Oral Presentations

ST26 - VarSITI - Variability of the Sun and Its Terrestrial Impact

Wednesday, July 30, 2014 | Regent Hall | 14:00-15:30

1. **ST26-D3-PM1-RH-001** (ST26-A007)

VarSITI - Variability of the Sun and Its Terrestrial Impact

Kazuo SHIOKAWA[1#+], Katya GEORGIEVA[2]

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The Scientific Committee on Solar Terrestrial Physics (SCOSTEP) is an interdisciplinary body of the International Council for Science (ICSU) to run international interdisciplinary scientific programs and promotes solar-terrestrial physics research. The last solar minimum in 2008-2009 and the current solar maximum of sunspot cycle 24 show much lower activities compared with the previous two solar cycles 22 and 23. The scientists in the solar-terrestrial physics are watching very low solar activities and their consequences on Earth, which have never been observed since modern scientific measurements become available. The SCOSTEP program "Variability of the Sun and Its Terrestrial Impact (VarSITI)" (2014-2018) will focus on this particular low solar activity and their consequences on Earth, for various times scales from the order of thousands years to milliseconds, and for various locations and their connections from the solar interior to the Earth's atmosphere. In order to elucidate various sun-earth connections, we encourage communication between solar scientists (solar interior, sun, and the heliosphere) and geospace scientists (magnetosphere, ionosphere, and atmosphere). Campaign observations will be promoted for particular interval in collaboration with relevant satellite and ground-based missions as well as modeling efforts. Four scientific projects will be carried out in VarSITI as (1) Solar Evolution and Extrema (SEE), (2) International Study of Earth-Affecting Solar Transients (ISEST/Minimax24), (3) Specification and Prediction of the Coupled Inner-Magnetospheric Environment (SPeCIMEN), and (4) Role Of the Sun and the Middle atmosphere/thermosphere/ionosphere In Climate (ROSMIC).

2. **ST26-D3-PM1-RH-002** (ST26-A017)

Specification and Prediction of the Coupled Inner-magnetospheric Environment (SPeCIMEN) of the VarSITI

Yoshizumi MIYOSHI[1+], Yoshiharu OMURA[2], Yuto KATOH[3#], Jacob BORTNIK[4], Craig RODGER[5]

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Specification and Prediction of the Coupled Inner-Magnetospheric Environment (SPeCIMEN) is a focus group of next SCOSTEP project: VarSITI. The goals and objectives are the quantitative prediction and specification of the Earth inner magnetospheric environment based on Sun/solar wind driving inputs. Our question is how the inner magnetosphere responds as a coupled system to Sun/solar-wind driving, which will be solved by a combination of physical and statistical modeling, theory and observations from various platforms under this project. The satellite missions such as NASA/Van Allen Probes (US), JAXA/ERG (Japan) and ground-based network observations provide a comprehensive picture on the dynamical evolutions of geospace and reveal processes and consequences of the inner magnetosphere. Anticipated outcome should be a series of coupled, related models that

quantitatively predict the dynamical evolution of the inner magnetospheric state including radiation belts, ring current, plasmasphere, plasma sheet. In this presentation, we give an overview of the SpeCIMEN project and the strategy of the project to gain the science output.

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3. **ST26-D3-PM1-RH-003** (ST26-A033)

Coordinated Long-period and Collaborative Study of Inner Magnetosphere by Akebono

Ayako MATSUOKA[1#+], Yoshiya KASAHARA[2], Tsugunobu NAGAI[3], Atsushi KUMAMOTO[4], Takumi ABE[1], Yoshizumi MIYOSHI[5]

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The Akebono satellite was launched in 1989 and has continued to be operated for over 25 years. Radiation monitor (RDM), electron temperature detector (TED), and wave instruments (PWS and VLF) are still operative. The stored data enables the study of the long-period variation of the magnetosphere. Currently the apogee and perigee altitudes of the satellite orbit are 4400km and 270km, respectively, and the inclination is 70 degrees. The enhancement or dissipation of the radiation particles, and the related wave activities are becoming major scientific targets of the Akebono project. Coordinated study with other satellites and ground observatories will contribute to the understanding of the three-dimensional inner magnetosphere, and its dynamics.

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4. **ST26-D3-PM1-RH-004** (ST26-A032)

Erg Project: Exploration of the Terrestrial Inner Magnetosphere

Kazushi ASAMURA[1#+], Takeshi TAKASHIMA[1], Yoshizumi MIYOSHI[2], Kazuo SHIOKAWA[3], Kanako SEKI[2], Tomoaki HORI[2], Yukinaga MIYASHITA[3], Kunihiro KEIKA[2], Masahumi SHOJI[2], Iku SHINOHARA[1], Masafumi HIRAHARA[2], Nana HIGASHIO[1], Haruhisa MATSUMOTO[1], Satoshi KASAHARA[1], Takefumi MITANI[1], Yasumasa KASABA[4], Ayako MATSUOKA[1], Hirotsugu KOJIMA[5], Masaki FUJIMOTO[1]

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The ERG (Exploration of energization and Radiation in Geospace) is Japanese satellite which will be launched in 2015 (Japanese fiscal year). ERG will make in-situ plasma / particle measurements in the terrestrial inner magnetosphere. One of scientific targets of ERG is to explore acceleration / loss mechanisms of high-energy electrons (~ MeV energy range) in the outer belt. ERG focuses on energy transfer between plasma particles and waves, which is most probably an important mechanism to provide the significant acceleration of electrons toward ~ MeV. Coordinated observations of ERG with Van Allen Probes, other spacecraft, and ground-based observation network will provide detailed, and also global-scale plasma environment in the inner magnetosphere, which will contribute to the VarSITI / SPeCIMEN program. In the presentation, the overview of the project will be presented and possible collaborations with other geospace satellite missions as well as the ground-based observations will be discussed.

ST26 - VarSITI - Variability of the Sun and Its Terrestrial Impact

Wednesday, July 30, 2014 | Regent Hall | 16:00-18:00

1. **ST26-D3-PM2-RH-005** (ST26-A029)

ISEST/MiniMax24 Project of VarSITI

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ISEST (International Study of Earth-Affecting Solar Transients)/MiniMax24 is one of the four scientific elements in the VarSITI (Variability of the Sun and Its Terrestrial Impact) program of SCOSTEP. The objectives of ISEST are to understand the propagation of solar transients from the Sun to the Earth through the interplanetary space, and to develop space weather prediction capability. In order to achieve these objectives, a number of scientific questions need to be addressed. One of key questions is how coronal mass ejections (CMEs) and corotating interaction regions (CIRs) propagate and evolve, drive shocks and accelerate energetic particles in the heliosphere. The ISEST will have activities to (1) create a comprehensive database of Earth-affecting solar transient events including CMEs, CIRs, flares, and energetic particle events based on remote sensing and in-situ observations from an array of ground- and space-based instruments (2) to run observation campaigns such as MiniMax24, (3) to develop empirical, theoretical, and numerical models of CME propagation and prediction, and (4) to validate models using observations. These ISEST activities will significantly improve space weather prediction capability.

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2. **ST26-D3-PM2-RH-006** (ST26-A012)

ICSWSE/MAGDAS Research Projects During the VarSITI Program Interval

Akimasa YOSHIKAWA[1#+], Hideaki KAWANO[1], Shuji ABE[1], Teiji UOZUMI[1],
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International Center for Space Weather Science and Education (ICSWSE) has developed a real time magnetic data acquisi-tion system (the MAGDAS project) to monitor the space environment around the world. The number of observational sites is increasing every year in collaboration with MAGDAS host countries. Up to now, the MAGDAS Project has installed 73 real time magnetometers: It is the largest magnetometer array in the world. Using data from this global network, we are developing many research projects. In this talk, we introduce our research projects planned during the VarSITI program interval, as follows:
(1) Global electromagnetic coupling from polar to equatorial ionosphere
(2) Vertical coupling among the atmosphere, the ionosphere and the magnetosphere
(3) Plasmaspheric diagnosis using the Field line resonance
(4) Magnetospheric diagnosis using geomagnetic disturbances
(5) Monitoring of Space weather phenomena using solar and magnetospheric indices
(6) Modeling of Space weather parameters
(7) Sun-atmosphere coupling

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3. **ST26-D3-PM2-RH-007** (ST26-A045)

GEOTAIL Over 20 Years Observation in Space

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The GEOTAIL satellite was launched on July 24, 1992. Even after over 20 years in space, the spacecraft remains healthy. At this moment, we believe, there are no reasons to expect any technical failures in coming a few years.

The primary purpose of GEOTAIL was to study the structure and dynamics of the tail region of the magnetosphere. After exploring the distant magnetotail, the spacecraft has remained in a 9 x 30 Re equatorial orbit for the past 19 years. This unique orbit allows study of a wide range of important geospace problems. In this orbit GEOTAIL crosses all the boundaries through which solar wind energy, momentum and particles must pass to enter the magnetosphere. Study of the physical processes at these boundaries is vital to the understanding of the Sun to Earth flow of mass and energy.
Even successor missions with higher spec instruments, such as, Cluster, THEMIS, are exploring the Earth's magnetosphere together, GEOTAIL is still now an active observatory and producing important scientific results.
In this presentation, we will briefly show recent important results of GEOTAIL observations those are enabled by long range observation, such as the statistical study of the spatial structure of magnetotail reconnection region.

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4. **ST26-D3-PM2-RH-008** (ST26-A004)

Observation of Solar Neutrons

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It is know that protons are sometimes accelerated to very high energy in association with solar flares. In some particular cases, the highest energy of protons exceed 10 GeV, which sometimes cause the increase of cosmic rays measured on the ground. This increase of cosmic rays on the ground is called Ground Level Enhancement (GLE). The acceleration mechanism of ions at the solar surface including GLEs is, however, not understood well. Observing solar neutrons which are created by the accelerated ions at the solar atmosphere is expected to give some key information on the understanding the accerelation of ions, because neutrons are not deflected by the interplanetary magnetic fields, and keep information on the accelerated time with their energies. The status of the observation of solar neutrons which is led by the Solar-Terrestrial Environment Laboratory, Nagoya University, is reviewd in this paper.

5. **ST26-D3-PM2-RH-009** (ST26-A008)

10-year Plan for Japan - Norway Sounding Rocket Experiment Program

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In order to achieve collective understanding of the microphysics and its role (scale coupling) in the global/meso scale phenomena in the polar ionosphere, 10-year plan for Japan-Norway sounding rocket experiment program is now under consideration. Norway has sounding rocket program ICI(Investigation-of-Cusp-Irregularities). The ICI sounding rockets are mainly focusing on plasma instability processes associated with cusp ionosphere dynamics and polar cap patches, of particular relevance for GNSS(Global-Navigation-Space-System) space weather. So far ICI-2 and ICI-3 sounding rockets were successfully launched from Spitzbergen in 2008 and 2011, and ICI-4 will be launched in October 2014. ICI-5, planned from Ny-Ålesund in 2016, will feature sub payloads to perform 4D space measurements of plasma turbulence. Japanese future sounding rockets from Norway in the 10-year plan includes four SS520 sounding rockets that can reach 1000km altitude and one S520 sounding rocket that can reach 350km altitude. These Japanese future sounding rockets are mainly focusing on understanding the role of the wave-particle interaction in the meso/global scale polar ionospheric phenomena. Three of the four SS520 sounding rockets are for achieving the collective understanding of the ionized atmospheric escape process. One of the SS520 sounding rockets is dedicated to the understanding of the momentum transfer process caused by the interaction between the neutrals and plasma. Another important sounding rocket experiment in the 10-year plan is S520 sounding rocket that will be launched from Andoya. The target of this sounding rocket is to answer the long lasting questions about the pulsating aurora including the generation mechanisms. The launch of this sounding rocket will be during the operation period of ERG that will be launched in 2015. Combining the Norwegian ICI sounding rockets and Japanese future sounding rockets from Norway strategically, we will be able to achieve much more fruitful science results than carrying out individual sounding rocket experiment separately.

6. **ST26-D3-PM2-RH-010** (ST26-A015)

Next Generation's Space Weather Forecast - NICT's Perspective

Tsutomu NAGATSUMA[1#+], Mamoru ISHII[1], Shinichi WATARI[1], Yuki KUBO[1], Hiroyuki SHINAGAWA[1], Takuya TSUGAWA[1]

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NICT has been responsible for national space weather forecast in Japan for a long time. Since NICT's space weather forecast center belongs to the International Space Environment Service (ISES) as the Regional Warning Center (RWC) Japan, our operational activities are supported by international cooperation. To understand the current conditions of "space weather", monitoring networks of space weather observations are operated and used. For future objective and advanced space weather monitoring, we have been developing a space weather numerical simulation codes,too. These activities are strongly related to the space weather research for improving space weather forecasting.

The VarSITI program is closely related to our space weather research and forecasting activity. Four projects (SEE, ISEST, SPeCIMEN, and ROSMIC) in VarSITI are also important

subjects for space weather and climate. The current conditions and future perspective of NICT's space weather forecast are introduced in our presentation.

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7. **ST26-D3-PM2-RH-011** (ST26-A005)

The Solar-C Program; Next Japanese-led Sun Observing Mission

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The "Solar-C" program is a next Japanese-led sun-observing mission designed to answer some of the most important questions in solar physics. It has long been known that the interplay between magnetic fields and plasmas is at the heart of most solar phenomena, but the details of this interplay are in many cases clouded in ambiguity and uncertainty. Solar-C represents a fundamentally new way of viewing the solar atmosphere. For the first time, it will simultaneously observe the entire atmosphere---photosphere, chromosphere, transition region, and corona---and do so with essentially the same spatial and temporal resolution at all locations. To achieve the following science objectives;

- Reveal the mechanisms responsible for the heating and dynamics of the chromosphere and corona and the acceleration of the solar wind, and understand how plasma and energy are transferred between different parts of the solar atmosphere;
- Determine the physical origin of the large-scale explosions and eruptions (flares, jets, and CMEs) that drive short-term solar, heliospheric, and geospace variability;
- Observe and understand fundamental physical processes such as magnetic reconnection, magneto-hydrodynamic waves, shocks, turbulence, and plasma instabilities taking place in the laboratory of solar atmosphere.
- Observe key features creating solar activity cycle and space climate,

Solar-C will deploy a carefully coordinated suite of three complementary instruments: the Solar Ultra-violet Visible and IR Telescope (SUVIT), the high-throughput EUV Spectroscopic Telescope (EUVST), and an X- ray Imaging Telescope (XIT). The instrument suite and its baseline specifications are motivated by several factors, including but not limited to the following. Temperatures ranging from $5x10^3$ to 10^7 K must be observed without significant gaps in order to address the fundamental linkages in the solar atmosphere. A spatial resolution of approximately 0.1-0.3 arcsec must be achieved in order to actually observe the important physical scales deduced by current observations.

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8. **ST26-D3-PM2-RH-012** (ST26-A025)

International Scientific Data Management Including ICSU-World Data System

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Solar terrestrial physics (STP) is multidisciplinary in nature, and so a wide variety of data is crucial which covers various regions from the sun to the earth's atmosphere. The new SCOSTEP's programme, or VarSITI of Variability of the Sun and Its Terrestrial Impact, is to study how the solar variability affects Earth from the approaches of data analysis, modeling, and theory of STP interdisciplinary research fields.

In past the international community has opened a number of frontiers in science and technology including new space explorations and advanced radar technologies contributing to growth of STP. Related important activities include also international frameworks, such as data archive and service of the former WDC (World Data Center) system of solar and space observations, aurora, geomagnetism, cosmic rays, etc., and also the former FAGS (Federation of Astronomical and Geophysical Data Services) including ISES (International Space Environmental Services) etc. The ICSU World Data System (ICSU-WDS) has been

established 2008, by reforming the former WDC and FAGS. WDS's primary goals are to ensure the long-term stewardship of quality-assessed data archives, targeting the interdisciplinary interoperable distributed data system.
Recently not only the G8 Open Data Charter in 2013, but also the international open data principle requires global sharing of scientific data. Such a concept is inclujded in targets of ICSU-WDS and other data international data activities for maximizing scientific achievement and inovation by open data. International data management activity like ICSU-WDS from the academic side, and RDA related to governmental arrangement, are part of such challenges. Furthermore Future Earth, the international 10-year transdisciplinary research programme are promoted by ICSU, UN bodies, Belmont Forum, etc. for our future with the planetary earth, where ICSU-WDS and CODATA are required to support Future Earth's international scientific data management.

ST26 - VarSITI - Variability of the Sun and Its Terrestrial Impact

Thursday, July 31, 2014 | Regent Hall | 08:30-10:30

1. **ST26-D4-AM1-RH-013** (ST26-A037)

UT Dependence of the Geomagnetic Storms

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The UT dependence of the geomagnetic storms obtained from the analysis of the Kyoto Dst and USGS (Jeffery Love) Dst data for 55 years (1957-2011) is presented. The UT variations of the number of main phase onsets (MPOs) and number of recovery phase onsets (RPOs, or DstMin) have minima at around 6 UT and 12 UT, respectively. The UT variations of the intensity (ΣDstMin), integrated intensity ($\Sigma\int Dst_{MP}$) and mean intensity ($\Sigma\int Dst_{MP}$/MP duration) also have minima at ~6 UT with MPO and ~12 UT with RPO. Kyoto Dst and Love Dst show similar UT dependence with RPO time though the number of storms are much less (by 402) in Love Dst than in Kyoto Dst; Love Dst data seem already smoothed. The results seem to suggest a cyclic UT variation of the geomagnetic field and geomagnetic storms.

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2. **ST26-D4-AM1-RH-014** (ST26-A018)

Probing the Heliosphere with the Global Muon Detector Network (GMDN)

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The intensity of ~10 GeV Galactic Cosmic Rays (GCRs) recorded at the Earth changes in the solar activity- and magnetic-cycles reflecting the solar cycle variations of the modulation parameters such as the sunspot number, the magnitude of the interplanetary magnetic field and the tilt-angle of the heliospheric current sheet. The best-known example of such variation can be seen in the count rate of neutron monitors. While the omnidirectional GCR intensity measured by a single detector represents the temporal variation of the GCR density at a single location of the detector on the Earth, the directional anisotropy of the GCR intensity tells us the spatial distribution of the GCR density around the Earth. The magnitude of the GCR anisotropy due to the diffusive streaming is proportional to the spatial gradient of the GCR density. By observing precisely the anisotropy with the global network of detectors, therefore, we can derive the spatial gradient of the GCR density in three dimensions and its temporal variation. The spatial density gradient is important, because it tells us the average feature of the large-scale magnetic field in the heliosphere which is responsible to the spatial distribution of GCRs and is still difficult to derive directly from any other in-situ and/or ground-based measurements. In this paper, we analyze the density gradient and its temporal variation

observed with two networks of muon detectors and neutron monitors.

3. **ST26-D4-AM1-RH-015** (ST26-A031)

Development of a High-resolution Atmosphere-Ionosphere Coupled Model for Space Weather Forecast

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Space weather forecasts are about to enter a stage incorporating numerical forecasts based on realistic numerical simulation, in addition to conventional methods used by forecasters to make predictions based on observational data and experience. However, geospace is a highly complex system, consisting of the solar wind, the magnetosphere, the ionosphere, and the neutral atmosphere. In order to quantitatively understand the complicated system, it is necessary to model the entire region by including all fundamental processes self-consistently. At the National Institute of Information and Communications Technology (NICT) of Japan, we have developed an atmosphere-ionosphere coupled model, which includes the whole neutral atmosphere and the ionosphere. The model is called GAIA (Ground-to-topside model of Atmosphere and Ionosphere for Aeronomy). The present version has spatial resolution of about 1 degree in horizontal direction. In addition, we are also developing a high-resolution regional ionospheric model, which has a horizontal resolution of about 10 km. We plan to combine GAIA and the regional model to reproduce mesoscale ionospheric phenomena, such as plasma bubbles and SED (storm enhanced density). The model will be a useful tool for space weather forecast. We will report previous results, and a plan for the new model.

4. **ST26-D4-AM1-RH-016** (ST26-A024)

Investigation of Magnetic Flux Transport on the Solar Surface Based on Hinode Satellite Data and Auto-tracking Technique

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We report spatial displacement character of patch structure on the solar surface based on satellite data and auto-tracking technique.

Understanding of magneto-convection on the solar surface is thought to be a basic and an important issue in the solar physics for long time because it is thought to store the energy and triggers many solar activities. One of the important issues is the transport of magnetic field there. In global scale, it is treated as a diffusion process. However it is not clear that diffusion treatment is appropriate in magneto-convection system both theoretically and observationally. Observational difficulty comes from smallness and short time scale of the element structures (<1,000km and order of minutes) compared with solar scale (~700,000km and order of years). We need stable high spatial and temporal resolution and to a new method of analysis to overcome the problem, huge scale difference.

I try this problem by means of satellite data and feature recognition technique. The dependence of mean-square displacement on elapsed time is investigated. The longest magnetogram data obtained by Hinode/FG is used.

In that data, number of tracked patches is enough for statistical study, more than 40000. The obtained dependence shows a different character above and below the point of L ~10^4 km. Below that scale, it has a power-law dependence with an index of ~-1.4, namely super-diffusion scheme. However, in the larger scale, the power-law dependence becomes ~-0.6, namely sub-diffusion scheme. These results show not-diffusive character of magnetic filed

transport. We interpreted these characters come from network flow structures.

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5. **ST26-D4-AM1-RH-017** (ST26-A041)

ROSMIC Project in SCOSTEP/VarSITI Program

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ROSMIC (Role Of the Sun and the Middle atmosphere/thermosphere/ionosphere In Climate, co-leaders: F.-J. Luebken, A. Seppala, W. Ward) is one of four projects in VarSITI (Variability of the Sun and Its Terrestrial Impact) a five year SCOSTEP program which started in 2014 project. The goal of the project is to understand the impact of the Sun on the terrestrial middle atmosphere/lower thermosphere /ionosphere (MALTI) and Earth's climate and its importance relative to anthropenic forcing over various time scales from minutes to centuries. The ROSMIC project consists of four sub-projects1) Coupling through solar variability (radiative, electrodynamics, ionospheric and photochemical effects), 2) Coupling by dynamics, 3) Trends in Mesosphere and Lower Thermosphere, 4) Trends and solar cycle effects in the thermosphere (incl. technological aspects).

The project will be conducted through close collaborations between observations and modeling activity. Observations include of the use of both existing data records and new measurements from a wide range of ground based (lidars, radars, mappers), in-situ (rockets, balloons, aircraft), and satellite (AIM, TIMED …) instruments. Dedicated models are used and developed for a better understanding of specific processes (e.g. gravity wave breaking, ice formation). Global scale models will be modified and applied from the ocean to the thermosphere. Through the five year projects, we expect to better understand the impact of solar activity on the entire atmosphere, relative to anthrogenic forcing and natural long term variability. In the paper, of the ROSMIC project will be introduced, and the Japanese activities of ROSMIC summarized.

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6. **ST26-D4-AM1-RH-018** (ST26-A013)

Characteristic Spatial Structure of the Surface Temperature Variation Related to the Solar Cycle

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Recent measurements from the space revealed that the variation of the total solar irradiance (TSI) associated with the 11-year solar cycle is about 0.1%, which cannot produce little effect on Earth's climate without a feedback from the atmosphere-ocean system. Several amplifying mechanism are proposed for different variation of solar origin, cosmic ray, visible light, solar ultra violet.

To determine which process is actually operating in the Earth's atmosphere, it needs to investigate not only the global mean temperature, but also its spatial structure. Observed 11-year solar signals in surface temperature can be characterizes by warming in midlatitudes and the absence of warming (or even slight cooling) in the tropics.

Midlatitudes warming of the surface temperature occurs in association with a downward penetration of stratospheric polar-night jet or the polar-night jet oscillation. Little change in tropical surface temperature is consistent with dynamical nature of the warming. Such characteristics of solar signal can be expected from that produced through change of the solar

ultraviolet. Change of the solar heating in the middle atmosphere modulates wave mean-flow interaction in the stratosphere through two processes: one is the polar-night jet oscillation, and the other is a modulation of the meridional circulation.

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7. **ST26-D4-AM1-RH-019** (ST26-A016)

Modeling Study for Understanding Atmospheric Responses to Solar Activities

Yasunobu MIYOSHI[1#+], Hitoshi FUJIWARA[2], Hidekatsu JIN[3], Hiroyuki SHINAGAWA[3]
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It is well established that temporal variation of solar activity significantly affects the general circulation in the middle atmosphere, thermosphere and ionosphere. In order to examine impact of solar activity on the general circulation in the middle and upper atmosphere quantitatively, we are planning to preform numerical simulation using an atmosphere-ionosphere coupled model (Ground-to-topside model of Atmosphere and Ionosphere for Aeronomy; GAIA). GAIA contains the region from the ground surface to the exobase, we can estimate whole atmosphere responses to temporal variation of solar activities. In particular, effects of temporal variations of the solar UV/EUV fluxes on the general circulation in the mesosphere and thermosphere are studied. In addition to solar UV/EUV variations, we will also investigate variations of the thermosphere/ionosphere during periods of significant energy inputs from the magnetosphere. In this presentation, we will show our research activities related to the "Role Of the Sun and the Middle atmosphere/thermosphere/ionosphere In Climate (ROSMIC)" project in VarSITI.

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8. **ST26-D4-AM1-RH-020** (ST26-A047)

Monitoring of Chemical Compositions in the Mesosphere and Lower Thermosphere by Using a Network of Ground-based Millimeter-wave Spectrometers

Akira MIZUNO[1#+], Tomoo NAGAHAMA[1], Taku NAKAJIMA[2], Hirofumi OHYAMA[2], Yasuko ISONO[1], Yasusuke KOJIMA[2], Hiroyuki MAEZAWA[3], Hideo OGAWA[3], Masaki TSUTSUMI[4], Mitsumu K. EJIRI[4], Takuji NAKAMURA[4]
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Temporal and spatial variations of atmospheric minor constituents in the mesosphere and lower thermosphere (MLT) region reflect the change of the solar-terrestrial environment. Energetic particle precipitation triggers ion-molecule chemistry that changes the chemical composition in the MLT region, and sometimes such chemical changes propagate downward to the stratosphere through the atmospheric transport. Changes of gravity-wave activities also make the composition changes caused by temperature variations in various timescales.
The ground-based millimeter-wave spectroscopy is one of the useful methods to monitor the temporal variation with high time resolution above the fixed location. To make such monitoring in different latitudes, we have started observations of atmospheric molecules such as ozone and NOx by using a small network of ground-based millimeter-wave spectroscopic radiometers with a high-sensitivity superconducting (SIS) mixer receivers. We have operated three millimeter-wave radiometers in the southern hemisphere; Atacama highland in Chile (23°S, 68°W), Rio Gallegos in Argentina (52°S, 69°W), and Syowa station in Antarctica (69°S, 39°E), and one radiometer in the northern hemisphere; Rikubetsu, Japan(44°N, 144°E). Especially, at Syowa station, we have been monitoring ozone and nitric oxide (NO) spectra in 250 GHz band, and we have clearly detected temporal variations of NO column density in the MLT region including sudden enhancements of NO suggested to be associated with the

energetic electron precipitation events. In this presentation, we will present the results of mesospheric ozone and NO observed by the network and discuss possible contribution to the VarSITI program.

ST26 - VarSITI - Variability of the Sun and Its Terrestrial Impact
Thursday, July 31, 2014 | Regent Hall | 11:00-12:30

1. **ST26-D4-AM2-RH-021** (ST26-A022)

Study of Equatorial Atmosphere/ionosphere Under RISH/LAPAN Collaboration

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The Earth's atmosphere is vertically coupled with atmospheric waves. Momentum/energy transfer from lower to upper atmosphere through wave propagation plays an big role of determining the dynamics of the atmosphere. The energy input from the sun is the maximum at the equator that leads to the intense convection, and then variety of atmospheric waves are generated in the region. The equatorial atmosphere could be regarded as an engine for dynamics of the whole atmosphere. RISH-LAPAN started collaboration for the study of equatorial atmosphere/ionosphere since mid 1980s, and conducted radiosonde observation campaigns, meteor and MF radars, etc. The Equatorial Atmosphere Radar (EAR) was installed over the geographic equator on Sumatra Island in 2001. We continued long-term experiment for more than 10 years, and have found that troposphere-stratosphere airmass exchange is controlled by the modulation of the tropopause by Kelvin waves. Turbulent structures of the tropopause region is also revealed by the EAR. In the ionosphere, spatial and temporal variability of the equatorial Spread-F are clearly observed by the multibeam experiment. With research collaboration with other Japanese university/institutes, the EAR site now became a complete observatory that consists of many instruments, i.e., a meteor radar, a boundary-layer radar, a meteorological radar, lidars, an ionosonode, GPS receivers, etc. The next big project of our own is to improve the EAR ability by building the Equatorial MU radar (EMU) aside of the EAR, which is now included in the Japanese Master Plan. RISH-LAPAN recently obtained a fund of "JSPS Bilateral Joint Research Projects" for FY2014-2016. We will have more chances to discuss collaborative research program for the equatorial atmosphere/ionosphere. In the presentation we summarize our collaboration, and discuss future direction of research including the new EMU.

2. **ST26-D4-AM2-RH-022** (ST26-A030)

Planetary Atmospheric Sciences Related to ROSMIC/VarSITI

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A variety of new evidences obtained during the CAWSES/CAWSES-II programs have significantly improved our understanding of the dynamical coupling between the terrestrial lower, middle, and upper atmospheres and its relevance to climate. Nonmigrating tides carry energy and momentum from the troposphere to the upper atmosphere, and produce the so-called wave-4 structure. Concentric gravity/acoustic waves generated from tsunami/tornado/hurricanes were observed to penetrate into the ionosphere and cause plasma disturbances. Thermospheric neutral density was found to drastically decrease during a major stratospheric sudden warming. MALTI (middle atmosphere/lower thermosphere/ionosphere) variability induced by these atmospheric waves of lower atmosphere origin has been widely recognized to compete with solar forcing from above. However, some fundamental effects such as vertical diffusion (eddy diffusion) induced by gravity waves are yet to be understood. In order to better understand the impacts of the solar and the lower atmospheric forcings on the terrestrial MALTI region, it is important to investigate the variability of the Sun and the terrestrial atmosphere at present and in the past. On the other hand, the MALTI variability induced by the atmospheric waves is ubiquitous in stably stratified atmospheres of planets. For example, Mars possesses huge mountains (e.g., Tharsis region) compared to those on Earth, which are expected to drive orographic gravity waves in the Martian atmosphere. Recent satellite observations and modeling studies revealed that thermal and dynamical effects of gravity waves play a major role in defining temperature and large-scale winds in the MALTI of Mars. In addition, upcoming MAVEN observations will directly measure upper-atmospheric constituents down to the homopause altitude at Mars, which are expected to advance our knowledge of the wave-induced diffusion. Thus, a comparison of the effects of atmospheric waves on the MALTIs of terrestrial-like planets (Earth, Mars and Venus) would provide a complementary view on the fundamental processes, and enhance our understanding of the scientific questions of ROSMIC/Coupling by Dynamics. In this presentation, we will show how the planetary atmospheric sciences will contribute to the ROSMIC/VarSITI project.

3. **ST26-D4-AM2-RH-023** (ST26-A014)

Solar Evolution and Extrema (SEE) Under VarSITI Scientific Program

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Following the recent unsual solar activities, the next SCOSTEP international scientific program “Variability of the Sun and Its Terrestrial Impact (VarSITI) ” was launched as a 5 years program covering 2014-2018. It will focus on the the unusual solar activities and their

consequences on Earth, for various times scales from the order of thousands years to milliseconds, and for various locations and their connections from the solar interior to the Earth's atmosphere.
The program consists of four elements:
(1) Solar Evolution and Extrema (SEE), (2) International Study of Earth-Affecting Solar Transients (ISEST/Minimax24), (3) Specification and Prediction of the Coupled Inner-Magnetospheric Environment (SPeCIMEN), and (4) Role Of the Sun and the Middle atmosphere/thermosphere/ionosphere In Climate (ROSMIC).
Among these elements, SEE will address, by promoting coordination of various projects between the Sun and the Earth, the following scientific questions:
(a) Are we at the verge of a new grand minimum? If not, what is the expectation for cycle 25? (b) Does our current best understanding of the evolution of solar irradiance and mass loss resolve the "Faint Young Sun" problem? What are the alternative solutions? (c) What is the largest solar eruption/flare possible? What is the expectation for periods with absence of activity?
An overview of SEE element will be presented.

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4. **ST26-D4-AM2-RH-024** (ST26-A002)

Why Microwave Emission Is a Good Proxy of Solar Activity

Kiyoto SHIBASAKI[1#+]
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Total decimetric radio emissions from the Sun have been used as solar activity indexes. They show good correlation with sunspot numbers. Sunspots are phenomena below the temperature minimum and decimetric waves are emitted from hotter plasma in the transition region and the corona. They are heated by unknown coronal heating mechanisms. Good correlation between physical properties on both side of the temperature minimum region suggests that coronal heating is proportional to sunspot numbers. We can define “solar activity” as coronal heating rate. The terrestrial upper atmosphere is strongly influenced by UV and soft X-ray emission from the Sun and they are emitted from the transition region and the corona from where microwave emissions are radiated. Hence radio flux values can be a more direct index for the terrestrial impacts of solar variability.
Sunspots are cooler at the photosphere and coronal and transition region loops tend to avoid sunspots. According to recent studies, the relation between total radio flux in the decimetric range and sunspot numbers shows small deviation from the previous relation since the 23rd solar cycle. However, the relation between radio flux and total surface magnetic flux remains unchanged. Coronal heating seems to be depending on total magnetic flux on the solar surface and sunspot numbers may be a proxy of them.
Existing coronal heating theories discuss about heating mechanism mainly. We need also temperature-regulated plasma supply to supplement continuous plasma outflow from the corona by the solar wind. Heated plasma in the corona flow outwards directly due to strong diamagnetism of charged particles rather than conducting heat backwards. Also, coronal heating have to work in open magnetic field regions, such as coronal holes. To explain these evidences, I propose a new mechanism that hot plasma are supplied directly from below the photosphere through magnetic flux tubes.

5. **ST26-D4-AM2-RH-025** (ST26-A006)

Numerical Simulations of Convection and Dynamo in the Solar Interior

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The solar magnetic cycle is one of the important and unsolved problems in the plasma astrophysics. It is widely accepted that the main mechanism is the periodic dynamo process in the solar interior. Magnetohydrodynamic (MHD) turbulence driven by the thermal convection plays a very important role for the generation of magnetic fields.

Here we report on our MHD simulations of the thermal convection in the solar convection zone based on our newly developed technique, i.e. the reduced speed of sound technique (RSST). In this environment, the turbulence is driven by the heat flux from the stellar core and has multi-scale structure because of the reduction of the pressure scale height with the stellar radius. The Reynolds stress by the turbulence as well as the mean flows, i.e. the differential rotation and meridional flow, both play important roles in the process of the interior. We will be focusing on the interaction of such multi-scale convection, mean flows and the magnetic field.

6. **ST26-D4-AM2-RH-026** (ST26-A042)

Progress in Our Understanding of the Solar Surface Magnetism Provided by HINODE

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HINODE has provided unique data sets for studies of magnetic fields on the solar surface since 2006. The most important advantage of HINODE is that we can obtain detailed diagnostics of surface magnetic fields with high spatial resolution. It allows us to make progress in our understanding on how magnetic flux interacts with convective flows on the surface and how the interaction creates various magnetic structures, such as sunspots and quiet-Sun magnetic fields. We can obtain accurate vector field maps of an active region so that we can track development of magnetic shear toward an onset of a flare. The vector field maps on the surface can be used as a boundary condition to perform the nonlinear force-free field (NLFFF) extrapolation for inferring magnetic field configuration in the solar corona. The continuous observation of the Sun's polar regions with HINODE is now revealing a process of the polarity reversal through the solar maximum, which also has an important influence for the near-earth environment.

Poster Presentations

ST26-D2-PM2-P-027 (ST26-A001)

Global Imaging of Polar Cap Patches

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Polar cap patches are chunks of dense plasma in the polar cap. Patches are known to be accompanied by plasma irregularities; thus, they would be sources of ionospheric scintillations on the satellite signals in the polar cap. Within patches, the total electron content also increases, which could introduce ranging inaccuracy in the global navigation satellite system (GNSS). In this sense, it is important to understand the characteristics of patches for the purpose of the space weather applications in the polar cap. During the last decade, an all-sky airglow imager (ASI) at Resolute Bay, Canada has been widely used to visualize the dynamical characteristics of patches. However, we have not yet been able to discuss the distribution/shape of patches in a global context due to the limitation of the FOV of the ASI. In order to image patches more globally, an additional ASI has been operative since 2011 in Longyearbyen, Norway. Since the deployment of this new imager, the polar cap ionosphere has been watched from two sites simultaneously. As one of the first results from the global imaging of the polar cap with dual ASIs, we present a patch event on November 12, 2012, during which patches were captured commonly by the two ASIs. During this interval of simultaneous airglow imaging, the nightside/dawnside (dayside/duskside) half of the patches was captured by the ASI at LYR (RSB). This unique situation enabled us to estimate the dawn-dusk extent of the patches to be around 1500 km, which was at least 60-70% of the width of the anti-sunward plasma stream. In contrast to the large extent in the dawn-dusk direction, the noon-midnight thickness of each patch was less than 500 km. These observations demonstrate that there exists a class of patches showing cigar-shaped structure. Such patches could be produced in a wide range of local time on the dayside nearly simultaneously and spread across many hours of local time soon after their generation.

ST26-D2-PM2-P-028 (ST26-A003)

Large-scale Streams of the Solar Wind and Their Interaction with Magnetosphere

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We analyze the large-scale streams of the solar wind and their interaction with magnetosphere on the basis of OMNI data base during 1976-2000. We prepared “Catalog of large scale phenomena during 1976-2000” [1] (presented on websites: ftp://ftp.iki.rssi.ru/pub/omni/ ftp://ftp.iki.rssi.ru/pub/omni/catalog/) which includes following types: heliospheric current sheet (HCS), slow and fast streams, cororating interaction regions (CIR), sheath, magnetic clouds (MC), ejecta, as well as direct and reverse interplanetary shocks. We consider the relative role of all elements for chain of processes and relations from the Sun to the Earth’s magnetosphere resulting in magnetic storm generation by various types of solar wind streams: occurrence rate of interplanetary drivers; probability of generation of magnetic storm (geoeffectiveness); efficiency of process of this generation (ratio of Dst-index as “output” to integrated electric field as “input”), influence of the interplanetary conditions on development of the magnetic storms. For modeling of the main phase of magnetic storms, driven by

different types of the solar wind structures, we use the approximation of Dst-index by linear dependence on 3 parameters of SW: integral electric field sumEy, solar wind dynamic pressure Pd and the level of fluctuations sB IMF. Our analyses show that the reaction of magnetosphere depends on the type of solar wind structure (see details on site http://www.iki.rssi.ru/people/yyermol_inf.html). This work was supported by the RFBR, project 13-02-00158a, and by the Program 22 of Presidium of Russian Academy of Sciences.
[1] Yu. I. Yermolaev, N. S. Nikolaeva, I. G. Lodkina, and M. Yu. Yermolaev, Catalog of Large-Scale Solar Wind Phenomena during 1976-2000, Cosmic Research, 2009, Vol. 47, No. 2, pp. 81-94.

ST26-D2-PM2-P-029 (ST26-A010)

Model Reconstruction of Total and Spectral Solar Irradiance Since 1974

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The variation in total and spectral solar irradiance, TSI and SSI, are key to understanding the influence of the Sun on externally driven changes in the Earth's climate. TSI and SSI have been monitored from space since 1978 through a succession of satellite-borne experiments, few of which operated for more than a decade. The composition of the data from the various missions into a single time series is a challenge due to instrumental effects such as aging and exposure degradation. The competing composite records of TSI published by ACRIM, IRMB and PMOD, while broadly in agreement at timescales of days to years, exhibit conflicting decadal trends. Consensus on SSI, in terms of the absolute level, and the amplitude and decadal trend of the variation, is even more elusive. Models which ascribe the variation in solar irradiance to the evolution of solar surface magnetic activity have been particularly successful in replicating measured variability, the SATIRE-S model being an established instance. Here, we present a SATIRE-S reconstruction of TSI and SSI from 1974 to the present. This is an update of preceding efforts based on full disc magnetograms from the KPVT and SoHO/MDI. We extended the model to the present with similar observations from SDO/HMI, and cross calibrated the various magnetogram data sets to yield a single, consistent solar irradiance time series. The decadal trend in the PMOD TSI composite is almost exactly reproduced. The reconstruction exhibits excellent agreement with various measurements of SSI but diverges significantly from the observations from SORCE/SIM, adding to existing evidence that the latter might contain unresolved instrumental trends.

ST26-D2-PM2-P-030 (ST26-A011)

Analysis of Geomagnetic Data and Cosmic Ray Variations in Periods of Magnetic Perturbations

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In the present paper we have suggested a model of the geomagnetic field variation, which allows us to present the characteristic variation of the field and local perturbations formed in periods of increased geomagnetic activity.
Using the proposed model we have developed a technique of identifying the characteristic variation of the geomagnetic field (in periods of quiet magnetosphere) and components presenting different conditions of the field in periods of perturbations. We have also created special rules for estimating the storminess degree of the geomagnetic field. The suggested theoretical tools allow us to determine time points when geomagnetic perturbations arise and to obtain quantitative estimates of the storminess degree. Furthermore, it is also possible to implement these rules in the automatic mode.

Using the combination of the wavelet transform and neural networks, we have developed a technique of approximating the time variation of cosmic-ray data. This technique allows us to perform detailed analysis of geomagnetic data and detect anomalies in periods of high solar activity.
Analysis of long geomagnetic data from the Paratunka observatory (Kamchatka region, Russia) provided quantitative estimates of the storminess degree of the geomagnetic field before and during magnetic storms. Furthermore, we have managed to identify local weak increases of the field perturbations prior to the main phase of storms. Abnormal time periods connected with increased solar activity have been detected in the flow of cosmic rays. Comparison of the results with the geomagnetic data has shown that the anomalies in the cosmic ray variations occur in periods of strong geomagnetic perturbations.
The tools and techniques suggested in the present work, together with other methods of data - analysis will help forecast space weather, estimate more accurately the condition of the Earth's magnetic field, and identify periods when the intensity of cosmic rays rises significantly.

ST26-D2-PM2-P-031 (ST26-A019)

Response of the D-region Ionosphere Over South-East Asia During the Maximum of Solar Cycle 24 Using AVON (Asia VLF Observation Network) Data

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We first introduce the Asia VLF Observation Network (AVON) system. The observation targets of the AVON are the D- and lower E-region ionosphere (altitudes from the ground: 60 – 120 km), lightning activities, and ionospheric disturbances associated with lightning in Southeast Asia. In this study, we show the results of Response of the D-region ionosphere over South-East Asia during the maximum of Solar Cycle 24. The observation system is installed at 5 sites: Tainan site (23.08ºN, 120.12ºE) in Taiwan, Saraburi site (14.53ºN, 101.03ºE) in Thailand, Pontianak site (LAPAN: 0.00ºN, 109.37ºE) in Indonesia, Los Banos (University of Philippines and PAGASA: 14.18 ºN, 121.25 ºE), and Hanoi site (21.13ºN, 105.5ºE) in Vietnam. We installed the observation system at Hanoi in Vietnam in December, 2013. At each site, we use a dipole antenna for the electric field measurements and an orthogonal loop antenna for the magnetic field measurements. At Tainan, Saraburi, and Pontianak sites, LF transmitter signals are monitored with a monopole antenna. With a set of orthogonal loop and dipole antennas, tweek atmospherics (0.1 - 10.0 kHz) and broadband lightning atmospherics (1.0-40.0 kHz) are observed. By analyzing the VLF/LF data obtained by AVON, we estimate the reflection heights of tweek atmospherics, which correspond to variations in electron density in the D- and lower E-region ionosphere in Southeast Asia. This network system is utilized in cooperation with other ground-based and satellite-based observation projects to investigate energetic-particle precipitation effects on low-latitude ionosphere. We show the results for Response of the D-region ionosphere during the maximum of Solar Cycle 24 using AVON data. At the magnetically quiet night, the average reflection height of tweeks observed at Tainan was 100.0 km. In the presentation, we show the variations in the tweek reflection height estimated from the AVON data.

ST26-D2-PM2-P-032 (ST26-A021)

Coordinated Measurements of Medium-scale Traveling Ionospheric Disturbances with Ground-based Airglow Imagers and CHAMP Satellite

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Medium-scale traveling ionospheric disturbances (MSTIDs) are a well-known wavy phenomenon in the F-region ionosphere. They typically have a horizontal wavelength of several hundred kilometers and a periodicity of about one hour. Although, the MSTIDs were considered to be caused by atmospheric gravity waves, recent studies have suggested that the generation of the MSTID in nighttime is highly associated with coupling processes between the E- and F-region electrodynamics. To confirm the different processes in the MSTID generation in daytime and nighttime, CHAMP satellite measurements would be greatly helpful; CHAMP plasma and neutral density data obtained in the day- and night-side sector can monitor the phase relations between the neutral (i.e., atmospheric gravity wave) and ionospheric plasma perturbations simultaneously at the top-side F-region (approximately 400 km).

As the first step in the abovementioned research, we compared the MSTID signatures between the CHAMP and ground-based 630-nm airglow measurements to validate the MSTID detection by CHAMP. Airglow imaging is a quite useful technique to investigate two-dimensional structure of the nighttime MSTIDs. Horizontal parameters of the MSTIDs (such as wavelengths, motions, and their spatial extent) can be estimated directly with a high spatial and temporal resolutions through the 630-nm airglow emission in the F-region ionosphere. Previous study by Park et al. [2009, JGR] made an investigation of spatial signatures regarding one MSTID event using airglow images along the CHAMP orbit. The Solar-Terrestrial Environment Laboratory, Nagoya University, have operated airglow imaging network, as the OMTI system, around the world since 2000; this network gives much more chance to make coordinated measurements with CHAMP.

In this presentation, we will report the statistics of simultaneous MSTID measurements with the ground-based optical network and CHAMP satellite in 2005-2008.

ST26-D2-PM2-P-033 (ST26-A026)

Japanese SuperDARN Contribution to VarSITI Program

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Super Dual Auroral Radar Network (SuperDARN) is an international collaborative HF-radar network operated by more than 15 institutions in over 10 countries, and the number of the radars is currently more than 30 and it is still growing and the FOVs are expanding to both higher and mid-latitudes covering considerable portions of global upper atmosphere. SuperDARN was originally designed to obtain global large scale two-dimensional polar ionospheric plasma convection patterns and polar cap potential drop in both hemispheres with a temporal resolution of 1 to 2 minutes since 1995, which have never been possible by any other observational techniques. SuperDARN is a powerful tool to be applied to many

scientific issues. It can be used not only to deduce dynamics of global large-scale convection patterns, but also to study dynamics of transient meso-scale phenomena, and polar cap boundary, to detect reconnection sites and to deduce reconnection rates, to study substorms, storms and phenomena related to subauroral regions, to deduce field aligned currents (FACs), to study MHD waves in a variety of frequency ranges, and also to study ionospheric irregularities. Moreover, it can be utilised not only to ionospheric researches but also to neutral atmospheric studies, e.g., on atmospheric waves like TIDs, neutral winds around mesopause region, and also polar mesospheric summer echoes (PMSEs), etc. 3 Japanese institutions have joined and contributed to SuperDARN by operating 4 radars in Antarctica, and Alaska, and Japan. As SuperDARN could have provided basic and important physical parameters in global upper atmosphere, it can provide essential contributions to VarSITI programs especially on ISEST, SPeCIMEN and ROSMIC by collaborating with other observational and theoretical researches. The expected contributions to VarSITI especially by Japanese groups will be discussed in detail.

ST26-D2-PM2-P-034 (ST26-A027)

The IUGONET Project and Its Contribution to the VarSITI Program

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The Inter-university Upper atmosphere Global Observation NETwork (IUGONET) project is an inter-university program initiated by the Japanese institutions which have a worldwide and long-term ground-based observation network of the upper atmosphere, Sun and planets. The project started in the year 2009, and we have released the metadata database (MDB) and an analysis software (the iUgonet Data Analysis Software, UDAS) to the Solar-Terrestrial Physics (STP) research community.

The IUGONET MDB adopted the Space Physics Archive Search and Extract (SPASE) metadata format to describe the information about the data (e.g. observatory, instruments, datasets, period, contact person, pathway to each data file), and we registered the metadata of the observation taken by radars, magnetometers, photometers, helioscopes, etc. Further, the IUGONET MD system is dealing with lower atmospheric data belonging to the IUGONET institutes, and holds flexibility to include satellites and the numerical simulation data.

The UDAS is a plug-in software of Themis Data Analysis Software (TDAS), which is upgraded to Space Physics Environment Data Analysis System (SPEDAS). These are written in the Interactive Data Language (IDL) and are integrated analysis platforms for visualizing and analyzing the ground-based and satellite observation data.

It is crucial for the VarSITI researchers to access the observed data of the different research domains. The international researchers can find the various kinds of ground-based observation data with the IUGONET MDDB, and will be able to handle many data including satellites with the same platform throughout the software we have been developing.

We have started a collaborative study with the European ESPAS project to connect the two databases on the STP community. With these increasing interoperability and extending scientific domains, the IUGONET program should contribute to four projects of the VarSITI. We welcome any kind of cooperation, metadata inputs and feedbacks in the near future.

ST26-D2-PM2-P-035 (ST26-A028)

Ionospheric Studies Using Total Electron Content Maps Obtained From

GPS Receiver Networks

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Since 1990's, GPS receivers has been installed at various locations, and the GPS data are widely used for the purpose of the ionospheric studies. Since each GPS receiver provides the phase advance and group delay (P-code pseudoranges) data of the radio waves at the dual frequency, Total electron content (TEC) along a ray path between the GPS satellite and receiver is accurately obtained. Using the GPS-TEC data in the world, ionospheric effects of solar flares and geomagnetic disturbances on global scale can be studied. Regional map of the TEC obtained from dense GPS receiver networks have revealed wavy structures of the TEC, caused by large- and medium-scale traveling ionospheric disturbances (LSTIDs and MSTIDs). Clear concentric waves also have been detected after huge earthquakes, tsunamis and massive tornados, indicating that acoustic and/or gravity waves launched from the Earth's surface,and propagate upward into the thermosphere, and modulate the ionospheric plasma density. Quick-look TEC maps are archived and available in DRAWING-TEC website (http://seg-web.nict.go.jp/GPS/DRAWING-TEC/). These GPS-TEC observations will contribute the next SCOSTEP program VarSITI, particularly to the ROSMIC (Role Of the Sun and the Middle atmosphere/thermosphere/ionosphere In Climate) project.

ST26-D2-PM2-P-036 (ST26-A034)

Periodic Changes of Global Lightning Activity and Cloud Coverage and Their Relation to the Solar Activity

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In order to study the periodic changes of the global lightning activity and their regional dependences, we have analyzed ELF magnetic field waveform data obtained at Syowa station in Antarctica, Onagawa observatory in Japan and Kiruna in Sweden for the period between February 2000 and December 2009. First, we have estimated day-to-day amplitude variation of the Schumann resonance (SR) waves excited by lighting discharges. As a next step, we have calculated a periodgram of the SR amplitude variation using MEM, FFT, and wavelet method. It is found that the periodgram showed steep spectral peak at ~28-day in 2000-2001 which is the solar maximum period. On the other hand, the periodgram showed steep spectral peak over 30-day after 2002, which is the transition phase from the solar maximum to the solar minimum or the solar minimum phase. Using outgoing longwave radiation (OLR) data, we have also estimated the day-to-day variation of the cloud coverage in the tropical region and have calculated periodgram. It is found that the periodgram of the tropical cloud coverage surprisingly showed same characteristics as that of the SR amplitude variation. These facts may imply that the solar influence on the global lightning activity and cloud coverage is relatively high during the solar maximum phase while an influence of a large-scale intraseasonal variation of the tropical atmosphere, such as Madden-Julian oscillation (MJO), is relatively high during the solar minimum phase. At the presentation, we will show the results of the comparison between the solar parameters and global lightning activity and cloud coverage more in detail.

ST26-D2-PM2-P-037 (ST26-A038)

Imageing Observation of the Earth's Upper Atmosphere by International Space Station Ionosphere, Mesosphere, Upper Atmosphere, and Plasmasphere Mapping Mission

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International Space Station Ionosphere, Mesosphere, upper Atmosphere, and Plasmasphere mapping (ISS-IMAP) mission is a space-borne mission to investigate the mesoscale structures in the ionosphere, the mesosphere, and the plasmasphere by imaging observations. It consists of two imaging instruments. Visible-light and infrared spectrum imager (VISI) observes the airglow in the MTI region. Extra ultraviolet imager (EUVI) observes the resonant scattering from ions in the ionosphere and the plasmasphere. The objective of this mission is to clarify the upper atmospheric structures whose horizontal scale is 50-500km, and the effect of the structures on the space-borne systems. ISS-IMAP measures the following three parameters in the lower latitude region than 50 degrees: (1) distribution of the atmospheric gravity wave in the mesopause (87km), the ionospheric E-region (95km), and the ionospheric F-region (250km) (2) distribution of the ionized atmosphere in the ionospheric F-region (3) distribution of O+ and He+ ions in the ionosphere and plasmasphere. Its continuous observation started in October 2012. The coordinated observation between ISS-IMAP and the several ground-based instruments have been carried out to elucidate the coupling process between the lower atmosphere and the upper atmosphere by the wave structures in this scale. The disturbances of the upper atmosphere caused by the geomagnetic activity are also investigated by ISS-IMAP. The results of the ISS-IMAP mission by VISI and EUVI will be introduced in the presentation.

ST26-D2-PM2-P-038 (ST26-A039)

ERG Science Center

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The ERG (Exploration of energization and Radiation in Geospace) is a Japanese geospace exploration project, and the ERG satellite will be launched in FY 2015. The project consists of the satellite observation team, the ground-based network observation team, and the integrated data analysis/simulation team. Besides these research teams, ERG Science Center (ERG-SC) has been organized to promote close collaborations of these teams and thereby maximize the science output. For studies of geospace, where different plasma populations are dynamically coupled with each other via cross-energy and cross-regional couplings, the environment for the integrated data analysis is critical for comprehensive understanding using various kinds of data sets. A standard data format and integrated data analysis tools are essential to realize the seamless data analysis environment. The ERG project data after Level-2 will be open to the public in the NASA CDF format. The integrated data analysis tool is developed as a plug-in tool of SPEDAS in collaboration with the THEMIS and IUGONET

teams. It should be noted that other project data, such as THEMIS and Van Allen Probes, can be easily analyzed with SPEDAS if the data are converted to the CDF format. Thus the integrated data analysis using many kinds of data is truly realized through SPEDAS. Other useful tools in the web browser have been developed by the science center: ERG Web Analysis Tool (ERGWAT) is an interactive visualization tool, and Conjunction Event Finder (CEF) is a web-based tool enabling users to easily find conjunctions between satellites and ground-based observations. These tools will contribute to a part of the capacity building activity of the SPeCIMEN (Specification and Prediction of the Coupled Inner-Magnetospheric Environment) project carried out under the Variability of the Sun and Its Terrestrial Impact (VarSITI) program for 2014-2018. In this presentation, we will report our activities as well as scientific products contributing to the geospace science.

ST26-D2-PM2-P-039 (ST26-A040)

Test of Solar Wind Models Using Interplanetary Scintillation Data

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We have studied the relationship between the solar wind speed and the coronal magnetic field properties (a flux expansion factor (f) and photospheric magnetic field intensity (Bs). We used photosperic magnetic field data observed at Kitt Peak National Solar Observatory, and the magnetic field properties were derived with the potential field analysis code developed by Hakamada and Kojima (1999). The tomographic interplanetary scintillation (IPS) analysis method was used to obtain the solar wind speed data on the source surface at 2.5 Rs in the longitude and latitude coordinates. In this study we tested three solar wind models known as Wang-Sheeley-Arge model [V□1/f; Arge and Pizzo (2000)], Fisk model [V□Bs; Fisk et al. (1999, 2003)], and Suzuki model [V□Bs/f; Suzuki (2004)] by making cross-correlation analyses between above data sets (V, Bs, and f) obtained for 24 years from 1986 to 2009. Then we obtained following results. 1) Good correlations for relationships of V-1/f and V-Bs/f are confirmed. 2) The relationship of V-Bs is not obvious however positive correlations are confirmed for V-Bs with same f. 3) For a purpose of solar wind prediction the relationship of V-1/f provides the best result with an average error of 50 km/s through solar cycles.

ST26-D2-PM2-P-040 (ST26-A043)

Researches on Solar Eruptive Phenomena and Solar Activities Using Chromospheric Imaging Data with Continuous H-Alpha Imaging Network (CHAIN)

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In 2010, Kyoto University moved the Flare Monitoring Telescope (FMT) from Japan to Peru, and currently we are technically supporting two projects of building new solar telescopes in Saudi Arabia and Algeria under the CHAIN project. We also held international data analysis workshops three times during this four years to train foreign and domestic young researchers to analyze the data obtained by the FMT and Solar Magnetic Research Telescope (SMART) at Hida Observatory in Japan.

Current main scientific themes of the CHAIN project are

(1) 3D velocity field measurement of eruptive phenomena on the solar surface:

By applying “cloud model fitting” to multi-wavelength H-alpha chromospheric images, we

can calculate physical parameters of floating and moving features on the chromospheres. We especially focus on the 3D velocity field of erupting filaments to understand the process of growth and propagation of CMEs.
(2) Detection of shock waves (Moreton wave) generated by solar explosive phenomena:
The FMT and SMART are quite effective to detect Moreton wave that was explained as the intersection of coronal shock wave on the solar chromosphere. Even if flares that has almost the same intensity, sometimes they are accompanied by Moreton waves and sometimes they are not accompanied by them. We are investigating what are differences between flares "with" and "without" Moreton waves.
(3) Estimation of solar UV radiation and comparison with ionospheric variation:
Solar radiation is also one of very important element for understanding the change of space weather. Especially solar UV around from 50 to 140 nm has strong influence for the ionosphere of the earth. We are currently trying to reproduce UV intensity from chromospheric images that have been obtained during longer-term than UV data.
In this talk, we introduce recent results and plans in VarSITI period on these themes.

ST26-D2-PM2-P-041 (ST26-A044)

Syowa Lidar Project in the Prioritized Observation Project for VIII-th Term Japanese Antarctic Research Expedition

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The National Institute of Polar Research (NIPR) is leading a six year prioritized project of the Antarctic research observations since 2010. One of the sub-project is entitled "the global environmental change revealed through the Antarctic middle and upper atmosphere". Profiling dynamical parameters such as temperature and wind, as well as minor constituents is the key component of observations in this project, together with a long term observations using existent various instruments in Syowa Station, Antarctica (69S, 39E). As a part of the sub-project, Rayleigh/Raman lidar was installed at Syowa in January, 2011 and has been observing temperature in the mesosphere, the stratosphere and part of the troposphere that provides data of gravity wave characteristics, and high altitude clouds of PSC (polar stratospheric clouds) and PMC (polar mesospheric clouds). In order to extend the height coverage to include the mesosphere and lower thermosphere (MLT) region, and also to extend the parameters observed, a new resonance scattering lidar with tunable wavelengths is developed at NIPR in Tachikawa (36N, 139E). The new lidar transmitter is based on injection-seeded, pulsed alexandrite laser for 768-788 nm and a second-harmonic generation (SHG) unit for 384-394 nm, and the lidar has capabilities to measure density variations of minor constituents such as atomic iron (386 nm), atomic potassium (770 nm), calcium ion (393 nm), and aurorally excited nitrogen ion (390-391 nm) and temperature profiles in the MLT region using potassium. The new lidar system will be installed at Syowa in 2016 and provide information on the MLT region as well as the ionosphere. This unique observation is expected to make important contribution to studies on the atmospheric vertical coupling process and the neutral and charged particle interaction. In this talk, current status of the research, observations, and system developments, as well as future plans will be presented.

ST26-D2-PM2-P-042 (ST26-A046)

Solar Activity and Seasonal Effects of the Upper Atmosphere at High Latitudes According to Observations and Modelling

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Statistical patterns of the high-latitude upper thermosphere neutral wind circulation and of the plasma density and temperature obtained on board the CHAMP spacecraft have revealed clear solar cycle and seasonal dependences. There are further evident dependences of the upper thermosphere/ionosphere to solar wind and interplanetary magnetic field (IMF) parameters like the IMF strength and orientation. It has been shown that the IMF dependent drivers of the magnetosphere-ionosphere-thermosphere (M-I-T) system can result in very dissimilar responses in the Northern and Southern Hemisphere with obvious solar activity and seasonal variations.

We present statistical studies of the high-latitude upper thermospheric neutral wind circulation patterns obtained from almost a decade of measurements with an accelerometer as well as plasma parameters deduced from a Langmuir probe on board the CHAMP spacecraft. The solar activity and seasonal variations are analysed with respect to average cross-polar wind velocities and high-latitude neutral wind vorticity values.

Using the Coupled Magnetosphere-Ionosphere-Thermosphere (CMIT) model, on the other hand, we simulated representative equinox as well as solstice intervals for low and high solar activity conditions. The comparative survey of both the numerical simulation and the statistical observation results show some prominent asymmetries between the two hemispheres, which are caused by the different geographic-geomagnetic offsets and/or the different patterns of geomagnetic flux densities.