial conditions given by white light coronagraph images; IPS observations can be used to derive the locations and speeds of CMEs in the interplanetary space. In our IPS data-driven MHD simulation system, many possible propagation patterns of a CME are calculated, then the IPS level is calculated using the 3D electron density variation derived from each MHD simulation. The most probable CME propagation is derived by comparing the calculated IPS results with the observed IPS results.



Left: IPS disturbances of a CME derived by the IPS observation of ISEE.
Right: Location of the CME derived by the IPS observation.

9-1. Research Divisions
Division for Ionospheric and Magnetospheric Research



Research topics and keywords

- Understanding the process of energy transfer from the solar wind to the magnetosphere and ionosphere
- Understanding the magnetosphere–ionosphere–thermosphere coupled system
- Ground-based and network observation
- Space and planetary exploration

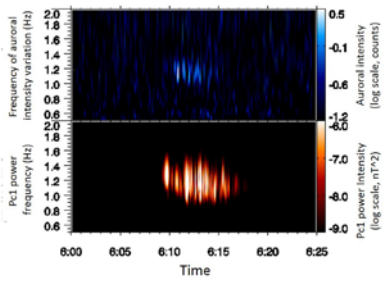
Introduction to Division for Ionospheric and Magnetospheric Research

The plasma and energy carried by the solar wind to the Earth and other planets exert physical effects on the magnetosphere and ionosphere, known as geospace. We study these effects and associated phenomena with international cooperation, primarily, through various observational approaches using ground-based instruments; for example, European Incoherent Scatter (EISCAT) radars, High-Frequency (HF)/Very High Frequency (VHF) radars, Global Navigation Satellite System (GNSS) receivers, high-sensitivity passive/active optical instruments, magnetometers, and instruments onboard satellites/spacecraft, which are developed in our division. We also lead the way to future space exploration missions based on our expertise.

Main Achievements in FY2017

1. Measurements of aurora and electromagnetic waves at subauroral latitudes

Since 2016, under the PWING project, we have operated aurora/airglow imagers and electromagnetic wave receivers at stations in Canada, Russia, Alaska, Finland, and Iceland around the North Pole at magnetic latitudes of about 60o to investigate the dynamics of plasma and waves in the inner magnetosphere. Same frequency oscillations at ~1 Hz were identified in the Pc1 geomagnetic pulsations (EMIC waves) and intensity variations of isolated proton aurora. We also reported clear differences in ELF/VLF wave features at stations separated by ~30 degrees of longitude, indicating the localization of these wave sources in the inner magnetosphere.



Dynamic spectra of (top) intensity variations of isolated proton aurora.and (bottom) power of the Pc1 geomagnetic pulsations (EMIC waves).

2. Study of the upper atmosphere using optical imaging instruments

To investigate the dynamics of the mesosphere, thermosphere, and ionosphere, we routinely operate Optical Mesosphere Thermosphere Imagers (OMTIs), which consist of five sky-scanning Fabry-Perot interferometers (FPIs), 17 all-sky charge-coupled device (CCD) imagers, three tilting photometers, and three airglow temperature photometers. Plasma bubble occurrence over Africa has been studied statistically using an all-sky airglow imager operated in Nigeria.

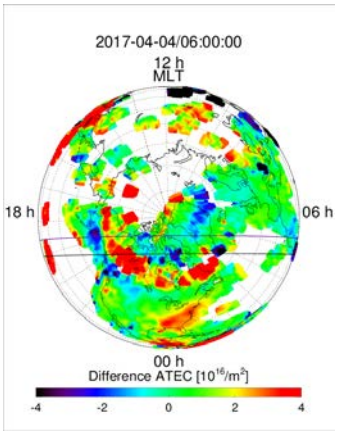
3. Response of the ionosphere and thermosphere to solar flares

Solar flares enhance solar EUV and X-ray radiation to rapidly increase the plasma density in the dayside ionosphere. We improved the GAIA, a coupled global model of the ionosphere and atmosphere, to investigate plasma density

depletion in the low latitude evening ionosphere after an intense solar flare, and found that the flare increases the plasma density in the dayside ionosphere to develop an eastward ionospheric current. Part of the current flows into the nightside to generate an electric field near the sunset terminator; this electric field transports plasma from low to high latitudes, which decreases the low latitude plasma density.

4. Temporal and spatial variations of the plasmasphere and ionosphere using GNSS receiver network

To clarify the characteristics of temporal and spatial variations of the plasmasphere and ionosphere during the development and decay of geomagnetic storms, and their physical mechanism, we collected new GNSS receiver data in the Canadian and Nordic regions, and developed a database of long-term TEC observations, and an analysis tool. The analysis results with these products show that an enhanced TEC region appears in the longitudinal direction in the auroral zone during the main phase of geomagnetic storms. The enhanced TEC region expands to lower latitudes as geomagnetic storms develop. Furthermore, a decreased TEC region corresponding to the mid-latitude ionospheric trough appears at the lower latitude of the auroral zone. The location of the mid-latitude ionospheric trough almost coincides with the plasmapause detected by the Arase satellite traveling in the inner magnetosphere.



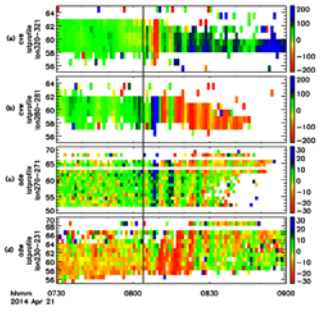
TEC map in the northern hemisphere in geomagnetic coordinates.

5. Study on lunar plasma environment

A tenuous region called the wake forms behind the Moon in the solar wind, and plasma entry/refilling into the wake is a fundamental problem in lunar plasma science. We have investigated, in detail, signatures of ions and electrons around the lunar wake boundary using the Kaguya (SELENE) data. We have proposed a new model of the wake boundary close to the Moon, taking into account the three-dimensionality of solar wind proton motions. This new model explains electron signatures around the wake boundary detected by Kaguya at an altitude ~100 km from the lunar surface.

6. SuperDARN Hokkaido HF Radars

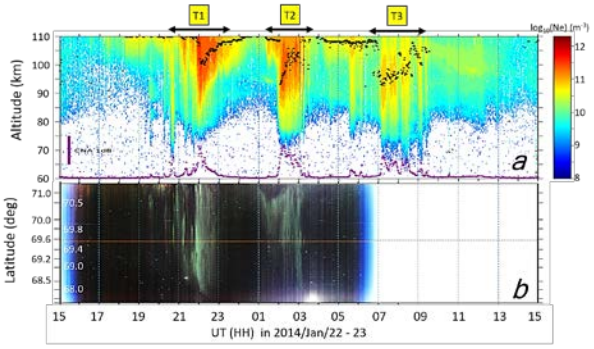
Using the SuperDARN Hokkaido HF East and West radars at Rikubetsu, Hokkaido, we studied the statistical characteristics of Sub-Auroral Polarization Streams (SAPS) and the relationship with ionospheric conductivity determined by the solar zenith angle. We also used worldwide SuperDARN radar data to study the characteristics of ionospheric electric field oscillations following sudden changes in solar wind dynamic pressure.



SuperDARN observation of electric field oscillations following a sudden change in solar wind dynamics pressure.

7. EISCAT project promotion: synthetic observations with collocated instruments

The EISCAT Radar Scientific Association is an international organization concentrating on operation of radar systems in northern Scandinavia. We combined a variety of instruments around the EISCAT radars to conduct complementary and synthetic observations throughout the ionosphere, thermosphere, and upper mesosphere. In FY2017, 13 proposals for EISCAT special experiments were accepted by the Japanese EISCAT committee, and 10 of these were conducted in collaboration with the National Institute of Polar Research (NIPR). Several optical instruments, including the Na Lidar, the FPI, the 5 wavelengths photometer, and several all-sky cameras were operated automatically at the EISCAT Tromsø site. An international session on “Study of coupling processes in the



(a) The electron density measured with the EISCAT radar repeatedly increases with aurora substorms, decreasing its lowest height of ionization. This means that energy of precipitation electrons increases with time.
(b) enhancement of the electron density associate with evolution of auroral patches [Oyama et al., 2017].

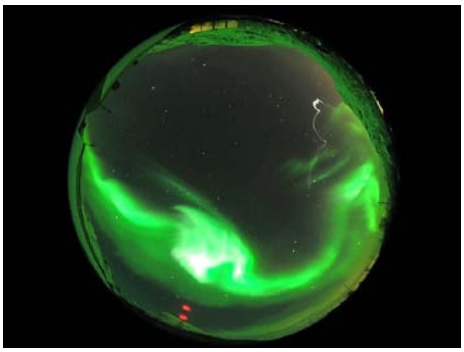
solar-terrestrial system", related to the EISCAT_3D project, was organized at the Japan Geoscience Union (JpGU) 2017 with the Research Institute for Sustainable Humanosphere (RISH), Kyoto University and NIPR. The 18th EISCAT symposium was held at NIPR in May 2017.

8. International collaboration to study impacts of the EPP on the atmospheric minor components

Energetic particle precipitation (EPP) can modify the density of atmospheric minor components such as NO_x and O_3, which affect the atmospheric temperature and dynamical field through chemical reactions, and we organized an international collaborative team to study this topic. We analyzed data from ground-based instruments such as the EISCAT radar and optical cameras and instruments onboard satellites, and presented EPP with the appearance of auroral patches.

9. International collaboration to study thermospheric responses to the substorm onset arc

Auroral morphological and brightness change is regulated by a sequence involving sudden explosive illumination, which is known as auroral substorm onset. The onset triggers energy flow from the magnetosphere to the polar ionosphere, and its dissipation modulates the upper atmosphere. One of the outstanding questions in this field concerns what area receives the energy and how the upper atmosphere changes through this energy input. We analyzed data taken during a coordinated experiment (DELTA-2 in January 2009) with a sounding rocket, the EISCAT radar, a Fabry-Perot interferometer (FPI) and optical cameras. The two wind measurements with the rocket and FPI revealed that, although wind speeds within about 70 kilometers of the auroral arc increased sharply as the substorm gained intensity, winds between 160 and 200 kilometers away from the arc's edge were not affected. This result was published in JGR Space Physics (Oyama et al., 2017), and chosen as an article for the Eos Research Spotlight.



An all-sky image with the breakup aurora (bottom) and a trail of the luminescent puff released from the rocket (top right). Credit: National Institute of Polar Research, Japan.

10. Evaluation of a method to derive ionospheric conductivities using two auroral emissions (428 and 630 nm) measured with a photometer at Tromsø (69.6°N)

We evaluated a photometric method for derivation of ionospheric conductivities based on simultaneous observations by a photometer (field-of-view = ~1.2°), a digital camera, and the EISCAT UHF radar (field-of-view = ~0.7°) operated at Tromsø, Norway (69.6°N, 19.2°E), for two nights on October 10 and 11, 2002. We compared height-integrated Pedersen and Hall

conductivities with a post-integration time of 10 sec derived from EISCAT UHF radar observations and photometer observations with wavelengths of 427.8 and 630.0 nm. In general, good agreement in temporal variations of the height-integrated Pedersen and Hall conductivities was found between EISCAT and photometer values. We conclude that the photometric method using wavelengths of 427.8 and 630 nm can capture temporal variations of the conductivities well, but unavoidable underestimations of the Pedersen (about 30–40%) and Hall (about 50–60%) conductivities are involved.

11. Development of a suprathermal ion energy-mass spectrometer for a Japanese sounding rocket experiment mission to observe the terrestrial polar ionosphere

We performed final calibrations of the suprathermal ion energy-mass spectrometer for the sounding rocket experiment mission (SS520-3) of ISAS/JAXA to observe the terrestrial polar ionosphere, which had an original planned launch window in December, 2017. Using the suprathermal ion beamline at ISEE, at Nagoya University, several ion species (H^+, He^+, N^+, etc.) with energies of 10–500 eV were produced in the ion source and emitted to the spectrometer for checking energy, angle and mass separation resolutions, which were confirmed to be of intended performance. We also carried out simulated solar irradiance tests with deuterium emissions and confirmed that the countermeasure performance for reducing dark count noises caused by solar ultra-violet emissions in the spectrometer was sufficient. (The launch of SS520-3 has been postponed to 2018 because of rocket common bus system problems.)

12. Investigation on mass spectrometry methods for future neutral particle analyzers

We are currently constructing a new type of neutral particle mass/energy analyzer for future terrestrial/planetary upper atmospheric explorations. While we have, thus far, developed the analyzer using a method applying a Bennett type high-frequency mass spectrometer, there are various technical problems in realization. We are therefore investigating the feasibility of an analyzer using a spectrometer with a time-of-flight method through numerical simulations of particle trajectories.

13. Construction of beamline monitoring systems for the developments of future particle analyzers

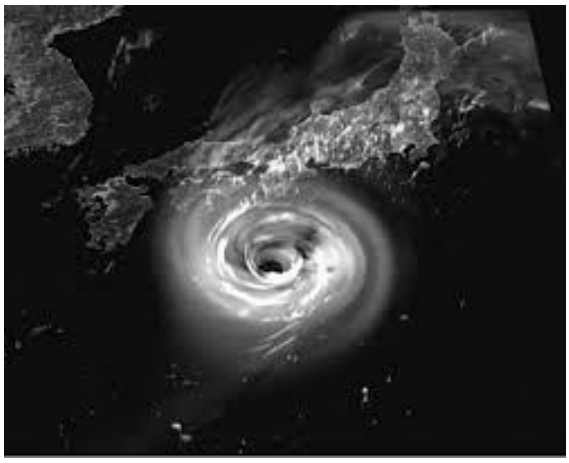
We are currently constructing beamline systems for calibration of new types of particle analyzers for future terrestrial/planetary upper atmosphere explorations. We have conducted performance tests on the newly developed beamline monitoring system using the beamline facilities in our institute and at ISAS/JAXA, and initial operation tests to obtain two-dimensional cross section profiles of the beam fluxes with compensating time variations through software programing in the system.

14. Data Archives

The following data archives are available to the public:

Database	Web site
OMTIs	http://stdb2.isee.nagoya-u.ac.jp/omti/
GPS scintillation	http://stdb2.isee.nagoya-u.ac.jp/QL-S4/
VHF (30.8 MHz) radar	http://stdb2.isee.nagoya-u.ac.jp/vhfr/
SuperDARN Hokkaido radar	http://cicr.isee.nagoya-u.ac.jp/hokkaido/
210-mm magnetic field data	http://stdb2.isee.nagoya-u.ac.jp/mm210/
ISEE magnetometer network	http://stdb2.isee.nagoya-u.ac.jp/magne/
ISEE VLF/ELF data	http://stdb2.isee.nagoya-u.ac.jp/vlf/
EISCAT radar, Sodium Lidar, MF/Meteor radar, Optics	http:// www.isee.nagoya-u.ac.jp/~eiscat/data/EISCAT.html

9-1. Research Divisions
Division for Meteorological and Atmospheric Research



Research topics and keywords

- Millimeter-wave/infrared interferometry of trace gases such as greenhouse gases and ozone depleting substances
- Precipitation measurements by advanced polarimetric radars and hydrometeor videosondes
- Laser/optical measurements and chamber data analysis of trace gases and aerosol properties
- Development of new instrumental technology
- Development of a numerical cloud model (CReSS) and meteorological studies with numerical simulations
- Clouds and precipitation observed by multiple satellites

Introduction to Division for Meteorological and Atmospheric Research

Ongoing global warming caused by increasing concentrations of carbon dioxide and other greenhouse gases will result in both gradual climate change and intensification of weather extremes and ecological catastrophes. Among the most urgent tasks for confronting global environmental problems more effectively is close monitoring of the atmosphere using different observation methods and a better understanding of the atmosphere through theoretical insights and numerical modeling. To address these problems, the Division for Meteorological and Atmospheric Research is dedicated to a number of research projects for exploring the atmosphere from a range of different angles.

Main Achievements in FY2017

1. Characteristics of a positive K_{DP}-peak layer above the melting level in a stratiform region observed by Ka-band radar and balloon-borne particle observation

Ka-band polarimetric radar is sensitive to the number and shape of ice crystals. A simultaneous observation using C- and Ka-band polarimetric radars and balloon-borne particle soundings, videosondes (VS) and Hydrometeor Videosondes (HYVIS), was conducted at Okinawa Island, Japan, in June 2016. A positive K_{DP}-peak layer between 6.0 and 7.5 km above the melting level in a stratiform region associated with the Baiu front was observed by the Ka-band radar during the VS and HYVIS observations on June 3. The maximum K_{DP} value reached 2.5 deg./km in the layer, although that above and below the layer was less than 1.0 deg./km. The layer extended over 20 km in the horizontal direction; however, the positive K_{DP}-peak was not observed by the C-band radar at that time.

An approximate formula for K_{DP} for oblate ice crystals provides a K_{DP} value dependent on the axis ratio, the equal-volume spherical diameter, and the number concentration of particles. The vertical profile of K_{DP} at every 250 m-height step was estimated using VS data and the approximate formula. The estimated K_{DP} profile reproduced the observed profile well, including the positive K_{DP}-peak layer. The axis ratio is approximately constant in the positive K_{DP}-peak layer and suggests the existence of plate- and/or column-type ice crystals. The number concentration of ice crystals has a clear peak corresponding to the positive K_{DP}-peak layer, indicating that the positive K_{DP}-peak can be attributed to the large number of plate and/or column-type ice crystals. The VS and HYVIS observations show the existence of a small number of snow-aggregates between the positive K_{DP}-peak layer and the melting level. K_{DP} values below the peak level can be attributed to the aggregation of ice crystals.

2. Possibility of particle identification in solid hydrometeors using Ka-band polarimetric radar

To clarify the relationship between the polarimetric parameters obtained using Ka-band radar and the characteristics of solid hydrometeors in snow clouds, we installed a Ka-band polarimetric radar at Ishikawa Prefectural University in the winter season of

2016–2017. We also installed a PARSIVEL that can observe the size, number, and fall speed of hydrometeors at Kanazawa University, located within the radar observation range. Here, the objective was to identify particles in solid hydrometeors using the polarimetric parameters (Z_H, Z_{DR}, K_{DP}) obtained by the Ka-band radar. Using the PARSIVEL data, we calculated the center of mass flux (CMF) every 1 min to categorize dominant precipitation particles. The periods of the dominant particles were divided into graupel-dominant, snowflake-dominant, and crystal-dominant periods using the CMF. The target region was set as a "circular sector" wherein particles are expected to reach the PARSIVEL observation point based on the movement direction and speed of the echo pattern. A total of 78 scanning data from the snowfall event observed on January 24 and 25, 2017, were analyzed. During the snowflake-dominant period, moderate numbers of crystals and snowflakes were detected by PARSIVEL. The positive spread in the probability density functions (PDFs) of Z_{DR} and K_{DP} in the target region was analyzed, corresponding to previous studies using X-band polarimetric radars. A large number of crystals and graupel particles co-exist during the graupel-dominant period, and the PDFs of Z_{DR} and K_{DP} were wide with both positive and negative components. However, there were no clear differences between the PDFs of Z_{DR} and K_{DP} between the graupel- and snowflake-dominant periods; hence, particle identification in solid hydrometeors using polarimetric parameters obtained by Ka-band radar is likely to be difficult.

3. Cloud radar observation for the initial development stage of summer cumulonimbus clouds

During summer in Japan, atmospheric stratification becomes unstable due to heating from the ground surface under strong solar radiation. Isolated convective clouds are frequently generated without large-scale disturbance; some of these convective clouds are highly developed and cause intense precipitation over short time periods. In contrast, many convective clouds disappear without development. To examine the characteristics of the initial development stage of highly developed cumulonimbus clouds, we conducted an observation using a Nagoya University cloud radar during the summer of 2017 in Kobe. The cloud radar is capable of detecting small cloud particles using a shorter wavelength (Ka band) than the more widely used precipitation radar, with high spatial resolution. The observation results suggested that there was a significant difference in the organization of convective cells between developed and undeveloped convective clouds. This observation project was conducted using a range of instruments in collaboration with other research institutions, and will be continued in the next fiscal year.

4. Development of MP-PAWR and analysis of a tornado event using PAWR

Under the CSTI's SIP program, a dual polarization multi-parameter phased array weather radar (MP-PAWR) was developed in cooperation with NICT, Tokyo Metropolitan University, the Toshiba Corporation and Nagoya University. Since MP-PAWR can provide denser 3-D data with a temporal resolution 10 times greater than that of conventional weather radar, it can be used to observe rapidly changing clouds such as torrential rain and tornadoes. A cumulonimbus cloud that brought a waterspout in Okinawa Prefecture was analyzed using single polarized phased array weather radar (PAWR) as a preliminary study for MP-PAWR. The cumulonimbus cloud was observed both by the KIN radar from Nagoya University located at the University of the Ryukyus and the PAWR located at NICT. In this analysis, a miso-scale vortex with a diameter of 1 to 2 km corresponding to a hook echo was observed, and the PAWR data revealed the detailed vertical extent of the miso-cyclone with high temporal resolution.

5. Radiative regulation of tropical convection by preceding cirrus clouds

Radiative-convective interactions, although known to be a critical physical element of the Earth's atmosphere, are not understood in the context of the development of individual convective systems. This work targeted evidence of convective-radiative interactions in satellite measurements, with a focus on the variability over the life cycle of tropical convection. To this end, the vertical profiles of cloud cover and radiative heating from the CloudSat-CALIPSO products were sorted into a composite time series around the hours of convective occurrence identified by TRMM PR. Cirrus cloud cover begins to increase, accompanied by a notable reduction in LW cooling, in moist atmospheres even 1–2 days before deep convection is invigorated. In contrast, LW cooling stays efficient and clouds remain shallow where the ambient air is very dry. A possible mechanism to support this observation was discussed using a simple conceptual model. The model

suggests that the preceding cirrus clouds could radiatively promote moistening with the aid of congestus-mode (or a vertical mode with a lower-tropospheric updraft) dynamics within a short period of time (about 2 days), as observed.

6. Monitoring of stratospheric ozone, UV, and aerosols in the Patagonia region, South America

We have continued a joint research project with Argentina and Chile called "Development of the Atmospheric Environmental Risk Management System in South America", as part of the SATREPS program operated by the Japan Science and Technology Agency (JST) and the Japan International Cooperation Agency (JICA). In 2017, we developed a risk information platform called GeoUV that provides UV forecasting and real-time UV data obtained from 36 stations located over Chile and Argentina. In addition, development of an aerosol lidar network that consists of nine lidars spread over the two countries has been completed in collaboration with the National Institute for Environmental Studies (NIES).

To forecast the influence of the ozone hole on the southern tip regions of South America, we conducted comparative experiments with two ozone prediction models in collaboration with the model analysis group at NIES. One is a chemical transport model nudged towards the meteorological forecast data provided by NCEP/GFS (model 1), and the other is a chemical climate assimilation mode using a local ensemble transform Kalman filter (model 2). The model results show good agreement with the observed data from OMI, within ±10 DU for 1-week forecasts and ±20 DU for 10-day forecasts, from models 1 and 2, respectively.

Fluctuations of ozone (O_3) concentrations with dimensions of a few kilometers, so-called O_3 laminae, were identified in the southern tip region during the 4th campaign observation in 2016. In 2017, we conducted a statistical analysis using the archived ozonesonde measurements from after 2008 and meteorological reanalysis data MERRA2/NASA to clarify the relationship between O_3 laminae and atmospheric waves. We found that Rossby wave–induced variability accounts for a larger proportion of the observed variability than gravity wave-induced variability in this region. We also found that the effect of Rossby waves is more significant inside the polar vortex than outside or near the edge of the polar vortex in the stratosphere, in the period between June and November.

7. Observations of chemical composition changes in the polar mesosphere

Due to the magnetic field configuration, the polar mesosphere is a region where energetic particle precipitation (EPP) events trigger a series of ion-molecule chemical reactions caused by ionization and dissociation of nitrogen and oxygen molecules, and affect the atmospheric composition. To understand these processes more fully, the ISEE and the NIPR conducted continuous monitoring of nitric oxide (NO) and O_3 concentrations in the mesosphere and lower thermosphere using a ground-based millimeter-wave spectral radiometer from January 2012 onwards. During a geomagnetic storm event in April 2017, we detected a fourfold enhancement of the NO column density, and also found that the annual variation of the NO column has exhibited a gradual decrease in amplitude since 2015.

Measurements with the millimeter-wave spectral radiometer installed at Tromsø, Norway, in collaboration with the University of Tromsø are suspended because of an abnormal increase in the room temperature, and snow cover to the skylight. We have installed a warm air system at the container and confirmed that it works well. Simultaneous measurements of NO in Syowa and Tromsø will start again in the 2018 season.

8. Long-term monitoring of tropospheric and stratospheric minor constituents using a high-resolution Fourier-Transform InfraRed (FTIR) spectrometer at Rikubetsu

Measurements of atmospheric trace gases in the troposphere and stratosphere with ground-based high-resolution FTIR instruments (Bruker IFS120 M up to 2010 and Bruker IFS120/5HR since 2014) have been conducted since 1995 as part of the Network for the Detection of Atmospheric Composition Change (NDACC). A solar absorption spectrum is obtained with six optical filters in the 2–15 μm region with a resolution of 0.0035 cm^{-1}, and the vertical distribution of trace gases is retrieved from the measured spectrum using the SFIT4 (version 0.944) software with the uniform retrieval parameters recommended by NDACC. Total column amounts and vertical profiles of O_3, HCl, HF, HNO_3, $ClONO_2$, CH_4, C_2H_6, N_2O, CO, HCN and CCl_4 are observed,

and their temporal variations and long-term trends from 1995 to 2016 have been obtained. The observed partial column of stratospheric O_3 does not show any significant trend, although that in the troposphere seemed to decrease in the 2000s. Negative trends were observed in the time series of the HCl and $ClONO_2$ columns since 2000, consistent with global results. Significant enhancement of HCN in the lower stratosphere from 1998 to 2001 was also observed, and a trajectory analysis suggested that this was not affected by transport of a polluted air mass following the huge biomass burning event in Indonesia in 1997.

9. Development of a wide frequency range and dynamic range detector for a new radiometer system

Recently, millimeter-terahertz band technologies for application to information, telecommunications and radio astronomy research have developed rapidly. We are developing a new receiver system for our atmospheric radiometers that is wide-band, highly sensitive and highly accurate based on these new technologies. This year, we have developed a superconducting tunnel junction (SIS) device and a multiplexer in the 200 GHz band through collaborative research with the Advanced Technology Center (ATC) at the National Astronomical Observatory of Japan (NAOJ) and NICT, respectively. We have successfully fabricated SIS devices in a clean room at the ATC, and started measurement of the performance of these devices. The multiplexer is a waveguide component for observation of multi-line atmospheric molecules (O_3, NO_x, HO_x and ClO_x) in Antarctica. At NICT, we have fabricated a waveguide circuit for the multiplexer by metal cutting, and measured the transmission characteristics with a mm-band network analyzer at NICT. This result correlated well with a 3D electromagnetic field simulator, and we have proved the validity of our waveguide circuit design.

10. Measurement of column-averaged molar mixing ratios of CO_2 using a portable spectrometer in Tokyo

We measured the daytime column-averaged dry-air molar mixing ratios of atmospheric CO_2 and XCO_2 in the central area of Tokyo between September 2014 and August 2016 using a portable optical spectrometer. The observed seasonal cycle was compared with that from the TCCON site in Tsukuba, 60 km northeast of Tokyo. The seasonal variation of XCO_2 at the Tsukuba site has maxima around March-April and minima in August-September. In contrast, the seasonal variations of XCO_2 at the Tokyo site reach maxima in December–January and minima in July–August. There are large differences in XCO_2 concentrations between the two different sites (~5 ppm) in December–February; however, these differences are smaller (~0.5 ppm) in June–September, probably due to large anthropogenic emissions of CO_2 from heating, especially in winter in the Tokyo metropolitan area.

11. Observation of $PM_{2.5}$ using low-cost optical sensors in Asian countries

Fine particulate matter such as $PM_{2.5}$ has negative impacts on human health, causing heart disease, stroke, lung cancer and chronic obstructive pulmonary disease, resulting in premature mortality. We have developed a new palm-sized optical $PM_{2.5}$ sensor with the Panasonic Corporation. The $PM_{2.5}$ mass concentrations obtained by this sensor correlate well with corresponding data obtained by large beta-attenuation monitors in many places. The $PM_{2.5}$ sensor has been used for observation in Asian countries, including Hanoi in Vietnam, New Delhi in India, and Ulaanbaatar in Mongolia. In both New Delhi and Ulaanbaatar, very high concentrations of $PM_{2.5}$ of over 1000 $\mu g/m^3$ were observed in winter, probably due to emissions from combustion processes such as burning of agricultural residues and combustion for heating/cooking.

12. Observation of ozone-induced potential aerosol formation in a suburban forest

Secondary organic aerosol (SOA) particles, which are generated during oxidation of volatile organic compounds (VOCs), constitute a large fraction of submicron particles. However, the formation processes of SOA remain largely uncertain. As a new approach to investigating their formation processes, ozone-induced potential aerosol formation was measured in summer at a suburban deciduous forest near Tokyo. After passage through a reactor containing high concentrations of ozone, increases in total particle volume were observed; however, the model simulation could explain only □40% of the observed particle formation, and large discrepancies were found, especially during the daytime when the concentrations of isoprene and oxygenated VOCs were high. The results suggest a significant contribution from missing SOA formation processes from VOCs, especially those emitted during the daytime.

9-1. Research Divisions
Division for Land–Ocean Ecosystem Research

Research topics and keywords

- Global warming and changes in terrestrial water-material cycles in the Arctic circumpolar region
- Effects of climate change and anthropogenic forcing on the terrestrial ecosystem
- Cloud/rainfall variability in Asian monsoon regions
- Dynamics of phytoplankton in marginal seas and coastal areas
- Climate variability and changing open ocean ecosystem dynamics and biogeochemical cycle
- Interaction between oceanic waves and climate variations

Introduction to Division for Land–Ocean Ecosystem Research

The Land–Ocean Ecosystem Research Division investigates regional and global energy, water and material cycles, and physical/biogeochemical processes in the land–ocean ecosystem.

The land research group contributes to advancing our understanding of the mechanisms of how on-going global warming and anthropogenic activity influence the terrestrial water cycle and ecosystem. Using field observations, satellite remote sensing, global meteorological data analysis, laboratory analysis, and model simulation approaches, our group works to understand the impact of global warming on hydrological and greenhouse gas cycles in the Arctic region, the dynamics of the continental scale water cycle, the processes that drive weather and climate over Asia, the interplay between the terrestrial ecosystem and the climate, and the detection of early signs of the influence of global warming in Antarctica.

Ocean research is performed using satellite remote sensing, numerical simulations, and *in-situ* observations. We perform synthetic studies of physical and biogeochemical processes in the ocean and their interactions with the atmosphere and climate. In particular, we investigate the manner in which oceanic heat content, circulation, and surface waves interact with atmospheric environments and how they are linked to climate and meteorological phenomena such as tropical cyclones. We also investigate how variations in ocean circulation, mixing processes, and air–sea fluxes influence marine ecosystems where phytoplankton is a primary producer. Moreover, we are interested in the possible impact of the marine ecosystem on physical processes and climate in the ocean and atmosphere.

Main Achievements in FY2017

1. Measurement of methane flux over a larch forest in eastern Siberia

The role of forests in methane cycling is not well understood, in part because of difficulties in assessing methane fluxes at the canopy scale, while previous chamber measurements at the forest floor show that many forest soils provide a methane sink. In particular, even though about 70 percent of boreal forest is in Eurasia, mostly in the Russian Federation, canopy-scale methane fluxes over such forests have not been reported. Thus, we measured the methane flux over a larch forest in eastern Siberia using the eddy covariance technique. The canopy-scale methane flux was calculated to be positive (methane emission), while the forest floor of this site was reported to be a methane sink by a previous study. However, since the absolute value of the methane flux is generally small over forests, it is necessary to pay sufficient attention to the accuracy of instruments and the quality of data for a better understanding of methane fluxes.

2. Modeling of larch forest dynamics in eastern Siberia under a changing climate

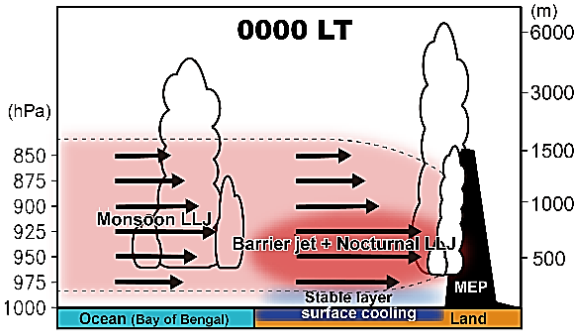
According to a projection from an earth system model under the RCP8.5 scenario, the boreal forest in eastern Siberia is predicted to experience significant changes in climate, with a positive change in mean annual air temperature and a twofold increase in annual precipitation by the end of the 21st century. Since the forest in this region is underlain by continuous permafrost, increases in both temperature and precipitation will affect forest dynamics through soil-water processes. To investigate such effects, we applied a newly developed terrestrial ecosystem dynamics model named 'S-TEDy' to a larch forest in eastern Siberia. By considering coexisting liquid water and ice under freezing temperatures, the seasonal variation in liquid soil water content was reproduced, and the above-ground biomass of larch trees calculated by S-TEDy agreed well with the values reported by previous studies.

3. Interpretation of ENSO-related precipitation changes in northern Borneo

The rainfall in Borneo exhibits an inter-annual variability related to the El Nino-Southern Oscillation (ENSO). However, there is not yet any comprehensive explanation of how the ENSO influences the year-to-year rainfall in Borneo. Here, we employed a new approach based on the oxygen isotope ratio ($\delta^{18}O$) to investigate ENSO-related rainfall variability. The values of $\delta^{18}O$ can be used to identify dominant factors controlling the ENSO-related Borneo rainfall variation, since its relative concentration is related to the moisture sources of precipitation. In this study, we merged three oxygen isotopic datasets available in Borneo into a single rainfall $\delta^{18}O$ dataset and created a 7-year long record from 2004 to 2011. We found that large negative $\delta^{18}O$ excursions are associated with synoptic-scale convective activity over the SCS, and the frequency of the convective activity is closely linked to the ENSO. Along with the significant correlation between $\delta^{18}O$ variations and Borneo rainfall variations on an inter-annual timescale, we concluded that ENSO-related Borneo rainfall variations can be chiefly attributed to changes in the frequency at which synoptic-scale convective activities occur.

4. Role of land surface processes on summer heavy rainfall over South Asia

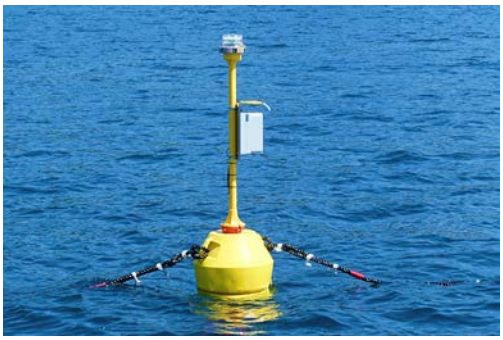
The Meghalaya Plateau of northeast India, with a maximum elevation of approximately 2000 m, is one of the wettest places in the world. Precipitation over the southern slope of the plateau is enhanced at nighttime under the westerly regime (WR) in the windward area over Bangladesh. Under the WR, a strong southwesterly low-level jet (LLJ) with a core of less than 1,500 m across Bangladesh encounters the southern slope of the plateau, and localized strong low-level southerlies running parallel to the Arakan Mountains (i.e., the barrier jet) also blow toward the plateau, concentrating convective unstable air onto its southern slopes. This situation provides favorable conditions for high orographic precipitation around the plateau. Atmospheric boundary layer processes over the plain of Bangladesh change the structure of the LLJ toward the plateau and cause a diurnal variation. The vertically well-mixed layer over land decelerates the prevailing low-level wind toward the plateau during the daytime and breaks up the LLJ structure, resulting in reduced daytime rainfall over the southern slopes. In contrast, the wind speed toward the southern slopes accelerates at night and exhibits a clear LLJ structure from 950 to 925 hPa above the surface stable layer, resulting in very high nocturnal rainfall.



A schematic of the low-level jet (LLJ) and atmospheric boundary layer from the Bay of Bengal to the Meghalaya Plateau during nighttime under the WR.

(Reference: Fujinami, H., T. Sato, H. Kanamori and F. Murata, 2017: Contrasting features of monsoon precipitation around the Meghalaya Plateau under westerly and easterly regimes. *J. Geophys. Res. Atmospheres*, 122, 9591-9610, DOI: 10.1002/2016JD026116.)

5. New Instrument for Joint Research at ISEE: Sea Spray Aerosol Optical Particle Counter



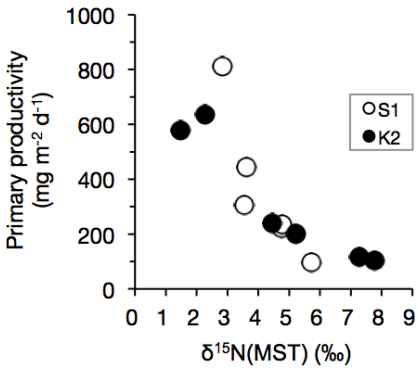
Sea-spray spectrometer probe on a mooring buoy.

Some of recent numerical studies on tropical cyclones have adopted an atmosphere-ocean surface-wave coupled model to incorporate the evolution of surface waves (Aiki et al. 2015). This surface wave information allows for advanced versions of bulk formulae for air-sea fluxes, such as wind stress and heat fluxes, to be used. It is necessary to develop yet further our understanding of microscopic material transport mechanisms, such as the distribution of sea-spray particles, associated with wind wave breaking. We have developed an optical particle spectrometer probe that can measure size-resolved particle concentrations in 8 bins spanning the diameter range between 0.3 and 15 micrometers at a rate of 10 Hz. The probe is also equipped with a 3-axis accelerometer to monitor basic marine-meteorological conditions as well as the phase of surface wave breaking. Preliminary measurements of sea spray have been performed in both Otuchi Bay in Iwate prefecture and Tanabe Bay in Wakayama prefecture, the latter of which successfully captured the passage of Tropical Cyclone Noru at 15 JST on August 7th, 2017, with a wind speed of 23 m/s and a wave height of 3.8 m. The sea-spray spectrometer probe has been registered as a new instrument for Joint Research at ISEE, and is expected to yield a series of new studies spanning the fields of meteorology, atmospheric chemistry, physical oceanography, and marine engineering. We have also promoted the study of surface waves by holding an annual workshop for the community, and by publishing a textbook on wave-mean-flow interaction theories for the ocean and atmosphere (Aiki, 2018).

(Reference: Aiki, H. 2018: Waves, eddies and mean flows in the ocean – the background and outlook of interaction theories –, Meteorological Research Note (published by Meteorological Society of Japan), vol. 235, 175 pp.)

6. Seasonal variations in $\delta^{15}N$ of settling particles in the western North Pacific

The isotope delta of particulate nitrogen $\delta^{15}N(PN)$ in the upper ocean is governed by both $\delta^{15}N$ in substrates and isotopic fractionation during PN formation. $\delta^{15}N$ for particles incorporated into sediments have frequently been used to reconstruct paleo-nutrient conditions and primary productivity (PP). $\delta^{15}N(PN)$ variations observed so far in the modern ocean are, however, still incompletely explained. We examined the $\delta^{15}N$ time-series of settling particles collected using a moored sediment trap (MST) in subtropical station S1 (30°N, 145°E) and subarctic station K2 (47°N, 160°E), to investigate the factors controlling $\delta^{15}N$ variation, and to assess its use as a proxy for the upper oceanic condition. These MST experiments revealed distinct seasonal patterns of $\delta^{15}N(PN)$ at both sites. Analyses with hydrographical data concluded that i) $\delta^{15}N(PN)$ variations in S1 were attributable to changes in nitrate supply into the euphotic zone from below, via mixing, while ii) those in K2 were due to light-controlled ammonium consumption by nitrifiers and, thereby, depended on light conditions within the mixed layer. Furthermore, significant correlations were found between $\delta^{15}N(PN)$ and PP in both sites (Figure). This implied that productivities in S1 and K2 would vary, dependent on nitrate and light availabilities, respectively. For both sites, even with contrasting oceanographic conditions, similar $\delta^{15}N(PN)$ vs PP relationships support the utility of $\delta^{15}N$ for estimating PP. However, it is not clear why the differences in resources limiting PP is not reflected, and this should be resolved to establish the$\delta^{15}N$ proxy for productivity.

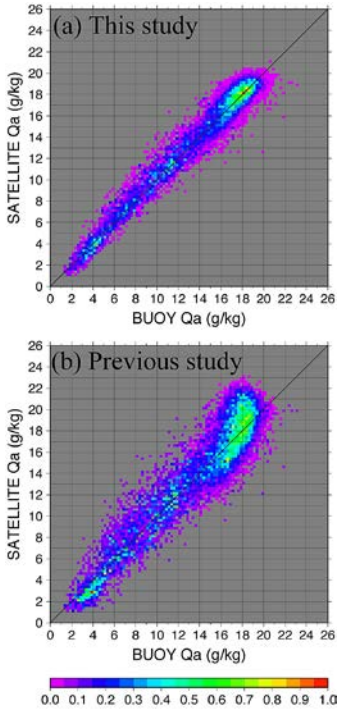


Relationship between $\delta^{15}N$ of MST particles and primary productivity in subtropic region S1 and subarctic region K2.

7. Improved satellite estimation of global near-surface air specific humidity

Near-surface air specific humidity is designated as an Essential Climate Variable (ECV) and a key variable in the estimation of air-sea latent heat flux and evaporation from the ocean surface. An accurate estimation over the global ocean is required. Current satellite remote sensing techniques are problematic and a major source of errors in flux and evaporation. This study proposes a new method for estimating surface humidity, using satellite microwave radiometer instruments, based on new findings on the relationships between multi-channel brightness temperatures measured by satellite microwave radiometers, surface humidity, and the vertical moisture structure. Satellite estimations using the new method were compared with *in situ* observations to evaluate the method, and confirmed that satellite estimations could be significantly improved (Figure). Moreover, this improvement has a significant impact on estimation of the latent heat flux. In particular, significant improvements were found in the western boundary current region where the world's largest heat release from the ocean is observed. Application to wide-range climate and air-sea interaction studies is expected.

(Reference: Tomita et al. 2018, Improved satellite estimation of near-surface humidity using vertical water vapor profile information. *Geophys. Res. Lett.*, 45, doi: 10.1002/2017GL076384)

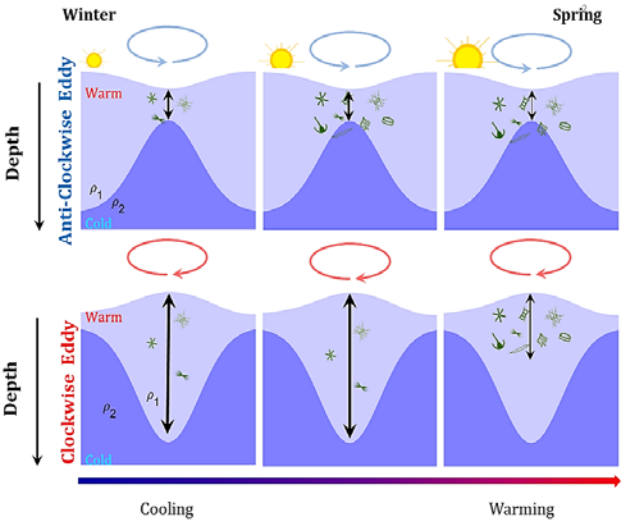


Comparison with *in situ* buoy observation for (a) this study and (b) previous study. Color means normalized data density.

8. Phytoplankton spring bloom: early anti-clockwise eddy and late clockwise eddy

It is known that abundance of phytoplankton increases during spring in temperate ocean. It is also known that oceanic currents forms eddy structures, like cyclone and anti-cyclone which correspond anti-clockwise and clockwise in the northern hemisphere, respectively. However, there have been no previous investigations of the influence of eddies on the spring phytoplankton bloom. In the Japan Sea, where eddy activity is intense, seasonal changes in phytoplankton, in the eddies, were observed using satellite data from 2002 to 2011. Satellite sea surface height data indicate the presence of frequent clockwise and anti-clockwise eddies, with diameters of 100 km near the Noto Peninsula. Satellite chlorophyll-a data showed that, in anti-clockwise eddies, phytoplankton increases in late February when the water temperature is still decreasing whereas, in clockwise eddies, phytoplankton increases in early April when the water temperature is increasing. In anti-clockwise eddies, the mixed layer is shallow and phytoplankton populations can increase with a slight increase in sunlight, whereas in clockwise eddies, the mixed layer is deep and the mixing conditions must be weakened for phytoplankton development. This is the first study showing the differences of the timing and the mechanism of the phytoplankton spring bloom with different types of eddies.

(Reference: Maúre et al., 2017, Mesoscale eddies control the timing of spring phytoplankton blooms: A case study in the Japan Sea. *Geophys. Res. Lett.*, 44, 11,115–11,124., doi:10.1002/2017GL074359)



Mechanism of phytoplankton spring bloom in anti-clockwise (upper) and clockwise (lower) eddies.

9-1. Research Divisions
Division for Chronological Research

Research topics and keywords

- Radiocarbon (^{14}C) dating by Accelerator mass spectrometry (AMS)
- Developing radiocarbon (^{14}C) pre-treatment and measurement techniques
- Analysis of cosmogenic nuclides
- CHIME (chemical U-Th total Pb isochron method)
- Microanalysis and spectroscopy
- Geochronology
- Isotope analysis

Introduction to Division for Chronological Research

Short- and long-term forecasts of global environmental changes and their countermeasures are issues of great urgency. Determining when an event occurred in the past, “dating,” is of great importance to predict future states of the Earth. Therefore, we conduct chronological studies on a broad range of subjects from events in Earth’s history spanning approximately 4.6 billion years, to archeological materials, cultural properties, and modern cultural assets. The Tandetron dating group conducts interdisciplinary research that involves radiocarbon (^{14}C) dating using accelerator mass spectrometry (AMS) to understand changes in the Earth’s environment and the cultural history of humankind from approximately 50,000 years ago to the present day. In addition, the group studies near-future forecasts of Earth and space environments, focusing on spatiotemporal variations in cosmogenic nuclides, such as ^{14}C and ^{10}Be, and conducts research that integrates art and science through collaborations between researchers in archeology, historical science, and other fields. The micro-scale spatial dating group uses CHIME (the chemical U-Th total Pb isochron method), which was first developed at Nagoya University, to shed light on events in Earth’s history from the formation of Earth 4.6 billion years ago up to approximately 1 million years ago. With an electron probe microanalyzer (EPMA), non-destructive microanalyses of rocks and other samples are performed to reveal records of complex events recorded in zircon, monazite, and other materials.

Main Achievements in FY2017

1. Climate and tectonic history in the Levant

The area surrounding the Dead Sea, the Levant, was the locus of humankind’s migration out of Africa and, thus, has been a home for peoples since the Stone Age. Understanding the climate and tectonic history of this region provides valuable insights into archaeology and studies of human history, and helps in gaining a better picture of future climate and tectonic scenarios. An International Continental Scientific Drilling Program (ICDP) deep drilling project was performed in the Dead Sea between November 2010 and March 2011. The project was conducted by the ICDP and scientists in Israel, Germany, Japan, Norway, Switzerland, and the United States. We have worked on deciphering evidence of past climates and crustal deformation from collected sediment cores. AMS ^{14}C dating of plant fossils from the upper 150 m of the sediment core revealed the occurrence time of climate and tectonic movement events over the past 50,000 years. We explored the relationship between these findings and the migration of early modern humans (Homo sapiens).

Drilling, observation and sampling in the Dead Sea; drilling at a water depth of 300 meters.

2. Small-scale ^{14}C dating of sediment core drilled from off Zambezi River, Africa

International Ocean Discovery Program (IODP) Expedition 361 drilled six sites at the southeast African margin and in the southwest Indian Ocean using a D/V JOIDES Resolution, from January to March 2016. Site U1477 was located at the continental slope of the western Mozambique Channel near the Zambezi River delta, and the sediment at Site U1477 is mainly composed of silty clay, with an abundance of planktonic foraminifer of less than 1%. The small-scale ^{14}C dating (~80 micrograms of carbon) results for planktonic foraminifer from the U1477 core indicate that the sedimentation rate (~1.2 m/kyr) of this core marks it as a very early sediment, and the age of the lowermost part of the core (~181 m) is approximately 150 ka. In future research, high-resolution reconstructions of African climate and environmental changes over the past 150,000 years will be obtained.

D/V JOIDES Resolution.

3. Reconstruction of hydrological variability during the late last glacial period from Lake Baikal sediment in southern Siberia

We reconstructed the hydrological variability (river input and chemical weathering intensity) at Lake Baikal in southern Siberia, using two independent sedimentological and geochemical proxies. This is a key region for bridging the spatial gap in climate reconstructions from the late glacial period. We found that the millennial-scale hydrological variability during the late last glacial period (31–11.5 cal ka BP) is associated with solar activity changes, with wet (dry) climate conditions in the Siberian region corresponding to solar maxima (minima). Millennial-scale biological responses to hydrological changes resulting from solar activity during the last glacial period were also observed. Our results indicate that solar-induced millennial-scale hydroclimate variability appears to control Eurasian biological change during the late last glacial period.

Lake Baikal and the terminal facet.

4. Chemical characteristics of ^{10}Be in bed-sediments of rivers flowing into Lake Biwa

We investigated the chemical characteristics of meteoric ^{10}Be extracted from bed-sediments in the Yasu and Ado rivers flowing into Lake Biwa, central Japan. The sediments were sieved into 5 grain-size fractions (180–150 μm, 150–125 μm, 125–63 μm, 63–32 μm, and <32 μm), and each of the fractions was sequentially leached into three phases: exchangeable, amorphous oxy-hydroxide, and crystalline oxy-hydroxide phases. The results were as follows: 1) most ^{10}Be (~95% of the total ^{10}Be) was located in the amorphous and crystalline oxy-hydroxide phases of bed-sediments for all grain size fractions; 2) the ^{10}Be concentrations of all the leachates decreased with increasing grain size; 3) the bed-sediments from upper streams showed higher ^{10}Be concentrations than those from lower streams; and 4) meteoric ^{10}Be concentrations in river bed-sediments is strongly dependent on river water pH as well as grain size.

Upstream (left) and downstream (right) parts of the Ado river.

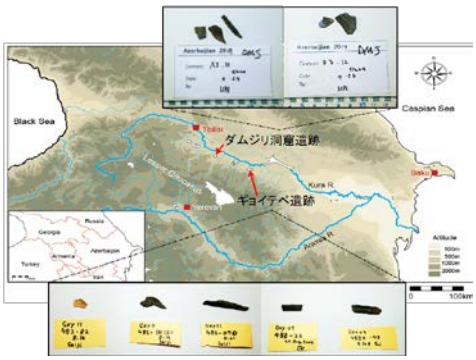
5. Cultural history of PaleoAsia

Modern humans (Homo sapiens) originated in East Africa approximately 200,000 years ago and migrated to the Eurasian continent while adapting to a diversified environment in Asia some 50,000 years ago, subsequently replacing more primitive species including Neanderthals. We conducted an interdisciplinary research project to understand the Cultural History of PaleoAsia (supported by Scientific Research on Innovative Areas, MEXT Grant-in-Aid Project FY2016–2020). We are advancing field studies of ruins and wetlands (Vietnam, Mongolia, Oman, Iran, Jordan, Pakistan) to explore the residence environments and lifestyles of early modern humans and past climate conditions.

Excavating cave ruins in Iran.

6. Radiocarbon dating of carbonate hydroxyapatite in fossil bones

We are aiming for accurate ^{14}C dating of carbonate hydroxyapatite (CHa), a bone inorganic component, in cremated bone with little remaining organic carbon from collagen. This year, we investigated seven burned bones collected from the Göytepe and Damjili archeological sites in Azerbaijan. The bone samples had low CHa crystallinity, and ^{14}C dates ~400 (Göytepe) and 1000–1700 (Damjili) years younger than expected. The results indicate that the bones had been burned at a low temperature (<600ºC), that they were heavily contaminated through diagenetic alteration during burial because of low CHa crystallinity, and that the degree of contamination from foreign carbon into the bones varied with burial conditions.



Burned bone samples from Azerbaijan.

7. Radiocarbon dating of the famous ancient sutras written in Asuka and Nara periods

We measured the radiocarbon ages of six famous ancient sutras written in the Asuka and Nara periods: Myohorenge kyo attributed to Nakatomi no Kamatari (AD614–669), Gogatsu Tsuitati kyo (AD770), Uokai kyo (AD770), Hyakumanntou Darani (AD764–770), Jishinin Darani (AD764–770), and Todaiji Nigatsudo Yakegyo (AD729–767). The calibrated radiocarbon ages of six samples excluding Myohorenge kyo and Jishinin Darani were consistent with their paleographical ages. In particular, Hyakumanntou Darani was shown to be the oldest print in the world. If Myohorenge kyo was truly written by Nakatomi no Kamatari, it would be the oldest existing sutra; however, its calibrated radiocarbon age was 1299–1404 cal AD and, hence, this theory was refuted by the radiocarbon dating. Jishinin Darani had been known as one of the oldest existing prints; however, radiocarbon dating indicated that Jishinin Darani was printed in 1527–1656 cal AD and, thus, is not one of the oldest prints.

Hyakumanntou Darani.

8. Radiocarbon dating to bronze implement

Radiocarbon dating is a useful method for samples that contain carbon derived from atmospheric CO_2. Verdigris, $CuCO_3 \cdot Cu(OH)_2$, is rust produced on bronze implements, formed from Cu in bronze and CO_2 from the atmosphere. When verdigris is initially formed, it produces a close film and limits generation of new rust and, therefore, verdigris should preserve atmospheric carbon from its time of formation. First, we improved the carbon extraction method for $CuCO_3 \cdot Cu(OH)_2$, then applied the method to archaeological samples of known age, measured the radiocarbon ages and combined the verdigris radiocarbon dating samples to demonstrate that verdigris is a suitable medium for radiocarbon dating.

Bronze pipe sample excavated from Hekirichi Jin'ya site, Hokuto.

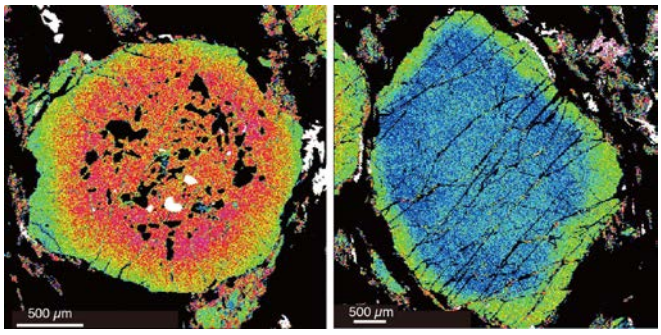
9. CHIME monazite age of Sanbagawa metamorphic rock

The Sanbagawa metamorphic rocks of epidote–amphibolite facies are extensively exposed in Nushima at the southern end of the Hyogo Prefecture, Japan. CHIME ages were determined for monazite grains from the Sanbagawa metamorphic rocks. CHIME monazite ages are 92.3 ± 3.2 and 90.3 ± 4.7 Ma for two chlorite–rich rocks collected from the reaction zone between pelitic schists and serpentinites. The monazite grains occur as isolated phases or aggregates with rutile/ilmenite in chlorite-rich matrix, and thus the CHIME monazite ages are interpreted to represent recrystallization close to the peak stage of prograde epidote-amphibolite facies metamorphism. This study is a first report of U-Pb age of the Sanbagawa epidote-amphibolite facies stage.

Monazite-bearing reaction zone between pelitic schists and serpentinites.

10. Zonal structures of garnet implying material mixing during prograde metamorphism

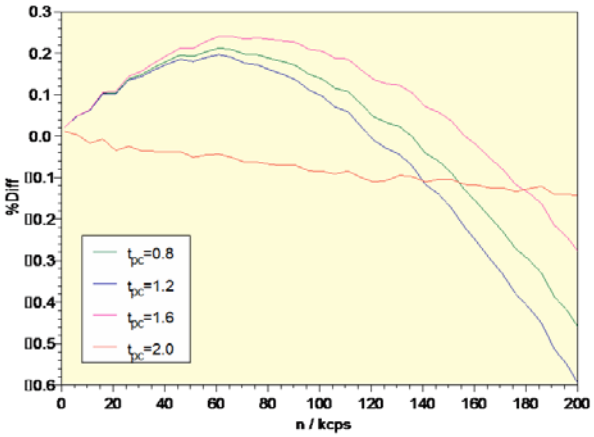
Kyanite-quartz eclogites, which were recrystallized under metamorphic conditions of 2.3–2.4 GPa/675–740°C, represent the deeper part of the Sanbagawa subduction zone. Garnet grains in the quartz eclogites are grouped into four types according to the compositional trends of their cores and these different type-zoned garnet grains sometimes coexist in a thin section. Central parts of these garnet grains usually show different compositional trends to each other, and their marginal parts share a similar compositional trend, implying that the equilibrium whole-rock compositional system changed during subduction metamorphism. This suggests that, in some cases, material interaction promoted by mechanical mixing probably controls mineral reactions and modification of mineral paragenesis of high-pressure metamorphic rocks.



Coexisting garnet grains showing different types of zonal structure.

11. Accurate dead time correction in quantitative electron probe microanalysis (EPMA)

A pseudo-fixed dead time circuit with a non-extendable approximation was developed to prevent systematic errors in quantitative electron probe microanalysis (EPMA) caused by inappropriate dead time corrections. EPMA of trace elements using wavelength dispersive spectrometers (WDS) requires high probe current and/or accelerating voltage. Therefore, the X-ray count rate of a standard material becomes extremely high when measured under the same conditions. Consequently, the accuracy of the dead time correction is a significant issue for quantification. The designed circuit suppresses the systematic error of the dead time correction to 0.6% or less when the true X-ray count rate is less than 200 kcps.



Monte Carlo simulation results of percentile errors.

9-2. Research Centers
Center for International Collaborative Research (CICR)

Research topics and keywords

- Internationally coordinated programs
- Ground-based observation networks and satellite projects
- Hosting international workshops
- International exchange of foreign and Japanese researchers and students
- Capacity building in developing countries through training courses and schools
- Observatories

Introduction to CICR

The Center for International Collaborative Research (CICR) was established in October 2015 to promote international collaborative studies for understanding physical mechanisms of the phenomena occurring in the space–Sun–Earth environmental system and their interactions with each other. The CICR provides leadership to encourage and promote internationally coordinated programs, such as those carried out by the Scientific Committee On Solar-TErrestrial Physics (SCOSTEP) and Future Earth, ground-based observation networks, international satellite projects, hosting of international workshops and conferences, international exchange of foreign and Japanese researchers and students, and capacity building in developing countries through training courses and schools. The CICR has taken over from the Geospace Research Center of the former Solar-Terrestrial Environment Laboratory, Nagoya University.

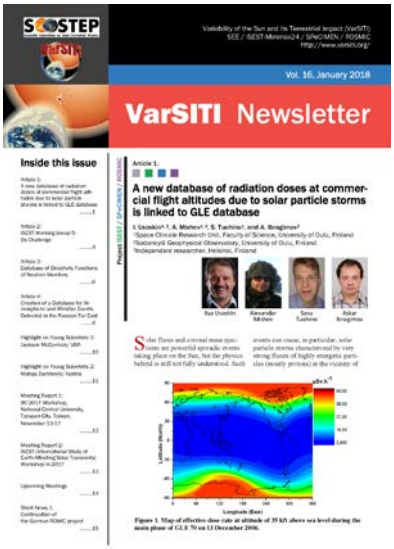
Cycle 24 of the 11-year solar cycle had the smallest maximum of the past 100 years, and world scientists in have a strong interest in this anomaly and its consequences for Earth's environment. Thus, SCOSTEP under the International Council for Science (ICSU) commenced a 5-year international program entitled "Variability of the Sun and Its Terrestrial Impact (VarSITI)" in 2014. One of the co-chairs of the VarSITI program is part of the CICR, and is responsible for taking a lead in this program. The CICR publishes a VarSITI Newsletter every three months, operates a VarSITI mailing list that currently contains more than 800 VarSITI members from more than 60 countries, and coordinates international symposiums related to VarSITI. The CICR also contributes to other international programs related to the space–Sun–Earth environment, such as Future Earth and Integrated Land Ecosystem-atmosphere Processes Study (iLEAPS). In relation to these international programs, the CICR also takes part in/operates ground-based observation projects, i.e., the EISCAT radar project, OMTIs, the ISEE magnetometer network, the SuperDARN radar network including the Hokkaido HF radars, the ISEE VLF/ELF network, and the ArCS operation office.

The CICR is operating the new international collaborative research programs from fiscal year 2016. The CICR also holds four domestic observatories at Moshiri, Rikubetsu, Fuji, and Kagoshima, which make observations of the solar wind, the geomagnetic field, and the upper atmosphere. Some of these observations have been conducted for more than 30 years.

Observation sites and foreign collaborative institutions of ISEE.

Main Achievements in FY2017

In FY 2017, the CICR conducted the following international collaborative research programs: 1) Joint Research Program (International, 27 projects), 2) ISEE International Joint Research Program to invite 15 foreign researchers, and 3) two ISEE/CICR International Workshops, as well as inviting 12 foreign designated professors and associate professors. Two newly designated professors were hired through a 5-year cross appointment with US universities and institutions. The ISEE/CICR International Workshop aimed to facilitate comprehensive discussions on a focused topic with 10–15 attendees over one week, and summarize the results into international journal papers and/or books. Eleven CICR colloquium were held with foreign senior scientists from nine countries including the US, UK, Germany and Russia.



VarSITINewsletter vol. 16 (Jan. 2018).

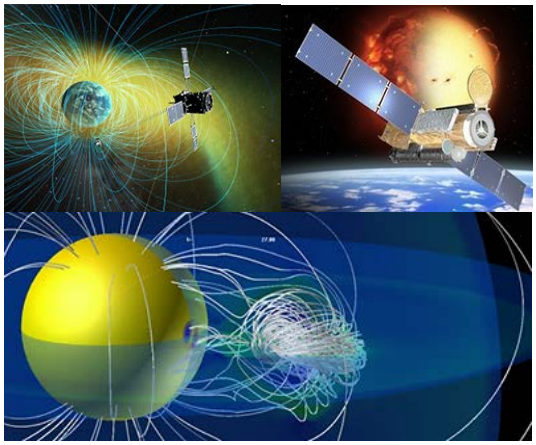
For the SCOSTEP/VarSITI program, we published four VarSITI newsletters in FY 2017, in May, July, October and January. We also organized the 2nd VarSITI General Symposium in Irkutsk, Russia, in June 2017. We continue to operate the VarSITI mailing list which contains ~1000 scientists from ~70 countries, and support selection of eleven international symposiums, five database constructions, and one campaign observation by VarSITI. In relation to the VarSITI project, we organized two international schools on the equatorial and low-latitude ionosphere, in Nigeria in September 2017 and in Indonesia in March 2018. One young scientist from India was invited to ISEE under the SCOSTEP Visiting Scholar (SVS) program for collaborative research on middle latitude thermosphere dynamics.

Under the ICCON Project, 29 scientists from the US, UK, China, Korea, Russia, Germany and Japan joined the operation of the Nobeyama Radioheliograph. The data are openly available at NAOJ and CIDAS/ISEE. The EISCAT Radar Project joined the operation of the EISCAT radar and the planning of the new EISCAT-3D radar. The PWING projects continued running in FY 2017 in relation to the OMTIs, ISEE magnetometer and ELF/VLF network projects. STARREPS/JST-JICA finished deploying nine lidars in South America to monitor volcanic ash in the atmosphere and released atmospheric risk data including UV emission intensity.

The four domestic observatories continued to operate in FY 2017. Moshiri Observatory continued to run electromagnetic instruments, i.e., an auroral photometer, magnetometers, and VLF receivers. Rikubetsu Observatory operates several spectrometers for comprehensive measurements of ozone and other minor constituents in the atmosphere, all-sky imagers and photometers for aurora and airglow, and SuperDARN Hokkaido radars for ionospheric disturbances as well as a new ELF atmospherics receiver. Multi-station interplanetary scintillation (IPS) observations using the Fuji, Kiso, and Toyokawa antennas were constructed in FY 2017. The Kiso Observatory was opened to the public on August 5–6, 2017. Kagoshima Observatory and Sata Station operated instruments for electromagnetic wave detection, and an all-sky camera and a photometer for airglow.

Kagoshima Observatory and active Sakurajima volcano.

9-2. Research Centers
Center for Integrated Data Science (CIDAS)



Research topics and keywords

- Hinode Science Center
- ERG Science Center
- Research and development of advanced simulations (SUSANOO, CReSS, Monte Carlo simulations for high-precision age calculations, etc.)
- Construction of various databases (IUGONET, WDS-CR, etc.)
- Operation of CIDAS supercomputer system
- Membership activity of HPCI consortium

Introduction to CIDAS

The aim of the Center for Integrated Data Science (CIDAS) was to construct infrastructure and conduct research and development to realize cutting-edge scientific study of the space–Earth environmental system through integrated analyses using various kinds of observational data and advanced computer simulations. CIDAS operates many projects in cooperation with the research divisions and the centers of the ISEE, as well as other universities and institutes.

Science centers for space missions: Hinode and ERG

The Hinode Science Center is operated as a joint project with the NAOJ and developed the database and analytical environment for the data provided by the Japanese solar observation satellite Hinode. In addition, ERG Science Center operates as a joint research center in cooperation with ISAS/JAXA, which releases the data from ERG and develops the data analysis software.

Cooperative research program for database construction and supercomputing

CIDAS produces various databases for space–Earth environmental research and provides supercomputing facilities in collaboration with the Information Technology Center (ITC) of Nagoya University and other universities and institutes. CIDAS has also joined the inter-university network project (Inter-university Upper atmosphere Global Observation NETwork: IUGONET) with Tohoku University, the NIPR, Kyoto University, Kyushu University, and Nagoya University to develop a metadata server and data analysis software. CIDAS is in charge of activities in the ISEE as a member of the High-Performance Computing Infrastructure Consortium (HPCI) in Japan.

Research and development of advanced simulations

CIDAS plays a leading role in research and development in the following advanced computer simulation models: Space Weather Forecast Usable System Anchored by Numerical Operations and Observations (SUSANOO), the Cloud Resolving Storm Simulator (CReSS), and Monte Carlo simulations for accurate Th-U-Pb dating. The CReSS model is designed for any type of parallel computer to simulate detailed structure of clouds and storm structures, and is free to use for the scientific community. It has been used for meteorological studies and real time weather forecast experiments, simulation experiments of tropical cyclones, heavy rainfall events, snow clouds, tornadoes and downscaling experiments of future tropical cyclones, among other applications.

Main Achievements in FY2017

1. Development of data analysis system for the ERG project

The scientific data from the ERG satellite, ground-network observations and modeling/simulation are archived at the ERG Science Center operated by ISAS/JAXA and ISEE/Nagoya University. These data files are in the CDF file format that includes metadata for each file, which is a de facto standard format for the solar-terrestrial physics community. The Space Physics Environment Data Analysis System (SPEDAS), widely-used software in the solar-terrestrial physics community, can easily read and manipulate CDF files. The ERG Science Center has developed and generated CDF files and SPEDAS plug-in software for the ERG project, and organized SPEDAS training sessions in Japan and Taiwan, which have provided important opportunities to learn SPEDAS and ERG data. The ERG Science Center has also developed a data analysis environment in the CIDAS system, and users can access the CIDAS system via the internet and analyze ERG project data using SPEDAS.

2. Development of nonlinear force-free field database of solar active regions

Solar flares are disruptive events in which the energy stored in the solar coronal magnetic field is explosively liberated. To measure the stored energy in the solar corona, reconstruction of the coronal magnetic field using photospheric magnetic field data is required, because direct measurement of the coronal field is not yet feasible. CIDAS has developed a tool that is utilized to semi-automatically calculate the nonlinear force-free field of the solar active region using Solar Software (SSW) and Interactive Data Language (IDL) in the CIDAS supercomputer system. Using this tool, we are constructing a database of the nonlinear force-free field for about 300 relatively large active regions observed by the Solar Dynamics Observatory (SDO) satellite since 2010.

3. Activity of Inter-university Global Upper atmosphere Observation NETwork (IUGONET)

We have promoted the use and application of upper atmospheric observation data through a database and analysis software in collaboration with other institutions (for example, the Research Organization of Information and Systems (ROIS)), and developed a foundation for a universal infrastructure for disclosing and citing data rapidly. We also abstracted a database design, a website, an analysis routine, and hardware construction equipped so that anyone can install these procedures easily and quickly, and now provide these developments to each institute and committee to promote data activity. We have held several international data analysis workshops in developing countries such as Nigeria and Indonesia in collaboration with a number of international programs: Variability of the Sun and Its Terrestrial Impact (VarSITI) and World Data System (WDS) affiliated with the International Council for Science (ICSU), and we have also started to support the construction of infrastructure for disclosing data and data integrity.

4. Operation of the CIDAS supercomputer system

The CIDAS supercomputer system for integrated data analysis has been under operation since FY 2016. The system consists of 20 compute nodes, and each compute node has two Intel Xeon E5-2660 v3 CPUs and 256 GB memory. In FY 2017, a total of 100 researchers/students were registered as users of the CIDAS supercomputer system, and data analyses related to the Hinode Science Center and the ERG/Arase Science Center were conducted.

5. Development of CReSS model

The CReSS model has been developed and improved for physical processes. It is available for scientific studies from CIDAS. It is planned that simulation output data from the CReSS model will be provided openly by CIDAS.

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”.

9-3. Interdisciplinary Researches
Project for Solar–Terrestrial Climate Research

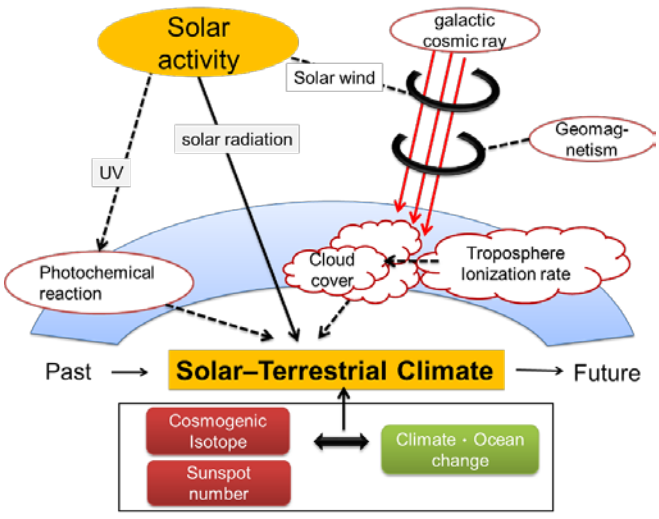
Introduction to Project for Solar–Terrestrial Climate Research

Do variations in solar activity influence our weather and climate? Researchers specializing in such fields as astronomy, solar physics, meteorology, climatology, paleoclimatology, and oceanography have grappled with this question for the past two hundred years or more. Two thousand years ago, astronomers of the Chinese imperial court chronicled sunspot activity for the purpose of studying variations in solar activity. In 1801 the British astronomer William Herschel discovered a significant correlation between the frequency of sunspot appearance and the market value of wheat in London and reported his findings in a paper published by the Royal Society. In the paper, he concluded that a reduction in the number of sunspots effected a change in climate that altered wheat yields and influenced the price of wheat as a result. This study is considered as the first attempt to examine correlations between the sun, climate, and society (human life). Even now, correctly identifying the characteristic variations of solar activity and investigating their effects on climate change and modern society remain important research topics in academics and society.

Solar activity varies over an 11-year cycle and is also known to exhibit variability in periods ranging from decades to thousands of years. Through observations using satellites, we know that solar irradiance varies about 0.1% over an approximate 11-year cycle of solar variability. Theoretical calculations indicate that a 0.1% increase in solar irradiance raises the global temperature only about 0.05°C on average. From the correlations between observed temperatures of seawater at the ocean surface and past solar activity indicators and climate change indicators, it is evident that, along with variations in solar activity over an approximate 11-year cycle, atmospheric temperature fluctuates at an amplitude about twice that estimated from theoretical values. More research will be needed to find a scientific explanation for this reality.

There is much evidence indicating that at least the Atlantic Ocean and surrounding areas, including Europe and North America, experienced significantly colder temperatures during the Maunder Minimum (a 70-year period from 1645 to 1715) in which very few sunspots were observed, and solar activity appeared nearly stagnant. Historical records show that New York Harbor froze over in the winter of 1780, enabling people to walk from Manhattan to Staten Island, and that sea ice surrounding Iceland extended for miles, closing the harbors and dealing a blow to the fishing industry and trade over a long period of time. While it is premature to conclude that a quieting of solar activity leads to a period of cooling, many researchers are of the opinion that variations in solar activity influence medium-to-long-term climate change. However, to obtain conclusive evidence it will be necessary to quantitatively reconstruct climate change and to continue accumulating data on annual variations in solar activity.

Radiocarbon (^{14}C) and Beryllium-10 (^{10}Be), known as cosmogenic isotopes, are produced at a rate that varies according to the intensity of incoming cosmic ray to Earth, which in turn are influenced by solar activity. Analyzing ^{14}C in tree rings and ^{10}Be in ice cores is an effective way to study long-term variations in solar activity going back tens of thousands of years. Such analyses of ^{14}C and ^{10}Be have suggested the possibility that episodes of declining solar activity resembling the Maunder Minimum may have occurred repeatedly a total of twelve times throughout the Holocene, which spans



Project scheme for Solar–Terrestrial Climate Research.

the past ten thousand years. Comparing cosmogenic isotopes against paleoclimate data could dramatically help us understand solar-driven climate change on a long-time scale.

Very few sunspots were observed in the period from March 7 to March 20, 2017. The cycle length of solar magnetic activity corresponding to the sunspot cycle is estimated at about 14 years during the Maunder Minimum. The projected sunspot cycle in Solar Cycle 24, which began in 2008, has grown to about 13 years, similar to the cycle length in the Maunder Minimum. This indicates that we may be entering a period of low solar activity, leading some to predict that cooling on a global scale could occur in the near future. In order to offer a qualified opinion on the likelihood of this prediction, we must examine diverse viewpoints on how solar activity affects climate.

We have accumulated evidence over the past quarter century that will be effective for studying the mechanisms by which variations in solar activity affect climate and human society. The interdisciplinary Project for Solar–Terrestrial Climate Research at ISEE integrates the latest knowledge in solar physics, meteorology, climatology, environmental studies, paleoclimatology, space physics, and cosmic ray physics with the aim of better understanding variability in solar activity, fostering an understanding of solar-driven earth systems, and contributing to predictions of future global environments.

Main Achievements in FY2017

1. Solar activity around the Wolf minimum

We have advanced the scientific field of cosmic ray archeology to investigate the history of solar activity and cosmic ray intensity recorded in annual tree rings and an ice sheet core. We have obtained new insights into the cyclic nature of the Schwabe solar cycles, with approximately 11-year periodicity, and solar flare events in the past based on highly precise ^{14}C analyses of annual tree rings. In this academic year, we have worked intensively on the ^{14}C measurement of annual rings in the interval from the 2nd to the 14th century of the Japanese cedar from Yaku Island (*Yaku sugi*). The periodicity of the Schwabe solar cycles became longer during the Wolf sola minimum (AD 1280–1350) and an abrupt increase in ^{14}C was probably associated with a solar flare event in the 12th century.

2. New approach for improving sediment core chronology

We have developed a new approach to improve the chronology of sediment cores that record long climate change histories, to investigate climate change driven by medium and long-term solar changes. Through improved throughput in sediment analyses, we can decode high-resolution climate change records from long sediment cores; however, there is still no method for applying a reliable chronology to the records, which limits investigation of the influences of solar activity on climate change. A unique and effective method was developed to improve the ^{14}C based chronology of sediment records, with a particular focus on the optical characteristics of sediments. Application of the newly developed method will provide new insights into solar–terrestrial climate interactions on a variety of time scales.

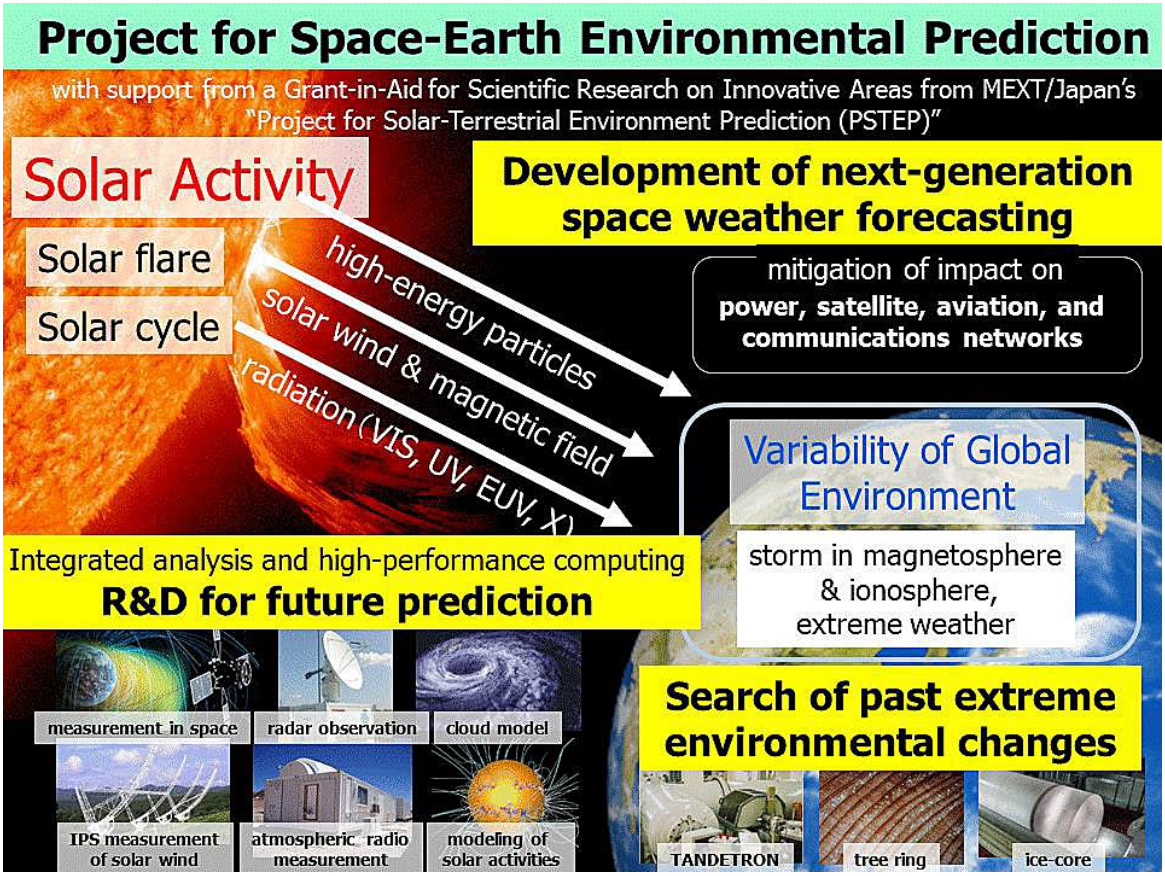
3. Paleoclimate research network

To understand climate change in Asia in detail, the on-going research project “Changing climate and resident-environment in the migrations and expansions of Homo sapiens across the continent of Asia” (Scientific Research on Innovative Areas, Scientific Research on Innovative Areas, MEXT Grant-in-Aid Project FY2016–2020) has created the “*Paleoclimate research network*”, an international research network in cooperation with universities and research organizations in Israel, Oman, Pakistan, Vietnam and Mongolia. The network aims to enhance our understanding of climatic changes in the past, and human migration and adaptation to fluctuating climates in Asia.

9-3. Interdisciplinary Researches
Project for Space–Earth Environment Prediction

Introduction to Project for Space–Earth Environment Prediction

Over the past 50 years, space exploration has expanded rapidly and has now gone past the edge of the heliosphere. Consequently, it is known that solar activity and the dynamics of the space environment can significantly impact human socio-economic systems as well as the global environment. For example, the giant solar flare observed by the British astronomer Richard Carrington in 1859 caused powerful magnetic storms, called the Carrington Event. If such an event occurred in the modern era, power, satellite, aviation, and communication networks could possibly be damaged, on a global scale. Moreover, analyses of the latest stellar observations and of cosmogenic isotopes in tree rings suggest the possibility of even larger solar flares. However, the mechanisms of the onset of solar flares and their subsequent processes have not yet been fully explained. Thus, modern society is at a risk from severe space-weather disturbances, caused by just such solar explosions, and understanding and predicting variations in the space–Earth environment is both an important scientific subject and a crucial issue for modern society. Furthermore, because the accurate prediction of complex phenomena is a common problem in science, the prediction is also a crucial subject for various scientific disciplines. The Project for Space–Earth Environmental Prediction is a new joint research project aimed at synergistically developing our predictive capability for the space–Earth environment through the cooperation and interaction of solar physics, geomagnetism and space sciences, meteorology, climatology, space engineering, and other related fields. This project addresses the various issues shown in the figure below, based on ISEE Collaborative Research Programs and the support of a Grant-in-Aid for Scientific Research on Innovative Areas from the Ministry of Education, Culture, Sports, Science and Technology (MEXT) Japan “Project for Solar-Terrestrial Environment Prediction (PSTEP)”.



The objectives and subjects of the Project for Space–Earth Environmental Prediction.

Main Achievements in FY2017

1. PSTEP Summer School 2017

The ISEE co-hosted the PSTEP Summer School 2017 in Rikubetsu in cooperation with the Project for Solar-Terrestrial Environment Prediction (PSTEP) supported by the MEXT Grant-in-Aid for Scientific Research on Innovative Areas, in collaboration with Rikubetsu-cho, Hokkaido and the Rikubetsu Observatory of ISEE from July 30 to August 4, 2017. During this summer school, more than 100 graduate students and young researchers from all over Japan participated in learning the fundamentals and state-of-the-art predictive schemes for space weather and space climate phenomena.

The participants of PSTEP Summer School 2017 in Rikubetsu.

2. ISEE/PSTEP International Workshop on the Benchmarks for Operational Solar Flare Forecasts

The ISEE conducted the International Workshop on the Benchmarks for Operational Solar Flare Forecasts in cooperation with the MEXT Project for Solar-Terrestrial Environment Prediction (PSTEP) from October 31 to November 2, 2017. Twenty researchers from research institutes around the world (including three researchers from Australia via the network) participated in the workshop. Forecast schemes of solar flares used for space weather operation in each country's space weather forecast agencies were compared quantitatively from various viewpoints. The results from this workshop will be applied to further development of solar flare prediction models.

The participants of International Workshop on the benchmarks for Operational Solar Flare Forecasts.

3. ISEE/PSTEP International Workshop on Solar Cycle 25 Prediction

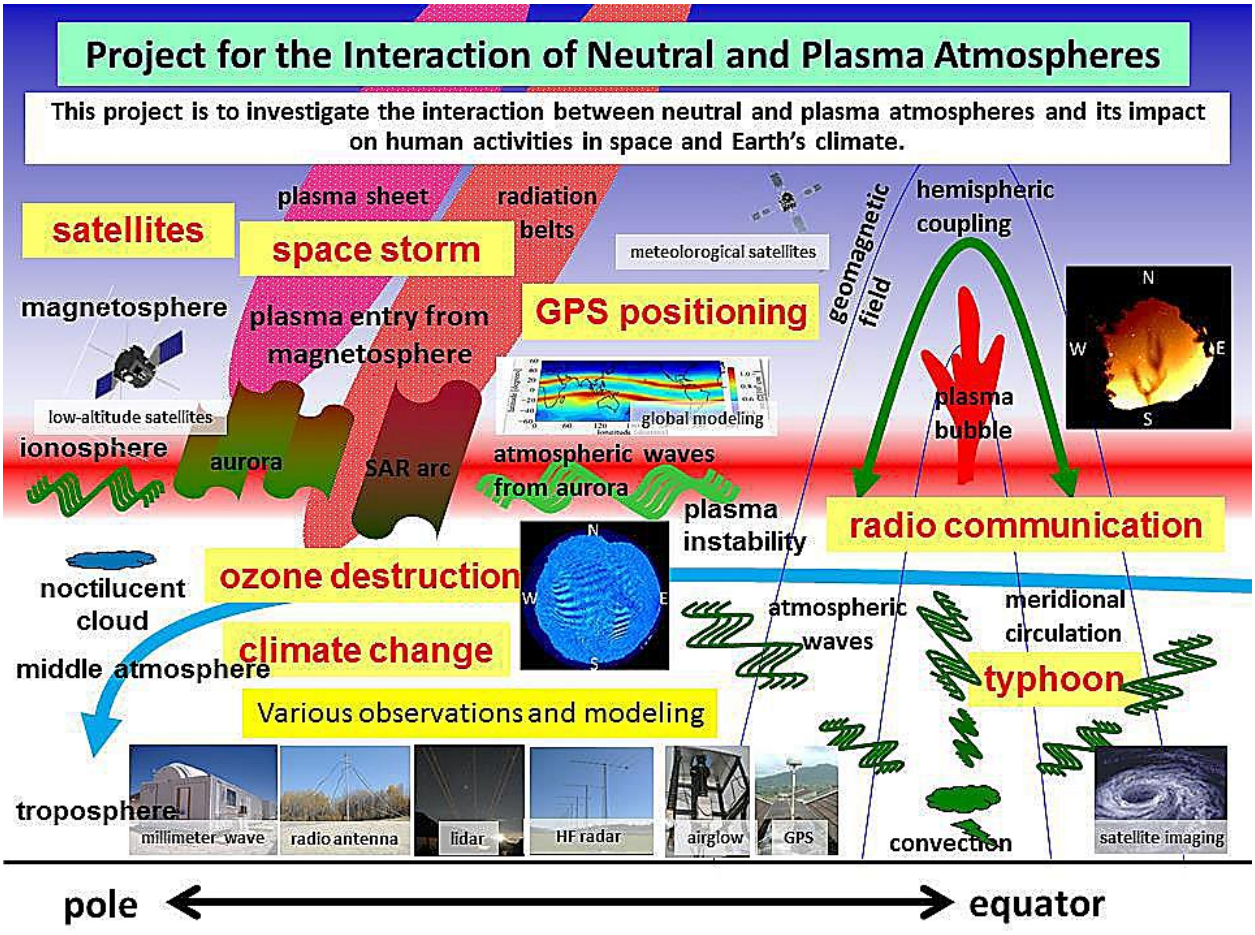
The ISEE conducted the International Workshop on Solar Cycle 25 Prediction in Nagoya in cooperation with the MEXT Project for Solar-Terrestrial Environment Prediction (PSTEP) from November 27 to December 2, 2017. The activity of the next solar cycle (Cycle 25) is an important issue for solar-terrestrial environmental study, because various predictions suggest that Cycle 25 will be more active or less active than the current cycle. Twelve researchers from around the world participated in the workshop. They compared prediction results of solar cycles based on various factors including the physical processes for prediction, the initial and boundary conditions, and numerical schemes used for prediction. The results from this workshop will be summarized and applied in future research to improve prediction accuracy and understanding of solar cycle activity.

The participants of International Workshop on the Solar Cycle 25 Prediction.

9-3. Interdisciplinary Researches
Project for the Interaction of Neutral and Plasma Atmospheres

Introduction to Project for the Interaction of Neutral and Plasma Atmospheres

The Earth's atmosphere is partly ionized because of solar ultraviolet emissions, forming the ionosphere. Ionospheric plasma affects human activities in space such as radio communications and GPS positioning. The consequences of climate change appear significantly in the upper atmosphere and ionosphere. As shown in the figure below, neutral-plasma interaction processes in the upper atmosphere and ionosphere can be observed as various phenomena occurring from high to low latitudes. The aurora in the polar region is caused by precipitation of high-energy plasma, which heats the upper atmosphere, and generates atmospheric waves and disturbances that propagate toward low latitudes. On the other hand, ionospheric plasma instability, known as plasma bubbles, occurs in the equatorial upper atmosphere, causing interference with satellite-ground communications and GPS positioning. These phenomena can be measured by various ground-based remote-sensing instruments, such as airglow imagers, magnetometers, radars and lidars, and millimeter wave telescopes. This interdisciplinary project investigates the interaction of neutral and plasma components of the Earth's atmosphere using various ground remote sensing techniques and *in situ* satellite measurements, as well as global and regional high-resolution modeling of the neutral-plasma interaction, and contributes to the reliable use of space by humans.



Research topics of the project for the interaction of neutral and plasma atmospheres.

Main Achievements in FY2017

In FY 2017, we operated 12 international collaborative studies, eight domestic collaborative projects, and 22 meetings under ISEE. Various scientific results have been obtained through these collaborative projects.

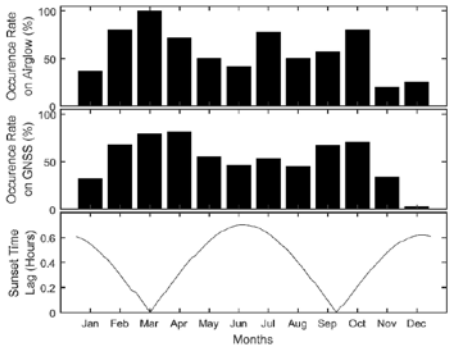
Photo of the auroral arc. The auroral Joule heating and Lorentz force cause heating and acceleration of the thermosphere.

For polar disturbances, we studied the thermospheric wind response to poleward-moving auroral arcs at the beginning of auroral substorms. Using data from a sounding rocket, the EISCAT radar, a Fabry-Perot Interferometer (FPI), and an all-sky camera during the DELTA-2 campaign in January 2009, we found that the thermospheric winds at altitudes of ~120 km are affected by the arc at a distance 70 km from the arc, but not affected 160-200 km away from the arc. This indicates that thermospheric disturbances associated with substorm aurora are localized in a limited region. We also installed a millimeter-wave receiver at Tromsø, Norway, to measure ozone and other atmospheric minor components. Operation of the receiver was stopped on December 2017 due to a fault with the FFT processor. We are repairing this and will recommence continuous observation soon.

The new scientific satellite ERG was launched by ISAS/JAXA in December 2016, to investigate wave-particle interactions between high-energy electrons and ions in the inner magnetosphere. We have conducted several ERG -ground campaign observations in FY 2017. From the combined ground-satellite measurements, including EISCAT and newly installed high-speed EMCCD cameras, we identified precipitation of keV-MeV electrons associated with VLF chorus waves. An ISEE researcher was hired by Oulu University in Finland through a cross appointment, and will conduct collaborative research related to this interdisciplinary project.

It is essential to develop velocity-mass spectrometers for neutral particles and ambient ions to conduct *in-situ* observations of energy transport due to collisions between charged and neutral particles in the terrestrial upper atmosphere and related upper atmospheric variations, which also means that appropriate particle beamlines must be constructed as calibration facilities. We are currently building two types of particle beamline in our laboratory for tests and calibrations across wide energy ranges, corresponding to those of plasma particle measurements in near-Earth space. We developed interface and control software programs, mechanical interface devices and components in vacuum, and conducted initial operations of the beamline monitoring system, to obtain sensor calibration data using the beamline monitoring system for measuring and controlling the beam flux and energy-angle dispersions.

At middle and low latitudes, we have succeeded in obtaining the statistical characteristics of plasma bubble appearance in West Africa using an airglow imager and a GNSS receiver at Abuja, Nigeria. We have also obtained the ionospheric D-region height variation estimated from the cut-off frequencies of a tweek atmospheric in Vietnam and Japan (Sata), and are continuing measurements using 5 FPIs in Norway, Japan, Thailand, Indonesia and Australia. The FPI is unique since it is the only instrument that can monitor winds and temperatures in the thermosphere at altitudes of 200–300 km from the ground through the Doppler shift and the spectrum width, respectively, of airglow emissions. The long-term variation of gravity waves and medium-scale traveling ionospheric disturbances were investigated using 16-year airglow images obtained at Shigaraki, Japan.

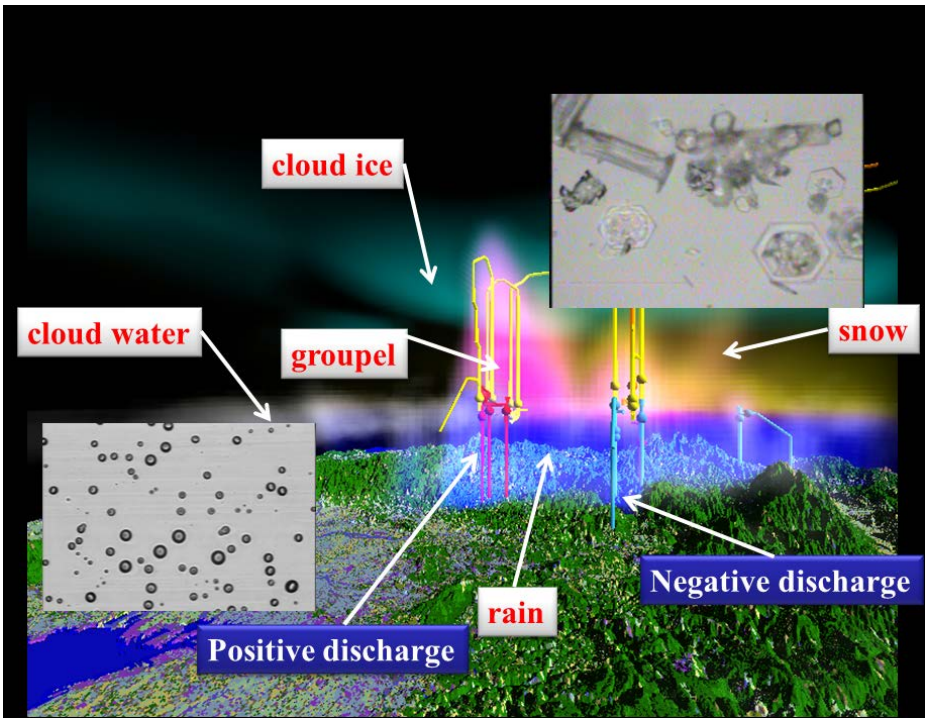


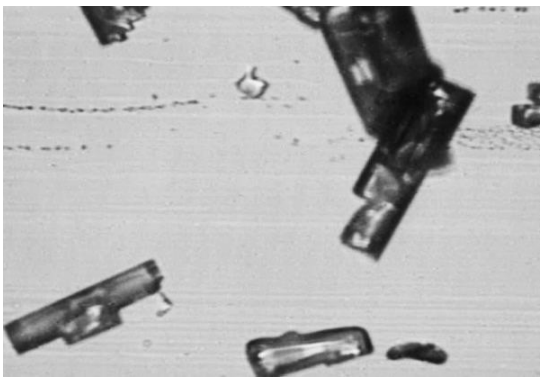
Seasonal variation of (top panel) plasma bubble observed in airglow images and (middle panel) scintillation of GNSS radio signal obtained at Nigeria. The bottom panel shows the time difference of sunset between the northern and southern hemispheres in the Nigerian meridian, which affects the occurrence of the plasma bubble.

9-3. Interdisciplinary Researches
Project for Aerosol and Cloud Formation

Introduction to Project for Aerosol and Cloud Formation

Hydrometeors and aerosols closely interact with each other in their generation and dissipation, and play important roles in atmospheric water circulation, formation of convective clouds and typhoons as well as in the Earth radiation budget. They are, however, some of the most unknown quantities in the atmosphere. So far, hydrometeors and cloud-precipitation systems have been studied in the Hydrospheric Atmospheric Research Center, whereas aerosols and related processes have been studied in the Solar-Terrestrial Environmental Laboratory. In the joint research program, researchers from both centers will cooperate to study the interaction between aerosols and hydrometeors, their variations in the formation of precipitation, and cloud-aerosol-radiation interactions by field observations and numerical simulations. On the basis of field observations, the numerical model will be improved for quantitative simulation of cloud and aerosol processes. In cooperation with the Center for Orbital and Suborbital Observations, we will conduct *in situ* observations of typhoons using an aircraft, balloons, and drones. This research will improve the cloud-resolving model (CReSS), and the impact of aerosols on typhoon clouds will be studied.



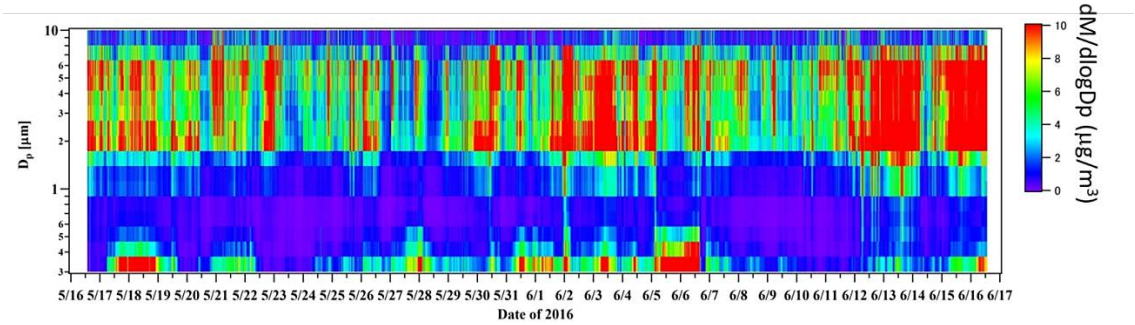


Upper: A mesoscale convective system and hydrometeors simulated by the CReSS model.
Lower: The superimposed images show hydrometeors expected to be present in the convective system. Balloon observation of typhoon clouds. Launching balloon (left) and observed hydrometeors (right).

Main Achievements in FY2017

1. Cloud and aerosol observation in the Okinawa region

Aerosol observation and numerical simulations of clouds and precipitation were performed to clarify the effect of aerosols on cloud formation, and typhoon-related cloud and precipitation. Typhoons often approach the Okinawa region. Oceanic precipitation often occurs there. An optical particle sizer (OPS) was utilized to observe aerosol in the central part of the main island of Okinawa for about one month. The figure shows the weights of aerosol particles in a unit mass of air as a function of particle size. Since the observation point was close to the sea, larger particles are dominant. This indicates that the air was clean and that large particles such as sea salt are the main component of aerosol. Although no typhoon was observed during the observation period, aerosol observations will be conducted in the future to investigate aerosol characteristics during a typhoon.



Time-series of aerosol size distribution observed by OPS at the Okinawa Electromagnetic Technology Center, National Institute of Information and Communication Technology in Onna village, Okinawa.

2 . Cloud and aerosol observation in United Arab Emirates (UAE) and aerosol modeling

Using an aircraft (Super King Air, B200T) equipped with an aerosol-cloud-precipitation observation system, aerosol observation was conducted over the UAE to clarify the physical and chemical characteristics of aerosols. Cloud micro-physical observations were also conducted in the UAE as well as along the flight path between Japan and UAE: over the Okinawa region, the Philippines, Thailand, Vietnam, India, and Oman. The effect of aerosols on cloud and precipitation was studied using the data. In the modeling study, the activation process of aerosols was investigated using CReSS, based on observed data. A unified model of aerosol, cloud and precipitation is now in development, and the observed data will contribute to the verification of the model.

Aerosol observation using B200T (left panel), observed diurnal convective clouds (central panel), and precipitation distribution caused by the diurnal convective clouds simulated by CReSS (right panel).

10. Publications and Presentations

Papers (in refereed Journals, April 2017–March 2018)

Abadi, P., **Y. Otsuka**, **K. Shiokawa**, A. Husin, H. Liu, and S. Saito, Equinoctial asymmetry in the zonal distribution of scintillation as observed by GPS receivers in Indonesia. *J. Geophys. Res. Space Physics*, **122(8)**, 8947–8958, Sep. 25, 2017 (10.1002/2017JA024146).

Abbott, B. P., R. Abbott, T. D. Abbott, F. Acernese, K. Ackley, C. Adams, T. Adams, P. Addesso, R. X. Adhikari, V. B. Adya et al. (**F. Abe**, **Y. Asakura**), Multi-messenger observations of a binary neutron star merger. *Astrophys. J. Lett.*, **848(2)**, L12, Oct. 20, 2017 (10.3847/2041-8213/aa91c9).

Abdellaoui, G., S. Abe, A. Acheli, J. H. Adams Jr., S. Ahmad, A. Ahriche, J.-N. Albert, D. Allard, G. Alonso, L. Anchordoqui et al. (**Y. Itow**), Meteor studies in the framework of the JEM-EUSO program. *Planet. Space Sci.*, **143**, 245–255, Sep. 1, 2017 (10.1016/j.pss.2016.12.001).

Abdellaoui, G., S. Abe, A. Acheli, J. H. Adams Jr., S. Ahmad, A. Ahriche, J.-N. Albert, D. Allard, G. Alonso, L. Anchordoqui et al. (**Y. Itow**), Cosmic ray oriented performance studies for the JEM-EUSO first level trigger. *Nucl. Instrum. Methods Phys. Res. Sect. A-Accel. Spectrom. Dect. Assoc. Equip.*, **866**, 150–163, Sep. 11, 2017 (10.1016/j.nima.2017.05.043).

Abdollahi, S.; M. Ackermann, M. Ajello, W. B. Atwood, L. Baldini, G. Barbiellini, D. Bastieri, R. Bellazzini, E. D. Bloom, R. Bonino et al. (**H. Tajima**), Cosmic-ray electron-positron spectrum from 7 GeV to 2 TeV with the Fermi Large Area Telescope. *Phys. Rev. D*, **95(8)**, 082007, Apr. 21, 2017 (10.1103/PhysRevD.95.082007).

Abe, K., C. Bronner, G. Pronost, Y. Hayato, M. Ikeda, K. Iyogi, J. Kameda, Y. Kato, Y. Kishimoto, Ll. Marti et al. (**Y. Itow**, **M. Murase**, **F. Muto)**, Search for an excess of events in the Super-Kamiokande detector in the directions of the astrophysical neutrinos reported by the IceCube Collaboration. *Astrophys. J.*, **850(2)**, 166, Nov. 28, 2017 (10.3847/1538-4357/aa951b).

Abe, K., K. Hiraide, K. Ichimura, Y. Kishimoto, K. Kobayashi, M. Kobayashi, S. Moriyama, M. Nakahata, T. Norita, et al. (**Y. Itow**, **R. Kegasa**, **K. Kobayashi**, **K. Masuda**, **H. Takiya**, **H. Uchida**), Identification of ^{210}Pb and ^{210}Po in the bulk of copper samples with a low-background alpha particle counter. *Nucl. Instrum. Methods Phys. Res. Sect. A-Accel. Spectrom. Dect. Assoc. Equip.*, **884**, 157–161, Mar. 11, 2018 (10.1016/j.nima.2017.12.015).

Acero, F., R. Aloisio, J. Amans, E. Amato, L. A. Antonelli, C. Aramo, T. Armstrong, F. Arqueros, K. Asano, M. Ashley et al. (**A. Okumura**, **H. Tajima**), Prospects for Cherenkov telescope array observations of the young supernova remnant RX J1713.7−3946. *Astrophys. J.*, **840(2)**, 74, May 10, 2017 (10.3847/1538-4357/aa6d67).

Ackermann, M., M. Ajello, A. Albert, W. B. Atwood, L. Baldini, J. Ballet, G. Barbiellini, D. Bastieri, R. Bellazzini, E. Bissaldi et al. (**H. Tajima**), The Fermi galactic center GeV excess and implications for dark matter. *Astrophys. J.*, **840(1)**, 43, May 4, 2017 (10.3847/1538-4357/aa6cab).

Adachi, K., **S. Nozawa**, Y. Ogawa, A. Brekke, C. M. Hall, and **R. Fujii**, Evaluation of a method to derive ionospheric conductivities using two auroral emissions (428 and 630 nm) measured with a photometer at Tromsø (69.6°N). *Earth Planets Space*, **69(1)**, 90, Dec. 2017 (10.1186/s40623-017-0677-4).

Adhikari, L., G. P. Zank, D. Telloni, P. Hunana, R. Bruno, and **D. Shiota**, Theory and transport of nearly incompressible magnetohydrodynamics turbulence. III. Evolution of power anistropy in magnetic field fluctuations throughout the heliosphere. *Astrophys. J.*, **851(2)**, 117, Dec. 19, 2017 (10.3847/1538-4357/aa9ce4).

Adhikari, L., G. P. Zank, P. Hunana, **D. Shiota**, R. Bruno, Q. Hu, and D. Telloni, II. Transport of Nearly Incompressible Magnetohydrodynamic Turbulence from 1 to 75 au. *Astrophys. J.*, **841(2)**, 85, Jun. 1, 2017 (10.3847/1538-4357/aa6f5d).

Adriani, O., E. Berti, L. Bonechi, M. Bongi, R. D'Alessandro, M. Haguenauer, **Y. Itow**, T. Iwata, K. Kasahara, **Y. Makino**, **K. Masuda**, **E. Matsubayashi**, **H. Menjo**, **Y. Muraki**, et al. (**T. Sako**, **M. Shinoda**, **M. Ueno, Q. D. Zhou**), Measurement of forward photon production cross-section in proton–proton collisions at $\sqrt{s}$ = 13 TeV with the LHCf detector. *Phys. Lett. B*, **780**, 233–239, Feb. 21, 2018 (10.1016/j.physletb.2017.12.050).

Aharonian, F., H. Akamatsu, F. Akimoto, S. W. Allen, L. Angelini, M. Audard, H. Awaki, M. Axelsson, A. Bamba, M. W. Bautz et al. (**H. Tajima**), Hitomi observation of radio galaxy NGC 1275: The first X-ray microcalorimeter spectroscopy of Fe-Kα line emission from an Active Galactic Nucleus. *Publ. Astron. Soc. Japan*, in press.

Aharonian, F., H. Akamatsu, **F. Akimoto**, S. W. Allen, L. Angelini, M. Audard, H. Awaki, M. Axelsson, A. Bamba, M. W. Bautz et al. (**H. Tajima, K. Yamaoka**), Solar abundance ratios of the iron-peak elements in the Perseus cluster. *Nature*, **551**, 478–480, Nov. 23, 2017 (10.1038/nature24301).

Aharonian, F., H. Akamatsu, **F. Akimoto**, S. W. Allen, L. Angelini, M. Audard, H. Awaki, M. Axelsson, A. Bamba, M. W. Bautz et al. (**H. Tajima**, **K. Yamaoka**), Measurements of resonant scattering in the Perseus cluster core with Hitomi SXS. *Publ. Astron. Soc. Japan*, in press.

Aharonian, F., H. Akamatsu, **F. Akimoto**, S. W. Allen, L. Angelini, M. Audard, H. Awaki, M. Axelsson, A. Bamba, M. W. Bautz et al. (**H. Tajima**, **K. Yamaoka**), Hitomi X-ray studies of Giant Radio Pulses from the Crab pulsar. *Publ. Astron. Soc. Japan*, in press.

Aharonian, F., H. Akamatsu, **F. Akimoto**, S. W. Allen, L. Angelini, M. Audard, H. Awaki, M. Axelsson, A. Bamba, M. W. Bautz, et al. (**H. Tajima**), Search for thermal X-ray features from the Crab nebula with Hitomi Soft X-ray Spectrometer. *Publ. Astron. Soc. Japan*, in press.

Aharonian, F., H. Akamatsu, **F. Akimoto**, S. W. Allen, L. Angelini, M. Audard, H. Awaki, M. Axelsson, A. Bamba, M. W. Bautz et al. (**H. Tajima**, **K. Yamaoka**), Atmospheric gas dynamics in the Perseus cluster observed with Hitomi. *Publ. Astron. Soc. Japan*, in press.

Aharonian, F., H. Akamatsu, **F. Akimoto**, S. W. Allen, L. Angelini, M. Audard, H. Awaki, M. Axelsson, A. Bamba, M. W. Bautz et al. (**H. Tajima**, **K. Yamaoka**), Glimpse of the highly obscured HMXB IGR J16318-4848 with Hitomi. *Publ. Astron. Soc. Japan*, in press.

Aharonian, F., H. Akamatsu, **F. Akimoto**, S. W. Allen, L. Angelini, M. Audard, H. Awaki, M. Axelsson, A. Bamba, M. W. Bautz et al. (**H. Tajima**, **K. Yamaoka**), Hitomi Observations of the LMC SNR N132D: Highly Redshifted X-ray Emission from Iron Ejecta. *Publ. Astron. Soc. Japan*, in press.

Aharonian, F., H. Akamatsu, **F. Akimoto**, S. W. Allen, L. Angelini, M. Audard, H. Awaki, M. Axelsson, A. Bamba, M. W. Bautz et al. (**H. Tajima**, **K. Yamaoka**), Atomic data and spectral modeling constraints from high-resolution X-ray observations of the Perseus cluster with Hitomi. *Publ. Astron. Soc. Japan*, in press.

Aharonian, F., H. Akamatsu, **F. Akimoto**, S. W. Allen, L. Angelini, M. Audard, H. Awaki, M. Axelsson, A. Bamba, M. W. Bautz et al. (**H. Tajima**, **K. Yamaoka**), Temperature Structure in the Perseus Cluster Core Observed with Hitomi. *Publ. Astron. Soc. Japan*, in press.

Aharonian, F., H. Akamatsu, **F. Akimoto**, S. W. Allen, L. Angelini, M. Audard, H. Awaki, M. Axelsson, A. Bamba, M. W. Bautz et al. (**H. Tajima**, **K. Yamaoka**), Hitomi X-ray Observation of the Pulsar Wind Nebula G21.5–0.9. *Publ. Astron. Soc. Japan*, in press.

Akter, N., and **K. Tsuboki**, Climatology of the premonsoon Indian dryline. *Int. J. Climatol.*, **37(11)**, 3991–3998, Sep. 3, 2017 (10.1002/joc.4968).

Albert, A. S. Funk, H. Katagiri, **T. Kawashima**, M. Murphy, **A. Okumura**, R. Quagliani, L. Sapozhnikov, A. Shigenaka,

H. Tajima et al., TARGET 5: A new multi-channel digitizer with triggering capabilities for gamma-ray atmospheric Cherenkov telescopes. *Astropart. Phys*., **92**, 49–61, Jun. 2017 (10.1016/j.astropartphys.2017.05.003).

Ando, R., K. Nakanishi, K. Kohno, T. Izumi, S. Martin, N. Harada, S. Takano, N. Kuno, N. Nakai, H. Sugai et al. (**T. Nakajima**), Diverse nuclear star-forming activities in the heart of NGC 253 resolved with ten-pc scale ALMA images. *Astrophys. J.*, **842(2)**, 81, Nov. 10, 2017 (10.3847/1538-4357/aa8fd4).

Ardhuin, F., N. Suzuki, J. C. McWilliams, and **H. Aiki**, Comments on "A Combined Derivation of the Integrated and Vertically Resolved, Coupled Wave–Current Equations". *J. Phys. Oceanogr*., **47(9)**, 2377–2385, Sep. 2017 (10.1175/JPO-D-17-0065.1).

Asano, A., D. Berge, G. Bonanno, M. Bryan, B. Gebhardt, A. Grillo, **N. Hidaka**, P. Kachru J. Lapington, S. Leach et al. (**Y. Nakamura**, **A. Okumura**, **H. Tajima**, **N. Yamane**), Evaluation of silicon photomultipliers for dual-mirror Small-Sized Telescopes of Cherenkov Telescope Array. *Nucl. Instrum. Methods Phys. Res. Sect. A-Accel. Spectrom. Dect. Assoc. Equip.*, in press (10.1016/j.nima.2017.11.017).

Balan, N., S. Tulasiram, **Y. Kamide**, I. S. Batista, J. R. Souza, **K. Shiokawa**, P. K. Rajesh, and N. J. Victor, Automatic selection of Dst storms and their seasonal variations in two versions of Dst in 50 years. *Earth Planets Space*, **69(1)**, 59, Dec. 1, 2017 (10.1186/s40623-017-0642-2).

Bamba, Y., and **K. Kusano**, Evaluation of the applicability of a flare trigger model based on the comparison of geometric structures. *Astrophys. J*., **856(1)**, 43, Mar. 20, 2018 (10.3847/1538-4357/aaacd1).

Bamba, Y., **S. Inoue**, **K. Kusano**, and **D. Shiota**, Triggering Process of the X1.0 three-ribbon flare in the great active region NOAA 12192. *Astrophys. J.*, **838(2)**, 134, Apr. 3, 2017 (10.3847/1538-4357/aa6682).

Bamba, Y., K.-S. Lee, **S Imada**, and **K. Kusano**, Study on precursor activity of the X1.6 flare in the great AR 12192 with SDO, IRIS, and Hinode. *Astrophys J.*, **840(2)**, 116, May 15, 2017 (10.3847/1538-4357/aa6dfe).

Bennett, D. P., I. A. Bond, **F. Abe**, **Y. Asakura**, R. Barry, A. Bhattacharaya, M. Donachie, P. Evans, A. Fukui, Y. Hirao, **Y. Itow** et al. (**K. Masuda**, **Y. Matsubara**, **Y. Muraki)**, MOA data reveal a new mass, distance, and relative proper motion for planetary system OGLE-2015-BLG-0954L. *Astronom. J.*, **154(2)**, 68, Jul. 25, 2017 (10.3847/1538-3881/aa7aee).

Bennett, D. P., A. Udalski, C. Han, I. A. Bond, J.-P. Beaulieu, J. Skowron, B. S. Gaudi, N. Koshimoto, **F. Abe**, **Y. Asakura** et al. (**Y. Itow**, **K. Masuda**, **Y. Matsubara**, **Y. Muraki**, **H. Oyokawa**, **A. Yonehara)**, The first planetary microlensing event with two microlensed source stars. *Astronom. J*., **155(3)**, 141, Mar. 2018 (10.3847/1538-3881/aaadfa).

Bensby, T., S. Feltzing, A. Gould, J. C. Yee, J. A. Johnson, M. Asplund, J. Meléndez, S. Lucatello, L. M. Howes, A. McWilliam et al. (**F. Abe**, **Y. Asakura**), Chemical evolution of the Galactic bulge as traced by microlensed dwarf and subgiant stars. VI. Age and abundance structure of the stellar populations in the central sub-kpc of the Milky Way. *Astron. Astrophys*., **605**, A89, Sep. 2017 (10.1051/0004-6361/201730560).

Bond, I. A., D. P. Bennett, T. Sumi, A. Udalski, D. Suzuki, N. J. Rattenbury, V. Bozza, N. Koshimoto, **F. Abe**, **Y. Asakura** et al. (**Y. Itow**, **K. Masuda**, **Y. Matsubara**, **Y. Muraki)**, The lowest mass ratio planetary microlens: OGLE 2016-BLG-1195Lb. *Mon. Not. Roy. Astron. Soc.*, **469(2)**, 2434–2440, Aug. 1, 2017 (10.1093/mnras/stx1049).

Buhari, S. M., M. Abdullah, **Y. Otsuka**, T. Yokoyama, M. Nishioka, A. M. Hasbi, and T. Tsugawa, Detection of plasma bubble in ionosphere using GPS receivers in Southeast Asia. *Sains Malays*., **46(6)**, 879–885, Jun. 1, 2017 (10.17576/jsm-2017-4606-06).

Chauvin, M., H.-G. Florén, M. Friis, M. Jackson, T. Kamae, J. Kataoka, T. Kawano, M. Kiss, V. Mikhalev, T. Mizuno et al. (**H. Tajima**), Shedding new light on the Crab with polarized X-rays. *Sci. Rep.*, **7**, 7816, Aug. 10, 2017

(10.1038/s41598-017-07390-7).

Choi, Y.-S., W. Kim, S.-W. Yeh, **H. Masunaga**, M.-J. Kwon, H.-S. Jo, and L. Huang, Revisiting the iris effect of tropical cirrus clouds with TRMM and A-Train satellite data. *J. Geophys. Res. Atmos.*, **122(11)**, 5917–5931, Jun. 16, 2017 (10.1002/2016JD025827).

Connors, M., and P. Wiegert, A retrograde object near Jupiter's orbit. *Planet. Space Sci.*, **151**, 71–77, Feb. 2018 (10.1016/j.pss.2017.11.009).

Crate, S., M. Ulrich, J. O. Habeck, A. R. Desyatkin, R. V. Desyatkin, A. N. Fedorov, **T. Hiyama**, Y. Iijima, S. Ksenofontov, C. Mészáros, and H. Takakura, Permafrost livelihoods: A transdisciplinary review and analysis of thermokarst-based systems of indigenous land use. *Anthropocene*, **18**, 89–104, Jun. 2017 (10.1016/j.ancene.2017.06.001).

Dao, T., **Y. Otsuka**, **K. Shiokawa**, M. Nishioka, M. Yamamoto, S. M. Buhari, M. Abdullah, and A. Husin, Coordinated observations of postmidnight irregularities and thermospheric neutral winds and temperatures at low latitudes. *J. Geophys. Res. Space Physics*, **122(7)**, 7504–7518, Aug. 12, 2017 (10.1002/2017JA024048).

Dee, M., B. Pope, D. Miles, S. Manning, and **F. Miyake**, Supernovae and single-year anomalies in the atmospheric radiocarbon record. *Radiocarbon*, **59(2)**, 293–302, Apr. 2017 (10.1017/RDC.2016.50).

Figueiredo, C. A. O. B., C. M. Wrasse, H. Takahashi, **Y. Otsuka**, **K. Shiokawa**, and D. Barros, Large-scale traveling ionospheric disturbances observed by GPS dTEC maps over North and South America on Saint Patrick's Day storm in 2015. *J. Geophys. Res. Space Physics*, **122(4)**, 4755–4763, May 13, 2017 (10.1002/2016JA023417).

Figueiredo, C. A. O. B., H. Takahashi, C. M. Wrasse, **Y. Otsuka**, **K. Shiokawa**, and D. Barros, Medium-scale traveling ionospheric disturbances observed by detrended total electron content maps over Brazil. *J. Geophys. Res. Space Physics*, **123(2)**, 2215– 2227, Mar. 2018 (10.1002/2017JA025021).

Finzell, T., L. Chomiuk, B. D. Metzger, F. M. Walter, J. D. Linford, K. Mukai, T. Nelson, J. H. S. Weston, Y. Zheng, J. L. Sokoloski et al. (**F. Abe)**, A detailed observational analysis of V1324 Sco, the most gamma-ray-luminous classical nova to date. *Astrophys. J.*, **852(2**), 108, Jan.10, 2018 (10.3847/1538-4357/aaa12a).

Fujinami, H., T. Sato, **H. Kanamori**, and F. Murata, Contrasting features of monsoon precipitation around the Meghalaya Plateau under westerly and easterly regimes. *J. Geophys. Res. Atmos.*, **122(18)**, 9591–9610, Oct. 13, 2017 (10.1002/2016JD026116).

Fujiwara, K., R. Kawamura, **H. Hirata**, T. Kawano, **M. Kato**, and **T. Shinoda**, A positive feedback process between tropical cyclone intensity and the moisture conveyor belt assessed with Lagrangian diagnostics. *J. Geophys. Res. Atmos.*, **122(23)**, 12502–12521, Dec. 16, 2017 (10.1002/2017JD027557).

Fukazawa, K., T. Soga, **T. Umeda**, and T. Nanri, Performance Evaluation and Optimization of MagnetoHydroDynamic Simulation for Planetary Magnetosphere with Xeon Phi KNL. in *Advances in Parallel Computing*, **32**, 178–187, edited by S. Bassini, M. Danelutto, P. Dazzi, G. R. Joubert, and F. Peters, 852pp, IOS Press, Amsterdam Netherlands, Mar. 2018 (10.3233/978-1-61499-843-3-178).

Fukuda, Y., R. Kataoka, H. Herbelt, **Y. Miyoshi**, D. Hampton, **K. Shiokawa**, Y. Ebihara, D. Whiter, N. Iwagami, and K. Seki, First evidence of patchy flickering aurora modulated by multi-ion electromagnetic ion cyclotron waves. *Geophys. Res. Lett.*, **44(9)**, 3963–3970, May 16, 2017 (10.1002/2017GL072956).

Fukui, Y., H. Sano, J. Sato, R. Okamoto, T. Fukuda, S. Yoshiike, K. Hayashi, K. Torii, T. Hayakawa, G. Rowell et al. (**A. Mizuno)**, A detailed study of the interstellar protons toward the TeV γ-ray SNR RX J0852.0–4622 (G266.2–1.2, Vela Jr.); the third case of the γ-ray and ISM spatial correspondence. *Astrophys. J.*, **850(1)**, 71, Nov. 20, 2017

(10.3847/1538-4357/aa9219).

Fukushima, D., **K. Shiokawa**, **Y. Otsuka**, M. Kubota, T. Yokoyama, M. Nishioka, S. Komonjinda, and C. Yatini, Geomagnetically conjugate observations of ionospheric and thermospheric variations accompanied by a midnight brightness wave at low latitudes. *Earth Planets Space*, **69(1)**, 112, Dec. 1, 2017 (10.1186/s40623-017-0698-z).

Gallardo-Lacourt, B., Y. Nishimura, L. R. Lyons, E. V. Mishin, J. M. Ruohoniemi, E. F. Donovan, V. Angelopoulos, and **N. Nishitani**, Influence of auroral streamers on rapid evolution of ionospheric SAPS flows. *J. Geophys. Res. Space Physics*, **122(12)**, 12406–12420, Dec. 7, 2017 (10.1002/2017JA024198).

Grandin, M., A. Kero, N. Partamies, D. McKay, D. Whiter, A. Kozlovsky, and **Y. Miyoshi**, Observation of pulsating aurora signatures in cosmic noise absorption data. *Geophys. Res. Lett.*, **44(11)**, 5292–5300, Jun. 27, 2017 (10.1002/2017GL073901).

Hakozaki, M., **F. Miyake**, **T. Nakamura**, K. Kimura, **K. Masuda**, and M. Okuno, Verification of the annual dating of the 10th century Baitoushan Volcano Eruption based on an AD 774–775 radiocarbon spike. *Radiocarbon*, **60(1)**, 261–268, Feb. 2018 (10.1017/RDC.2017.75).

Hammer, S., R. Friedrich, B. Kromer, A. Cherkinsky, S. J. Lehman, H. A. J. Meijer, **T. Nakamura**, V. Palonen, R. W. Reimer, A. M. Smith et al., Compatibility of atmospheric $^{14}CO_2$ measurements: comparing the Heidelberg low-level counting facility to international accelerator mass spectrometry (AMS) laboratories. *Radiocarbon*, **59(3)**, 875–883, Jun. 2017 (10.1017/RDC.2016.62).

Han, C., A. Udalski, A. Gould, I. A. Bond, M. D. Albrow, S.-J. Chung, Y. K. Jung, Y.-H. Ryu, I.-G. Shin, J. C. Yee et al. (**F. Abe**, **Y. Asakura**, **Y. Itow**, **K. Masuda**, **Y. Matsubara**, **Y. Muraki**), OGLE-2016-BLG-0263Lb: microlensing detection of a very low-mass binary companion through a repeating event channel. *Astronom. J.*, **154(4)**, 133, Oct. 2017 (10.3847/1538-3881/aa859a).

Han, C., A. Udalski, T. Sumi, A. Gould, M. D. Albrow, S.-J. Chung, Y. K. Jung, Y.-H. Ryu, I.-G. Shin, J. C. Yee et al. (**F. Abe**, **Y. Asakura**, **Y. Itow**, **K. Masuda**, **Y. Matsubara**, **Y. Muraki**, **H. Oyokawa**), OGLE-2016-BLG-1469L: Microlensing binary composed of brown dwarfs. *Astrophys. J.*, **843(1)**, 59, Jul. 3, 2017 (10.3847/1538-4357/aa740e).

Hashimoto, A., **M. Murakami**, and S. Haginoya, First application of JMA-NHM to meteorological simulation over the United Arab Emirates. *SOLA*, **13**, 146–150, Sep. 4, 2017 (10.2151/sola.2017-027).

Hashimoto, K. K., **T. Kikuchi**, I. Tomizawa, and T. Nagatsuma, Substorm overshielding electric field at low latitude on the nightside as observed by the HF Doppler sounder and magnetometers, *J. Geophys. Res. Space Physics*, **122(10)**, 10851–10863, Oct. 30, 2017 (10.1002/2017JA024329).

Hayashi, K., X. Feng, M. Xiong, and C. Jiang, An MHD Simulation of Solar Active Region 11158 Driven with Time-Dependent Electric Field Determined from HMI Vector Magnetic Field Measurement Data. *Astrophys. J.*, **855(1)**, 11, Feb. 28, 2018 (10.3847/1538-4357/aaacd8).

Hikishima, M., H. Kojima, Y. Katoh, Y. Kasahara, S. Kasahara, T. Mitani, N. Higashio, A. Matsuoka, **Y. Miyoshi**, K. Asamura, T. Takeshima, S. Yokota, M. Kitahara, and **S. Matsuda**, Data processing in Software-type wave-particle interaction analyzer on board the Arase satellite. *Earth Planets Space*, in press (10.1186/s40623-018-0817-5).

Hirao, Y., A. Udalski, T. Sumi, D. P. Bennett, N. Koshimoto, I. A. Bond, N. J. Rattenbury, D. Suzuki, **F. Abe**, **Y. Asakura** et al. (**Y. Itow**, **K. Masuda**, **Y. Matsubara**, **Y. Muraki**), OGLE-2013-BLG-1761Lb: A massive planet around an M/K dwarf. *Astronom. J.*, **154(1)**, 1, Jun. 8, 2017 (10.3847/1538-3881/aa73da).

Hirata, H., R. Kawamura, **M. Kato**, and **T. Shinoda**, A positive feedback process related to the rapid development of an extratropical cyclone over the Kuroshio/Kuroshio Extension. *Mon. Weather Rev.*, **146(2)**, 417–433, Feb. 2018

(10.1175/MWR-D-17-0063.1).

Holloway, C. E., A. A. Wing, S. Bony, C. Muller, **H. Masunaga**, T. S. L'Ecuyer, D. D. Turner, and P. Zuidema, Observing convective aggregation. *Surv. Geophys*., **38(6)**, 1199–1236, Nov. 2017 (10.1007/s10712-017-9419-1).

Honda, M. C., M. Wakita, K. Matsumoto, T. Fujiki, E. Siswanto, K. Sasaoka, H. Kawakami, **Y. Mino**, C. Sukigara, M. Kitamura et al, Comparison of carbon cycle between the western Pacific subarctic and subtropical time-series stations: highlights of the K2S1 project. *J. Oceanogr.*, **73(5)**, 647–667, Oct. 2017 (10.1007/s10872-017-0423-3).

Hori, T., M. Shidatsu, Y. Ueda, T. Kawamuro, M. Morii, S. Nakahira, N. Isobe, N. Kawai, T. Mihara, M. Matsuoka et al (**K. Yamaoka**), The 7-year MAXI/GSC Source Catalog of the Low-Galactic-latitude Sky (3MAXI). *Astrophys. J. Suppl. Ser*., **235(1)**, 7, Feb. 26, 2018 (10.3847/1538-4365/aaa89c).

Hui, D., D. Chakrabarty, R. Sekar, G. D. Reeves, A. Yoshikawa, and **K. Shiokawa**, Contribution of storm time substorms to the prompt electric field disturbances in the equatorial ionosphere. *J. Geophys. Res. Space Physics*, **122(5)**, 5568–5578, Jun. 20, 2017 (10.1002/2016JA023754).

Hurley, K., R. L. Aptekar, S. V. Golenetskii, D. D. Frederiks, D. S. Svinkin, V. D. Pal'shin, M. S. Briggs, C. Meegan, V. Connaughton, J. Goldsten et al. (**K. Yamaoka**), The InterPlanetary Network supplement to the second fermi GBM catalog of cosmic gamma-ray bursts. *Astrophys. J. Suppl. Ser*., **229(2)**, 31, Apr. 2017 (10.3847/1538-4365/229/2/31).

Ieda, A., K. Kauristie, Y. Nishimura, Y. Miyashita, H. U. Frey, L. Juusola, D. Whiter, M. Nosé, M. O. Fillingim, F. Honary, N. C. Rogers, **Y. Miyoshi**, T. Miura, T. Kawashima, and S. Machida, Simultaneous observation of auroral substorm onset in Polar satellite global images and ground-based all-sky images. *Earth Planets Space*, in press.

Iijima, H., and T. Yokoyama, A three-dimensional simulation of chromospheric jets with twisted magnetic field lines. *Astrophys. J.*, **848(1)**, 38, Oct. 10, 2017 (10.3847/1538-4357/aa8ad1).

Iijima, H., H. Hotta, **S. Imada**, **K. Kusano**, and D. Shiota, Improvement of solar-cycle prediction: Plateau of solar axial dipole moment. *Astron. Astrophys*., **607**, L2, Nov. 6, 2017 (10.1051/0004-6361/201731813).

Inoue, S., Y. Bamba, and **K. Kusano,** Onset mechanism of solar eruptions. *J. Atmos. Sol.-Terr. Phys*., in press (10.1016/j.jastp.2017.08.035).

Inoue, S., **K. Kusano**, J. Büchner and J. Skála, Formation and dynamics of a solar eruptive flux tube. *Nat. Commun*., **9**, 174, Jan. 12, 2018 (10.1038/s41467-017-02616-8).

Inoue, Y., T. Ichie, T. Kenzo, A. Yoneyama, **T. Kumagai**, and T. Nakashizuka, Effects of rainfall exclusion on leaf gas exchange traits and osmotic adjustment in mature canopy trees of Dryobalanops aromatica (Dipterocarpaceae) in a Malaysian tropical rain forest. *Tree Physiol*., **37(10)**, 1301–1311, Oct. 1, 2017 (10.1093/treephys/tpx053).

Ishiguro, N., and **K. Kusano**, Double arc instability in the solar corona. *Astrophys. J*., **843(2)**, 101, Jul. 11, 2017 (10.3847/1538-4357/aa799b).

Ishihara, D., T. Kondo, H. Kaneda, T. Suzuki, K. Nakamichi, S. Takaba, H. Kobayashi, **S. Masuda**, T. Ootsubo, J. Pyo, and T. Onaka, A likely detection of a local interplanetary dust cloud passing near the Earth in the AKARI mid-infrared all-sky map. *Astron. Astrophys.*, **603**, A82, Jul. 10, 2017 (10.1051/0004-6361/201628954).

Iwai, K., M. Loukitcheva, M. Shimojo, S. K. Solanki, and S. M. White, ALMA Discovery of Solar Umbral Brightness Enhancement at $\lambda = 3$ mm. *Astrophys. J. Lett*., **841(2)**, L20, May 24, 2017 (10.3847/2041-8213/aa71b5).

Iwai, K., Y. Kubo, H. Ishibashi, T. Naoi, K. Harada, K. Ema, Y. Hayashi, and Y. Chikahiro, OCTAD-S: digital fast Fourier transform spectrometers by FPGA. *Earth Planets Space*, **69(1)**, 95, Dec. 2017 (10.1186/s40623-017-0681-8).

Izumi, T., K. Kohno, K. Fathi, E. Hatziminaoglou, R. I. Davies, S. Martin, S. Matsushita, E. Schinnerer, D. Espada, S. Aalto,

et al. (**T. Nakajima**), On the disappearance of a cold molecular torus around the low-luminosity active galactic nucleus of NGC 109. *Astrophys. J. Lett*., **745(1)**, L5, Aug. 10, 2017 (10.3847/2041-8213/aa808f).

Jayachandran, P. T., A. M. Hamza, K. Hosokawa, H. Mezoui, and **K. Shiokawa,** GPS amplitude and phase scintillation associated with polar cap auroral forms. *J. Atmos. Sol.-Terr. Phys*., **164,** 185–191, Nov. 2017 (10.1016/j.jastp.2017.08.030).

Jomori, Y., **M. Minami**, A. Sakurai-Goto, and A. Ohta, Comparing the $^{87}Sr/^{86}Sr$ of the bulk and exchangeable fractions in stream sediments: Implications for $^{87}Sr/^{86}Sr$ mapping in provenance studies. *Appl. Geochem*., **86**, 70–83, Nov. 2017 (10.1016/j.apgeochem.2017.09.004).

Jung, Y. K., A. Udalski, I. A. Bond, J. C. Yee, A. Gould, C. Han, M. D. Albrow, C.-U. Lee, S.-L. Kim, K.-H. Hwang et al. (**F. Abe**, **Y. Asakura**, **Y. Itow**, **K. Masuda**, **Y. Matsubara**, **Y. Muraki**), GLE-2016-BLG-1003: First resolved caustic-crossing binary-source event discovered by second-generation microlensing surveys. *Astrophys. J.*, **841(2)**, 75, May 25, 2017 (10.3847/1538-4357/aa7057).

Kameda, S., S. Ikezawa, M. Sato, M. Kuwabara, N. Osada, G. Murakami, K. Yoshioka, I. Yoshikawa, M. Taguchi, R. Funase, S. Sugita, **Y. Miyoshi**, and M. Fujimoto, Ecliptic north-south symmetry of hydrogen geocorona. *Geophys. Res. Lett*., **44(23)**, 11706–11712, Dec. 16, 2017 (10.1002/2017GL075915).

Kanada, S., **K. Tsuboki**, **H. Aiki**, **S. Tsujino**, and I. Takayabu, Future enhancement of heavy rainfall events associated with a typhoon in the midlatitude regions. *SOLA*, **13**, 246–254, Dec. 24, 2017 (10.2151/sola.2017-045).

Kanada, S., **S. Tsujino**, **H. Aiki**, **M. K. Yoshioka**, Y. Miyazawa, **K. Tsuboki**, and I. Takayabu, Impacts of SST patterns on rapid intensification of Typhoon Megi (2010). *J. Geophys. Res. Atmos.*, **122(24)**, 13245–13262, Dec. 27, 2017 (10.1002/2017JD027252).

Kanada, S., T. Takemi, **M. Kato**, S. Yamasaki, H. Fudeyasu, **K. Tsuboki**, O. Arakawa, and I. Takayabu, A multimodel intercomparison of an intense typhoon in future, warmer climates by Four 5-km-Mesh models. *J. Clim.*, **30(15)**, 6017–6036, Aug. 2017 (10.1175/JCLI-D-16-0715.1).

Kaneda, K., H. Misawa, K. Iwai, F. Tsuchiya, T. Obara, Y. Katoh, and **S. Masuda**, Polarization characteristics of zebra patterns in type IV solar bursts. *Astrophys. J*., **842(1)**, 45, Jun. 13, 2017 (10.3847/1538-4357/aa74c1).

Kaneda, K., H. Misawa, **K. Iwai**, **S. Masuda**, F. Tsuchiya, Y. Katoh, and T. Obara, Detection of propagating fast sausage waves through detailed analysis of a zebra-pattern fine structure in a solar radio burst. *Astrophys. J. Lett*., **855(2)**, L29, Mar. 15, 2018 (10.3847/2041-8213/aab2a5).

Kaneko, T., and T. Yokoyama, Reconnection-condensation model for solar prominence formation. *Astrophys. J.*, **845(1)**, 12, Aug. 10, 2017 (10.3847/1538-4357/aa7d59).

Kasaba, Y., T. Imamura, F. Tsuchiya, N. Terada, **Y. Miyoshi**, Y. Kasai, and Y. Saito, Planetary plasma and atmospheres explored by space missions in Japan: Hisaki, Akatsuki, and beyond. *J. Phys. Conf. Ser.*, **869(1)**, 012094, Oct. 13, 2017 (10.1088/1742-6596/869/1/012094).

Kasaba, Y., K. Ishisaka, Y. Kasahara, T. Imachi, S. Yagitani, H. Kojima, **S. Matsuda**, **M. Shoji**, **S. Kurita**, **T. Hori**, **A. Shinbori**, **M. Teramoto**, **Y. Miyoshi** et al., Wire Probe Antenna (WPT) and Electric Field Detector (EFD) of Plasma Wave Experiment (PWE) aboard the Arase satellite: specifications and initial evaluation results. *Earth Planets Space*, **69**, 174, Dec. 27, 2017 (10.1186/s40623-017-0760-x).

Kasahara, S., **Y. Miyoshi**, S. Yokota, T. Mitani, Y. Kasahara, **S. Matsuda**, A. Kumamoto, A. Matsuoka, Y. Kazama, H. U. Frey, V. Angelopoulos, S**. Kurita**, K. Keika, K. Seki, and I. Shinohara, Pulsating aurora from electron scattering by chorus waves. *Nature*, **554**, 337–340, Feb. 15, 2018 (55410.1038/nature25505).

Kasahara Y., Y. Kasaba, H. Kojima, S. Yagitani, K. Ishisaka, A. Kumamoto, F. Tsuchiya, M. Ozaki, S. Matsuda, T. Imachi et al. (**Y. Miyoshi**, **M. Shoji**), The Plasma Wave Experiment (PWE) on board the Arase (ERG) satellite. *Earth Planets Space*, in press (10.1186/s40623-017-0759-3).

Katoh, Y., H. Kojima, M. Hikishima,T. Takashima, K. Asamura, **Y. Miyoshi**, Y. Kasahara, S. Kasahara, T. Mitani, N. Higashio et al. (**S. Matsuda**), Software-type Wave-Particle Interaction Analyzer on board the ARASE satellite. *Earth Planets Space*, **70**, 4, Jan. 8, 2018 (10.1186/s40623-017-0771-7).

Kato, T., **K. Suzuki**, M.-J. Jeen, and **M. Minami**, Pseudo-fixed dead time circuit for designing and implementation of JEOL-type X-ray counting systems. *Chem. Geol*., in press (10.1016/j.chemgeo.2017.12.030).

Kawabata, Y., **S. Inoue**, and T. Shimizu, Non-potential field formation in the X-shaped quadrupole magnetic field configuration. *Astrophys. J*., **842(2)**, 106, Jun. 20, 2017 (10.3847/1538-4357/aa71a0).

Kawaguchi, K., **R. Fujimori**, J. Tang, and T. Ishiwata, Infrared spectroscopy of the NO_3 radical from 2000 to 3000 cm^{-1}. *J. Mol. Spectrosc.*, **344**, 6–16, Feb. 2018 (10.1016/j.jms.2017.09.012).

Kawaguchi, K., T. Nakahara, **R. Fujimori**, J. Tang, and T. Ishiwata, Infrared spectroscopy of $2\nu_4$ and $\nu_3 + 2\nu_4$ bands of the NO_3 radical. *J. Mol. Spectrosc.*, **334**, 10–21, Apr. 1, 2017 (10.1016/j.jms.2017.02.008).

Kawahara, T. D., **S. Nozawa**, N. Saito, T, Kawabata, T. T. Tsuda, and S. Wada, Sodium temperature/wind LIDAR based on laser-diode-pumped Nd: Yag lasers deployed at Tromsø, Norway (69.6°N, 19.2°E). *Opt. Express*, **25(12)**, A491–A50, Jun. 12, 2017 (10.1364/OE.25.00A491).

Kawakubo, Y., T. Sakamoto, S. Nakahira, **K. Yamaoka**, M. Serino, Y. saoka, M. L. Cherry, S. Matsukawa, M. Mori, Y. Nakagawa et al., Detection of the thermal component in GRB 160107A. *Publ. Astron. Soc. Japan*, **70(1)**, 6, Jan. 1, 2018 (10.1093/pasj/psx152).

Kazama, Y., Y. Kazama, B.-J. Wang, S.-Y. Wang, P. T. P. Ho, S. W. Y. Tam, **T.-F. Chang**, C.-Y. Chiang, and K. Asamura, Low-energy particle experiments–electron analyzer (LEPe) onboard the Arase spacecraft. *Earth Planets Space*, **69**, 165, Dec. 11, 2017 (10.1186/s40623-017-0748-6).

Keika, K., K.Seki, M. Nosé, **Y. Miyoshi**, L. J. Lanzerotti, D. G. Mitchell, M. Gkioulidou, and J. W. Manweiler, Three-step buildup of the 17 March 2015 storm ring current: Implication for the cause of the unexpected storm intensification. *J. Geophys. Res. Space Physics*, **123(1)**, 414–428, Jan. 2018 (10.1002/2017JA024462).

Keika, K., **Y. Miyoshi**, **S. Machida**, **A. Ieda**, K. Seki, **T. Hori**, Y. Miyashita, **M. Shoji**, I. Shinohara, V. Angelopoulos, J. W. Lewis, and A. Flores, Visualization tool for three-dimensional plasma velocity distributions (ISEE_3D) as a plug-in for SPEDAS. *Earth Planets Space*, **69**, 170, Dec. 21, 2017 (10.1186/s40623-017-0761-9).

Kikuchi, M., H. Okamoto, K. Sato, K. Suzuki, G. Cesana, Y. Hagihara, **N. Takahashi**, T. Hayasaka, and R. Oki, Development of algorithm for discriminating hydrometeor particle types with a synergistic use of CloudSat and CALIPSO. *J. Geophys. Res. Atmos*., **122(20)**, 11022–11044, Oct. 27, 2017 (10.1002/2017JD027113).

Kim, S.-I., K.-H. Kim, H.-J. Kwon, H. Jin, E. Lee, G. Jee, **N. Nishitani**, **T. Hori**, M. Lester, and J. R. Wygant, SC-associated electric field variations in the magnetosphere and ionospheric convective flows. *J. Geophys. Res. Space Physics*, **122(11)**, 11044–11057, Nov. 2017 (10.1002/2017JA024611).

Kitagawa, H., M. Stein, S. L. Goldstein, **T. Nakamura**, B. Lazar, and DSDDP Scientific Party, Radiocarbon chronology of the DSDDP CORE at the deepest floor of the Dead Sea. *Radiocarbon*, **59(2)**, 383–394, Apr. 2017 (10.1017/RDC.2016.120).

Kitamura, M., M. C. Honda, Y. Hamajima, Y. Kumamoto, M. Aoyama, H. Kawakami, T. Aono, M. Fukuda, and **Y. Mino**, Temporal changes in radiocesium contamination derived from the Fukushima Dai-ichi Nuclear Power Plant

accident in oceanic zooplankton in the western North Pacific. *J. Environ. Radioact.*, **172**, 163–172, Jun. 2017 (10.1016/j.jenvrad.2017.03.024).

Kobayashi, S., S. Nakada, M. Nakajima, K. Yamamoto, S. Akiyama, M. Fuchi, **M. Hayashi**, and **J. Ishizaka**, Visualization of the distribution of dissolved organic matter in Osaka Bay using a satellite ocean color sensor (COMS/GOCI). *Journal of Water and Environment Technology*, **15(2)**, 55–64, Apr. 10, 2017 (10.2965/jwet.16-055).

Koga, K., **Y. Muraki**, **S. Masuda**, S. Shibata, H. Matsumoto, and H. Kawano, Measurement of Solar Neutrons on 05 March 2012, Using a Fiber-Type Neutron Monitor Onboard the Attached Payload to the ISS. *Sol. Phys*., **292(8)**, 115–131, Aug. 2017 (10.1007/s11207-017-1135-y).

Koshimoto, N., Y. Shvartzvald, D. P. Bennett, M. T. Penny, M. Hundertmark, I. A. Band, W. C. Zang, C. B. Henderson, D. Suzuki, N. J. Rattenbury, T. Sumi, **F. Abe**, **Y. Asakura** et al (**Y. Itow**, **K. Masuda**, **Y. Matsubara**, **Y. Muraki)**, MOA-2016-BLG-227Lb: A massive planet characterized by combining light-curve analysis and Keck AO imaging. *Astronom. J*., **154(1)**, 3, Jun. 9, 2017 (10.3847/1538-3881/aa72e0).

Kotani, A., **T. Hiyama**, T. Ohta, M. Hanamura, J. R. Kambatuku, S. K. Awala, and M. Iijima, Impact of rice cultivation on evapotranspiration in small seasonal wetlands of north-central Namibia. *Hydrological Research Letters*, **11(2)**, 134–140, Jun. 22, 2017 (10.3178/hrl.11.134).

Kouketsu, T., **H. Uyeda**, **T. Ohigashi**, and **K. Tsuboki**, Relationship between cloud-to-ground lightning polarity and the space-time distribution of solid hydrometeors in isolated summer thunderclouds observed by X-band polarimetric radar. *J. Geophys. Res. Atmos.*, **122(16)**, 8781–8800, Sep. 28, 2017 (10.1002/2016JD026283).

Kumamoto, A., F. Tsuchiya, Y. Kasahara, Y. Kasaba, H. Kojima, S. Yagitani, K. Ishisaka, T. Imachi, M. Ozaki, **S. Matsuda** et al (**Y. Miyoshi**), High Frequency Analyzer (HFA) of Plasma Wave Experiment (PWE) onboard the Arase spacecraft. *Earth Planets Space*, in press (10.1186/s40623-018-0782-z).

Kunita, K., **T. Nakamura**, and K. Kato, Accurate age estimation using ^{14}C content in Japanese human teeth. *Radiocarbon*, **59(3)**, 739–756, Jun. 2017 (10.1017/RDC.2016.106).

Lapington, J. S., A. Abchiche, D. Allan, J.-P. Amans, T. P. Armstrong, A. Balzer, D. Berge, C. Boisson, J.-J. Bousquet, R. Bose et al. (**N. Hidaka**, **T. Kawashima**, **A. Okumura**, **Y. Sato**, **H. Tajima**), The GCT camera for the Cherenkov Telescope Array. *Nucl. Instrum. Methods Phys. Res. Sect. A-Accel. Spectrom. Dect. Assoc. Equip*., **876**, 1–4, Dec. 21, 2017 (10.1016/j.nima.2016.12.010).

Lee, J., S. M. White, C. Liu, **B. Kliem**, and **S. Masuda**, Magnetic Structure of a Composite Solar Microwave Burst, *Astrophys. J*, **856(1)**, 70, Mar. 26, 2018 (10.3847/1538-4357/aaadbc).

Lee, J., S. M. White, J. Jing, C. Liu, **S. Masuda**, and J. Chae, Thermal and nonthermal emissions of a composite flare derived from NoRH and SDO observations. *Astrophys. J.*, **850(2)**, 124, Dec. 1, 2017 (10.3847/1538-4357/aa96b6).

Lee, K., T. Matsuno, T. Endoh, **J. Ishizak**a, **Y. Zhu**, S. Takeda, and C. Sukigara, A role of vertical mixing on nutrient supply into the subsurface chlorophyll maximum in the shelf region of the East China Sea. *Cont. Shelf Res*., **143**, 139–150, Jul. 1, 2017(10.1016/j.csr.2016.11.001).

Lee, S.-G., **T. Tanaka**, Y. Asahara, and **M. Minami**, A distinctive chemical composition of the tektites from Thailand and Vietnam, and its geochemical significance. *Jour. Petrol. Soc. Korea*, **26(3)**, 281–295, Sep. 2017 (10.7854/JPSK.2017.26.3.281).

Li, G., B. Ning, M. A. Abdu, C. Wang, **Y. Otsuka**, W. Wan, J. Lei, M. Nishioka, T. Tsugawa, L. Hu, G. Yang, and C. Yan, Daytime F-region irregularity triggered by rocket-induced ionospheric hole over low latitude. *Prog. Earth Planet. Sci*., **5(1)**, 11, Feb. 20, 2018 (10.1186/s40645-018-0172-y).

Li, M. C. A., N. J. Rattenbury, I. A. Bond, T. Sumi, D. P. Bennett, N. Koshimoto, **F. Abe**, **Y. Asakura**, R. Barry, A. Bhattacharya et al. (**Y. Itow**, **K. Masuda**, **Y. Matsubara**, **Y. Muraki**), The first eclipsing binary catalogue from the MOA-II data base. *Mon. Not. Roy. Astron. Soc*., **470(1)**, 539–550, Aug. 2017 (10.1093/mnras/stx1280).

Lin, C. H., C. H. Chen, **M. Matsumura**, J. T. Lin, and Y. Kakinami, Observation and simulation of the ionosphere disturbance waves triggered by rocket exhausts. *J. Geophys. Res. Space Physics*, **122(8)**, 8868–8882, Sep. 25, 2017 (10.1002/2017JA023951).

Lin, C. H., M. H. Shen, M. Y. Chou, C. H. Chen, J. Yue, P. C. Chen, and **M. Matsumura**, Concentric traveling ionospheric disturbances triggered by the launch of a SpaceX Falcon 9 rocket. *Geophys. Res. Lett*., **44(15)**, 7578–7586, Aug. 26, 2017 (10.1002/2017GL074192).

Loukitcheva, M. A., **K. Iwai**, S. K. Solanki, S. M. White, and M. Shimojo, Solar ALMA observations: constraining the chromosphere above sunspots. *Astrophys. J*., **850(1)**, 35, Nov. 20, 2017(10.3847/1538-4357/aa91cc).

Mapes, B. E., E.-S. Chung, W. M. Hannah, **H. Masunaga**, A. J. Wimmers, and C. S. Velden, The meandering margin of the meteorological moist Tropics. *Geophys. Res. Lett*., **45(2)**, 1177–1184, Jan. 28, 2018 (10.1002/2017GL076440).

Matsumoto, T., Thermal responses in a coronal loop maintained by wave heating mechanisms. *Mon. Not. Roy. Astron. Soc*., in press (10.1093/mnras/sty490).

Matsunaga, K., K. Seki, D. A. Brain, T. Hara, K. Masunaga, J. P. Mcfadden, J. S. Halekas, D. L. Mitchell, C. Mazelle, J. R. Espley, J. Gruesbeck, and B. M. Jakosk, Statistical study of relations between the induced magnetosphere, ion composition, and pressure balance boundaries around mars based on MAVEN observations. *J. Geophys. Res. Space Physics*, **122(9)**, 9723–9737, Sep. 29, 2017 (10.1002/2017JA024217).

Matsuoka, A., **M. Teramoto**, R. Nomura, M. Nosé, A. Fujimoto, Y. Tanaka, M. Shinohara, T. Nagatsuma, **K. Shiokawa**, Y. Obana, **Y. Miyoshi**, M. Mita, T. Takashima, and I. Shinohara, The ARASE (ERG) magnetic field investigation. *Earth Planets Space*, **70(1)**, 43, Mar. 14, 2018 (10.1186/s40623-018-0800-1).

Maúre, E. R., **J. Ishizaka**, C. Sukigara, **Y. Mino**, **H. Aiki**, T. Matsuno, **H. Tomita**, J. I. Goes, and H. R. Gomes, Mesoscale eddies control the timing of spring phytoplankton blooms: a case study in the Japan Sea. *Geophys. Res. Lett*., **44(21)**, 11115–11124, Nov. 16, 2017 (10.1002/2017GL074359).

Maw Maw Win, M. Enami, **T. Kato**; and **Ye Kyaw Thu**, A mechanism for Nb incorporation in rutile and application of Zr-in-rutile thermometry: A case study from granulite facies paragneisses of the Mogok metamorphic belt, Myanmar. *Mineral. Mag*., **81(6)**, 1503–1521, Dec. 1, 2017 (10.1180/minmag.2017.081.014).

McComas, D. J., E. J. Zimstein, M. Bzowski, M. A. Dayeh, H. O. Funsten, S. A. Fuselier, P. H. Janzen, M. A. Kubiak, H. Kucharck, E. Möbius et al. (**M. Tokumaru)**, Seven years of imaging the global heliosphere with IBEX. *Astrophys. J. Suppl. Ser*., **229(2)**, 41, Apr. 17, 2017 (10.3847/1538-4365/aa66d8).

Minami, M., and **K. Suzuki**, $^{87}Sr/^{86}Sr$ compositional linkage between geological and biological materials: A case study from the Toyota granite region of Japan. *Chem. Geol.*, in press (10.1016/j.chemgeo.2018.03.013).

Minami, M., **Y. Jomori**, **K. Suzuki**, and A. Ohta, Grain-size variations in $^{87}Sr/^{86}Sr$ and elemental concentrations of stream sediments in a granitic area: Fundamental study on $^{87}Sr/^{86}Sr$ spatial distribution mapping. *Geochem. J*., **51(6)**, 469–484, Dec. 5, 2017 (10.2343/geochemj.2.0478).

Minda, H., N. Tsuda, and Y. Fujiyoshi, Three-dimensional shape and fall velocity measurements of snowflakes using a multi-angle snowflake imager. *J. Atmos. Oceanic Technol.*, **34(8)**, 1763–1781, Aug. 2017 (10.1175/JTECH-D-16-0221.1).

Miyake, F., **K. Masuda**, **T. Nakamura**, K. Kimura, M. Hakozaki, A. J. T. Jull, T. E. Lange, R. Cruz, I. P. Panyushkina, C. Baisan, and M. W. Salzer, Search for annual ^{14}C excursions in the past. *Radiocarbon*, **59(2)**, 315–320, Apr.

2017 (10.1017/RDC.2016.54).

Miyake, Y., Y. Funaki, **M. N. Nishino**, and H. Usui, Particle simulations of electric and dust environment near the lunar vertical hole. in *Diverse World of Dusty Plasmas Proceeding of the 8th International Conference on the Physics of Dusty Plasmas*, AIP Conference Proceedings, edited by Z. Nemecek, J. Pavlu, and J. Safrankova, **1925(1)**, 020001, AIP Publishing, NY, U.S.A., Jan. 5, 2018 (10.1063/1.5020389).

Miyoshi, Y., Y. Kasaba, I. Shinohara, T. Takashima, K. Asamura, H. Matsumoto, N. Higashio, T. Mitani, S. Kasahara, S. Yokota et al (**K. Shiokawa**), Geospace exploration project: Arase (ERG). *J. Phys. Conf. Ser.*, **869(1)**, 12095, Oct. 13, 2017 (10.1088/1742-6596/869/1/012095).

Mizuochi, H., **T. Hiyama**, T. Ohta, Y. Fujioka, J. R. Kambatuku, M. Iijima, and K. N. Nasahara, Development and evaluation of a lookup-table-based approach to data fusion for seasonal wetlands monitoring: An integrated use of AMSR series, MODIS, and Landsat. *Remote Sens. Environ.*, **199**, 370–388, Sep. 15, 2017 (10.1016/j.rse.2017.07.026).

Montel, J.-M., **T. Kato**, **M. Enami**, A. Cocherie, F. Finger, M. Williams, and M. Jercinovic, Electron-microprobe dating of monazite: The story. *Chem. Geol.*, in press (10.1016/j.chemgeo.2017.11.001).

Morgan, J. S., J-P. Macquart, R. Ekers, R. Chhetri, **M. Tokumaru**, P. K. Manoharan, S. Tremblay, M. M. Bisi, and B. V. Jackson, Interplanetary Scintillation with the Murchison Widefield Array I: A sub-arcsecond survey over 900 deg^2 at 79 and 158 MHz. *Mon. Not. Roy. Astron. Soc.*, **473(3)**, 2965–2983, Jan. 21, 2018 (10.1093/mnras/stx2284).

Mróz, P., A. Udalski, I. A. Bond, J. Skowron, T. Sumi, C. Han, M. K. Szymański, I. Soszyński, R. Poleski, P. Pietrukowicz et al. (**F. Abe**, **Y. Asakura**, **Y. Itow**, **K. Masuda**, **Y. Matsubara**, **Y. Muraki)**, OGLE-2013-BLG-0132Lb and OGLE-2013-BLG-1721Lb: Two Saturn-mass Planets Discovered around M-dwarfs. *Astrophys. J.*, **154(5)**, 205, Nov. 2017 (10.3847/1538-3881/aa8f98).

Muhamad, J., **K. Kusano**, **S. Inoue**, and **D. Shiota**, Magnetohydrodynamic simulations for studying solar flare trigger mechanism. *Astrophys. J.*, **842(2)**, 86, Jun. 6, 2017 (10.3847/1538-4357/aa750e).

Murata, F.; T. Terao, **H. Fujinami**, T. Hayashi, H. Asada, J. Matsumoto, and H. J. Syiemlieh, Dominant synoptic disturbance in the extreme rainfall at Cherrapunji, northeast India, based on 104 years of rainfall data (1902–2005). *J. Clim.*, **30(20)**, 8237–8251, Oct. 2017 (10.1175/JCLI-D-16-0435.1).

Nagai, A., C. Alispach, T. Berghöfer, G. Bonanno, V. Coco, D. della Volpe, A. Haungs, M. Heller, K. Henjes-Kunst, R. Mirzoyan et al. (**H. Tajima)**, SENSE: A comparison of photon detection efficiency and optical crosstalk of various SiPM devices. *Nucl. Instrum. Methods Phys. Res. Sect. A-Accel. Spectrom. Dect. Assoc. Equip.*, in press (10.1016/j.nima.2017.11.018).

Nagakane, M., T. Sumi, N. Koshimoto, D. P. Bennett, I. A. Bond, N. Rattenbury, D. Suzuki, **F. Abe**, **Y. Asakura**, R. Barry et al (**Y. Itow**, **K. Masuda**, **Y. Matsubara**, **Y. Muraki**), MOA-2012-BLG-505Lb: A super-earth-mass planet that probably resides in the galactic bulge. *Astron. J.*, **154(1)**, 35, Jun. 30, 2017 (10.3847/1538-3881/aa74b2).

Nagano, H., H. Ikawa, **T. Nakai**, M. Matsushima-Yashima, H. Kobayashi, Y. Kim, and R. Suzuki, Extremely dry environment down-regulates nighttime respiration of a black spruce forest in Interior Alaska. *Agric. For. Meteorol.*, **249**, 297–309, Feb. 14, 2018 (10.1016/j.agrformet.2017.11.001).

Nakada, S., S. Kobayashi, M. Hayashi, **J. Ishizaka**, S. Akiyama, M. Fuchi, and M. Nakajima, High-resolution surface salinity maps in coastal oceans based on geostationary ocean color images: quantitative analysis of river plume dynamics. *J. Oceanogr.*, in press (10.1007/s10872-017-0459-4).

Nakagawa, T., **M. N. Nishino**, H. Tsunakawa, F. Takahashi, H. Shibuya, H. Shimizu, M. Matsushima, and Y. Saito, Electromagnetic ion cyclotron waves detected by Kaguya and Geotail in the Earth's magnetotail. *J. Geophys. Res.*

Space Physics, **123(2)**, 1146–1164, Feb. 2018 (10.1002/2017JA024505).

Nakajima, T., S. Takano, K. Kohno, N. Harada, and E. Herbst, A molecular line survey toward the nearby galaxies NGC 1068, NGC 253, and IC 342 at 3 mm with the Nobeyama 45 m radio telescope: Impact of an AGN on 1 kpc scale molecular abundances. *Publ. Astron. Soc. Japan*, **70(1)**, 7, Jan. 1, 2018 (10.1093/pasj/psx153).

Nakamura, Y., **K. Shiokawa**, **Y. Otsuka**, **S. Oyama**, **S. Nozawa**, T. Komolmis, S. Komonjida, D. Neudeg, C. Yuile, J. Meriwether, H. Shinagawa, and H. Jin, Measurement of thermospheric temperatures using OMTI Fabry-Perot interferometers with 70-mm etalon. *Earth Planets Space*, **69(1)**, 57, Apr. 4, 2017 (10.1186/s40623-017-0643-1).

Nakanishi, T., M. Torii, K. Yamasaki, E. Bariso, D. J. Rivera, R. Lim, C. Pogay, A. Daag, W. Hong, **T. Nakamura** et al., Tephra identification and radiocarbon chronology of sediment from Paitan Lake at the northern part of Luzon Central Plain, Philippines. *Quat. Int.*, **456**, 210–216, Oct. 15, 2017 (10.1016/j.quaint.2017.08.047).

Nakayama, T., **Y. Matsumi**, K. Kawahito, and Y. Watabe, Development and evaluation of a palm-sized optical $PM_{2.5}$ sensor. *Aerosol Sci. Technol*., **52(1)**, 2–12, Jan. 2018 (10.1080/02786826.2017.1375078).

Nakayama, T., K. Sato, T. Imamura, and **Y. Matsumi**, Effect of oxidation process on complex refractive index of secondary organic aerosol generated from isoprene. *Environ. Sci. Technol*., **52(5)**, 2566–2574, Jan. 31, 2018 (10.1021/acs.est.7b05852).

Nakayama, T., **Y. Kuruma**, **Y. Matsumi**, Y. Morino, K. Sato, H. Tsurumaru, S. Ramasamy, Y. Sakamoto, S. Kato, Y. Miyazaki et al., Missing ozone-induced potential aerosol formation in a suburban deciduous forest. *Atmos. Environ.*, **171**, 91–97, Dec. 2017 (10.1016/j.atmosenv.2017.10.014).

Nishi, K., **K. Shiokawa**, and D. Frühauff, Conjugate observation of auroral finger-like structures by ground-based all-sky cameras and THEMIS satellites. *J. Geophys. Res. Space Physics*, **122(7)**, 7291–7306, Aug. 12, 2017 (10.1002/2016JA023774).

Nishino, M. N., Y. Harada, Y. Saito, H. Tsunakawa, F. Takahashi, S. Yokota, M. Matsushima, H. Shibuya, and H. Shimizu, Kaguya observations of the lunar wake in the terrestrial foreshock: Surface potential change by bow-shock reflected ions, *Icarus*, **293**, 45–51, Sep. 1, 2017 (10.1016/j.icarus.2017.04.005).

Nuijens, L., K. Emanuel, **H. Masunaga**, and T. S. L'Ecuyer, Implicatinos of warm rain in shallow cumulus and congestus clouds for large-scale circulations. *Surv. Geophys.*, **38(6)**, 1257–1282, Nov. 2017(10.1007/s10712-017-9429-z).

Ochiai, S. P. Baron, T. Nishibori, Y. Irimajiri, Y. Uzawa, T. Manabe, H. Maezawa, **A. Mizuno**, **T. Nagahama**, H. Sagawa, M. Suzuki, and M. Shiotani, SMILES-2 mission for temperature, wind, and composition in the whole atmosphere. *SOLA*, **13A**, 13–18, Sep. 14, 2017 (10.2151/sola.13A-003).

Ohishi, S., T. Tozuka, and M. F. Cronin, Frontogenesis in the Agulhas Return Current region simulated by a high-resolution CGCM. *J. Phys. Oceanogr.*, **47(11)**, 2691–2710, Nov. 2017 (10.1175/JPO-D-17-0038.1).

Oka, N., K. Abe, K. Hiraide, K. Ichimura, Y. Kishimoto, K. Kobayashi, M. Kobayashi, S. Moriyama, M. Nakahata, T. Norita et al. (**Y. Itow**, **K. Kanzawa**, **R. Kegasa**, **K. Masuda**, **H. Takiya**), Search for solar Kaluza–Klein axions by annual modulation with the XMASS-I detector. *Prog. Theor. Exp. Phys.*, **2017(10)**, 103C01, Oct. 1, 2017 (10.1093/ptep/ptx137).

Okoh, D., B. Rabiu, **K. Shiokawa**, **Y. Otsuka**, B. Segun, E. Falayi, S. Onwuneme, and R. Kaka, First study on the occurrence frequency of equatorial plasma bubbles over West Africa using an all-sky airglow imager and GNSS receivers. *J. Geophys. Res. Space Physics*, **122(12)**, 12430–12444, Dec. 2017 (10.1002/2017JA024602).

Okumura, A., D. V. Tan, S. Ono, S. Tanaka, M. Hayashida, J. Hinton, H. Katagiri, K. Noda, M. Teshima, T. Yamamoto, and T. Yoshida, Prototyping hexagonal light concentrators using high-reflectance specular films for the large-sized

telescopes of the Cherenkov Telescope Array. *J. Instrum.*, **12**, P12008, Dec. 6, 2017 (10.1088/1748-0221/12/12/P12008).

Okuno, M., S. Nagaoka, Y. Saito-Kokubu, **T. Nakamura**, and T. Kobayashi, AMS radiocarbon dates of pyroclastic-flow deposits on the southern slope of the Kuju volcanic group, Kyushu, Japan. *Radiocarbon*, **59(2)**, 483–488, Apr. 2017 (10.1017/RDC.2016.66).

Okuno, M., A. Harijoko, I. W. Warmada, K. Watanabe, **T. Nakamura**, S. Taguchi, and T. Kobayashi, Geomorphological classification of post-caldera volcanoes in the Buyan–Bratan caldera, North Bali, Indonesia. *IOP Conf. Series: Earth and Environmental Science*, **103**, 012014, Jan. 10, 2018 (10.1088/1755-1315/103/1/012014).

Okuno, M., P. Izbekov, K. P Nicolaysen, E. Sato, **T. Nakamura**, A. B. Savinetsky, D. Vasyukov, O. A. Krylovich, B. Khasanov, J. Miranda et al., AMS radiocarbon dates on peat section related with tephra and archaeological sites in Carlisle Island, the Islands of Four Mountains, Alaska. *Radiocarbon*, **59(SI6)**, 1771–1778, Dec. 2017 (10.1017/RDC.2017.130).

Ono, K., K. Makishima, S. Sakurai, Z. Zhang, **K. Yamaoka**, and K. Nakazawa, A hard-to-soft state transition of Aquila X-1 observed with Suzaku. *Publ. Astron. Soc. Japan*, **69(2)**, 23, Apr. 1, 2017 (10.1093/pasj/psw126).

Oyama, S., **A. Kero**, C. J. Rodger, M. A. Clilverd, **Y. Miyoshi**, N. Partamies, E. Turunen, T. Raita, P. T. Verronen, and **S. Saito**, Energetic electron precipitation and auroral morphology at the substorm recovery phase. *J. Geophys. Res. Space Physics*, **122(6)**, 6508–6527, Jul. 12, 2017 (10.1002/2016JA023484).

Oyama, S., K. Kubota, T. Morinaga, T. T. Tsuda, J. Kurihara, M. F. Larsen, M. Yamamoto, and L. Cai, Simultaneous FPI and TMA measurements of the lower thermospheric wind in the vicinity of the poleward expanding aurora after substorm onset. *J. Geophys. Res. Space Physics*, **122(10)**, 10864–10875, Nov. 22, 2017 (10.1002/2017JA024613).

Ozaki, M., **K. Shiokawa**, **Y. Miyoshi**, R. Kataoka, M. Connors, T. Inoue, S. Yagitani, Y. Ebihara, C.-W. Jun, R. Nomura, K. Sakaguchi, **Y. Otsuka** et al., Discovery of 1 Hz range modulation of isolated proton aurora at subauroral latitudes. *Geophys. Res. Lett*., **45(3)**, 1209–1217, Feb. 16, 2018 (10.1002/2017GL076486).

Ozaki, M., S. Yagitani, Y. Kasahara, H. Kojima, Y. Kasaba, A. Kumamoto, F. Tsuchiya, **S. Matsuda**, A. Matsuoka, T. Sasaki, and T. Yumoto, Magnetic Search Coil (MSC) of Plasma Wave Experiment (PWE) aboard the Arase (ERG) satellite. *Earth Planets Space*, in press (10.1186/s40623-017-0770-8).

Park, H., Y. Yoshikawa, D. Yang, and K. Oshima, Warming water in Arctic terrestrial rivers under climate change. *J. Hydrometeorol.*, **18(7)**, 1983–1995, Jul. 2017 (10.1175/JHM-D-16-0260.1).

Park, K., J. Lee, Y. Yi, **J. Lee**, and J. Sohn, Characteristics of solar wind density depletions during solar cycles 23 and 24. *J. Astron. Space Sci.*, **34(2)**, 105−110, Jun. 2017 (10.5140/JASS.2017.34.2.105).

Pasachoff, J. M., A. B. Babcock, R. F. Durst, F. Rebecca, C. H. Seeger, S. E. Levine, A. M. Bosh, M. J. Person, A. A. Sickafoose, C. A. Zuluaga et al. (**F. Abe)**, Pluto occultation on 2015 June 29 UTC with central flash and atmospheric spikes just before the New Horizons flyby, *Icarus*, **296**, 305–314, Nov. 1, 2017 (10.1016/j.icarus.2017.05.012).

Patra, A. K., P. Pavan Chaitanya, J.-P. St.-Maurice, **Y. Otsuka**, T. Yokoyama, and M. Yamamoto, The solar flux dependence of ionospheric 150-km radar echoes and implications. *Geophys. Res. Lett*., **44(22)**, 11257–11264, Nov. 28, 2017 (10.1002/2017GL074678).

Pavan Chaitanya, P., A. K. Patra, **Y. Otsuka**, T. Yokoyama, M. Yamamoto, R. A. Stoneback, and R. A. Heelis, Daytime zonal drifts in the ionospheric 150 km and E regions estimated using EAR observations. *J. Geophys. Res. Space Physics*, **122(8)**, 9045–9055, Sep. 25, 2017 (10.1002/2017JA024589).

Poleski, R., A. Udalski, I. A. Bond, J. P. Beaulieu, C. Clanton, S. Gaudi, M. K. Szymański, I. Soszyński, P. Pietrukowicz, S. Kozłowski et al. (**F. Abe**, **Y. Asakura**, **Y. Itow**, **K. Masuda**, **Y. Matsubara**, **Y. Muraki)**, A companion on the planet/brown dwarf mass boundary on a wide orbit discovered by gravitational microlensing. *Astronom. Astrophys*., **604**, A103, Aug. 2017 (10.1051/0004-6361/201730928).

Qin, X.-C., **T. Nakayama**, **Y. Matsumi**, M. Kawasaki, A. Ono, S. Hayashida, R. Imasu, L. -P. Lei, I. Murata, T. Kuroki, and M. Ohashi, Ground-based measurement of column-averaged mixing ratios of methane and carbon dioxide in the Sichuan Basin of China by a desktop optical spectrum analyzer. *J. Appl. Remote Sens.*, **12(1)**, 12002, Sep. 12, 2017 (10.1117/1.JRS.12.012002).

Raak, F., Y. Susuki, **K. Tsuboki**, **M. Kato**, and T. Hikihara, Quantifying smoothing effects of wind power via Koopman mode decomposition: A numerical test with wind speed predictions in Japan. *Nonlinear Theory and Its Applications, IEICE*, **8(4)**, 342–357, Oct. 1, 2017 (10.1587/nolta.8.342).

Ratnam, D. V., **Y. Otsuka**, G. Sivavaraprasad, and. J. R. K. K. Dabbakuti, Development of Multivariate Ionospheric TEC Forecasting Algorithm using Linear Time Series Model and ARMA over Low-latitude GNSS Station. *Adv. Space Res.*, in press.

Rattenbury, N. J., D. P. Bennett, T. Sumi, N. Koshimoto, I. A.Bond, A. Udalski, Y. Shvartzvald, D. Maoz, U. G. Jorgensen, M. Dominik et al. (**F. Abe**, **Y. Asakura**, **Y. Itow**, **K. Masuda**, **Y. Matsubara**, **Y. Muraki**, **H. Oyokawa)**, Faint-source-star planetary microlensing: the discovery of the cold gas-giant planet OGLE-2014-BLG-0676Lb. *Mon. Not. Roy. Astron. Soc*., **466(3)**, 2710–2717, Apr. 21, 2017 (10.1093/mnras/stw3185).

Rauniyar, S. P., A. Protat, and **H. Kanamori**, Uncertainties in TRMM-Era multisatellite-based tropical rainfall estimates over the Maritime Continent. *Earth Space Science*, **4(5)**, 275–302, Jun.10, 2017 (10.1002/2017ea000279).

Ren, J., Q.-G. Zong, **Y. Miyoshi**, X. Z. Zhou, Y. F. Wang, R. Rankin, C. Yue, H. E. Spence, H. O. Funsten, J. R. Wygant, and C. A. Kletzing, Low-energy (< 200 eV) electron acceleration by ULF waves in the plasmaspheric boundary layer: Van Allen Probes observation. *J. Geophys. Res. Space Physics*, **122(10)**, 9969–9982, Nov. 21, 2017 (10.1002/2017JA024316).

Ryu, Y.-H., J. C. Yee, A. Udalski, I. A. Bond, Y. Shvartzvald, W. Zang, R. Figuera Jaimes, U. G. Jorgensen, W. Zhu, C. X. Huang et al (**F. Abe**, **Y. Asakura**, **Y. Itow**, **K. Masuda**, **Y. Matsubara**, **Y. Muraki)**, OGLE-2016-BLG-1190Lb : the first Spitzer bulge planet lies near the planet/brown-dwarf boundary. *Astron. J.*, **155(1)**, 40, Jan. 2018 (10.3847/1538-3881/aa9be4).

Saito, S., Y. Nariyuki, and **T. Umeda**, Generation of intermittent ion acoustic waves in whistler-mode turbulence. *Phys. Plasmas*, **24(7)**, 072304, Jun. 29, 2017 (10.1063/1.4990443).

Saito, T., **T. Kumagai**, M. Tateishi, **N. Kobayashi**, K. Otsuki and T. W. Giambelluca, Differences in seasonality and temperature dependency ofstand transpiration and canopy conductance between Japanesecypress (Hinoki) and Japanese cedar (Sugi) in a plantation. *Hydrol. Process.*, **31(10)**, 1952–1965, May 15, 2017 (10.1002/hyp.11162).

Sasai, Y., **Y. Matsubara**, **Y. Itow**, **T. Sako**, **T. Kawabata**, D. Lopez, R. Hikimochi, **A. Tsuchiya**, M. Ikeno, T. Uchida et al., A faster and more reliable data acquisition system for the full performance of the SciCRT. *Nucl. Instrum. Methods Phys. Res. Sect. A-Accel. Spectrom. Dect. Assoc. Equip.*, **857**, 50–57, Jun. 11, 2017 (10.1016/j.nima.2016.12.060).

Sasaki, A., and **A. N. Mizuno**, Pdrtitioning light spectra: Adaptive stratification of phytobenthic communities in Antarctic lakes. *J. Theor. Biol*., **424**, 1–10, Jul. 7, 2017 (10.1016/j.jtbi.2017.04.022).

Sato, N., A. S.Yukimatu, Y. Tanaka, and **T. Hori**, Morphologies of omega band auroras. *Earth Planets Space*, **69,** 103, Aug. 3, 2017 (10.1186/s40623-017-0688-1).

Satoh, M., H. Tomita, H. Yashiro, Y. Kajikawa, Y. Miyamoto, T. Yamaura, T. Miyakawa, M. Nakano, C. Kodama, A. T. Noda, T. Nasuno, Y. Yamada, and **Y. Fukutomi**, Outcomes and challenges of global high-resolution non-hydrostatic atmospheric simulations using the K computer. *Prog. Earth Planet. Sci.*, **4**, 13, Apr. 28, 2017 (10.1186/s40645-017-0127-8).

Sekaranom, A. B., and **H. Masunaga**, Comparison of TRMM-derived rainfall products for general and extreme rains over the Maritime Continent. *J. Appl. Meteorol. Climatol.*, **56**, 1867–1881, Jul. 2017 (10.1175/JAMC-D-16-0272.1).

Seki, K., **Y. Miyoshi**, Y. Ebihara, Y. Katoh, T. Amano, S. Saito, **M. Shoji**, A. Nakamizo, K. Keika, **T. Hori** et al. (**A. Ieda**), Theory, modeling, and integrated studies in Arase (ERG) project. *Earth Planets Space*, **70**, 17, Feb. 1 2018 (10.1186/s40623-018-0785-9).

Shimizu, M., K. Shibata, M. Shimizu, **K. Suzuki**, S. Sueoka, and M. Niwa, CHIME monazite dating: Pb analysis on an R_R=100 mm spectrometer and correction of interferences between Th, U, and Pb with natural monazite. *J. Mineral. Petrol. Sci.*, **112(2)**, 88–96, Apr. 2017 (10.2465/jmps.160719d).

Shimizu, S., S. Shimada, and **K. Tsuboki**, Assimilation impact of different GPS analysis methods on precipitation forecast: A heavy rainfall case study of Kani City, Gifu Prefecture on July 15, 2010. *J. Disaster Res.*, **12(5)**, 944–955, Oct. 1, 2017 (10.20965/jdr.2017.p0944).

Shimojo, M., H. S. Hudson, S. M. White, T. S. Bastian, and **K. Iwai**, The first ALMA observation of a solar plasmoid ejection from an X-ray bright point. *Astrophys. J. Lett.*, **841(1)**, L5, May 20, 2017 (10.3847/2041-8213/aa70e3).

Shimojo, M., **K. Iwai**, A. Asai, S. Nozawa, T. Minamidani, and M. Saito, Variation of the solar microwave spectrum in the last half century. *Astrophys. J.*, **848(1)**, 62, Oct. 12, 2017 (10.3847/1538-4357/aa8c75).

Shimojo, M., T. S. Bastian, A. S. Hales, S. M. White, **K. Iwai**, R. E. Hills, A. Hirota, N. M. Phillips, T. Sawada, P. Yagoubov et al., Observing the Sun with the Atacama Large Millimeter/submillimeter Array (ALMA): High-Resolution Interferometric Imaging, *Sol. Phys.*, **292**, 87, Jul. 2017 (10.1007/s11207-017-1095-2).

Shinagawa, H., H. Jin, Y. Miyoshi, H. Fujiwara, T. Yokoyama, and **Y. Otsuka**, Daily and seasonal variations in the linear growth rate of the Rayleigh-Taylor instability in the ionosphere obtained with GAIA. *Prog. Earth Planet. Sci.*, **5**, 16, Mar. 9, 2018 (10.1186/s40645-018-0175-8).

Shinbori, A., Y. Koyama, M. Nosé, **T. Hori**, and **Y. Otsuka**, Characteristics of seasonal variation and solar activity dependence of the geomagnetic solar quiet daily variation. *J. Geophys. Res. Space Physics*, **122(10)**, 10796–10810, Nov. 21, 2017 (10.1002/2017JA024342).

Shiokawa, K., **Y. Kato**, **Y. Hamaguchi**, **Y. Yamamoto**, **T. Adachi**, M. Ozaki, **S.-I. Oyama**, M. Nosé, T. Nagatsuma, Y. Tanaka, **Y. Otsuka**, **Y. Miyoshi**, R. Kataoka, **Y. Takagi**, **Y. Takeshita**, **A. Shinbori**, **S. Kurita**, **T. Hori**, **N. Nishitani** et al., Ground-based instruments of the PWING project to investigate dynamics of the inner magnetosphere at subauroral latitudes as a part of the ERG-ground coordinated observation network. *Earth Planets Space*, **69(1)**, 160, Dec. 2017 (10.1186/s40623-017-0745-9).

Shirai, K., **K. Kubota**, N. Murakami-Sugihara, K. Seike, M. Hakozaki, and K. Tanabe, Stimpson's hard clam Mercenaria stimpsoni; A multi-decadal climate recorder for the northwest Pacific coast. *Mar. Environ. Res.*, **133**, 49–56, Feb. 2018 (10.1016/j.marenvres.2017.10.009).

Shoji, M., and Y. Omura, Nonlinear generation mechanism of EMIC falling tone emission. *J. Geophys. Res. Space Physics*, **122(10)**, 9924–9933, Nov. 21, 2017 (10.1002/2017JA023883).

Shoji, M., **Y. Miyoshi**, Y. Katoh, K. Keika, V. Angelopoulos, S. Kasahara, K. Asamura, S. Nakamura, and Y. Omura, Ion hole formation and nonlineargeneration of electromagneticion cyclotron waves: THEMIS observations. *Geophys. Res.*

Lett., **44(17)**, 8730–8738, Sep. 26, 2017 (10.1002/2017GL074254).

Sugita, T., H. Akiyoshi, E. Wolfram, J. Salvado, **H. Ohyama**, and **A. Mizuno**, Comparison of ozone profiles from DIAL, MLS, and chemical transport model simulations over Río Gallegos, Argentina, during the spring Antarctic vortex breakup, 2009. *Atmos. Meas. Tech.*, **10**, 4947–4964, Dec. 19, 2017 (10.5194/amt-10-4947-2017).

Sukigara, C., **Y. Mino**, S. C. Tripathy, **J. Ishizaka**, and T. Matsuno, Impacts of the Changjiang diluted water on sinking processes of particulate organic matters in the East China Sea. *Cont. Shelf Res.*, **151**, 84–93, Dec. 1, 2017 (10.1016/j.csr.2017.10.012).

Sun, H., T. Kasahara, K. Otsuki, **T. Saito**, and Y. Onda, Spatio-temporal streamflow generation in a small, steep headwater catchment in western Japan, *Hydrol. Sci. J.*, **62(5)**, 818–829, Apr. 4, 2017 (10.1080/02626667.2016.1266635).

Sun, H., T. Kasahara, K. Otsuki, M. Tateishi, **T. Saito**, and Y. Onda, Effects of thinning on flow peaks in a forested headwater catchment. *Water*, **9(6)**, 446, Jun. 21, 2017 (10.3390/w9060446).

Suzuki, K., **M. Enami**, H. Maekawa, **T. Kato**, and T. Ueno, Late Cretaceous CHIME monazite ages of Sanbagawa metamorphic rocks from Nushima, Southwest Japan. *J. Mineral. Petrol. Sci.*, **113(1)**, 1–9, Feb. 2018 (10.2465/jmps.170613b).

Suzuki, K., K. Matsuo, D. Yamazaki, K. Ichii, Y. Iijima, F. Papa, Y. Yanagi, and **T. Hiyama**, Hydrological variability and changes in the Arctic circumpolar tundra and the three largest pan-Arctic river basins from 2002 to 2016. *Remote Sens.*, **10(3)**, 402, Mar. 2018 (10.3390/rs10030402).

Suzuki, T., **Y. Itow**, K. Kasahara, **T. Sako**, and S. Torii, Monte Carlo study of a new experiment at RHIC measuring the nuclear effect for cosmic ray observations. *J. Instrum.*, **12(9)**, P09016, Sep. 14, 2017 (10.1088/1748-0221/12/09/P09016).

Takahashi, A., **T. Kumagai**, **H. Kanamori**, **H. Fujinami**, **T. Hiyama**, and M. Hara, Impact of tropical deforestation on precipitation over Borneo Island. *J. Hydrometeorol.*, **18(11)**, 2907–2922, Nov. 2017 (10.1175/JHM-D-17-0008.1).

Takahashi, N., Surface echo characteristics derived from the wide swath experiment of the precipitation radar onboard TRMM satellite during its end-of-mission operation. *IEEE Trans. Geosci. Remote Sensing*, **55(4)**, 1988–1993, Apr. 2017 (10.1109/TGRS.2016.2633971).

Takahashi, N., Y. Kasaba, Y. Nishimura, **A. Shinbori**, **T. Kikuchi**, **T. Hori**, Y. Ebihara, and **N. Nishitani**, Propagation and evolution of electric fields associated with solar wind pressure pulses based on spacecraft and ground-based observations. *J. Geophys. Res. Space Physics*, **122(8)**, 8446–8461, Sep. 25, 2017 (10.1002/2017JA023990).

Takeo, D., **K. Shiokawa**, **H. Fujinami**, **Y. Otsuka**, T. S. Matsuda, M. K. Ejiri, T. Nakamura, and M. Yamamoto, Sixteen year variation of horizontal phase velocity and propagation direction of mesospheric and thermospheric waves in airglow images at Shigaraki, Japan. *J. Geophys. Res. Space Physics*, **122(8)**, 8770–8780, Sep. 25, 2017 (10.1002/2017JA023919).

Tan, L. M., **K. Shiokawa**, N. N. Thu, and T. Q. Ha, Electron density variability of nighttime D region ionosphere in Vietnamese and Japanese sectors. *J. Geophys. Res. Space Physics*, **122(6)**, 6543–6551, Jul. 12, 2017 (10.1002/2017JA024025).

Tanaka, M., Y. Utsumi, P. A. Mazzali, N. Tominaga, M. Yoshida, Y. Sekiguchi, T. Morokuma, K. Motohara, K. Ohta, K. S. Kawabata, **F. Abe**, K. Aoki, **Y. Asakura** et al, Kilonova from post-merger ejecta as an optical and near-Infrared counterpart of GW170817. *Publ. Astron. Soc. Japan*, **69(6)**, 102, Dec. 1, 2017 (10.1093/pasj/psx121).

Tanaka, T., Y. Ebihara, M. Watanabe, M. Den, S. Fujita, **T. Kikuchi**, K. K. Hashimoto, and R. Kataoka, Global simulation study for the time sequence of events leading to the substorm onset. *J. Geophys. Res. Space Physics*, **122(6)**, 6210–6239, Jul. 12, 2017 (10.1002/2017JA024102).

Tapiador, F. J., A. Navarro, V. Levizzani, E. García-Ortega, G. J. Huffman, C. Kidd, P. A. Kucera, C. D. Kummerow, **H. Masunaga**, W. A. Petersen et al., Global precipitation measurements for validating climate models. *Atmos. Res.*, **197**, 1–20, Nov. 15, 2017 (10.1016/j.atmosres.2017.06.021).

Tominaga, N., M. Tanaka, T. Morokuma, Y. Utsumi, M. S. Yamaguchi, N. Yasuda, M. Tanaka, M. Yoshida, T. Fujiyoshi, H. Furusawa et al. (**F. Abe**, **Y. Asakura**), Subaru Hyper Suprime-Cam Survey for an optical counterpart of GW170817. *Publ. Astron. Soc. Japan*, **70(2)**, 28, Mar. 1, 2018 (10.1093/pasj/psy007).

Tomita, H., T. Hirata, and M. Kubota, Improved satellite estimation of near-surface humidity using vertical water vapor profile information., *Geophys. Res. Lett.*, **45(2)**, 899–906, Feb. 19, 2018(10.1002/2017GL076384).

Tomsick, J. A., M. L. Parker, J. A. García, **K. Yamaoka**, D. Barret, J.-L. Chiu, M. Clavel, A. Fabian, F. Fürst, P. Gandhi et al., Alternative explanations for extreme supersolar iron abundances inferred from the energy spectrum of Cygnus X-1. *Astrophys. J.*, **855(1)**, 3, Mar. 1, 2018 (10.3847/1538-4357/aaaab1).

Tosaki, T., K. Kohno, N. Harada, K. Tanaka, F. Egusa, T. Izumi, S. Takano, **T. Nakajima**, A. Taniguchi, and Y. Tamura, A statistical study of giant molecular clouds traced by ^{13}CO, $C^{18}O$, CS, and CH_3OH in the disk of NGC 1068 based on ALMA observations. *Publ. Astron. Soc. Japan*, **69(2)**, 18, Apr. 1, 2017 (10.1093/pasj/psw122).

Tozuka, T., **S. Ohishi**, and M. F. Cronin, A metric for surface heat flux effect on horizontal sea surface temperature gradients. *Clim. Dyn.*, in press (10.1007/s00382-017-3940-2).

Tozuka, T., M. F. Cronin, and **H. Tomita**, Surface frontogenesis by surface heat fluxes in the upstream Kuroshio Extension region. *Sci Rep.*, **7**, 10258, Aug. 31, 2017 (10.1038/s41598-017-10268-3).

Tsuda, T. T., M. T. Rietveld, M. J. Kosch, **S. Oyama**, K. Hosokawa, **S. Nozawa**, **T. Kawabata**, **A. Mizuno**, and Y. Ogawa, A survey of conditions for artificial aurora experiments at EISCAT Tromsø site using dynasonde data. *Earth Planets Space*, **70**, 40, Mar. 8, 2018 (10.1186/s40623-018-0805-9).

Tsujino, S., **K. Tsuboki**, and H.-C. Kuo, Structure and maintenance mechanism of long-lived concentric eyewalls associated with simulated Typhoon Bolaven (2012). *J. Atmos. Sci.*, **74(11)**, 3609–3634, Nov. 14, 2017 (10.1175/JAS-D-16-0236.1).

Udalski, A., C. Han, V. Bozza, A. Gould, I. A. Bond, P. Mróz, J. Skowron, Ł. Wyrzykowski, M. K. Szymański, I. Soszyński et al. (**F. Abe**, **Y. Itow**, **K. Masuda**, **Y. Matsubara**, **H. Munakata**, **Y. Muraki**), OGLE-2014-BLG-0289: precise characterization of a quintuple-peak gravitational microlensing event. *Astrophys. J.*, **853(1)**, 70, Jan. 10, 2018 (10.3847/1538-4357/aaa295).

Umeda, T., A three-step Boris integrator for Lorentz force equation of charged particles. *Comput. Phys. Commun.*, in press (10.1016/j.cpc.2018.03.019).

Umeda, T., and K. Fukazawa, Performance measurement of Eulerian kinetic code on the Xeon Phi KNL, Proc. *HPC Asia 2018*, P1, 2018.

Umeda, T., and Y. Wada, Non-MHD effects in the nonlinear development of the MHD-scale Rayleigh-Taylor instability. *Phys. Plasmas*, **24(7)**, 072307, Jul. 7, 2017 (10.1063/1.4991409).

Umeda, T., **S. Saito**, and Y. Nariyuki, Rapid decay of nonlinear whistler waves in two dimensions: Full particle simulation. *Phys. Plasmas*, **24(5)**, 054503, Apr. 26, 2017 (10.1063/1.4982609).

Utsumi, Y., M. Tanaka, N. Tominaga, M. Yoshida, S. Barway, T. Nagayama, T. Zenko, K. Aoki, T. Fujiyoshi, H. Furusawa et al. (**F. Abe**, **Y. Asakura**), J-GEM observations of an electromagnetic counterpart to the neutron star merger GW170817. *Publ. Astron. Soc. Japan*, **69(6)**, 101, Dec. 1, 2017 (10.1093/pasj/psx118).

Utsumi, Y., N. Tominaga, M. Tanaka, T. Morokuma, M. Yoshida, **Y. Asakura**, F. Finet, H. Furusawa, K. S. Kawabata, W. Liu

et al., A challenge to identify an optical counterpart of the gravitational wave event GW151226 with Hyper Suprime-Cam. *Publ. Astron. Soc. Japan*, **70(1)**, 1, Jan. 1, 2018 (10.1093/pasj/psx125).

Vekstein, G., and **K. Kusano**, Taylor problem and onset of plasmoid instability in the Hall-magnetohydrodynamics. *Phys. Plasmas*, **24(10)**, 102116, Sep. 26, 2017 (10.1063/1.4996982).

Wada, R., **Y. Matsumi**, **T. Nakayama**, **T. Hiyama**, Y. Fujiyoshi, **N. Kurita**, K. Muramoto, S. Takanashi, N. Kodama, and Y. Takahashi, Continuous measurements of stable isotopes of carbon dioxide and water vapor in an urban atmosphere: isotopic variations associated with meteorological conditions. *Isot. Environ. Health Stud*., **53(6)**, 646–659, Dec. 2017 (10.1080/10256016.2017.1348351).

Wang, T., W. Zhu, S. Mao, I. A. Bond, A. Gould, A. Udalski, T. Sumi, V. Bozza, C. Rane, A. Cassan et al. (**F. Abe**, **Y. Asakura**, **Y. Itow**, **K. Masuda**, **Y. Matsubara**, **Y. Muraki**), Ground-based parallax confirmed by Spitzer: Binary microlensing event MOA-2015-BLG-020, *Astrophys. J*., **845(2)**, 129, Aug. 20, 2017 (10.3847/1538-4357/aa813b).

Watanabe, K., **J. Kitagawa**, and **S. Masuda**, Characteristics that produce white-light enhancement in solar flares observed by Hinode/SOT. *Astrophys. J*., **850(2)**, 204, Dec. 4, 2017 (10.3847/1538-4357/aa9659).

Xiong, M., J. A. Davies, B. Li, L. Yang, Y. D. Liu, L. Xia, R. A. Harrison, **K. Hayashi**, and H. Li, Prospective Out-of-ecliptic White-light Imaging of Interplanetary Corotating Interaction Regions at Solar Maximum, *Astrophys. J*., **844(1)**, 76, Jul. 24, 2017 (10.3847/1538-4357/aa7aaa).

Xu, H., **K. Shiokawa**, and D. Frühauff, Statistical analysis of severe magnetic fluctuations in the near-Earth plasma sheet observed by THEMIS-E. *Ann. Geophys*, **35(5)**, 1131–1142, Oct. 9, 2017 (10.5194/angeo-35-1131-2017).

Xu, W., R. A. Marshall, X. Fang, E. Turunen, and **A. Kero**, On the effects of bremsstrahlung radiation during energetic electron precipitation. *Geophys. Res. Lett.*, **45(2)**, 1167–1176, Jan. 28, 2018 (10.1002/2017GL076510).

Yamamoto, M., **Y. Otsuka**, H. Jin, and Y. Miyoshi, Relationship between day-to-day variability of equatorial plasma bubble activity from GPS scintillation and atmospheric properties from GAIA assimilation. *Prog. Earth Planet. Sci*., in press.

Yamaoka, K., M. Ohno, M. S. Tashiro, K. Hurley, H. A. Krimm, A. Y. Lien, N. Ohmori, S. Sugita, Y. Urata, T. Yasuda et al., Suzaku Wide-band All-sky Monitor (WAM) observations of GRBs and SGRs. *Publ. Astron. Soc. Japan*, **69(3)**, R2, Jun. 1, 2017 (10.1093/pasj/psx026).

Yokota, S., S. Kasahara, T. Mitani, K. Asamura, **M. Hirahara**, T. Takashima, K. Yamamoto, and Y. Shibano, Medium-energy particle experiments-ion mass analyzer (MEP-i) onboard ERG (Arase). *Earth Planets Space*, **69**, 172, Dec. 2017 (10.1186/s40623-017-0754-8).

Yonezu, Y., **K. Shiokawa**, M. Connors, M. Ozaki, J. Manninen, H. Yamagishi, and M. Okada, Simultaneous observations of magnetospheric ELF/VLF emissions in Canada, Finland, and Antarctica. *J. Geophys. Res. Space Physics*, **122(6)**, 6442–6454, Jul. 12, 2017 (10.1002/2017JA024211).

Zank, G. P., L. Adhikari, P. Hunana, S. K. Tiwari, R. Moore, **D. Shiota**, R. Bruno, and D. Telloni, Theory and Transport of Nearly Incompressible Magnetohydrodynamic Turbulence. IV. Solar Coronal Turbulence. *Astrophys. J*., **854(1)**, 32, Feb.10, 2018 (10.3847/1538-4357/aaa763).

Zhou, Q.-D., **Y. Itow**, H. Menjo, and **T. Sako**, Monte Carlo study of particle production in diffractive proton-proton collisions at $\sqrt{s}$ = 13 TeV with the very forward detector combined with central information, *Eur. Phys. J. C*, **77(4)**, 212, Apr. 2017 (10.1140/epjc/s10052-017-4788-7).

Zhu, Y., **J. Ishizaka**, S. C. Tripathy, S. Wang, C. Sukigara, J. Goes, T. Matsuno, and D. J. Suggett, Relationship between light, community composition and the electron requirement for carbon fixation in natural phytoplankton. *Mar. Ecol.-Prog. Ser.*, **580**, 83–100, Sep. 29, 2017 (10.3354/meps12310).

Zhu, W., A. Udalski, C. X. Huang, S. Calchi Novati, T. Sumi, R. Poleski, J. Skowron, P. Mróz, M. K. Szymański, I. Soszyński et al. (**F. Abe**, **Y. Asakura**, **Y. Itow**, **K. Masuda**, **Y. Matsubara**, **H. Munakata**, **Y. Muraki)**, An isolated microlens observed from K2, Spitzer, and Earth. *Astrophys. J. Lett*., **849(2)**, L31, Nov. 10, 2017 (10.3847/2041-8213/aa93fa).

Zou, Y., B. M. Walsh, Y. Nishimura, V. Angelopoulos, J. M. Ruohoniemi, K. A. McWilliams, and **N. Nishitani**, Spreading speed of magnetopause reconnection X-lines using ground-satellite coordination. *Geophys. Res. Lett*., **45(1)**, 80–89, Jan. 16, 2018 (10.1002/2017GL075765).

Seven more Papers were published in Japanese.

Books (April 2017–March 2018)

Hiyama, **T.,** and H. Takakura, Editors, *Global Warming and Human - Nature Dimension in Northern Eurasia (Global Environmental Studies)*, 224pp, Springer, Singapore, 2018 (10.1007/978-981-10-4648-3).

Sakai, T., H. Takakura, M. Okumura, S. Hatta, Y. Yosikawa, **T. Hiyama**, and Y. Yamaguchi, Monitoring spring floods on the Lena River using multiple satellite sensors. in *Global Warming and Human - Nature Dimension in Northern Eurasia (Global Environmental Studies)*, 53–69, edited by **T. Hiyama**, and H. Takakura, 224pp, Springer, Singapore, 2018 (10.1007/978-981-10-4648-3_4).

Takakura, H., Y. Yoshikawa, M. Watanabe, T. Sakai, and **T. Hiyama**, Ice movement in the Lena River and the typology of spring flood: An interpretation of local sources integrated with satellite imagery using a multidisciplinary approach. in *Global Warming and Human - Nature Dimension in Northern Eurasia (Global Environmental Studies)*, 101–123, edited by **T. Hiyama**, and H. Takakura, 224pp, Springer, Singapore, 2018 (10.1007/978-981-10-4648-3_7).

Yoshikawa, Y., H. Takakura, M. Watanabe, **T. Hiyama**, and T. Sakai, Using air temperature data to calculate changes in ice sheet thickness on the Lena River to predict ice-jam disasters. in *Global Warming and Human - Nature Dimension in Northern Eurasia (Global Environmental Studies)*, 87–99, edited by **T. Hiyama**, and H. Takakura, 224pp, Springer, Singapore, 2018 (10.1007/978-981-10-4648-3_6).

Six more books were published in Japanese.

Publication of Proceedings

Title	Date of Publication
Proceedings of 23th Symposium on Atmospheric Chemistry	Oct. 3, 2017
Proceedings of 22th Workshop on Lidar Observation of Atmosphere	Feb. 19, 2018
The Nagoya University Bulletin of Chronological Research, vol.2	Mar. 31, 2018

One more book was published in Japanese.

Conference Presentations (April 2017–March 2018)

■ International Conferences

Title	Country/ Region	Date	Orga-nizers	Number of Presentations			
				Staffs and PDs	Students	Total	invited
Birkeland 150 year Anniversary Symposium “The Heritage of Kristian Birkeland and beyond”	Tokyo, Japan	Apr. 6, 2017	0	2	0	2	2
The First International Workshop of SCMREX RDP	Beijing, China	Apr. 12-13, 2017	0	1	0	1	0
Laser Solution for Space and the Earth (LSSE2017)	Yokohama, Japan	Apr. 18-21, 2017	0	1	0	1	1
European Geosciences Union General Assembly	Vienna, Austria	Apr. 23–28, 2017	0	2	0	2	1
International Conference on Mars Aeronomy	Boulder, Colorado, USA	May 15–19, 2017	0	0	1	1	0
2017 International Space Weather Meridian Circle Program Workshop	Qingdao, China	May 15–27, 2017	0	3	0	3	2
Intenationtal Symposium on Remote Sensing 2017 (ISRS2017)	Nagoya, Japan	May 17–19, 2017	1	6	2	8	1
JpGU-AGU Joint Meeting 2017	Chiba, Japan	May 20–25, 2017	13*	40	25	65	7
The 18th EISCAT international symposium	Tachikawa, Japan	May 26–30, 2017	3	5	0	5	0
15th International Workshop on Technical and Scientific Aspects of MST radar	Tachikawa, Japan	May 27–31, 2017	1	2	0	2	0
NDACC-IRWG/TCCON annual meeting 2017	Paris, France	May 29–Jun. 2, 2017	0	2	0	2	0
Meteorology Departmental Seminar	Reading, UK	May 30, 2017	0	1	0	1	0
Joint Hinode-11/IRIS-8 Science Meeting	Seattle, Washington, USA	May 30–Jun. 2, 2017	0	2	0	2	1
2017 SuperDARN Workshop	San Quirico d’Orcia, Italy	Jun. 4–9, 2017	0	1	0	1	0
13th International Workshop on Greenhouse Gas Measurements from Space (IWGGMS)	Helsinki, Finland	Jun. 6–8, 2017	0	0	1	1	0
33rd Symposium on Chemical Kinetics and Dynamics	Nagoya, Japan	Jun. 7–9, 2017	0	1	0	1	0
CEDAR Workshop	Keystone, Colorado, USA	Jun. 18–23, 2017	0	0	2	2	0
The International Symposium on Cloud Physics & Weather Modification	Beijing, China	Jun. 19–21, 2017	0	1	0	1	1
RHIC&AGS Annual Users’ Meeting	Upton, New York, USA	Jun. 20–23, 2017	0	1	0	1	1
FLARECAST Science Workshop	Paris, France	Jun. 26–29, 2017	0	1	0	1	0
American Meteorological Society: 21st Conference on Atmospheric and Oceanic Fluid Dynamics	Portland, Oregon, USA	Jun. 26–30, 2017	0	2	0	2	0
The 17th conference on Elastic and Diffractive scattering (EDS Blois 2017)	Prague, Czech	Jun. 26–30, 2017	0	0	1	1	0
Symposium “Evolution of Molecules in Space”	Sapporo, Japan	Jun. 27–29, 2017	0	1	0	1	0
2nd Asian Conference on Permafrost (ACOP2017)	Sapporo, Japan	Jul. 2–6, 2017	0	3	0	3	0
8th International Conference on New \Development in Photodetection	Tours, France	Jul. 3–6, 2017	0	1	0	1	0
2nd International Conference on Airborne Research for the Environment (ICARE 2017)	Oberpfaffenhofen, Germany	Jul. 10–13, 2017	0	1	0	1	0
Future of Cumulus Parametrization Workshop	Delft, Netherlands	Jul. 10–14, 2017	0	1	0	1	0
The 2nd VarSITI General Symposium (VarSITI-2017)	Irkutsk, Russia	Jul. 10–15, 2017	1	2	1	3	0
35th International Cosmic-Ray Conference (ICRC2017)	Busan, Korea	Jul. 12–20, 2017	0	2	2	4	1

Title	Country/ Region	Date	Orga-nizers	Number of Presentations			
				Staffs and PDs	Students	Total	invited
IAU Symposia (IAUS335) Space Weather of the Heliosphere: Processes and Forecasts	Exeter, UK	Jul. 17–21, 2017	1	0	0	0	0
Daiwa-Adrian workshop	Dorking, UK	Jul. 19–21, 2017	0	1	1	0	0
The 14th AOGS (Asia Oceania Geosciences Society) Annual Meeting	Singapore	Aug. 6–11, 2017	0	8	9	3	3
21st International Northern Research Basins Symposium and Workshop	Yakutsk, Russia	Aug. 6–12, 2017	0	1	1	0	0
14th International Conference on Accelerator Mass Spectrometry	Ottawa, Canada	Aug. 14–18, 2017	1	6	6	0	0
32th International Union of Radio Science (URSI) General Assembly & Scientific Symposium	Montreal, Canada	Aug. 19–26, 2017	0	2	2	0	0
48th Meeting SPD	Portland, Oregon, USA	Aug. 21–25 2017	0	1	1	0	0
IAGA-IAMAS-IAPSO (Good Hope for Earth Sciences)	Cape Town, South Africa	Aug. 27–Sep. 1, 2017	0	1	1	1	1
38th Conference on Radar Meteorology	Chicago, Illinois, USA	Aug. 28–Sep. 1, 2017	0	2	3	0	0
The 8th International Symposium of Advanced Energy Science: Interdisciplinary Approach to Zero-Emission Energy	Uji, Japan	Sep. 5–7, 2017	0	1	1	1	1
The 3rd ERG Mission Science Workshop	Taipei, Taiwan	Sep. 5–8, 2017	2	3	3	0	0
EISCAT_3D kickoff meeting	Tromsø, Norway	Sep. 6–8, 2017	0	1	1	0	0
5th iLEAPS Science Conference	Oxford, UK	Sep. 11–14, 2017	0	2	2	0	0
Jeju World Heritage Global Forum 2017	Jeju Island, Korea	Sep. 11–14, 2017	0	1	1	1	1
6th Asia-Pacific Symposium on Radiochemistry (APSORC17)	Jeju Island, Korea	Sep. 17–22, 2017	0	1	1	0	0
25th International Conference on Numerical Simulation of Plasmas (ICNSP 2017)	Leuven, Belgium	Sep. 18–20, 2017	0	2	2	0	0
The 3rd COSPAR Symposium 2017	Jeju Island, Korea	Sep. 18–22, 2017	0	1	1	1	1
1st Asia-Pacific Conference on Plasma Physics	Chengdu, China	Sep. 18–23, 2017	0	1	1	0	0
LMD Seminar	Paris, France	Sep. 21, 2017	0	1	1	0	0
BepiColombo Science Working Team Meeting #16	Matera, Italy	Sep. 23–27, 2017	0	1	1	0	0
13th International conference on substorms	Portsmouth, New Hampshire, USA	Sep. 25–29, 2017	0	2	3	1	1
Workshop on forward physics and high-energy scattering at zero degrees 2017 (HESZ2017)	Nagoya, Japan	Sep. 26–29, 2017	2	1	2	1	1
World Data System Asia-Oceania Conference 2017	Kyoto, Japan	Sep. 27–29, 2017	1	1	1	0	0
Isotoope for Tropical Ecosystem Studies	San José, Costa Rica	Oct. 2–6, 2017	0	1	1	1	1
ATS (Atmospheric Science) / CIRA (Cooperative Institute for Research in th Atmosphere) Colloquium	Fort Collins, Colorado, USA	Oct. 13, 2017	0	1	1	0	0
Third Research Coordination Meeting (RCM) on “Stable isotopes in precipitation and paleoclimatic archives in tropical areas to improve regional hydrological and climatic impact models”	Vienna, Austria	Oct. 16–20, 2017	0	1	1	0	0
12th International Conference on Mesoscale Convective Systems and High-Impact Weather in East Asia (ICMCS-XII)	Taipei, Taiwan	Oct. 17–20, 2017	2	3	4	0	0
Progress towards improving CME forecast	Nagoya, Japan	Oct. 30, 2017	0	1	1	0	0

Title	Country/ Region	Date	Orga-nizers	Number of Presentations			
				Staffs and PDs	Students	Total	invited
CHAMOS workshop	Helsinki, Finland	Oct. 30–Nov. 3, 2017	0	3	3	0	0
Enviro-Health Conference 2017 - Air Pollution & Future Strategies with a Focus on the NCT of Delhi	New Delhi, India	Nov. 2, 2017	0	1	1	0	0
Korea-Japan Space Weather Meeting	Naogya, Japan	Nov. 6, 2017	0	7	2	9	0
The 4th Asia-Pacific Solar Physics Meeting (APSPM2017)	Kyoto, Japan	Nov. 7–10, 2017	1	2	1	3	1
The 17th Australian Space Research Conference (ASRC)	Sydney, Australia	Nov. 13–15, 2017	0	0	1	1	0
6th WMO International Workshop on Monsoons (IWM-VI)	Singapore	Nov. 13–17, 2017	0	2	0	2	1
International Workshop “Across the Movius Line – Cultural Geography of South and Southeast Asia in the Late Pleistocene”	Tokyo, Japan	Nov. 18–19, 2017	0	1	0	1	0
Helicity Thinkshop 3	Tokyo, Japan	Nov. 19–23, 2017	0	3	0	3	1
EA-AMS-7	Guilin, China	Nov. 20–25, 2017	0	1	0	1	0
The 19th East Asia Sub-millimeter-wave Receiver Technology Workshop	Taipei, Taiwan	Nov. 28–30, 2017	0	0	1	1	0
Into the Read Dragon’s Lair: Four-in-One WorkshopTacking Outstanding Problems in Heliophysics and Space Weather	Cardiff, Wales, UK	Dec. 3–8, 2017	0	1	0	1	0
Climate Change Cluster (C3) Colloquium 2017: AQUAFLUO II Chlorophyll Fluorescence in Aquatic Sciences	Sydney, Australia	Dec. 4–8, 2017	0	2	0	2	0
AGU Fall Meeting 2017	New Orleans, Louisiana, USA	Dec. 11–15, 2017	0	13	10	23	1
The 5th Asia & 14th Korea-Japan Workshop on Ocean Color Remote Sensing	Busan, Korea	Dec. 14–15, 2017	0	4	2	6	0
ALMA/45m/ASTE Users Meeting 2017	Mitaka, Japan	Dec. 26–27, 2017	0	1	0	1	0
Review of mid-latitude SuperDARN follow-up workshop	Nagoya, Japan	Jan. 9–12, 2018	1	0	0	0	0
SGO Observatory Days	Sodankylä, Finland	Jan. 10–12, 2018	0	1	0	1	0
Fifth International Symposium on Arctic Research (ISAR-5)	Tokyo, Japan	Jan. 15–18, 2018	0	9	0	9	0
Symposium - Frontiers of Atmospheric Aerosol Studies: Toward the Understanding of the Health and Climatic Effects	Nagoya, Japan	Jan. 23–24, 2018	1	2	0	2	0
International conference series on HPC technologies in Asia Pacific region	Tokyo, Japan	Jan. 28–31, 2018	0	1	0	1	0
2018 Ocean Sciences Meeting	Portland, Oregon, USA	Feb. 11–16, 2018	0	2	0	2	0
DKIST CSP Workshop at Nagoya University	Nagoya, Japan	Feb. 26–28, 2018	0	3	0	3	0
Minutes of the LHC Committee meeting 133, Open Session	Geneve, Switherland	Feb. 28–Mar. 2, 2018	0	1	0	1	0
The 1st KMI School: “Dark Matter”	Nagoya, Japan	Feb. 28–Mar. 2, 2018	0	1	0	1	1
Total			31	194	57	251	33

■ Domestic Conferences

Number of Conferences	Organizers	Number of Presentations			
		Staff and PDs	Student	Total	invited
97	48	278	100	378	34

■ Lectures for Researchers

Date	Title	Number of Paticipants
May 9, 2017, Jun. 5, 2017, Jul. 7, 2017, Jul. 27, 2017, Spt. 8, 2017, Oct. 27, 2017, Nov. 2, 2017, Dec. 19, 2017, Jan. 25, 2018	PSTEP Seminar	60 a time on average
Apr. 24, 2017, May 15, 2017, Jul. 6, 2017, Jul. 14, 2017, Oct. 10, 2017, Oct. 26, 2017, Oct. 27, 2017, Nov. 15, 2017, Nov. 22, 2017, Nov. 24, 2017, Jan. 11, 2018, Mar. 22, 2018	ISEE/CICR Colloquium	20 a time on average
Apr. 20, 2017, Apr. 27, 2017, May 11, 2017, May 18, 2017, Jun. 1, 2017, Jun. 8, 2017	ROOT Training Workshop 2017	100
Jul. 9, 2017	Introduction to Space Weather: Concepts and Tools School at the 2nd VarSITI General Symposium	35
Jul. 30 –Aug. 4, 2017	PSTEP Summer School Rikubetsu 2017	100
Jul. 31, 2017	Cosmic Ray Lab Guest Seminar	15
Sep. 11–15, 2017	2nd International School on Equatorial and Low-Latitude Ionosphere (ISELLI-2)	52
Nov. 17, 2017	J-OFURO3 Data Seminar	12
Dec. 4 –15, 2017	27th IHP Training Course	17
Dec. 7, 2017	Cloud and Precipitation Climatology Lab Guest Seminar	21
Dec. 18, 2017	Numerical Prediction Division Seminar, Japan Meteorological Agency	19
Feb. 20, 2018	Meteorology Lab Guest Seminar	15
Mar. 1–2, 2018	11th VL Training Course	27
Mar. 5–9, 2018	International School on Equatorial and Low-latitude Ionosphere (ISELION2018)	45
Mar. 12, 2018	Kick-off Workshop “Frontier of Future Earth researches in Nagoya University”	54
Mar. 23–24, 2018	Typhoon Seminar 2017	29

Awards

■ Staffs and PDs

Date	Awards	Award Winners	Title
Apr. 3, 2017	Most Accessed Paper Award 2017, Progress in Earth and Planetary Science	Kazuo Shiokawa	Oberheide, J., K. Shiokawa, S. Gurubaran, et al, The geospace response to variable inputs from the lower atmosphere: A review of the progress made by Task Group 4 of CAWSES-II, *Progr. Earth Planet. Sci.*, 2:2, DOI 10.1186/s40645-014-0031-4, 2015.
Apr. 19, 2017	The Young Scientists' Prize, The Commendation for Science and Technology by the Minister of Education, Culture, Sports, Science and Technology	Fusa Miyake	Research of annual cosmic ray events in the past using cosmogenic nuclides
May 22, 2017	Tanakadate Award, Society of Geomagnetism and Earth, Planetary and Space Sciences (SGEPSS)	Satonori Nozawa	Studies of the polar upper mesosphere and lower thermosphere by using the EISCAT radars and the Tromsø sodium LIDAR
		Yoshizumi Miyoshi	Studies on cross-energy coupling processes in the inner magnetosphere via plasma transportation and acceleration, and wave-particle interactions
Aug. 8, 2017	Provost's Prize, Nagoya University Science Forum for Young Women Researchers	Masako Yamane	
Dec.15, 2017	Best Poster Award, The 20th Japanese Symposium of Accelerator Mass Spectrometry	Fumiko Nara	^{10}Be exposure dating of rocks from the shore of Lake Puma Yumco in Tibet
Mar. 28, 2018	Outstanding reviewer, Nuclear Inst. and Methods in Physics Research, A	Hiroyasu Tajima	

Additionally, one domestic award.

■ Students

Date	Awards	Award Winners	Title
May 19, 2017	Remote Sensing Society of Japan Young Researcher Award	Masataka Hayashi	Evaluation and Improvement of MODIS and SeaWIFS-derived Chlorophyll a Concentration in Ise-Mikawa Bay, *Journal of the Remote Sensing Society of Japan*, 35(4), 245-259, 2015
May 31, 2017	Outstanding Student Presentation Awards of JpGU-AGU Joint Meeting 2017	Yuki Asahi	The statistical analysis of correlation between solar flares and photospheric magnetic field
		Kei Kamiya	Formation of butterfly pitch angle distributions of relativistic electrons in the outer radiation belt due to the drift resonance with a monochromatic Pc5 wave
		Katsuki Nishi	Ground-based and magnetospheric observation of auroral finger-like structures using the RBSP-A satellite in the inner magnetosphere
		Eligio de Raus Maure	Impact of mesoscale eddies on spring bloom initiation in the Japan Sea
Nov. 15, 2017	Best Poster Presentation - 2nd runner-up at the 17th Australian Space Research Conference (ASRC)	Prayitno Abadi	Longitudinal variation of equatorial plasma bubble occurrence in Southeast Asia
Mar. 26, 2018	IEEE Excelent Student Award	Masashi Fujiyama	Solar Surface Velocity in the Large Scale estimated by Magnetic Element Tracking Method
Mar. 26, 2018	Graduate School of Science Award, Nagoya University	Ryoya Uemura	

11. Education

The Institute for Space–Earth Environmental Research primarily offers graduate programs in three schools, i.e., Science, Engineering, and Environmental Studies; however, it also provides opportunities for both undergraduate and postdoctoral experiences in these schools. In addition to the academic staff of the faculties, specially appointed members also contribute to education via graduate and undergraduate courses. Graduates are enrolled in the doctoral programs. Academic members are responsible for guiding the progress of the students' thesis projects. The students studying at the institute also have opportunities to attend seminars and discussions with foreign researchers and to participate in international meetings/conferences and observations/experiments.

Graduate Programs

The institute has its own graduate course program for Heliospheric and Geospace Physics as a part of the Division of Particle and Astrophysical Science in the Graduate School of Science at Nagoya University.

In addition, it cooperates with the Department of Electrical Engineering and Computer Science via the Space Electromagnetic Environment group (http://www.nuee.nagoya-u.ac.jp/soshiki/electrical-e.php) in the Graduate School of Engineering and the Department of Earth and Environmental Sciences (as a group in the Earth and Planetary Sciences Course and the Hydrospheric–Atmospheric Sciences Course http://www.env.nagoya-u.ac.jp/english/dept/index.html) in the Graduate School of Environmental Studies by teaching/training graduate students in disciplines related to Space–Earth Environmental Research. They also teach core and topical courses.

Staff association between the research divisions in the ISEE and the graduate schools

		Graduate School of Science					Graduate School of Engineering		Graduate School of Environmental Studies					
		Division of Particle and Astrophysical Science					Department of Electrical Engineering and Computer Science		Department of Earth and Environmental Sciences					
		Heliospheric and Geospace Physics					Electrical Engineering Course Space Electromagnetic Environment		Earth and Planetary Sciences Course Earth History Study		Hydrospheric-Atmospheric Sciences Course Global Water Cycle			
		Atmospheric and Environmental Science (AM)	Space Science – Experiment (SS_E)	Solar and Space Physics - Theory (SS_T)	Cosmic-Ray Physics (CR)	Heliospheric Plasma Physics (SW)	Space Observation	Information Engineering	CHIME	Tandetron AMS	Meteorology	Cloud and Precipitation Sciences	Hydroclimatology	Oceanography
Institute for Space–Earth Environmental Research	Integrated Studies			●				●						
	Cosmic-Ray Research				●									
	Heliospheric Research					●								
	Ionospheric and Magnetospheric Research		●				●							
	Meteorological and Atmospheric Research	●					●				●	●		
	Land–Ocean Ecosystem Research												●	●
	Chronological Research				●				●	●				
	Center for International Collaborative Research	●	●		●		●		●				●	
	Center for Intergrated Data Science			●	●			●	●		●	●		●
	Center for Orbital and Suborbital Observations	●	●		●						●	●		●

Number of Students Supervised by ISEE Staff

(April 1, 2017–March 31, 2018)

	M1	M2	D1	D2	D3	Undergraduate Students	Research Students	Total
Graduate School of Science	11	18	4	7	8	-	2	50
Graduate School of Engineering	7	8	1	0	1	-	-	17
Graduate School of Environmental Studies	6	6	5	0	9	-	5	31
School of Science	-	-	-	-	-	8	-	8
School of Engineering	-	-	-	-	-	8	-	8
Total	24	32	10	7	18	16	7	114

* cumulative total in FY 2017

Faculty Members

(April 1, 2017–March 31, 2018)

■ Graduate School of Science Division of Particle and Astrophysical Science

Field/Topics	Professor	Associate Professor	Lecturer	Assistant Professor
Solar-Terrestrial Chemistry	Yutaka Matsumi		Tomoki Nakayama *1	
	Akira Mizuno	Tomoo Nagahama		
Solar-Terrestrial Relationships	Masafumi Hirahara	Satonori Nozawa	Shin-ichiro Oyama	
		Yuichi Otsuka		
	Kanya Kusano	Satoshi Masuda		Akimasa Ieda
Solar-Terrestrial Physics	Yoshitaka Itow	Kimiaki Masuda	Takashi Sako *2	Akira Okumura *3
	Hiroyasu Tajima	Fumio Abe		
		Yutaka Matsubara		
	Munetoshi Tokumaru	Kazumasa Iwai		Ken-ichi Fujiki

*1 Left the Institute at February 2018

*2 Left the Institute at October 2017

*3 Lecturer after March 2018

■ Graduate School of Engineering Department of Electrical Engineering and Computer

Field/Topics	Professor	Associate Professor	Lecturer	Assistant Professor
Space Electromagnetic Environment	Kazuo Shiokawa	Nozomu Nishitani		Taku Nakajima
	Shinobu Machida	Yoshizumi Miyoshi	Takayuki Umeda	Shinsuke Imada*4

*4 Lecturer after February 2018

■ Graduate School of Environmental Studies Department of Earth and Environmental

Field/Topics	Professor	Associate Professor	Lecturer	Assistant Professor
Hydrospheric-Atmospheric Sciences Course Global Water Cycle	Kazuhisa Tsuboki	Taro Shinoda		
	Nobuhiro Takahashi	Hirohiko Masunaga		
	Tetsuya Hiyama	Naoyuki Kurita *5	Hatsuki Fujinami	
	Joji Ishizaka	Hidenori Aiki		Yoshihisa Mino
Earth and Planetary Sciences Course Earth History Study	Masaki Enami	Takenori Kato		
	Hiroyuki Kitagawa	Masayo Minami		Hirotaka Oda

*5 Associate Professor after October 2017

Undergraduate Education

Based on demand, the faculty of the institute offers numerous undergraduate courses in the School of Science, the School of Engineering, and in other departments and at other universities in the adjacent area.

■ During the 2017 Academic Year, The Following Courses were Offered;

- First Year Seminar A
- Foundations of Electromagnetics I
- Laboratory in Physics
- Introduction to Earth Science
- From the Big Bang to the Present-day Human Society
- Astrophysics and Space Science
- Science of Atmospheric-Hydrospehric Environment
- Astrophysics III
- Experimental Physics
- Physics Laboratory I, II
- Introduction to Physics I, II
- Graduation Research-Experiments
- Topics in Advanced Physics
- Atmospheric and Hydrospheric Sciences I
- Practical Petrology and Petrology Experiments I
- Solar System Science
- Geosphere Environmental Chemistry
- Geology Experiments
- Geochemical Analysis II and Experiments
- Mathematics 1 with Exercises A/B
- Probability Theory and Numerical Analysis with Exercises
- Electric Circuits with Exercise
- Electromagnetic Wave Engineering

12. International Relations

Academic Exchange

Institution	Country/Region	Establishment
Indonesian National Institute of Aeronautics and Space	Indonesia	May 31,1988
Korean Space Weather Center	Korea	December 24, 2012
Korea Institute of Ocean Science and Technology, Korea Ocean Satellite Center	Korea	April 17, 2014
Pukyong National University, College of Fisheries Sciences	Korea	October 2, 2006
Institute of High Energy Physics, Chinese Academy of Sciences	China	February 20, 2001
Polar Research Institute of China	China	November 11, 2005
Department of Atmospheric Sciences, National Taiwan University	Taiwan	October 30, 2009
Center for Weather Climate and Disaster Research, National Taiwan University	Taiwan	September 3, 2014
Bangladesh University of Engineering & Technology, Department of Physics	Bangladesh	March 4, 2008
National Institute of Water andAtmospheric Research	New Zealand	July 26, 1989
Centre for Geophysical Research, University of Auckland	New Zealand	December 7, 1992
Faculty of Science, University of Canterbury	New Zealand	July 30, 1998
Geophysical Institute, University of Alaska Fairbanks	U.S.A.	July 16, 1990
Space Environment Center, National Oceanic and Atmospheric Administration	U.S.A.	December 15, 1992
National Geophysical Data Center, National Oceanic and Atmospheric Administration	U.S.A.	January 5, 1993
Haystack Observatory, Massachusetts Institute of Technology	U.S.A.	October 24, 1994
Center for Astrophysics and Space Sciences, University of California at San Diego	U.S.A	December 22, 1997
Center for Space Science and Engineering Research, Virginia Polytechnic Institute and State University	U.S.A.	January 23, 2013
Chacaltaya Cosmic Ray Observatory, Faculty of Sciences, Universidad Mayor de San Andres, La Paz	Bolivia	February 20, 1992
National Institute for Space Research	Brazil	March 5, 1997
Swedish Institute of Space Physics	Sweden	September 1, 2005 (since March 25, 1993)
Faculty of Science, University of Tromsø	Norway	April 2, 2003 (since October 8, 1993)
Department of Geophysics, Finnish Meteorological Institute	Finland	October 21, 1994
Yerevan Physics Institute	Armenia	October 18, 1996
Institute of Cosmophysical Research and Radiowave Propagation, Far Eastern Branch, Russian Academy of Sciences	Russia	April 14, 2007
Institute of Solar-Terrestrial Physics, Siberian Branch of the Russian Academy of Sciences	Russia	October 28, 2008
Yu.G. Shafer Institute of Cosmophysical Research and Aeronomy, Siberian Branch of the Russian Academy of Sciences	Russia	November 28, 2012
The Polar Geophysical Institute, Murmansk	Russia	March 13, 2017

Note: The List includes the academic exchanges established in the former organizations before ISEE.

Research Projects

■ Major International Collaborative Projects

Research Project	ISEE Representative	Collaborating Country/Region	Collaborating Organization
VarSITI (Variability of the Sun and Its Terrestrial Impact)	K. Shiokawa	U.S.A., France, Germany, U.K., Italy, Canada, Australia, India, China, *and other countries*	SCOSTEP
Study of the Polar/Midlatitude Ionosphere and Magnetosphere Using the SuparDARN HF Radar Network	N. Nishitani	U.S.A. U.K. France South Africa Australia Canada Italy Russia China	JHUAPL, Virginia Polytechnic Institute and State University University of Leicester LPC2E/CNRS University of KwaZulu-Natal La Trobe University University of Saskatchewan IFSI ISTP/SB RAS Polar Research Institute of China
Project for Development of the Atmospheric Environmental Risk Management System in South America	A. Mizuno	Argentina Chile	CEILAP Servicio Meteorológico Nacional Argentina University of Magallanes(UMAG) Dirección Meteorológica de Chile
Study of the Onset Mechanism of Solar Eruptions	K. Kusano	Germany	University of Potsdam
Observational Study of the Onset Mechanism of Solar Eruptions	K. Kusano	U.S.A China	New Jersey Institute of Technology University of Science and Technology of China
Study of Modeling of Solar Eruptions	K. Kusano	U.S.A.	Harvard-Smithsonian Center for Astrophysics
Study of Triggering Mechanism of Solar Flares	K. Kusano	U.K.	UCL-Mullard Space Science Laboratory
Study of Magnetic Reconnection	K. Kusano	U.K.	University of Manchester
Solar Researches with Nobeyama Radioheliograph	S. Masuda	U.S.A. China Korea Russia U.K. Germany	GSFC/NASA, Catholic University of America National Astronomical Observatories Chinese Academy of Sciences, Shandong University KASI, Seoul National University Russian Academy of Sciences University of Warwick Georg-August-Universität Göttingen
Radiation Belt Storm Probes (RBSP) Project	Y. Miyoshi	U.S.A.	NASA, JHUAPL
Modeling Study of Inner Magnetosphere	Y. Miyoshi	U.S.A.	Los Alamos National Laboratory

Research Project	ISEE Representative	Collaborating Country/Region	Collaborating Organization
Pulsating Aurora as a Manifestation of Non-Linear Wave Particle	Y. Miyoshi	U.S.A China Finland Czech	UCLA Peking University Sodankylä Geophysical Observatory: SGO Czech Academy of Sciences
A Search for Dark Objects Using the Gravitational Microlensing Effect	F. Abe	New Zealand U.S.A.	University of Auckland, University of Canterbury, Victoria University of Wellington, Massey University University of Notre Dame
Study in Cosmic Neutrinos by Using a Large Water Cherenkov Detector	Y. Itow	U.S.A. Canada U.K. Spain Korea China	Boston University, Brookhaven National Laboratory, UCI, Duke University, George Mason University, University of Hawaii, Indiana University, Los Alamos National Laboratory, University of Maryland, State University of New York, University of Washington University of British Columbia, University of Toronto, TRIUMF Queen Mary University of London, Imperial College London, University of Liverpool, University of Oxford, University of Sheffield Complutense University of Madrid Chonnam National University, Seoul National University, Sungkyunkwan University
Study in Interaction of Very High Energy Cosmic Rays by Using Large Hadron Collider	Y. Itow	Italy France Switzerland U.S.A.	University of Florence, Catania University École Polytechnique CERN Lawrence Berkeley National Laboratory
Study of Dark Matter and Solar Neutrinos Using a Liquid Xenon Detector	Y. Itow	Korea	Seoul National University, Sejong University, Korea Research Institute of standards and Science
Research and Development for the Next Generation Water Cherenkov Detector, Hyper-Kamiokande	Y. Itow	U.S.A. Korea China U.K. Italy France Switzerland Spain Poland Brazil *Canada, Russia* *Portugal*	Boston University, Brookhaven National Laboratory, UCI, Duke University, George Mason University, Indiana University, University of Hawaii, Los Alamos National Laboratory, University of Maryland, State University of New York, University of Washington Chonnam National University, Seoul National University, Sungkyunkwan University Tsinghua University Imperial College London, Lancaster University, University of Oxford, Queen Mary University of London, University of Sheffield, Rutherford Appleton Laboratory INFN Sezione di Bari, INFN Sezione di Napoli, INFN Sezione di Padova, INFN Sezione di Roma CEA Saclay, École Polytechnique University of Bern, Swiss Federal Institute of Technology Zurich Autonomous University of Madrid University of Warsaw University of São Paulo *and other Institutions*

Research Project	ISEE Representative	Collaborating Country/Region	Collaborating Organization
Study of Solar Neutrons	Y. Matsubara	Bolivia Armenia China Switzerland U.S.A. Mexico	Research Institute of Physics, University of San Andres Yerevan Physics Institute Institute of High Energy Physics, Chinese Academy of Sciences University of Bern University of Hawaii National Autonomous University of Mexico
Search for Cosmic-ray Excursions in the Past by Single-year Measurements of ^{14}C in Tree Rings	F. Miyake	U.S.A. Switzerland	The University of Arizona Swiss Federal Institute of Technology
Study in Interaction of Very High Energy Cosmic Rays by Using Relativistic Heavy Ion Collider	T. Sako	Italy U.S.A.	University of Florence, Catania University Brookhaven National Laboratory
Solar Flare Research with Hard X-ray Spectral Imaging Observations	H. Tajima	U.S.A.	UCB, MSFC/NASA, Air Force Research Laboratory
Solar Flare Research with Gamma-ray Spectral Imaging Observations with Polarimetry	H. Tajima	U.S.A.	UCB, Lawrence Berkeley National Laboratory, GSFC/NASA
Research on Origin of Cosmic Rays with Fermi Satellite	H. Tajima	U.S.A. France Italy Sweden	Stanford University, SLAC National Accelerator Laboratory, GSFC/NASA, U.S. Naval Research Laboratory, UCSC, Sonoma State University University of Washington, Purdue University, Ohio State University, University of Denver CENS, CNRS, École Polytechnique INFN, Italian Space Agency, IFSI Royal Institute of Technology, Stockholm
Research on Origin of Cosmic Rays with CTA (Cherenkov Telescope Array)	H. Tajima	Germany France Italy Spain Switzerland U.K. U.S.A. *Brazil, Argentina, Poland, Armenia, Australia, Czech, Bulgaria, Croatia, Finland, Greece, Sweden Slovenia, India, Ireland, South Africa*	Deutsches Elektronen-Synchrotron, Max-Planck-Institut, Heidelberg University CENS, École Polytechnique, University of Paris INFN, IFSI University of Barcelona, Complutense University University of Zürich Durham University, University of Leicester, University of Leeds SLAC National Accelerator Laboratory, Argonne National Laboratory, University of Washington, Iowa State University, UCLA, UCSC, University of Chicago, Smithsonian Observatory *and other institutions*
Observations of Interplanetary Disturbances Using the International IPS Network	M. Tokumaru	U.K. Russia India Mexico Australia	LOFAR-UK Lebedev Physical Institute Tata Institute of Fundamental Research National Autonomous University of Mexico Murchison Widefield Array
Study of 3-D Solar Wind Structure and Dynamics Using Heliospheric Tomography	M. Tokumaru	U.S.A.	CASS/UCSD
Study on the Application of Interplanetary Scintillation Observations to Space Weather Forecast	M. Tokumaru	Korea	Korean Space Weather Center

Research Project	ISEE Representative	Collaborating Country/Region	Collaborating Organization
Study of the Heliospheric Boundary Region Using Observations of Interplanetary Scintillation	M. Tokumaru	U.S.A.	Interstellar Boundary Explorer
Magnetic Conjugate Observations of Midlatitude Thermospheric Disturbances	K. Shiokawa	Australia	Radio and Space Service/IPS
Variation of the Thermosphere and Ionosphere owing to the Energy of Atmospheric Waves	K. Shiokawa	Indonesia	LAPAN
High-Sensitive Imaging Measurements of Airglow and Aurora in the Canadian Arctic	K. Shiokawa	U.S.A. Canada	University of California, Augsburg College Virginia Polytechnic Institute and State University University of Calgary, Athabasca University
Ionosphere and Upper Atmosphere Research, Observations and Monitoring	K. Shiokawa	Thailand	Chiang Mai University
Comparison of Dynamical Variations of the Mesosphere, Thermosphere, and Ionosphere between Asian and Brazilian Longitudes	K. Shiokawa	Brazil	INPE
Ground and Satellite Measurements of Geospace Environment in the Far-Eastern Russia	K. Shiokawa	Russia	Institute of Cosmophysical Research and Radiowave Propagation, Far Eastern Branch, Russian Academy of Sciences
Observations of the Equatorial Ionosphere in South-East Asia and West Africa	K. Shiokawa	Nigeria Cote d'Ivoire	National Space Research and Development Agency, Federal University of Technology, Akure Université Félix Houphouët-Boigny
Observations of Waves and Particles in the Inner Magnetosphere in the Siberian Region of Russia	K. Shiokawa	Russia	IKFIA/SB RAS, ISTP/SB RAS
Future Satellite Mission for the Terrestrial Magnetosphere-Ionosphere-Thermosphere Explorations by Formation Flight Observations and its Feasibility Study and Collaboration of the Satellite and Ground-Based Observations	M. Hirahara	Sweden	Swedish Institute of Space Physics(IRF), Swedish National Space Board
Research and Development of the Plasma/Particle Instrument Suite for the Mercury Magnetospheric Exploration Mission	M. Hirahara	France Sweden U.K. U.S.A. Switzerland	CESR-CNRS, CETP-IPSL Institute for Solar Physics of the Royal Swedish Academy of Sciences Rutherford Appleton Laboratory Boston University University of Bern
Study of the Polar Upper Atmosphere Using the EISCAT Radars and Other Instruments	S. Nozawa	Norway Sweden, Finland, Germany, U.K.,	University of Tromsø EISCAT Scientific Association
Magnetosphere-Ionosphere-Thermosphere coupling study with ISRs and optical instruments	S. Oyama	U.S.A.	University of Maryland, College Park, University of Alaska Fairbanks, University of Oulu
Study of Auroral Energetic Electron Precipitation (EEP) Impacts on the Upper/Middle Atmosphere	S. Oyama	Finland New Zealand U.K. Norway U.S.A.	Sodankylä Geophysical Observatory, University of Oulu, Finnish Meteorological Institute University of Otago British Antarctic Survey University Centre in Svalbard University of Alaska Fairbanks
Observatiopn of PM2.5 in Hanoi	Y. Matsumi	Vietnam	Hanoi University of Science and Technology
Observation of PM2.5 in Ulan Bator	Y. Matsumi	Mongolia	National University of Mongolia

Research Project	ISEE Representative	Collaborating Country/Region	Collaborating Organization
Continuous Observation of Methane at a Paddy Field in Northern India	Y. Matsumi	India	University of Delhi
High Energy Particles in Geospace: the Acceleration Mechanism and the Role in Earth's Climate	A. Mizuno	U.S.A. Norway Sweden	University of Colorado Boulder, UCLA, University of Arizona University of Tromsø EISCAT Scientific Association
Global Precipitation Measurement Mission (GPM)	H. Masunaga N. Takahashi	U.S.A.	NASA
Tropical Rainfall Measuring Mission	N. Takahashi	U.S.A.	NASA
Tropical Cyclones-Pacific Asian Research Campaign for Improvement of Intensity Estimations/Forecasts (T-PARCII)	K. Tsuboki T. Shinoda	Taiwan	National Taiwan University Atmospheric Sciences
Study of Equatorial Waves in the Atmosphere and Ocean	H. Aiki	Germany	GEOMAR Helmholtz Centre for Ocean Research Kiel
Validation of GOCI Products and Application to Environmental Monitoring of Japanese Coastal Waters	J. Ishizuka	Korea	Korea Institute of Ocean Science and Technology
Collection of Validation Dataset of GCOM-C Coastal Products	J. Ishizaka	Korea U.S.A. Taiwan Thailand China Estonia	Korea Institute of Ocean Science and Technology Columbia University, East Carolina University National Cheng Kung University Burapha University First Institute of Oceanography, Nanjing University of Science and Technology University of Tartu
Sea Surface Nitrate and Nitrate Based New Production - two innovative research products from SGLI on board GCOM-C	J. Ishizaka	U.S.A.	Columbia University
Investigating the optical characteristics of red tides in the upper Gulf of Thailand	J. Ishizaka	Thailand	University of Burapa Kasetsart University
Validation of ocean color products in the western North Pacific and Japanese coastal waters：Collaboration with JAXA GCOM-C project	J. Ishizaka	Germany	European Organisation for the Exploitation of Meteorological Satellites
Integrated Land Ecosystem - Atmosphere Processes Study (iLEAPS), one of the Global Research Projects (GRPs) of the Future Earth	T. Hiyama	Sweden, Finland, U.K., China, *and others*	iLEAPS/Future Earth
Observational Study of Vegetation, Energy and Water in Eastern Siberia Towards Elucidation of Climate and Carbon Cycle Changes	T. Hiyama	Russia	Institute for Biological Problems of Cryolithozone /SB RAS
Arctic Challenge for Sustainability (ArCS) Project	T. Hiyama	U.S.A.	International Arctic Research Center of the University of Alaska Fairbanks (IARC)
Estimating Permafrost Groundwater age in Central Mongolia	T. Hiyama	Mongol	Institute of Geography and Geoecology of the Mongolian Academy of Sciences
Geochronological Research on the Basement Rocks in Japan and Korea	T. Kato	Korea	Korea Institute of Geoscience and Mineral Resources (KIGAM)

Research Project	ISEE Representative	Collaborating Country/Region	Collaborating Organization
Development of New Analytical Techniques and Accurate Quantification of Electron Microprobe Analysis	T. Kato	Korea	Pusan National University (PNU)
Stable Isotopes in Precipitation and Paleoclimatic Archives in Tropical Areas to Improve Regional Hydrological and Climatic Impact Models	N. Kurita	U.S.A., Australia, Argentina, Brazil, Bangladesh, China, *and other countries*	International Atomic Energy Agency (IAEA)
Towards a Deeper understanding of Tropical Isoscapes	N. Kurita	Australia	James Cook University, Cairn
Comparison Between 1 MV AMS and 5 MV AMS on Precision and Accuracy of ^{10}Be Measurement	M. Minami	Korea	Korea Institute of Geoscience and Mineral Resources (KIGAM)
Radiocarbon Dating of Kraftu Cave Guano Deposit in Kurdistan, Iran	M. Minami	Iran	University of Kurdistan
High Precision Radiocarbon Measurements of Tree Annual Rings	T. Nakamura	U.S.A.	Department of Geosciences, University of Arizona
Radiocarbon Measurement of Peat Sediments in Aleutian Islands, Alaska, North America	T. Nakamura	U.S.A.	The Museum of the Aleutians, Unalaska
Eruption History of the Calderas Located in Bali, Indonesia	T. Nakamura	Indonesia	Department of Geological Engineering, Gadjah University
Investigation on Bottom Topography and the Formation Ages of Maar Lakes in Philippines Using the Lake Sediments	T. Nakamura	Philippine	Philippine Institute of Volcanology and Seismology
Heidelberg pure CO_2 Intercomparison Project	T. Nakamura	Germany	Heidelberg University
Study on History of Palaeo-Environmental Changes Based on Radiocarbon Ages of Cored-Sediment Samples from a Wetland in South India	T. Nakamura	India	Indian Institute of Science, Banglore
Study on Radiocarbon Chronology of Buddhistic Archaeological Remains at the Bamiyan Site, Islamic Republic of Afghanistan	T. Nakamura	France	Directeur de la Mission Archéologique Française
Study of Grand-Water Circulation Based on ^{14}C Ages of Underground Water and Hot-Spring Water Samples from Korea	T. Nakamura	Korea	Korea Institute of Geoscience and Mineral Resources (KIGAM)
Research and Development on Geochemical Proxies of Isotope and Trace Element for Understanding of Earth and Universe Evolution Processes	G. Tanaka	Korea	Korea Institute of Geoscience and Mineral Resources (KIGAM)
Radiocarbon dating of bronze wares excavated from Indian archeological site	H. Oda	India	Deccan College
Radiocarbon dating of bronze wares excavated from Russian archeological site	H. Oda	Russia	Institute of Ethnology and Anthropology Russian Academy of Science

Research Project	ISEE Representative	Collaborating Country/Region	Collaborating Organization
Climate change reconstruction of the Central Highlands in Vietnam	H. Kitagawa	Vietnam	Vietnam Academy of Science And Technology
International Continental Scientific Drilling Program - Dead Sea Deep Drilling Project （ICDP-DSDDP)	H. Kitagawa	Israel U.S.A Germany Switzerland	Geological Survey of Israel Hebrew University of Jerusalem Columbia University University of Minnesota German Research Centre for Geosciences Max-Planck-Institute Mainz for Chemistry Université de Genève Université de Genève

Visitors from Foreign Institutes

Name	Country/ Region	Affiliation	Period	Status at Nagoya University
Cai Lei	Finland	University of Oulu	Jul. 1, 2016 - May 31, 2017	Foreign Collaborative Researcher
Anglu Shen	China	Chinese Academy of Fisher Sciences	Sep. 1, 2016 - Aug. 31, 2017	Foreign Collaborative Researcher
Jie Ren	China	Peking University	Oct. 1, 2016 - Jan. 31, 2018	Foreign Collaborative Researcher
Martin Gerard Connors	Canada	Athabasca University	Jan. 1 - May 31, 2017	Foreign Collaborative Researcher
Joseph Benjamin Harold Baker	U.S.A.	Virginia Polytechnic Institute and State University	Jan. 1 - Jun. 30, 2017	Foreign Collaborative Researcher
Bernhard Hartmut Kliem	Germany	University of Potsdam	Mar. 1 - May 31, 2017	Foreign Visiting Research Fellow
Berti Engenio	Italy	University of Florence	Mar. 21 - Apr. 9, 2017	Visitor
Haimin Wang	U.S.A.	New Jersey Institute of Technology	Apr. 12 - 15, 2017	Visitor
Antonio Ferriz Mas	Spain	University of Vigo	Apr. 15 - 17, 2017	Visitor
Quing Chang	China	Chinese Academy of Sciences	Apr. 18 - 21, 2017	Foreign Collaborative Researcher
Wenzhe Jiao	China	Chinese Academy of Sciences	Apr. 18 - 21, 2017	Foreign Collaborative Researcher
K. D. Leka	U.S.A.	NorthWest Research Associates	Apr. 18 - May 2, 2017	Foreign Collaborative Researcher
Ventaka Subrahmanya Srinivasa Sarma Vedula	India	National Institute of Ocean Technology	May 1 - Jun. 10, 2017	Foreign Visiting Research Fellow
Byambatseren Chuluunpurev	Mongol	The National University of Mongolia	May 8 - 16, 2017	Foreign Collaborative Researcher
Sonomdagva Chonokhuu	Mongol	The National University of Mongolia	May 8 - 16, 2017	Foreign Collaborative Researcher
Jeongwoo Lee	Korea	Seoul National University	May 9 - 19, 2017	Foreign Collaborative Researcher
Elena Kupriyanova	Russia	Central Astronomical Observatory at Pulkovo of the RAS	May 9 - Jul. 11, 2017	Foreign Collaborative Researcher
Tam Dao Ngoc Hanh	Vietnam	Ho Chi Minh Institute of Physics	May 12 - Aug. 4, 2017	Foreign Collaborative Researcher
Janardhan Padmanabhan	India	Physical Research Laboratory	May 14 - Jun. 5, 2017	Foreign Collaborative Researcher
Xuchen Wang	China	Ocean University of China	May 15, 2017	Visitor
Yuejun Xue	China	Ocean University of China	May 15, 2017	Visitor
Savcheva Antonia	U.S.A.	Smithsonian Observatory	May 15 - 19, 2017	Foreign Collaborative Researcher
Surendra Kumar Dhaka	India	University of Delhi	Jun. 1 - Jul. 31, 2017	Foreign Visiting Research Fellow
Bich Thuy Ly	Vietnam	Hanoi University of Science and Technology	Jun. 1 - Aug. 31, 2017	Foreign Visiting Research Fellow
Daniel Okoh	Nigeria	National Space Research and Development Agency	Jun. 2 - Aug. 31, 2017	Foreign Collaborative Researcher
Magnus Woods	U.K.	University College London Space & Climate Physics	Jun. 20 - Aug. 21, 2017	Foreign Collaborative Researcher
Hajihossein Azizi	Iran	University of Kurdistan	Jun. 23 - Aug. 23, 2017	Foreign Collaborative Researcher

Name	Country/ Region	Affiliation	Period	Status at Nagoya University
Jeonghoon Lee	Korea	Korea University of Technology and Education	Jul. 14, 2017	Foreign Collaborative Researcher
Jihye Kang	Korea	Kyung Hee University	Jul. 18 - 21, 2017	Visitor
Nghiem Trung Dung	Vietnam	Hanoi University of Science and Technology	Jul. 18 - 22, 2017	Foreign Collaborative Researcher
Chih-Ying Yeh	Taiwan	National Dong Hwa University	Jul. 18 - 29, 2017	Visitor
Venkata Ratnam Devanaboyina	India	KL University	Jul. 19 - Oct. 20, 2017	Foreign Collaborative Researcher
Yoonyeol Yoon	Korea	Korea Institute of Geoscience and Mineral resources	Jul. 20 - 25, 2017	Foreign Collaborative Researcher
Sergii Panasenko	Ukraine	Institute of ionosphere	Jul. 31 - Sep. 29, 2017	Foreign Collaborative Researcher
K. D. Leka	U.S.A.	NorthWest Research Associates	Sep. 4 - 22, 2017	Foreign Collaborative Researcher
Hua Hsu	Taiwan	National Taiwan University	Sep. 8, 2017	Visitor
Hung-Chi Kuo	Taiwan	National Taiwan University	Sep. 8, 2017	Visitor
Hungjui Yu	Taiwan	National Taiwan University	Sep. 8, 2017	Visitor
Pei-Yuan Hsieh	Taiwan	National Taiwan University	Sep. 8, 2017	Visitor
Yuhan Chen	Taiwan	National Taiwan University	Sep. 8, 2017	Visitor
Sergey Tyul'bashev	Russia	Lebedev Physical Institute	Sep. 10 - Dec. 9, 2017	Foreign Collaborative Researcher
Jih-Hong Shue	Taiwan	National Central University	Sep. 11, 2017	Visitor
Helga Rosario Do Gomes	U.S.A.	Columbia University	Sep. 15 - Dec. 14, 2017	Foreign Visiting Research Fellow
Joaquim Ignacio Goes	U.S.A.	Columbia University	Sep. 15 - Dec. 14, 2017	Foreign Visiting Research Fellow
Ioannis Daglis	Greece	University of Athens	Sep. 15 - Dec. 15, 2017	Foreign Visiting Research Fellow
Savcheva Antonia	U.S.A.	Smithsonian Observatory	Sep. 17 - 30, 2017	Foreign Collaborative Researcher
Jianwei Lin	Taiwan	National Taiwan University	Sep. 25, 2017	Foreign Collaborative Researcher
Neethal Thomas	India	Indian Institute of Geomagnetism	Sep. 27 - 28, 2017	Foreign Collaborative Researcher
Stephen White	U.S.A.	Air Force Research Laboratory	Oct. 3 - 7, 2017	Visitor
Angelos Vourlidas	U.S.A.	Johns Hopkins University	Oct. 11 - Nov. 2, 2017	Visitor
Neel Prakash Savani-Patel	U.S.A.	NASA Goddard Space Flight Center	Oct. 13 - Nov. 26, 2017	Foreign Collaborative Researcher
Ivana Kolmasova	Czech	The Czech Academy of Sciences	Oct. 14 - Nov. 1, 2017	Foreign Collaborative Researcher
Ondrej Santolik	Czech	The Czech Academy of Sciences	Oct. 14 - Nov. 1, 2017	Foreign Collaborative Researcher
Ulrich Taubenschuss	Czech	The Czech Academy of Sciences	Oct. 14 - Nov. 1, 2017	Foreign Collaborative Researcher
Horky Miroslav	Czech	The Czech Academy of Sciences	Oct. 14 - Nov. 2, 2017	Foreign Collaborative Researcher

Name	Country/ Region	Affiliation	Period	Status at Nagoya University
Jihye Kang	Korea	Kyung Hee University	Oct. 15 - 18, 2017	Visitor
Zamri Zainal Abidin	Malaysia	University of Malaya	Oct. 19, 2017	Visitor
Arakel Petrosyan	Russia	Russian Academy of Sciences	Oct. 22 - 28, 2017	Visitor
Geeta Vichare	India	Indian Institute of Geomagnetism	Oct. 24 - 27, 2017	Foreign Collaborative Researcher
Graham Barnes	U.S.A.	NorthWest Research Associates	Oct. 28 - Nov. 3, 2017	Participant in the Symposium
David Falconer	U.S.A.	University of Alabama Huntsville	Oct. 29 - Nov. 3, 2017	Participant in the Symposium
Leila Mays	U.S.A.	NASA	Oct. 29 - Nov. 3, 2017	Participant in the Symposium
Shaun Bloomfield	U.K.	Northumbria University	Oct. 29 - Nov. 3, 2017	Participant in the Symposium
Tarek Am Hamad Nagem	U.K.	University of Bradford	Oct. 29 - Nov. 4, 2017	Participant in the Symposium
Diptiranjan Rout	India	Physical Research Laboratory	Oct. 29 - Nov. 22, 2017	Foreign Collaborative Researcher
Junchul Mun	Korea	Korean Space Weather Center	Oct. 30 - Nov. 2, 2017	Participant in the Symposium
Sangwoo Lee	Korea	Korea Advanced Institute of Science and Technology	Oct. 30 - Nov. 2, 2017	Participant in the Symposium
Aoife Elizabeth Mc Closkey	Ireland	Trinity College Dublin	Oct. 30 - Nov. 3, 2017	Participant in the Symposium
Robert Steenburgh	U.S.A.	NOAA	Oct. 30 - Nov. 3, 2017	Participant in the Symposium
Suzanne Jane Bingham	U.K.	Met Office	Oct. 30 - Nov. 3, 2017	Participant in the Symposium
Emmanouil Georgoulis	Greece	Academy of Athens	Oct. 30 - Nov. 4, 2017	Participant in the Symposium
K. D. Leka	U.S.A.	NorthWest Research Associates	Oct. 30 - Nov. 24, 2017	Foreign Collaborative Researcher
Hocheol Jeon	Korea	Radar&Space	Oct. 31, 2017	Visitor
Jaehyung Lee	Korea	Korean Space Weather Center	Oct. 31, 2017	Visitor
Jaewoo Park	Korea	Radar&Space	Oct. 31, 2017	Visitor
Taeyoung Kim	Korea	Radar&Space	Oct. 31, 2017	Visitor
Yoon Kichang	Korea	Korean Space Weather Center	Oct. 31, 2017	Visitor
Hsiu-Shan Yu	U.S.A.	University of California San Diego	Nov. 2, 2017	Visitor
Zesty S.B. Hamidi	Malaysia	MARA University of Technology	Nov. 4 - 11, 2017	Participant in the Symposium
Sarah Jabbari	Australia	Monash University	Nov. 4 - 12, 2017	Participant in the Symposium
Lee Jaejin	Korea	Korea Astronomy & Space Science Institute	Nov. 5 - 7, 2017	Foreign Collaborative Researcher
Gopal Hazra	India	Indian Institute of Science Bangalore	Nov. 5 - 13, 2017	Participant in the Symposium
Rahul Yadav	India	Udaipur Solar Observatory	Nov. 5 - 16, 2017	Participant in the Symposium

Name	Country/ Region	Affiliation	Period	Status at Nagoya University
Eunkyung Lim	Korea	Korea Astronomy & Space Science Institute	Nov. 6, 2017	Participant in the Symposium
Heesu Yang	Korea	Korea Astronomy & Space Science Institute	Nov. 6, 2017	Participant in the Symposium
Jaeheung Park	Korea	Korea Astronomy & Space Science Institute	Nov. 6, 2017	Participant in the Symposium
Kyuhyoun Cho	Korea	Seoul National University	Nov. 6, 2017	Participant in the Symposium
Miyashita Yukinaga	Korea	Korea Astronomy & Space Science Institute	Nov. 6, 2017	Participant in the Symposium
Rok-Soon Kim	Korea	Korea Astronomy and Space Science Instutute	Nov. 6, 2017	Participant in the Symposium
Su-Chan Bong	Korea	Korea Astronomy & Space Science Institute	Nov. 6, 2017	Participant in the Symposium
Sujin Kim	Korea	Korea Astronomy & Space Science Institute	Nov. 6, 2017	Participant in the Symposium
Youngsil Kwak	Korea	Korea Astronomy & Space Science Institute	Nov. 6, 2017	Participant in the Symposium
Agustinus Gunawan Admiranto	Indonesia	Indonesian National Institute of Aeronautics and Space	Nov. 6 - 11, 2017	Participant in the Symposium
Jie Hong	China	Nanjing University	Nov. 6 - 11, 2017	Participant in the Symposium
Jingwen Zhang	China	Peking University	Nov. 6 - 11, 2017	Participant in the Symposium
Keiji Hayashi	China	National Space Science Center, Chinese Academy of Science	Nov. 6 - 11, 2017	Participant in the Symposium
Navin Chandra Joshi	Korea	Kyung Hee University	Nov. 6 - 11, 2017	Participant in the Symposium
Pengfei Chen	China	Nanjing University	Nov. 6 - 11, 2017	Participant in the Symposium
Samanta Tanmoy	China	Peking University	Nov. 6 - 11, 2017	Participant in the Symposium
Tangmu Li	China	Nanjing University	Nov. 6 - 11, 2017	Participant in the Symposium
Wenjun Ding	China	Nanjing University	Nov. 6 - 11, 2017	Participant in the Symposium
Yuhao Zhou	China	Nanjing University	Nov. 6 - 11, 2017	Participant in the Symposium
Yun-Chen Yang	Taiwan	National Central University	Nov. 6 - 11, 2017	Participant in the Symposium
Ze Zhong	China	Nanjing University	Nov. 6 - 11, 2017	Participant in the Symposium
Zigong Xu	China	Nanjing University	Nov. 6 - 11, 2017	Participant in the Symposium
Yu Chen	Taiwan	National Central University	Nov. 6 - 15, 2017	Participant in the Symposium
Yu Lun Liou	Taiwan	National Central University	Nov. 6 - 15, 2017	Participant in the Symposium
Willi Exner	Germany	Technische Universität Braunschweig	Nov. 6 - Dec. 1, 2017	Visitor
Takuma Nakamura	Austria	Austrian Academy of Sciences	Nov. 11 - 16, 2017	Foreign Collaborative Researcher
Wai-Leong Teh	Malaysia	Space Science Centre, Institute of Climate Change	Nov. 11 - 16, 2017	Foreign Collaborative Researcher
Elena Kupriyanova	Russia	Central Astronomical Observatory at Pulkovo of the RAS	Nov. 13 - 15, 2017	Foreign Collaborative Researcher

Name	Country/ Region	Affiliation	Period	Status at Nagoya University
Uma Das	India	Indian Institute of Information Technology Kalyani	Nov. 14 - Dec. 29, 2017	Foreign Collaborative Researcher
Chen-Jeih Pan	Taiwan	Institute of Space Sciences, National Central University, Taiwan	Nov. 20 - 22, 2017	Visitor
Andres Munoz Jaramillo	U.S.A.	South West Research Institute	Nov. 24 - Dec. 3, 2017	Participant in the Symposium
Leif Svalgaard	U.S.A.	Stanford University	Nov. 25 - Dec. 2, 2017	Participant in the Symposium
Lisa Upton	U.S.A.	High Altitude Observatory	Nov. 25 - Dec. 2, 2017	Participant in the Symposium
Mausumi Dikpati	U.S.A.	High Altitude Observatory	Nov. 25 - Dec. 2, 2017	Participant in the Symposium
Robert Cameron	Germany	Max-Planck Institute for Solar System Research	Nov. 25 - Dec. 3, 2017	Participant in the Symposium
Jie Jiang	China	Beihang University	Nov. 27 - Dec. 2, 2017	Participant in the Symposium
Chia-Chun Wu	Taiwan	Taiwan Typhoon and Flood Research Institute	Nov. 28, 2017	Visitor
Chi-June Jung	Taiwan	Taiwan Typhoon and Flood Research Institute	Nov. 28, 2017	Visitor
Hsuan-Wei Wang	Taiwan	Taiwan Typhoon and Flood Research Institute	Nov. 28, 2017	Visitor
Lei Feng	Taiwan	Taiwan Typhoon and Flood Research Institute	Nov. 28, 2017	Visitor
Jianwei Lin	Taiwan	National Taiwan University	Dec. 18 - 22, 2017	Foreign Collaborative Researcher
Byambatseren Chuluunpurev	Mongol	The National University of Mongolia	Dec. 18 - 23, 2017	Foreign Collaborative Researcher
Sonomdagva Chonokhuu	Mongol	The National University of Mongolia	Dec. 18 - 26, 2017	Foreign Collaborative Researcher
Ruoying He	U.S.A.	North Carolina State University	Dec. 22, 2017	Visitor
John Michael Ruohoniemi	U.S.A.	Virginia Tech	Jan. 6 - 13, 2018	Participant in the Symposium
Alexandre Vasilyevich Koustov	Canada	University of Saskachewan	Jan. 7 - 13, 2018	Participant in the Symposium
Joseph Benjamin Harold Baker	U.S.A.	Virginia Polytechnic Institute and State University	Jan. 7 - 13, 2018	Participant in the Symposium
Mark Lester	U.K.	University of Leicester	Jan. 7 - 13, 2018	Participant in the Symposium
Seiji Yashiro	U.S.A.	Catholic University and GSFC, NASA	Jan. 14 - 24, 2018	Foreign Collaborative Researcher
Ji Young Lee	Korea	Naju National Research Institute of Cultural Heritage	Jan. 17, 2018	Visitor
Jiseon Han	Korea	Jungwon National Research Institute of Cultural Heritage	Jan. 17, 2018	Visitor
So Young Kang	Korea	National Research Institute of Cultural Heritage	Jan. 17, 2018	Visitor
Esa Turunen	Finland	Sodankylä Geophysical Observatory: SGO	Jan. 18 - 24, 2018	Visitor
Xingyao Chen	China	Chinese Academy of Sciences	Jan. 23 - Feb. 10, 2018	Visitor
Stephen Michael Playfer	U.K.	University of Edinburgh	Feb. 1 - Jul. 31, 2018	Foreign Visiting Research Fellow
Jing Huang	China	Chinese Academy of Sciences	Feb. 4 - 20, 2018	Foreign Collaborative Researcher

Name	Country/ Region	Affiliation	Period	Status at Nagoya University
Yin Zhang	China	Chinese Academy of Sciences	Feb. 4 - 20, 2018	Foreign Collaborative Researcher
Zhang Jin	China	Chinese Academy of Sciences	Feb. 4 - 21, 2018	Foreign Collaborative Researcher
Seung-Gu Lee	Korea	Korea Institute of Geoscience and Mineral resources	Feb. 5 - 13, 2018	Foreign Collaborative Researcher
Jeongwoo Lee	Korea	Seoul National University	Feb. 9 - 28, 2018	Foreign Collaborative Researcher
Carsten Bumann	Norway	University of Tromsø	Feb. 17 - 23, 2018	Foreign Collaborative Researcher
Dorata Jozwicki	Norway	University of Tromsø	Feb. 17 - Mar. 1, 2018	Foreign Collaborative Researcher
Tetsu Anan	U.S.A.	National Solar Observatory	Feb. 17 - Mar. 1, 2018	Participant in the Symposium
Alphonse Sterling	U.S.A.	NASA Marshall Space Flight Center	Feb. 23 - Mar. 1, 2018	Participant in the Symposium
David Mckenzie	U.S.A.	NASA Marshall Space Flight Center	Feb. 23 - Mar. 1, 2018	Participant in the Symposium
Keiji Hayashi	China	National Space Science Center, Chinese Academy of Science	Feb. 25 - Mar. 2, 2018	Participant in the Symposium
Dana W. Longcope	U.S.A.	Montana State University	Feb. 26 - 28, 2018	Participant in the Symposium
Gregal Vissers	Sweden	Stockholm University	Feb. 26 - 28, 2018	Participant in the Symposium
Kevin Reardon	U.S.A.	National Solar Observatory	Feb. 26 - 28, 2018	Participant in the Symposium
Mark Rast	U.S.A.	University of Colorado, Boulder	Feb. 26 - 28, 2018	Participant in the Symposium
Thomas Schad	U.S.A.	National Solar Observatory	Feb. 26 - 28, 2018	Participant in the Symposium
Linda. E. Sugiyama	U.S.A.	Massachusetts Institute of Technology	Mar. 6 - 8, 2018	Visitor
Periasamy Kaliappan Manoharan	India	Tata Institute of Fundamental Research	Mar. 11 - 30, 2018	Foreign Collaborative Researcher
Hwang Junga	Korea	Korea Astronomy & Space Science Institute	Mar. 15 - 21, 2018	Foreign Collaborative Researcher
Zhongping Lee	U.S.A.	University of Massachusetts Boston	Mar. 15 - Jun. 14, 2018	Foreign Visiting Research Fellow
Harada Hiroki	U.S.A.	University of Iowa	Mar. 19 - 20, 2018	Participant in the Symposium
Junga Hwang	Korea	Korea Astronomy & Space Science Institute	Mar. 19 - 20, 2018	Participant in the Symposium
Miyashita Yukinaga	Korea	Korea Astronomy & Space Science Institute	Mar. 19 - 20, 2018	Participant in the Symposium
Imai Masafumi	U.S.A.	University of Iowa	Mar. 19 - 21, 2018	Participant in the Symposium
Futaana Yoshifumi	Sweden	Swedish Institute of Space Physics	Mar. 19 - 22, 2018	Participant in the Symposium
Antonia Savcheva	U.S.A.	Smithsonian Observatory	Mar. 19 - 30, 2018	Visitor

Seminars by Foreign Visitors

Date	Name	Affiliation	Title	Number of Participant
Apr. 3, 2017	Haimin Wang	New Jersey Institute of Technology	Recent Scientific Results of 1.6m New Solar Telescope at Big Bear Solar Observatory	15
Apr. 17, 2017	Antonio Ferriz Mas	Facultad de Ciencias, de Orense Universidad de Vigo	THE THIN FLUX-TUBE APPROXIMATION AND SOME APPLICATIONS IN SOLAR/STELLAR MAGNETISM	15
Apr. 21, 2017	Fulvia Pucci	Princeton Plasma Physics Laboratory	Flares, CMEs and explosive events: the “ideal” tearing mode and fast reconnection triggering in magnetized plasmas, from fluid to kinetic scales.	16
Apr. 24, 2017	K. D. Leka ∗	NorthWest Research Associates	Solar Flares and Space Weather Forecasting	19
May 11, 2017	Ch Sonomdagva	National University of Mongolia	The air pollution study in Ulaanbaatar city, Mongolia	9
May 15, 2017	Andrew Hillier	University of Exeter	The linear growth of oscillation driven magnetic Kelvin-Helmholtz Instability	22
May 15, 2017	Bernhard Hartmut Kliem∗	University of Potsdam	Decay index profile and coronal mass ejection speed	26
May 17, 2017	Antonia Savcheva	Harvard-Smithsonian Center for Astrophysics	Solar Sigmoidal Active Regions: From Formation to Eruption	24
May 19, 2017	Janardhan Padmanabhan	Physical Research Laboratory, India	Declining solar activity: Is the sun going into hibernation?	8
Jun. 12, 2017	Elena Kupriyanova	Central Astronomical Observatory at Pulkovo of the RAS	About method of multi-wavelength diagnostics of mechanism of quasi-periodic pulsations in solar flares	21
Jul. 6, 2017	Surendra Kumar Dhaka∗	University of Delhi	An overview of convective sources and dynamical processes in shaping the troposphere and stratosphere	7
Jul. 7, 2017	Daniel Izuikedinachi Okoh ∗	National Space Research and Development Agency	Occurrence frequency of Equatorial Plasma Bubbles over West Africa using an All-sky Airglow Imager and GNSS receivers	26
Jul. 10, 2017	Magnus Morton Woods ∗	University College London Space & Climate Physics	Observations and Modelling of the Pre-flare Period of the 29 March 2014 X1 Flare	14
Jul. 14, 2017	Jeonghoon Lee	Korea University of Technology & Education	Photothermal Interferometry: An alternative tool for measuring light absorbing carbon	7
Jul. 19, 2017	Jihye Kang	Kyung Hee University	Distribution Characteristic of Coronal Electric Current Density as an Indicator for Occurrence of a Solar Flare	11
Jul. 19, 2017	Nghiem Trung Dung	Hanoi University of Science and Technology	Nanoparticles in Hanoi: Level, chemical compositions and potential sources	9
Sep. 1, 2017	Sergii V. Panasenko ∗	Institute of ionosphere	Ionospheric Research in Ukraine using Kharkiv Incoherent Scatter Facility	25

Date	Name	Affiliation	Title	Number of Participant
Sep. 7, 2017	Devanaboyina Venkata Ratnam ∗	KL University	Ionospheric Total Electron Content Forecasting Algorithms using Ground Based GNSS observations over India and Japan	37
Sep. 8, 2017	Hung-Chi Kuo	National Taiwan University	Research introduction (monsoon, typhoon, precipitation, etc.).	25
Oct. 10, 2017	Sergey Anatolievich Tyul'bashev ∗	Lebedev Physical Institute	Space Weather from IPS Observations at 111 MHz	9
Oct. 23, 2017	Angelos Vourlidas	JHU, APL	The Magnetic Flux Rope Nature of Coronal Mass Ejections	25
Oct. 26, 2017	Ondrej Santolik	Czech Academy of Sciences	From lightning to chorus	17
Oct. 27, 2017	Geeta Vichare	Indian Institute of Geomagnetism	Overview of low latitude current systems	24
Oct. 30, 2017	M. Leila Mays	GSFC, NASA	The Community Coordinated Modeling Center: A Hub for Advancing Space Science and Space Weather Capabilities	30
Nov. 10, 2017	Diptiranjan Rout	Physical Research Laboratory, India	Magnetosphere-Ionosphere-Thermosphere System Under Varying Space Weather Conditions	6
Nov. 15, 2017	Ioannis A. Daglis ∗	National & Kapodistrian University of Athens	Storms, substorms, particles and waves: the quintessence of geospace weather	17
Nov. 16, 2017	Willi Exner	Technische Universität Braunschweig	CME Impacts onto the Hermean Magnetosphere	11
Nov. 22, 2017	C. J. Pan	Institute of Space Sciences, National Central University	Effect of Kelvin Waves on stratospheric QBO during El Nino periods using ECMWF reanalysis data	15
Nov. 24, 2017	Joaquim I. Goes and Helga do Rosario Gomes ∗	Columbia University	(1) The role of the Aleutian Low Pressure System in regulating phytoplankton production and carbon export in the North Pacific Ocean (2) The contrasting influence of two large revers on the biogeography of phytoplankton communities across the river-ocean continuum	15
Nov. 24, 2017	Uma Das	Indian Institute of Information Technology Kalyani	Tidal Variability in the Middle and Upper Atmosphere	36
Nov. 26, 2017	Chi-June Jung	Taiwan Typhoon and Flood Research Institute	Applications of Unmanned Aircraft Sounding System in Taiwan	23
Nov. 26, 2017	Hsuan-Wei Wang	Taiwan Typhoon and Flood Research Institute	Airborne observation: Experience of DOTSATR and Future	23
Dec. 22, 2018	Ruoying He	North Carolina State University	Observational and Modeling Study of Ocean Circulation, Air-sea Interactions, and Biogeochemical Processes in the Northwest Atlantic Coastal Ocean	20
Jan. 11, 2018	Mark Lester	University of Leicester	Radio Sounding of Planetary Ionospheres: Examples at Earth and Mars	20

Date	Name	Affiliation	Title	Number of Participant
Feb. 6, 2018	Chen Xingyao	National Astronomical Observatories, Chinese Academy of Sciences	Spectral and Imaging analysis of the solar radio bursts observed by LOFAR and MUSER	7
	Huang Jing	National Astronomical Observatories, Chinese Academy of Sciences	The microwave emission of an eruptive prominence	
	Zhang Yin	National Astronomical Observatories, Chinese Academy of Sciences	VLA Observa,ons of A M8. 4 Flare	
Feb. 13, 2018	Lynn Marie Kisteler ✱	University of New Hampshire	Contributions of Oxygen to the Storm-Time Ring Current	24
Mar. 7, 2018	Linda E. Sugiyama	Massachusetts Institute of Technology	The structure of solar coronal loops	9
Mar. 19, 2017	Periasamy Kaliappan Manoharan	Radio Astronomy Centre	Space Weather and Solar Wind Studies with the Ooty Radio Telescope	11
Mar. 22, 2018	Daniel Philip Stern	Naval Research Laboratory	Understanding Extreme Updrafts and Wind Gusts Using Dropsondes and Large-Eddy Simulations	15
Mar. 23, 2018	Antonia Savcheva	Harvard-Smithsonian Center for Astrophysics	Data-constrained MHD simulations of Erupting Solar Active Regions	13
Mar. 23-24, 2018	Daniel Philip Stern	Naval Research Laboratory	(1) The Structure and Dynamixs of the Tropical Cyclone Eyewall (2) The Tropical Cyclone Warm Core (3) Understanding Extreme Updrafts and Wind Gusts Using Dropsonde Observations and Large-Eddy Simulations	19
Mar. 28, 2018	Frederic Clette	Royal Observatory of Belgium	Sunspot and synoptic science at the World Data Center SILSO	13

✱ Foreign Visiting Staff

＜Abbreviations＞

APL:	Applied Physics Laboratory
CASS:	Center for Astrophysics and Space Sciences
CERN:	Conseil Européen pour la Recherche Nucléaire, European Organization for Nuclear Research
CESR:	Centre d'Etude Spatiale des Rayonnements
CETP:	Centre d'étude des environnements terrestres et planétaires
CNRS:	Centre National de la Recherche Scientifique
EISCAT:	European Incoherent Scatter Scientific Association
GSFC:	Goddard Space Flight Center
IBEX:	Interstellar Boundary Explorer
IFSI:	Istituto di Fisica dello Spazio Interplanetario
iLEAPS:	Integrated Land Ecosystem-Atmosphere Processes Study
IKFIA:	Institute of Cosmophysical Research and Aeronom
INFN:	Istituto Nazionale di Fisica Nucleare
INPE:	Instituto Nacional de Pesquisas Espaciais, Brazilian Institute of Space Research
IPS:	Ionospheric Prediction Services
IPSL:	Institut Pierre-Simon Laplace
ISTP:	Institute of Solar-Terrestrial Physics
JHUAPL:	Johns Hopkins University Applied Physics Laboratory
KASI:	Korea Astronomy and Space Science Institute
LAPAN:	Lembaga Penerbangan dan Antariksa Nasional, National Institute of Aeronautics and Space
LOFAR:	Low Frequency Array
LPC2E:	Laboratoire de Physique et Chimie de l'Environnement et de l'Espace
MSFC:	Marshall Space Flight Center
MWA:	Murchison Widefield Array
NASA:	National Aeronautics and Space Administration
SB RAS:	Siberian Branch, Russian Academy of sciences
SCOSTEP	Scientific Committee on Solar Terrestrial Physics
UCB:	University of California, Berkeley
UCI:	University of California, Irvine
UCLA:	University of California, Los Angeles
UCSC:	University of California, Santa Cruz
UCSD:	University of California, San Diego

13. Outreach

Public lectures, open labs, and school visits

ISEE members have contributed to public education through 31 lecture visits, seven public lectures at the university, three open laboratory events, three public laboratory demonstrations, one field trip for children, and ten high-school student visits.

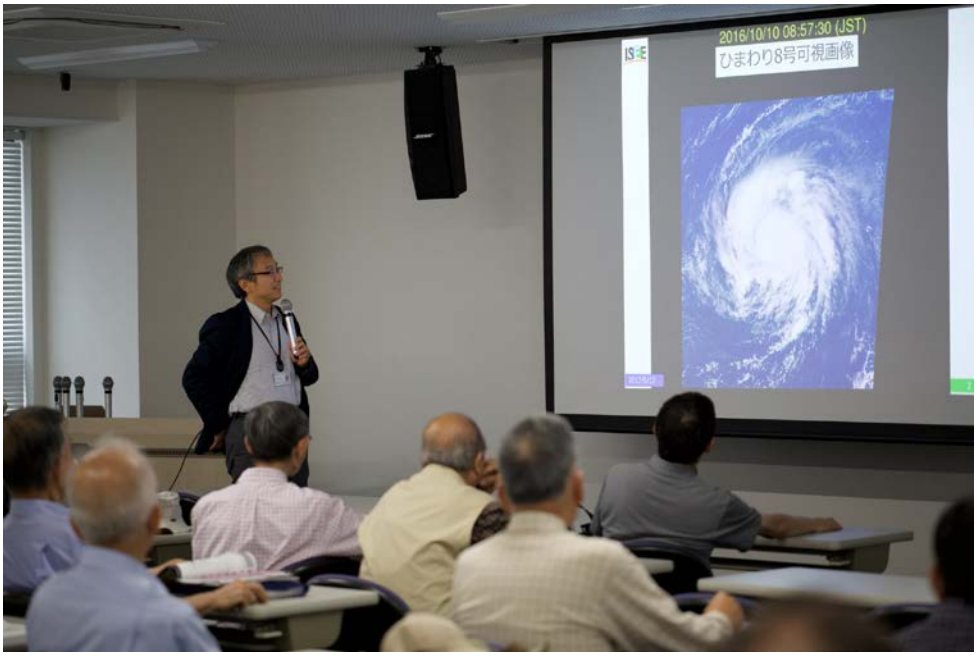
ISEE held open laboratory sessions and special lectures for the public on June 10 and 11 during the 2017 Nagoya University Festival, and a half-day public lecture meeting on December 2, 2017.

ISEE and the former STEL have maintained a close relationship with the town of Rikubetsu in Hokkaido since 2003. Public lectures were held on November 10, 2017 at Rikubetsu Elementary School and Rikubetsu Junior High School, and on November 26, 2017 at Rikubetsu Junior High School. Public laboratory demonstrations were presented on November 11, 2017 at the Rikubetsu Space Earth Science Museum.

ISEE distributes a series of booklets that answer 50 questions on various topics, as well as informative comic books related to space–Earth subjects for the public.

A video introducing ISEE for young students and the public was produced, and can be seen on the ISEE website.

The ISEE website (http://www.isee.nagoya-u.ac.jp/) continues to publish the most up-to-date activities and outcomes of laboratory science to the public. The digitized booklet series can also be browsed at this site.



Public lecture on the ISEE open laboratory (June 10, 2017).

Addresses of Facilities

Location		Name	Address	TEL/FAX
Nagoya	①	ISEE Research Institutes Buildings I/II	Furo-cho, Chikusa-ku, Nagoya, Aichi 464-8601	TEL:+81-52-747-6303 FAX:+81-52-747-6313
Toyokawa	②	Toyokawa Branch	3-13 Honohara, Toyokawa-shi, Aichi 442-8507	TEL:+81-533-89-5206 FAX:+81-533-86-3154
Hokkaido	③	Moshiri Observatory	Moshiri, Horokanai, Uryu, Hokkaido 074-0741	TEL:+81-165-38-2345 FAX:+81-165-38-2345
	④	Rikubetsu Observatory	345 Uenbetsu, Rikubetsu-cho, Ashoro-gun, Hokkaido 089-4301	TEL:+81-156-27-8103
			58-1, 78-1, 78-5, 129-1, 129-4 Pontomamu, Rikubetsu-cho, Ashoro-gun, Hokkaido 089-4300	TEL:+81-156-27-4011
Yamanashi	⑤	Fuji Observatory	1347-2 Fujigane, Fujikawaguchiko-machi, Minamitsuru-gun, Yamanashi 401-0338	TEL:+81-555-89-2829
Kagoshima	⑥	Kagoshima Observatory	3860-1 Honjo, Tarumizu-shi, Kagoshima 891-2112	TEL:+81-994-32-0730