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National Institute of Information and Communications Technology

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NICT

2011 New Year's Greeting

National Institute of Information and Communications Technology (NICT)

President **Hideo Miyahara, Ph.D.**

A happy New Year!

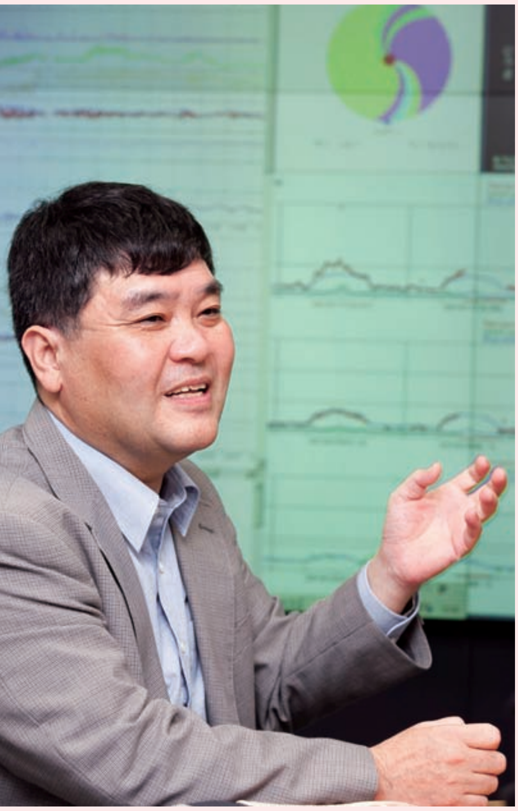
Our nation is still under lingering sluggish economy, which can hardly be restored. The environment surrounding science and technology has become increasingly severe, and as reported by mass media, the circumstances of incorporated administrative agencies like NICT are not favorable either. The recent trend of extremely efficiency-oriented attitudes seeking instant results is apparently bringing pessimistic mood in industry and making the buds of future growth shrunk. I strongly believe that such a situation is indeed a challenge for our researchers, and accordingly, they would recognize where their studies are and what is their vision so that they could work on their assignments with confidence and pride.

In the R&D area of information and telecommunications, each of field-specific elemental technologies in our nation is remarkably competitive in the world. Meanwhile, the specific technology functioning as a system in Japan is slightly inferior. It is indeed required to deal with all the processes until combining and integrating those elemental technologies into specific systems. NICT will continue to strive for the combination and integration of each research assignment within our organization and collaborate with universities and private research institutions in promoting research projects with emphasis on to create systems having novel functions. I believe that outlining the future development and showing the vision through these research activities is to fulfill the accountability of NICT to our society.

Science might be referred to as finding out universal principles or analyzing of any existing object. In contrast, technology might be defined as devising, constructing, applying, and designing specific approaches to realize novel functions. I think that science and technology should be further improved by allowing these two elements to work as “two wheels of one cart”. It appears to me that science and technology have recently become more separated. But to create truly valuable science and technology, fusion of both is essentially required, and therefore the studies in the interdisciplinary fields across different research fields are important. Forming a certain constant cycle for innovation requires modeling present systems, conducting mathematical analyses of it, extracting properties of the systems, and then building a new model. NICT hopes to create true culture as an authentic research organization by performing substantial development of science and technology through the fusion of science and technology.

As of April this year, NICT marks the launch of its third R&D medium-term plan. Amid the drastically changing social situation, we would like to have a broad perspective for the future of science and technology to meet the true demand of society. Further, I wish that the R&D results by NICT in the field of information and communications would serve the source of future growth of our nation, and that we would contribute to solve social problems such as global environment, population problems, and food issues.

I would like to conclude my New Year's Greeting by hoping that the year 2011 would be wonderful for all of you.



Space Weather Forecast Predicts Changes in Sun-Earth Space Environment by Using Observation Data

Giving Real-Time Information on Space Environment That Has Influence on Our Daily Life

Shinichi Watari

Research Manager, Space Environment Group, Applied Electromagnetic Research Center

In 1984, he entered the Radio Research Laboratories (current NICT) From 1994 to 1995, he was Guest Expert Researcher at the National Oceanic and Atmospheric Administration/Space Environment Center (NOAA/SEC) [National Oceanic and Atmospheric Administration/Space Weather Prediction Center (present NOAA/SWPC)]. He has been engaged in the space weather forecast studies including extraordinary propagation of VHF radio wave by Sporadic E layer, solar activities causing disturbance of solar wind, and Geomagnetically Induced Current (GIC) observed in Japan.

Changes in space environment have impacts on our daily life in various forms and in the similar way as the meteorological weather. NICT has long since been carrying on the space weather forecasting and delivering information as "space weather forecast".

What is the Weather Forecast of the Space?

—— **First, could you outline the nature of "space weather forecast"?**

Watari: In our daily life, we usually check weather before leaving home, or watch TV for weather forecast to determine whether we should do washing or not. Please consider the space weather forecast as a spatial version of our familiar daily meteorological weather forecast. While the space is normally considered to be under perfect vacuum, there are, in reality, a very minute amount of electrically charged particles. The "space weather" is what we call space environment changes caused by those particles.

To be more specific, the space environment is significantly affected by the Sun just like we are on the ground. For example, when an explosive phenomenon called solar flare occurs on the solar surface, the influence is felt as far as possible in the space around the Earth. Immediately after the generation of solar flare, high-energy particles from the Sun cause spacecraft failures and radiation dose to astronauts. Two or three days after that, a cloud-like substance that is electrically charged is ejected from the Sun associated with the solar flare, which reaches the Earth and causes a geomagnetic storm. When the geomagnetic storm occurs, aurora may appear, the geomagnetic storm can impact the reliability of electric power grids (Figure 1).

Such space environment changes that may affect human beings and man-made systems are called as the "space weather" .Predicting the changes in space environment from the conditions of the Sun, solar wind, and so on, and delivering that information comprise the "space weather forecast" service.

—— **Please describe some specific examples of the impact of solar activities.**

Watari: In the period toward the end of October 2003 when solar activities became violent, which we call "Halloween event", the Japanese Data Relay Test Satellite (DRTS) called "KODAMA" suffered from the noise of its Earth sensor by high-energy particles from the Sun, resulting in the loss of its orientation toward the Earth (Figure 2). At that time, the restor-

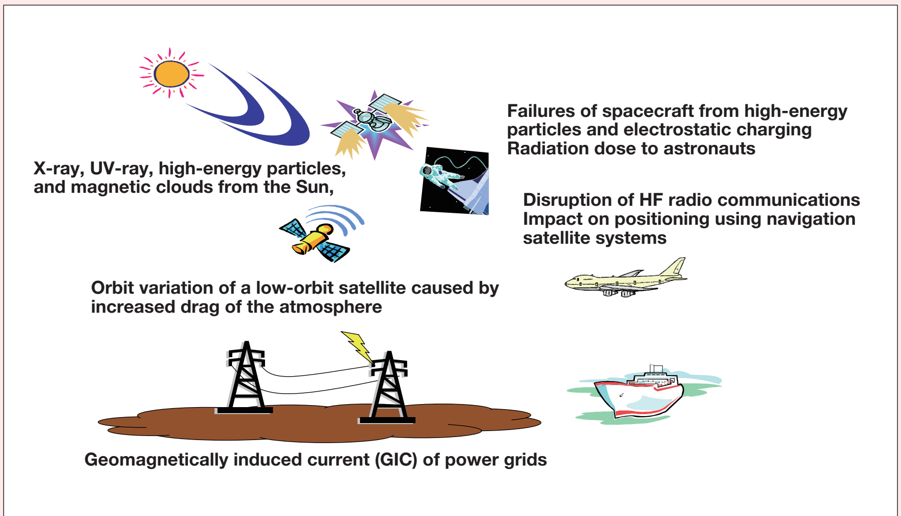


Figure 1 ●Impact of space storms on social systems
Changes in space environment due to solar activities impact our daily life.

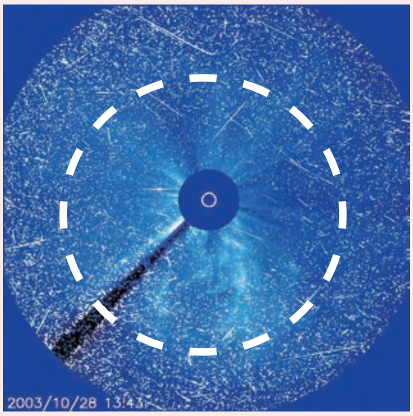


Figure 2 ●Coronal mass ejection (the area surrounded with a white dotted line) observed by the SOHO spacecraft (ESA/NASA) at the "Halloween event". The numerous white dots indicate the impacts of high-energy particles from the Sun.

ing operation of the satellite was conducted after the activities ceased. Also at the "Bastille Day event" in July 2000, the atmospheric density was increased by the extremely large geomagnetic storm, causing the affected Japanese X-ray astronomical satellite called "ASUKA" to lose its attitude control, and in the following year, it re-entered the Earth's atmosphere. Besides these satellite failures, electric power blackouts may result from these disturbances. Geomagnetic storms give rise to induced current on power grids, but even if the current itself is not so large, it is well known that it causes protection relays of the power grids to trip erroneously and operation points of transformers to shift their optimum ones to increase electric loss, resulting in failures. The power blackout that went on for nine hours in Canada in March 1989 was caused by a large geomagnetic storm. At the "Halloween event", a power blackout occurred in Malm, Sweden.

In the field of communications, HF radio communications with civil aircraft and fishing boats in ocean fishery, they are significantly affected by the space weather. Similarly, GPS and other navigation systems using satellites are affected. But I must say it may be hard for you to feel it by yourself because the space weather is not so tangible as the meteorological weather. The only exception is the aurora that can be observed with bare eyes on the ground.

—— How is the space weather forecast utilized?

Watari: Those people who operate communication satellites and broadcasting satellites as well as those who work on HF radio communications and broadcasting are making good use of it. In recent years, GPS and other navigation satellite systems have become popular and are used for aircraft operation, take-off, and landing as well as land surveying and unmanned agricultural machinery. In the previous sunspot maximum period, navigation satellite systems were not widely used for sophisticated applications, and thus we cannot exactly tell what sort of influences will arise in the next sunspot maximum period. That is why it is necessary to make effective use of space weather forecast information in the navigation satellite systems for precise positioning.

Space Weather Forecasting Exercised ever since the Times of Radio Research Laboratory (RRL)

—— Please brief the history of space weather forecast created by NICT.

Watari: When NICT was in its precursor stage of Radio Research Laboratories (RRL), Ministry of Posts and Telecommunications, the space weather forecast was practiced already in the International Geophysical Year (IGY) in 1957. It certainly was an old time. At that time, the HF radio wave band was widely used for domestic as well as overseas communications and broadcasting. It was indeed an important mission of RRL to forecast the changes in space environment that affect the HF radio wave propagation. However, situation has significantly changed now. Because of the expansion of communications by way of satellite communications and through optical fibers, the importance of HF radio communications is relatively reduced. Instead, utilization of the space has increased in such a way as staying onboard inside the International Space Station. We started space weather forecast to support such activities based on our expertise.

—— Since when the term "space weather forecast" has been in use?

Watari: As the study started in 1988 or so, it was about 20 years ago. The year 1988 was exactly when the RRL was renamed Communications Research Laboratory, and since then, we have been using the term space weather forecast. While researchers in other countries including the USA claim that they coined the term "space weather" first, we believe that the term originated here.

—— So, the international collaboration has been practiced since early stages.

Watari: Definitely. After the IGY, an international organization called "International URSIgram and World Days Service (IUWDS) started, and since then, we have been participating in its activities. Later in 1996, IUWDS changed its name to International Space Environment Service (ISES) (Figure 3).

More Precise Forecasting with Full Use of Observation Data

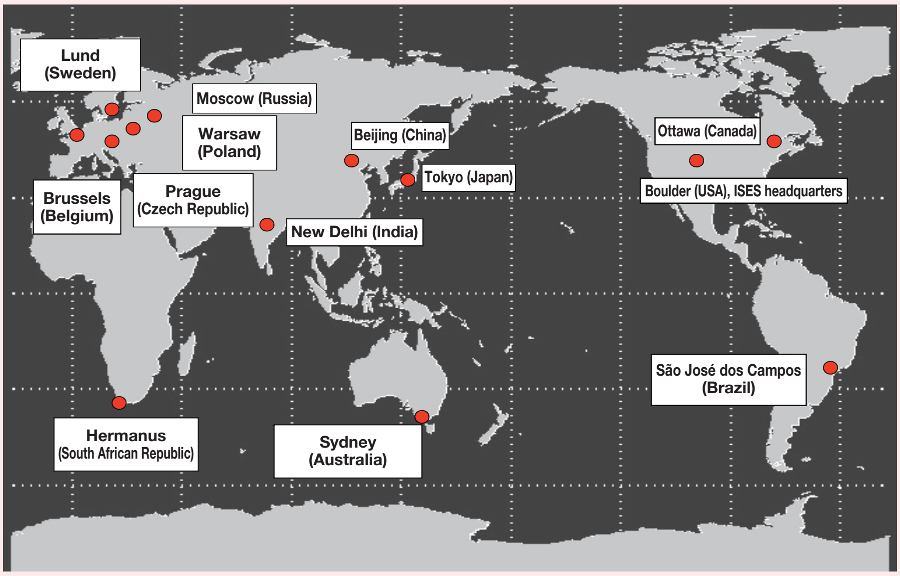


Figure 3 ●Prediction centers of the International Space Environment Service (ISES), in which 13 nations participate and carry on activities.

—— What sort of services do you do on a routine basis?

Watari: We are constantly monitoring the data on the Sun, solar wind, magnetosphere, as well as geomagnetic field and ionosphere. Every day at 14:30, we hold a forecast meeting to conduct forecasting the solar flare activities and geomagnetic storms as well as prediction of high-energy particles from the Sun (Figure 4). Our forecast is issued at 15:00 Japan Standard Time (JST). As far as other countries are concerned, the forecast is issued in Brussels (Belgium) at 20:30 JST, in Sydney (Australia) at 9:00 JST, and in Boulder (the USA) at 12:30 JST.

—— What kinds of data do you use for your forecast?

Watari: On the Sun, we use data on sunspots and solar corona sent from the Solar

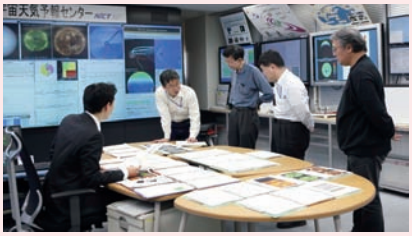


Figure 4 ●The Space Weather Prediction Center holds its Space Weather Pre diction Meeting everyday in the afternoon. (Upper)

The sound of the bell calls for the members to attend. (Right)

and Heliospheric Observatory (SOHO) that was launched by ESA/NASA in 1995. We also directly receive the solar wind data from the Advanced Composition Explorer (ACE) by using the 11-meter antenna at the NICT headquarters (Figure 5). SOHO and ACE are located at the Lagrange point (L1) where the gravity of the Sun and the Earth is balanced. From the Geostationary Operational Environmental Satellite (GOES) of the National Oceanic and Atmospheric Administration (NOAA), observation data of solar X-ray flux and high-energy particles from the Sun and the high-energy electrons at the geostationary orbit. Geomagnetic data is collected through observations at the Kakioka Magnetic Observatory of Japan Meteorological Agency in Ibaraki Prefecture and NICT's observations in Okinawa and Russia. Regarding ionosphere, we use the data from Hokkaido (Wakkanai), Tokyo (Kokubunji), Kagoshima (Yamagawa), and Okinawa (Ohgimi) where NICT has made routine observations. Additionally, we make use of the total electron content (TEC) of ionosphere calculated from the data obtained by the GPS Earth Observation Network System (GEONET) of the Geospatial Information Authority of Japan.

Figure 5 ●In the NICT headquarters, a parabolic antenna is installed to receive real-time solar wind data from the ACE spacecraft.

—— At a forecast meeting, what kind of subjects is discussed?

Watari: Primarily we try to be aware of the current status of the Sun. Specifically, we would assume if the sunspot groups are in their growing or declining stage, or if they are active or not. Based on such information, we attempt to predict whether the solar flare will take place. Furthermore, we discuss the possibility whether the Earth will be inflicted by the large-scale ejection phenomenon of corona gas called coronal mass ejection (CME). Moreover, since there is likelihood that geomagnetic field is disturbed by the influence of the coronal hole that is the outlet of high-speed solar wind; we should pay attention to the size and location of coronal holes. Also, we discuss whether or not the flux of high-energy particles from the Sun is on the increase.

—— In what way do you present your space weather forecast information?

Watari: We disclose information on the web site of NICT (http://swc.nict.go.jp) and by distributing e-mail messages (Figure 6). On every Friday, we dispatch weekly report, and whenever any event that may affect the Earth occurs, we send out a presto report. Additionally, with the aim of presenting information for the general public in a readily understandable way, we distribute animated version called "Weekly Space Weather News" through the NICT's channel of YouTube (http://www.youtube.com/user/NICTchannel).

Figure 6 ●The "Space Weather Information Center" web site provided by NICT.

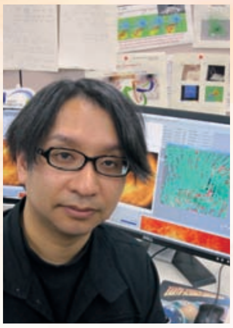
—— How far ahead can you predict on the future?

Watari: For forecasting, we make use of the time lag pertaining to a distance of 150 million kilometers between the Sun and the Earth. When an explosive phenomenon called solar flare takes place on the surface of the Sun, the light and electromagnetic waves associated with the flare reach the Earth in about 8 minutes. At this time point, we can get information on the event that occurred at the Sun. As the high-energy particles from the Sun take several tens of minutes to several hours, we can issue an alert in the meantime. Since the ACE spacecraft carries on in-situ solar wind measurement at the speed of solar wind in the upstream of approximately 1 hour from the Earth, we can make a fairly precise forecast in an hour or so by using that data. The effect of CMEs and coronal holes reaches the Earth in a period of 2 to 3 days. Accordingly, we can predict the events of 2 to 3 days later by using the solar observation data. Likewise, since the Sun is axially rotating in a period of approximately 27 days, the effect from the same region may reach after elapse of 27 days. That is, we can predict events that may occur in approximately 1 month to a certain extent. Further, since solar activities vary in a cycle of approximately 11 years on average, we can also make a long-term forecast of active or quiet periods of the solar cycle as well.

We, the Space Environment Group, are working with emphasis on the simulation projects by using the supercomputer in NICT. In the field of numerical modeling, NICT is well advanced as compared with other prediction centers in other countries. We also conduct studies on quantitative forecasting by using not only numerical models but also empirical models based on statistical data analysis.

By using real-time observation data, reporting on current status and its changes is important to be aware of space weather. It is called "nowcast". As the operational use of numerical prediction still needs some more time to achieve, we believe that we should improve our forecasting by first using empirical models and then switching to the forecast using numerical models with the improved precision of numerical prediction.

Assessment of Solar Storms Generated in the Solar Active Regions



Satoshi Inoue

Expert Researcher, Space Environment Group, Applied Electromagnetic Research Center

After graduating from a graduate school, he served as a doctoral research fellow at Nagoya University and Japan Agency for Marine-Earth Science and Technology. In August 2009, joined NICT, and has been engaged in the researches ranging from the analysis of magnetic field structure in the solar active region to the solar storm generation mechanism by using a large computer. Ph.D. in Natural Science

Background

In our geospace, spacecraft often encounters electromagnetic disturbances in the form of space storms such as magnetic storms, substorms, and ionospheric storms. Since they give rise to failures of artificial satellites and affect power grids on earth, so,they may adversely influence our daily life. The occurrence of these space storms is considered to be due to the "solar flare" (Figure 1a), which is an explosion phenomenon on the solar corona and "coronal mass ejection (CME)"(Figure 1b), which is ejection of coronal gas toward the interplanetary. These phenomena (hereafter collectively called "solar storms") are widely believed to be magnetic energy liberation in the solar corona, however, their trigger mechanisms are not yet clarified.One of the reasons is that the three-dimensional (3D) magnetic field structure in the solar active region is not clearly understood. The solar active region is composed of the black stains (sun spots) appearing on the solar surface, where the magnetic energy that enhances the magnetic activities causing solar storms is accumulated. The reason why the 3D magnetic field structure in the solar active region is not clarified is that the solar observation at the current stage can only provide the two-dimensional information on the magnetic field on the photosphere corresponding to the solar surface. Especially, since the solar storms are widely understood to be a phenomenon of energy liberation in the corona above the photosphere, it is required that "where the energy in the solar corona is accumulated". Accordingly, we have devised a method to extrapolate a 3D coronal magnetic field based on observational photospheric magnetic field data, and developed the numerical code.

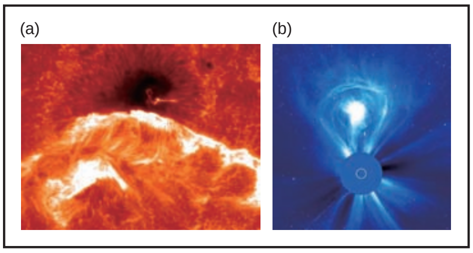


Figure 1●(a) The solar flare observed by the "HINODE". The choromosphere is observed by CaII line, and the illumination parts are called as “flare ribbon” (Presented by HINODE Science Project). (b) Corona mass ejection observed by the SOHO satellite. The white circle in the disk represents the sun, and the outer illuminating region indicates the coronal gas. (Source: http://sohowww.nascom.nasa.gov).

3D magnetic field in the solar active regions

By using the newly developed program, we calculated 3D magnetic field. Figure 2a indicates the normal component of the magnetic field on the photosphere. White and black colors represent the positive (upward from the paper) of the magnetic component and the negative (downward from the paper). In this study, we calculated the 3D magnetic field based on these photospheric data as a boundary condition. After 6 hours, this active region caused a X3.4 class flare accompanying enormous space storms. Figure 2b shows the magnetic field structure based on the only normal component of the magnetic field on the photosphere. The green lines indicate the magnetic field lines. This structure called "potential field" can easily be calculated only from normal component of magnet field on the photosphere, and its unique solution is mathematically proved. However, since

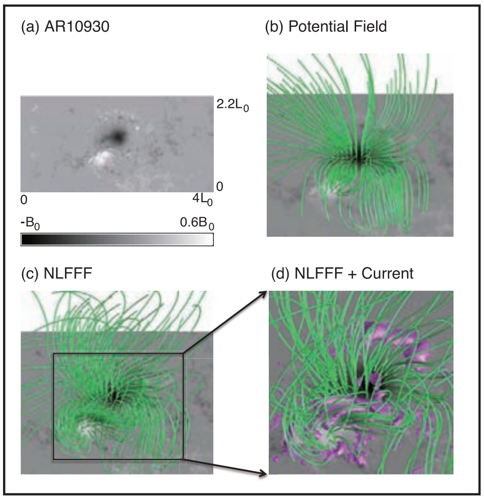


Figure 2●(a) The magnetic field data on the photosphere observed by the "HINODE".The normal component of the magnetic field is plotted at the locations of positive (facing upward from the paper) and negative (downward from the paper) sunspot. (b) Potential field extrapolated from only the normal component on the photosphere. The green lines represent the magnetic field lines. (c) The force-free field extrapolated from the three components of the magnetic field on the photosphere. (d) Magnified view of the rectangular region in Figure (c). The purple surfaces indicate the region in which a strong current is flowing.

this potential field corresponds to the minimum energy state, this is not enough energy level to cause a solar storm. Thus, the results of a 3D magnetic field structure extrapolated from boundary conditions, including not only the normal component of magnetic field relative to photosphere surface but also the tangential component, are obtained as shown in Figure 2c. We clearly find that these structures enclosed in a black square are much different. This magnetic structure is specifically called "force free field". Figure 2d is elongated view in Figure 2c. The purple surfaces indicate the region in which a strong current is flowing. In these strong current regions, free energy that can cause solar storms is accumulated. Thus, numerical 3D magnetic structure extrapolated from photospheric data as a boundary condition has clearly revealed the structure and location of a "strain" in the corona where energy is accumulated.

Comparison Between the Computed Magnetic Field Structure and Solar Observation Results

While the energy regions in the solar corona have successfully been reproduced, we have to check how the 3D structure is able to reproduce the other observations from satellite. These comparisons between 3D structure and observations are given in Figure 3. Figure 3a shows the X-ray luminance distribution in the active regions observed by the X-ray telescope of HINODE. The red and the blue lines represent the location of positive and negative poles of the sunspot, respectively. The green lines represent the magnetic field lines. It has long been widely believed that those regions with strong X-ray are composed of strong sheared magnetic field lines. This result has verified that the strong X-ray regions are composed of sheared magnetic field lines of different topology. Furthermore, Figure 3b shows the magnetic field lines plotted on the flare ribbons observed by HINODE with a solar optical telescope. Flare ribbon has been believed as the location corresponding to the footpoint of reconnected magnetic field lines during a flare. Although the flare ribbon forms asymmetric and complex configuration, the location of flare ribbon well corresponds to the footpoint of magnetic field lines. Therefore, our calculated 3D structure well reproduces the flare region.

Toward the Application of Space Weather Forecast (Solar Storm Occurrence Prediction)

In this study, the photospheric data given as the boundary condition were taken 6 hours before the occurrence of the flare. However, the location of the footpoint of calculated magnetic lines well corresponds to the flare ribbons. These results indicate that a magnetic structure with high enough level flares was formed already 6 hours in advance. Consequently, if we were able to obtain the vector-field map 6 hours before a flare onset, we may be able to reconstruct the “strain” as an energy-accumulating region in the solar corona. Hereafter, we have to investigate a time evolution of this “strain” quantitatively. Last year, a new solar physics satellite called "Solar Dynamics Observatory (SDO)" was launched. Despite its admittedly lower spatial resolution than that of "HINODE" satellite, it can observe the magnetic field in wider view and higher time resolution than the other (for the details, refer to http://sdo.gsfc.nasa.gov/). Thus, computing the 3D magnetic field from photospheric data obtained by the SDO satellite is expected to clarify when is the timing for development and collapse of "strain" and how it grows. To examine it more in detail, the dynamics of the magnetic field can be clarified by carrying out a magnetohydrodynamic (MHD) simulation with the use of the calculated magnetic structure as an initial condition. Figure 4 represents the results of dynamics simulated by the author and others in the past. This simulation could produce an eruption of the helical twisted magnetic field so-called as ‘flux tube’ due to be kink instability (the instability being caused when the twisted field lines reach a predetermined threshold value of twist). As a critical issue, the magnetic field structure treated in this study has a simple structure that is far from the actually observed magnetic field structure. However, as reported here, since we have successfully derived the complex magnetic field structure based on the photospheric data obtained by observation and this structure well corresponds to the other observations, this issue is approaching resolution. The remaining problems lie with the resources for analyses (analyzing and visualizing environment and disks) that arise when treating 3D data of the high space resolution or high time resolution. The Space Environment Group is building up the Science Cloud "OneSpaceNet" to solve these problems. OSN can provide an environment to facilitate analyses of the simulation data of high space resolution or high time resolution. The author expects that we can make the first step toward the solar storm forecast by combining the latest super-computer systems with the latest satellite data, and more extensively, by fully making use of the latest informatics technologies.

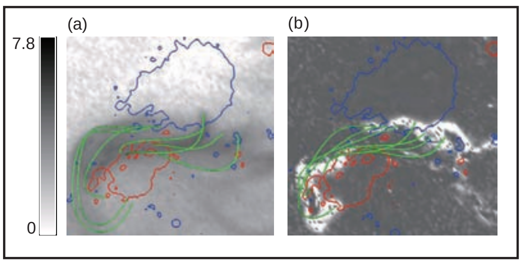


Figure 3●(a) Results of plotting magnetic field lines on the X-ray luminance distribution observed by the "HINODE". Red and blue contours represent the positive and negative sunspot locations, respectively. (b) Results of plotting magnetic field lines on the flare ribbons observed by HINODE with a solar optical telescope.

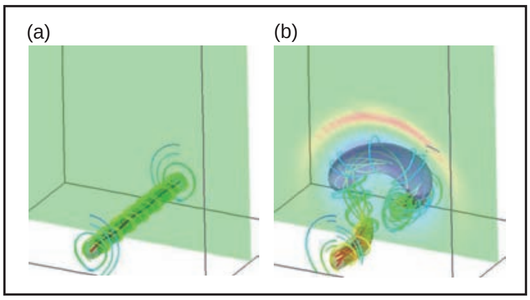
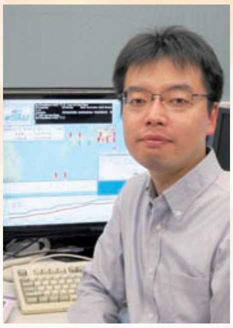


Figure 4●(a) A "flux tube" in the solar corona. The lines represent the magnetic field lines. (b) This figure reproduces an eruption of the "flux tube" as a result of becoming unstable against the kink mode. The regions with enhanced density are indicated in red, while those with decreasing density are shown in blue.

Configuring a Large Distributed Storage That Supports Space Weather Forecast Studies



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After completing a course at the Graduate School of Science Studies, Hokkaido University, he entered NICT in April 2009, and has been working on construction of the cloud computing environment for space weather studies. Ph.D. in Natural Science

Background

With the objectives of reducing and preventing the space disasters, the Space Environment Group of NICT Applied Electromagnetic Research Center is striving for realizing the space weather forecast with the use of a variety of observation data. To meet the end, we use a wide variety of approaches ranging from ground observation network for monitoring the earth's ionospheric disturbances and solar activities to numerical simulations with supercomputer. In these studies, data storage facilities play a vital role as the infrastructure of research activities. With the development of observation equipment and the enhancement of supercomputers' performance, the volume of processed data is on the increase day by day, and consequently, the storage facilities for those enormous data are assumed to be indispensable for further research activities. Thus, the Space Environment Group is working on the construction and experimental operation of large distributed file systems (DFS) intended for space weather forecast studies by utilizing the R&D test-bed network JGN2plus operated by NICT, and the distributed file system Gfarm*1.

Upsizing Storage by Using Commodities

Since the simulation studies on space weather forecast need to deal with various objects including the ionosphere, magnetosphere, as well as the sun that is the origin of solar winds and corona mass ejection (CME), the data volume increases with the progress of the studies. In the near future, even a storage unit with a capacity of 1peta (10^{15}) bytes will not suffice for the needs, and thus upsizing the storage capacity while suppressing its cost will be of critical importance. To minimize the cost per capacity, we have tested a number of combinations by making use of commodities. At present, we have successfully limited the cost per capacity of tera (10^{12}) bytes to about 10,000 Japanese yen as illustrated in Figure 1. By introducing the distributed file systems middleware Gfarm to these servers, we allow a plurality of storage units distributed on a network to function as a single virtual storage. Even if a disk trouble occurs on a server, the storage on the distributed file systems as a whole can remain operable by routinely storing a copy of a file on two or more servers. When increasing capacity, providing a new server and installing the middleware in it are all that is required. Since a conventional storage increase normally requires the entire system to be replaced, the new system substantially decreases the cost. We believe that the storage that satisfies the requirements for large capacity, stability, and extension feasibility has almost been realized by contriving a new system.

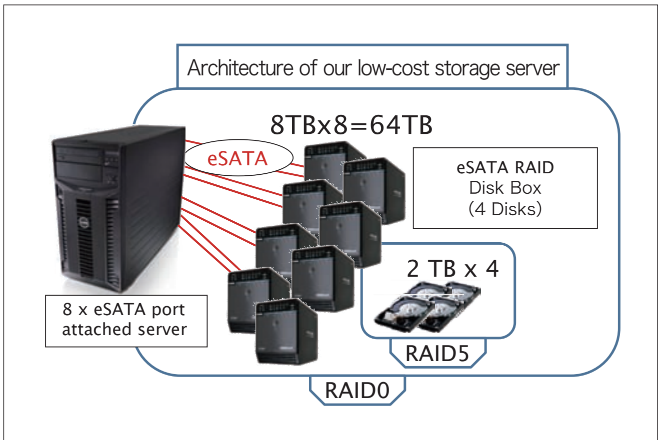


Figure 1●Architecture of Our Low-cost Storage Server

Collaborating with a Supercomputer

To avail the data computed on each supercomputer efficiently on the distributed file systems for research activities, the network having the rate of 1 to 10 Gbps is connected with each of supercomputers at three locations (NICT headquarters in Koganei, Cybermedia Center, Osaka University, and Information Technology Center, Nagoya University) by way of the JGN2plus (Figure 2). As a result, the data computed by the supercomputers located in three different places can now be transferred to each of the servers of the distributed file systems. For the convenience of researchers stationed in geographically remote areas from one another, we are providing a new arrangement to allow them to share these storage servers deployed in Tokyo (Koganei and Ohtemachi), Osaka, Nagoya, and Okinawa.

Presenting Storage Services that are Readily Usable by Researchers

To allow every researcher to avail this storage system and promptly start his or her research work, we are now creating such an environment that the user need not notice the middleware when accessing a file, or specifically from the viewpoint of the researcher, he or she can feel and use the system as if NFS*2 or

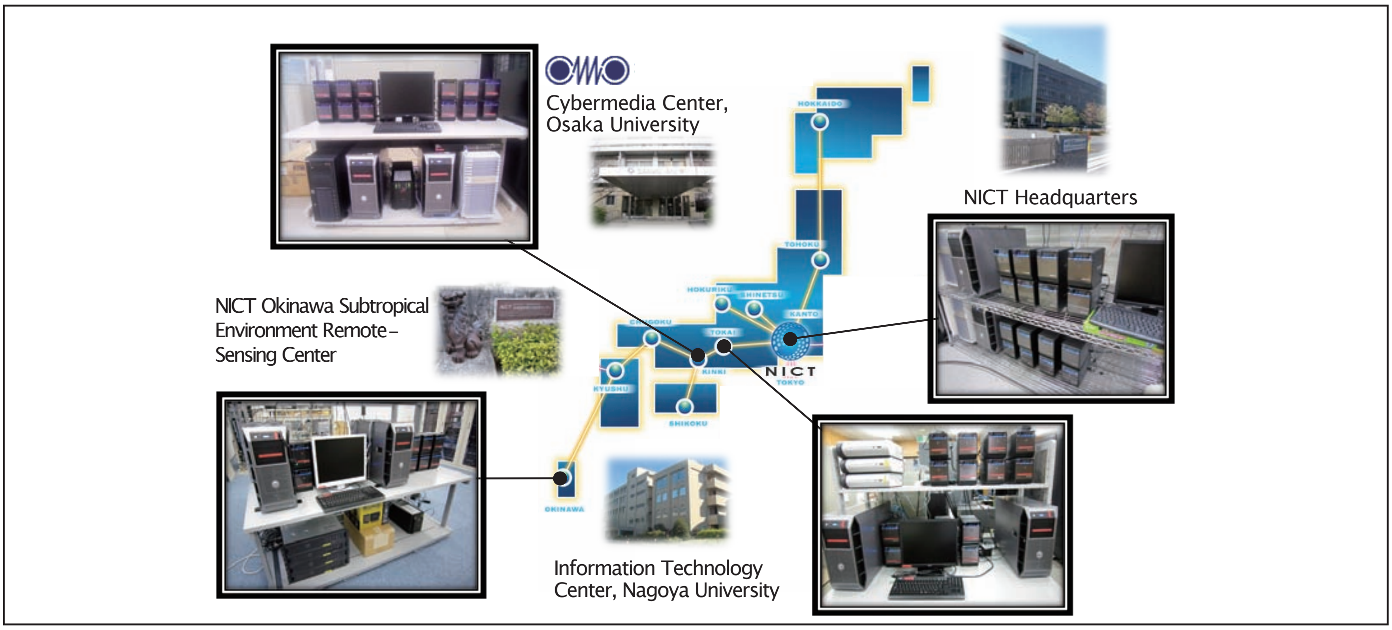


Figure 2●Nation-wide Distribution of Storage Servers

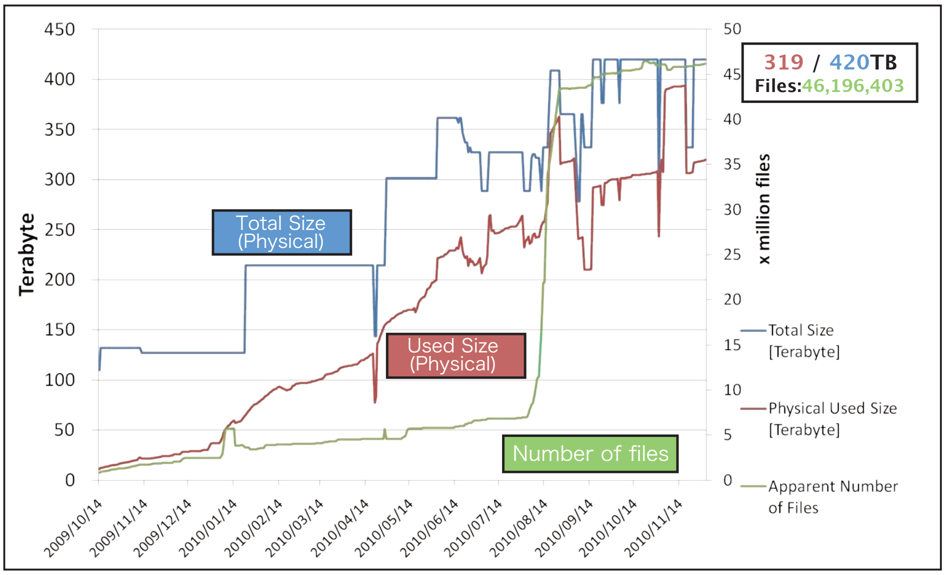


Figure 3●Changes in Total Capacity and Usage Size (Converted to Physical Capacity) and Number of Stored Files

CIFS*3 is mounted. This distributed file system has been used since October 2009. More than a dozen researchers are starting their studies on the storage network on the precondition that the system is on the experimental operation. Of the total capacity of approximately 420 terabytes, the space of about 340 terabytes (with a number of files reaching 40 million or thereabouts) is being used (Figure 3).

Future Perspective

The large distributed file system introduced here is a new system with the aim of performing a complete range of services required by researchers, including the storage and analysis of a wide diversity of data generated by supercomputers and creation of graphic images incorporated in their theses, while having a capacity of more than several hundred terabytes. Since this is an unprecedented attempt, we often encounter unforeseen troubles and failures; however, the researchers of and outside our group are extending supportive efforts, and thus we can carry on the improvements on a trial-and-error basis to realize the formal operation. Thus introduced storage system is offered as one of the integral services of the NICT Science Cloud "OneSpaceNet" which has been constructed by the Space Environment Group as the core team. Every interested reader is cordially invited to our web site, https://seg-web.nict.go.jp/scuser/.

Terminology

***1 Gfarm**

This is a distributed file system being developed by the National Institute of Advanced Industrial Science and Technology (AIST) and TATEBE Osamu, Ph.D., the University of Tsukuba on an open-source basis.

Development efforts are directed to the objective of building up a distributed file system that can be accessed at a high speed from any spot on a wide real network.

(http://datafarm.apgrid.org/)

***2 Network File System (NFS)**

This system has been developed by Sun Microsystems and consists of the distributed file system with its protocol normally used in UNIX-based operating systems.

***3 Common Internet File System (CIFS)**

This is a protocol that makes a protocol that has been extended so that the Server Message Block (SMB) for sharing files, which is used mainly on the Microsoft Windows, can be used on other operation systems as well.

Topics

NICT Has Been Nominated As the International Programme Office of the ICSU World Data System

– The Next Chairman Yuan Tseh Lee (1986 Nobel Chemistry Award Winner) and Other ICSU Delegates Visited NICT –

Mamoru Ishii, Director, Project Promotion Office, Applied Electromagnetic Research Center

On December 8(Wed.) and 9(Thu.), 2010, Prof. Yuan Tseh Lee and other four delegates from the International Council for Science (hereafter called ICSU) paid a visit to the NICT headquarters to observe the facilities and exchange views. The visit was organized in response to the nomination by ICSU of NICT as the International Programme Office for the ICSU World Data System (hereafter WDS-IPO) after the public offering. The ICSU is an international organization participated by a total of 121 nations including Japan, represented by the Science Council of Japan. Professor Lee is the President-elect of ICSU.

The nomination of NICT has been realized because of its performance of operating the World Data Center for Ionosphere, one of the precursor facilities of World Data Center, since 1957 as well as having the large-scale data processing and applying technologies based on ICT, and recommended by the Science Council of Japan. Thus, the aim of WDS-IPO is to act as the core organization to manage over 100 data centers distributed in the world.

During their visit, the delegates paid courtesy calls to Prof. Hideo Miyahara, the NICT President, the Science Council of Japan, the Ministry of Internal Affairs and Communications, and inspected the facilities of NICT headquarters. Then, they discussed in order to exchange the formal letter expressing cooperative efforts, and exchanged views with domestic officials of WDC. From now on, we will work on preparations for the launch of WDS-IPO in the first half of 2011.

Members of the ICSU delegation team (visitors):

Prof. Yuan Tseh LEE (Former President of the Academia Sinica, Taiwan)
ICSU President-Elect (received the 1986 Nobel Prize in Chemistry)

Prof. Deliang CHEN (Professor at the Gothenburg University, Sweden)
ICSU Secretary General

Prof. Bernard MINSTER (Professor at California Institute of Technology)
Chairman of the Scientific Committee, ICSU World Data System (WDS)

Dr. Michael DIEPENBROEK (WDC Director, University of Bremen)
Vice Chairman of the Committee mentioned above

Dr. Mustapha MOKRANE (ICSU staff member)
ICSU Scientific Information Technology Office

Figure 1●Courtesy call to the NICT President
From extreme left, clockwise: Prof. Lee, Dr. Mokrane, Prof. Chen, Prof. Minster, Dr. Diepenbroek, Prof. Emeritus Akira Watanabe, Ibaraki University, Hiroshi Kumagaya (NICT Vice President, Member of the Board of Directors), Hideo Miyahara (NICT President), Prof. Emeritus Norihisa Doi, Keio University, and Yoshiaki Takeuchi (Director Space Communications Policy Division, Global ICT Strategy Bureau (GISB), Ministry of Internal Affairs and Communications)

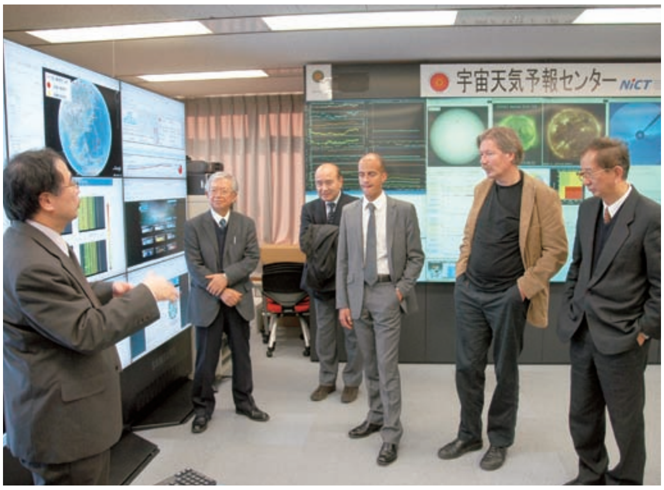


Figure 2●Scene of facilities inspection by the delegation team at the Space Weather Prediction Center
From right: Prof. Lee, Dr. Diepenbroek, Dr. Mokrane, Prof. Emeritus, Shuichi Iwata, the University of Tokyo, Prof. Emeritus Akira Watanabe, Ibaraki University, and Takeshi Murata (Group Leader NICT Space Environment Group)

Prize Winners

Prize Winner ● Shin-ichiro Matsuo Senior Researcher, Security Fundamentals Group, Information Security Research Center

◎DATE : September 15, 2010

◎NAME OF THE PRIZE :

Certificate of Appreciation

◎DETAILS OF THE PRIZE :

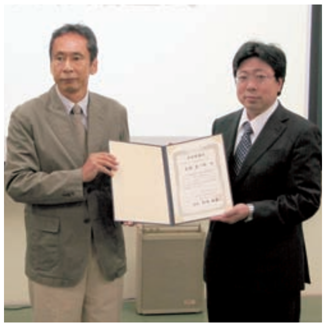
Contribution as a secretariat of Special Section on Cryptography and Information Security

◎NAME OF THE AWARDING ORGANIZATION :

IEICE Engineering Science Society

◎Comments by the Winner :

The "Special Section on Cryptography and Information Security" of IEICE Engineering Science Society is one of the most reputed pieces of English journals in Japan. I have renewed my recognition of the importance of publicizing papers in order to contribute for academic society through working experiences as a secretariat on editing for 2 years. I am immensely proud of receiving the Certificate of Appreciation. I decide to make use of my past experiences in our further research work and external activities for the academic society.



Left: Toshiyasu Matsushima, chairman, Shin-ichiro Matsuo

Prize Winner ● Yoshihisa Takayama Senior Researcher, Space Communication Group, New Generation Wireless Communications Research Center

◎DATE : September 15, 2010

◎NAME OF THE PRIZE :

Distinguished Contributions Award

◎DETAILS OF THE PRIZE :

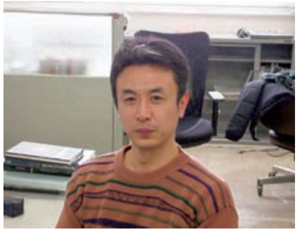
Contribution related to steering IEICE Satellite Telecomunications Technical Committee

◎NAME OF THE AWARDING ORGANIZATION :

IEICE Communications Society

◎Comments by the Winner :

As a secretariat of the Satellite Communications Committee of the IEICE Communications Society, I have organized study meetings and planned lecture meetings. I am grateful for having the valuable opportunity of participating in the activities of academic society.



Prize Winner ● Yasushi Naruse Researcher, Strategic Planning Office, Strategic Planning Department

◎DATE : September 24, 2010

◎NAME OF THE PRIZE :

Young Investigator Award

◎DETAILS OF THE PRIZE :

A novel method for estimating instantaneous phase and amplitude of alpha rhythm based on Bayes' theorem
(Authors: Yasushi Naruse, Ken Takiyama, Masato Okada, and Tsutomu Murata)

◎NAME OF THE AWARDING ORGANIZATION :

The Society of Instrument and Control Engineers

◎Comments by the Winner :

High-precision extraction of brain information is of vital importance in promoting studies on brain information communications. The award given this time is attributable to the evaluation of high-precision extraction of brain information relative to α rhythm that is based on the statistical approach developed by us. I believe that we should further develop this approach and thus contribute to the furtherance of the studies on brain information communications.

Prize Winner ● Shigeyuki Kan Expert Researcher, Kobe Advanced ICT Research Center

◎DATE : October 14, 2010

◎NAME OF THE PRIZE :

IFCN Fellowship

◎DETAILS OF THE PRIZE :

Award for the excellent paper entitled " The reticular activating system is associated with spontaneous fluctuations of alpha rhythm: a simultaneous EEG/fMRI study" (Author: S. Kan, T. Koike, T. Uehara, S. Tobimatsu, and S. Miyauchi) in ICCN 2010

◎NAME OF THE AWARDING ORGANIZATION :

International Federation of Clinical Neurophysiology

◎Comments by the Winner :

We have been honored with the IFCN Fellowship for our paper on the relationship between brain stem activities and spontaneous fluctuations of α rhythm. We have been engaged in the development of the simultaneous EEG/fMRI recording system and the studies on spontaneous brain activity in humans. Encouraged by this award, we will further investigate the neural basis and functional significance of the spontaneous brain activities by using the most advanced recording system that we developed.

Report on the WINDS Workshop “WINDS and Future Satellite Communications”

Maki Akioka, Senior Researcher, Project Promotion Office, New Generation Wireless Communications Research Center

Satellite communications are exhibiting remarkable performance in remote islands, island areas, and developing countries. With the wide variety of test results of the Wideband Inter-Networking engineering test and Demonstration Satellite "KIZUNA(WINDS)" jointly developed with the Japan Aerospace Exploration Agency (JAXA) and launched in February 2008, the applications and advanced technical research efforts were discussed at the workshop held at the NICT headquarters in Koganei City on Thursday, 2 December. Over 120 participants were from enterprises, government agencies, and universities and 15 lectures were given. Mr. Takahiro Sumitomo, Senior Officer for Satellite Development Program, Space Communications Policy Division, Global ICT Strategy Bureau (GISB), Ministry of Internal Affairs and Communications, gave a keynote speech on spatial communications policy in general and the sequence of WINDS development by NICT. Then three sessions and plenary discussion meeting were held.

Session 1: Under the title “Current Status and Issues in the Wideband Inter-Networking engineering test and Demonstration Satellite “KIZUNA (WINDS)” ,the development results of the 1.2-Gbps high-speed burst modem that has successfully been tested recently, as well as the basic experiments conducted by NICT/JAXA and the results of applications demonstrated by researchers in Japan and abroad, were presented.

Session 2: On the subject “Far-reaching Studies on Spatial Communications” , lectures were given on the development by NICT of adaptive satellite communications technologies by using WINDS as well as the results of studies including the optical satellite communications and on mobile satellite communications through the Engineering Test Satellite VIII "KIKU No. 8"(ETS-VIII), and Satellite-Terrestrial Integrated mobile Communication Systems. In the current demand for safety and reliability on remote islands and the ocean, the importance of the leading-edge studies was pointed out by the participants.

Session 3: In the “Expectations for the Future Studies on Satellite Communication” , Mr. Akinori Matsui, Rescue Section Chief of the Tokyo Fire Department, gave a report on the importance of broadband satellite communications on the disaster site by referring to his actual services and emphasized the vital role of collaboration from now on.

At the final plenary session, voices were raised by those from universities, satellite systems manufacturers, and satellite communications operating bodies on the approaches to be employed as well as applications so that the people in the field would take up next projects with a perspective that they could make substantial efforts to lead the global industry. Although the scheduled time was considerably exceeded, about 60 persons joined the exchange party after the session to continue live discussion and information exchanges until late in the evening.

Please visit our web site http://spacecom-e.nict.go.jp/winds/index.html for further details.

Guest speech by Director Takashi Mori of the Space Communications Policy Division, Global ICT Strategy Bureau (GISB), Ministry of Internal Affairs and Communications

A scene of the lecture meeting

Information for Readers

The next issue will feature the invincible “quantum encryptions” that are well underway for commercialization.

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