

# AIST

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**FEATURE**

## **GEO Grid**

**Innovation in Global Earth Observation**

## **Research Hotline**

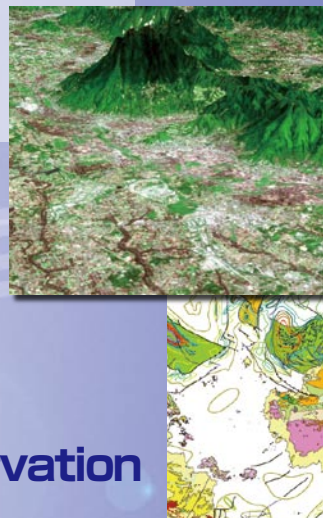
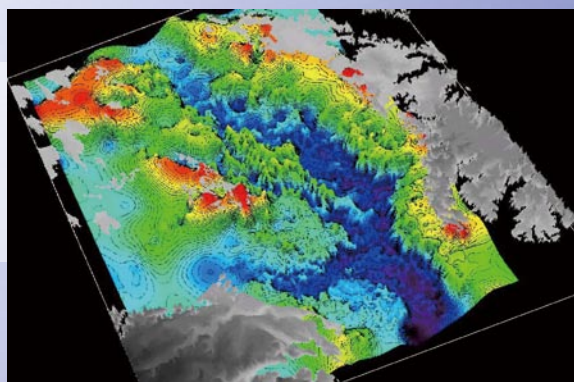
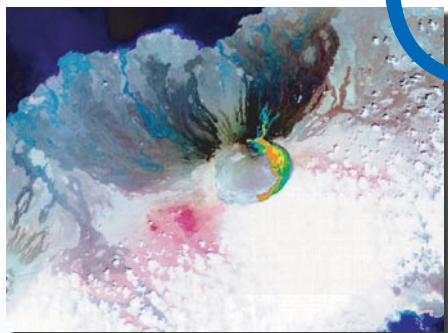
UPDATE FROM THE CUTTING EDGE (July-September 2007)

## **In Brief**

<http://www.geogrid.org/>

# GEOGrid

Innovation in Global Earth Observation



## Significance of in-depth understanding of earth observation

### Dream of integrating global earth observation information

The various global problems that our society faces today must be solved on the basis of common knowledge of the people, by providing information of the earth where we live. Construction of GEO (Global Earth Observation) Grid system is indispensable as it promises high reliability and continuity for solving problems related to precise predictions for preservation of global environment, efficient use of energy resources, reduction of natural disasters, etc. It minimizes future risk and helps in building a society which is safe and secure. It would not be an exaggeration to say that people around the whole world are demanding a system that might become a common base for all. However, there is not an integrated system as yet which can be used freely to handle an enormous quantity of information under the present conditions.

We handle large quantities and various types of information existing as complex entangled data under different administrative bodies. It is not a simple task to construct a system keeping in

mind that it must be user-friendly. But we seek to cross this "Valley of Death" and aim to realize a society that assures our future vision of a sustainable society and pursue our dream of "integrating global earth observation information". For that purpose, we are promoting GEO Grid as an important tool. Through the development of GEO Grid, a large-scale earth observation information archive is set up which can retrieve from satellite observation data to ground as well as underground information and we are aiming at the development of technology for providing safe and high speed data through an integrated service of various observation databases and GIS (Geographic Information System) data at the AIST. We are involved in merging the diverse research fields including geology / energy / environment technology / information technology.

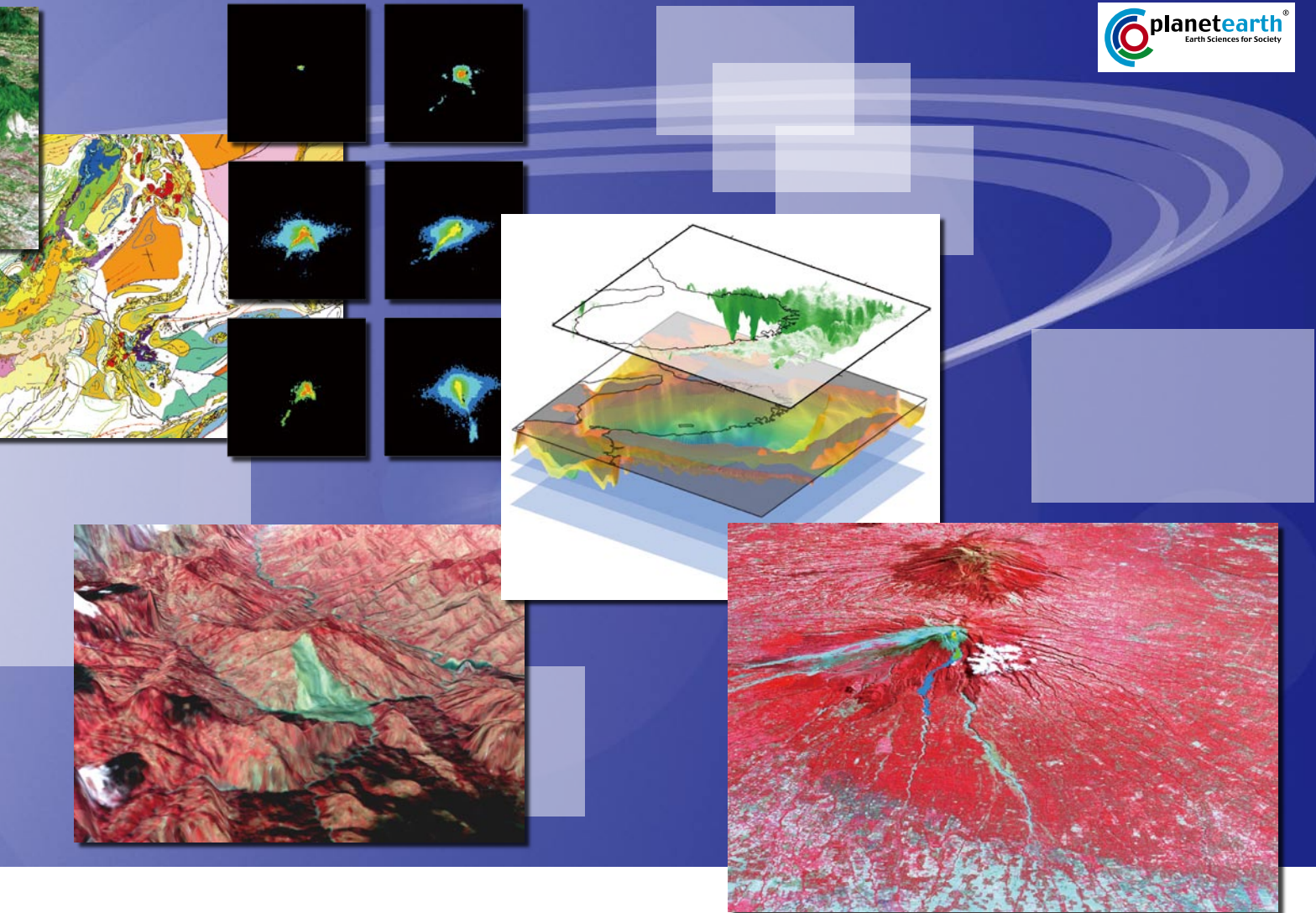
### Anticipating Earth Observation Unification System

In the 3rd Earth Observation Summit held in Brussels in February, 2005, the ten years enforcement plan that was applied in the construction of

GEOSS(Global Earth Observation System of Systems) was decided. It will be promoted by cooperation of various countries in the world including Japan. "A promotion strategy for earth observation" was decided in the general Council for Science and Technology Policy in Japan in the end of 2004 and is promoted under the cooperation of the Cabinet Office, ministries and organizations (secretariat: the Ministry of Education, Culture, Sports, Science and Technology). GEO Grid is perceived as a medium of cooperation between the concerned domestic and international organizations and strong initiative of AIST is anticipated.

### Steady progress of GEO Grid advancing system

To promote GEO Grid, AIST set up "Executive Committee" to decide the enforcement policy within AIST and "Steering Committee" to supervise the details of enforcement. AIST also set up "Cooperation Committee" for coordination with other organizations. In addition, subcommittees at the researcher level according to their



topics were established aiming at active research exchange.

It is spreading its user network globally, focusing around Asia based on cooperation of the Coordinating Committee for Geoscience Programmes in East and Southeast Asia (CCOP) that contributed for many years in the field of geology. To promote activities, we have commissioned an in-charge for long term stay in the Bangkok secretariat from April, 2007.

#### **Towards the realization of "Geospatial information for higher practical use in society"**

The contents and services which we offer are considered to be greatly useful for improvement of daily life of the people. As the characteristic of contents, it offers information related to underground geological features, resources, etc. and information about the use / maintenance / preservation of the land. It aims to contribute in providing not only two-dimensional data of the outer layer but also three and four-dimensional information introducing time axis, and offer important information

for helping decision makers to judge the infrastructure for mitigation of natural disaster, environmental preservation, usage of underground structure, etc.

#### **Expected development of geotechnology**

This pamphlet introduces the complete picture of GEO Grid at present. Contents are limited to information mainly focusing on system summary, inquiry system for resources utilizing satellite information and geological features. It also mentions the applicable examples for reduction of volcano disaster and its conditions of spreading in Asia. We are convinced that its use will spread further through cooperation with various organizations from now on. According to the U.S. Department of Labor, information technology of the earth (Geotechnology) will be one of the three major fields alongside nanotechnology and biotechnology that will develop and create new employment and industry. In Japan, it is ranked as one of the main fields of information technology to be promoted toward "Science and technology creation nation". There is

high expectation from it as a new field of information contents service.

United Nations declared 2008 as international year and activities for "international planet earth year" (<http://www.gsj.jp/iype/>) will be carried out for 3 years from 2007 to 2009. For sustainable future of the earth and the human, this activity is going to contribute to society by providing knowledge and technology of earth sciences. GEO Grid will become the precise system to contribute for this purpose greatly. By all means we would like to establish a clear milestone during this period

Research Coordinator (Geological Survey and Applied Geoscience).

**Eikichi Tsukuda**



## Connecting the earth to know it better

### Contribution of IT in solving global-scale problems

Social problems concerning the earth such as the global warming must be solved in a global scale. Therefore, accumulation of knowledge about the earth in various forms and precise understanding of the earth are necessary. Geological maps based on minute geological research and enormous earth observation data of remote sensing from satellites are archived in AIST. In addition, data federated on earth observation network on a daily minute to minute basis is accessible through the Internet from all over the world. However, aren't we getting flooded with such enormous data? On the other hand, isn't it true that there is a shortage of necessary data when it is needed? GEO Grid on earth observation offers various data in an IT environment for safe and secure use by enterprises and research communities.

### Points to be pursued in the IT environment of earth observation

The following technical requirements must be fulfilled to realize such an IT environment.

**Providing large-scale data:** Remote sensing data from a satellite need a capacity of more than 200 terabytes during its operative period (in case of sensor ASTER built-in satellite TERRA). Quantity of data surpasses 10 times the capacity of ASTER in PALSAR of satellite ALOS.

**Handling of various data:** Data about earth observation are diverse. The modeling of the carbon cycle needs various input parameters, such as land-use map, climate data and vegetation indices. Research communities wish to integrate some of these data according to their interests. In addition to this data diversity, metadata and derivatives associated with the original data should be taken into account. These data sets have been accumulated in different spatial and time resolution, with individual data schema. Hence the IT infrastructure must support the creation of user groups which represent various types of virtual research/business communities, and the federation of distributed and heterogeneous

data resources which is shared in such communities.

**Respect of the data owner's publication policy:** In our example, some of the input data sets, such as ASTER imagery, in-situ data from PEN and AsiaFlux, and ECMWF climate data, cannot be freely accessible. Due to restrictions concerning the protection of national security, intellectual property, privacy, confidentiality, and relevant ethical issues, the data owner is generally willing to permit only a range of data access, certain choices of data format. They wish to require the users to accept certain limits on the transfer of the rights, etc., and wish to reserve the authority to set and modify licensing rights and conditions. Therefore, the IT infrastructure must provide a security infrastructure which supports flexible publication policies for both data and computing services providers.

**Unification with large-scale simulation:** Stored data itself is not of much value. An environment must be provided for simple and easy calculations such as a change of form or predisposal of data, calculation of pyroclastic flow coverage based on data, calculation of quantity of carbon dioxide input and output, and artificial earthquake large-scale simulation. Modeling of the city basement geological feature structure would also be possible.

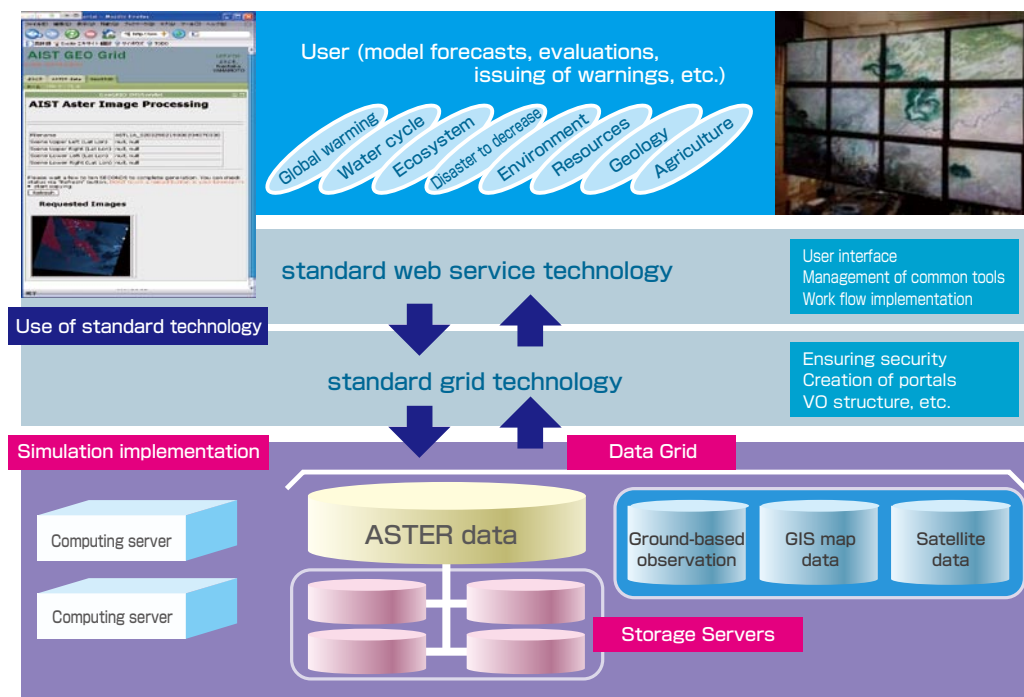
**Various forms of community support:** Flexible structural change is anticipated beginning with disaster monitor and resource inquiry in earth observation and in various communities and also on projects related to earth science. Mutual use of processing flow tools and templates within the same group is important.

### Why does Grid Technology draw attention?

Grid Technology Research Center of AIST started in 2002 and has been pursuing research concerning the construction of next-generation IT environment to support business and technology. Grid technology is a highly network oriented technology that surmounts obstacles of an organization silo, distance, handling of a variety of data, etc.

It is believed that the basic functions of grid technology could be extremely helpful in the construction of IT environment to aid earth observation. Realization of a user-driven IT environment can be easily provided by the observation data of earth that was dispersed corresponding to user demand (community), or by carrying out simulation by adequately assembling computers together.

Let's see a design of GEO Grid in detail (figure). At first we will use a data grid for managing large-scale data. By connecting PC servers with a lot of cheap built-in disk drives in a network, we can virtually store data as a large-scale storage tool. Next we use data grid for handling various other data. Providing unified searches and results would be possible by arranging data according to their types. Basically even in this case the side offering data does not have to change. A schema (a format and an access method) of data called "meta data" is determined by the data owner, but its dispersion to the next place needs to be managed by the user. In addition, it distinguishes a user by complying with the strict and secure mechanism by grid security infrastructure. To be able to grasp who is really accessing it, grid performs the distinctive authorization for abiding by the policy of data provision. Of course one does not need to login individually by single sign-on function. Grid is providing the best at making ensembles of data and simulation. Particular functions are to secure calculation server by large-scale simulation and transfer data to the server directly. There is a concept of Virtual Organization (VO) in grid. Technically it is about the "multiple management domains communicated through a network (for example, an organization offering a user account) based on computing resources in a grouped virtual management domain". Privacy is secured between different VOs that would help in promotion of research and business by making a VO for every community. When GEO Grid is used every day in the future, by administering GOC (Grid Operation Center), we can take requests for VO operation of management from community and offer indispensable support services effectively. We establish a



Complete structure of GEO Grid

web site and portal site within this VO and promote sharing of information.

Promotion of GEO Grid was mentioned in WEB2.0 of CGM (Consumer Generated Media) for application in the field of earth science. If anyone can send imminent data, for example, with implementation of land level carbon input and output model, we can hope that the information of dynamic carbon (GPP, NPP) of the developing Asian countries participating in the Kyoto Protocol can be mutually shared by the administration and citizen.

#### Participation in GEO Grid and plan

We receive questions like "What are the requirements to participate in GEO Grid?" Introduction of the necessary software packages differs depending on the form of participation of data provider, a VO manager (a leader of project or community), and a general user. As long as general users do not perform any specialized task, they use only a normal web browser, but need to decide the VO they belong to and have to ask the administrator for making an account. Other than this anyone might have a limited accessibility to the data participating in the

GEO Grid. We offer participation based on the provision of application and computing resources, but it is considered to have lesser specialty in GEO Grid.

At present, online usage of ASTER data is of top priority and complete tape archive of the past has been uploaded since March, 2007, and we make global level DEM (Digital Elevation Model), a highly advanced product generated on-demand, by March, 2008. Again from an advantage of having the details of the design data of ASTER, we plan to offer global mosaic DEM with 15m resolving power after performing enough precision inspection in the future. At the same time we offer a prototype equipped with a necessary function by software packaging of GEO Grid.

#### Spreading E- science of earth science in the world

Quantity of data which a person can read, look and feel alone during a lifetime has a natural limit. By selecting the truly necessary parts from exploding information of earth observation data, there must be opportunities for everyone to establish innovations. Cutting edge IT is indispensable

for its realization. The new infrastructure technology such as that of GEO Grid is called the 4th mode of science : E-science.

The computational science that was the 3rd mode of science covers the theory that was impossible to experiment even with supercomputers. E-science in addition to this is a new scientific mode for sharing of dispersion data along with carrying out high quality data processing.

GEO Grid as E-science in earth sciences is building a system for possible use by fusion of earth observation information and data handling programs. By promoting fusion of information related to geosciences and the satellite, AIST has plans of fusion with larger communities of earth observation information. In addition, by promoting international cooperation positively, higher use in Asia in particular is of main concern. Considering the general trend of internationalization in this case, we aim at securing mutual use of the information system and data at an international level.

Director,  
Grid Technology Research Center  
**Satoshi Sekiguchi**

## Observing the present to secure the future of the earth

### From "presumption" to "possibility"

This is the slogan for careful driving in Japan. However, we are unable to ignore the impact of human activities towards the earth at present, and this slogan may be considered the correct preventive method towards the global environment problem. But more precisely the car called the earth which is steered by nature, is being driven by humans who do not have a driver's license.

Global warming is the topic of the day, but, on the other hand, doubt is posed on the scientific grounds, too. The reason behind this is uncertainty in prediction by a model and earth observation as well. However, there is a fact to be considered even in its uncertainty, in addition to sensing the danger of our future with some accuracy.

### To understand and reduce uncertainty

Presently, we are handling earth observatory satellite data in the GEO Grid. Concerning the aforementioned global warming research, we are advancing research and development of carbon dioxide flux calculations from satellite data, and some scientific results have been achieved already. At first glance these results might seem to be a fact, however, they have uncertainty. In order to grasp the precise results, it is essential to know the extent of uncertainty of these results. In addition, it also means that we need to make efforts

to decrease the uncertainty.

For that, calibration and validation of the satellite-derived data and its algorithm/model by ground observation data have become necessary (figure below).

As for the calibration and validation of GEO Grid, geometric calibration using Lidar and DCP (Degree Confluence Project) data and radiometric calibration, such as vicarious and cross calibrations, are firstly carried out for the standardized satellite data. Next, we verify various surface data derived from the standardized satellite data (reflectance ratio, the amount of insolation, vegetation index, land coating, leaf area index, photosynthetically active radiation absorbance, etc.) by DCP and PEN (Phenological Eyes Network) of earth's surface observation. Furthermore, these satellite-derived surface data and the climatic data are input into the ecosystem model, and the net primary production of the vegetation is calculated. The result is verified by comparing with AsiaFlux (ground observation network of carbon dioxide flux, etc.) and improvement of the precision is assured. Furthermore, in order to do these activities smoothly, web portal with the quick look function for observation data (<http://kushi.geogrid.org>) is also under development.

But, most of these data and its algorithm/model are placed under different managing organizations, and

have different format and handling.

Furthermore, in order to deduce precise results, the integration and fusion of various kinds of observation data is going on, and the necessity of processing/analysis system which integrates and fuses the observation data, algorithm and model which disperses in the world is anticipated.

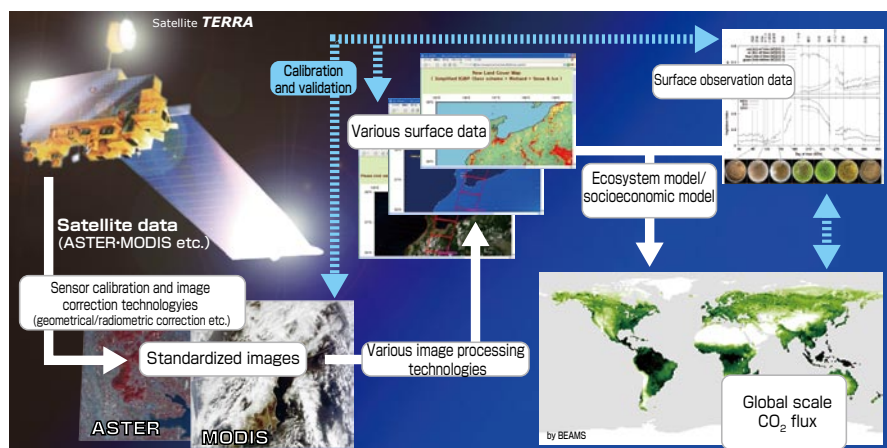
As for GEO Grid, the various types of earth observation data, operated by different organizations, can be applied to the VO (Virtual Organization) introduced in the last page, and it exceeds the obstacle of geographical/owner/access method, and makes the process and analyzing of the earth observation data possible. By this, we aim to decrease the uncertainty of earth observation by understanding its uncertainty.

### A second's notice would prevent a lifelong disability

Perhaps in case of prolonged "careful driving with possibility" the continuous development of the mankind is difficult. But, by knowing the uncertainty in earth observation and decreasing that, correctly grasping the information of these earth observations, believing those which can protect the future of the earth, we would like to advance the research and development and spread of GEO Grid.

"A second's notice would prevent a lifelong disability", which is the slogan for careful driving in Japan, by always observing the earth carefully, overcoming the problems of the earth with the intelligence of the mankind, and without causing major accident of the earth due to reckless driving, we desire to build a rich society.

Grid Technology Research Center  
**Satoshi Tsuchida**



Calibration and validation of carbon dioxide flux calculation



# Internet promotes usage of geological information

## From papers to Internet

Geological information, which has been accumulated as basic information on resources/ environment/ prevention of disasters since 100 years or more, could be obtained only from the published papers just about twenty years ago.

In the 1980s computer processing of geological maps started, and in the 90s, the geological maps were released on CD-ROMs. And these days, it is designed in such a way that geological information can be retrieved directly from the Internet database. Presently, AIST has released 22 databases on the comprehensive features of geological information (<http://www.gsj.jp/Gtop/geodb/geodb.html>).

The style of database was changed by the advancement of geographical information display technology on the Internet such as WebGIS. In the past, display was carried out by changing the range of graphics data prepared beforehand. Now, the user can select the area and display items freely and furthermore display system of color, transparency, etc., can be indicated finely. In AIST, geological map database (GeoMapDB), which was introduced as WebGIS database in our journal (February, 2007), and the geological information index retrieval system (G-INDEX), which aims toward the thorough retrieval system of the geological information including the geological map (see figure), are released.

## Dispersive Database

As for the geological and geographical information database which utilizes WebGIS technology, beginning with "the national land information web mapping system" of the Ministry of Land, Infrastructure and Transport, "the landslide map database" of the National Research Institute for Earth Science and Disaster Prevention, such database became released even by the local governments and the private companies. Now one can view various information related to geological features on the Internet and further requests for



Top page of the Geological Information Index retrieval system  
[http://www.aist.go.jp/RIODB/GINDEX/GSJ\\_E1](http://www.aist.go.jp/RIODB/GINDEX/GSJ_E1)

simultaneous viewing by superposing those data have been received.

In order to enable the user to simultaneously display information of the WebGIS database on the Internet freely, standard regulations have been decided recently. Several WebGIS databases have begun to support this service and superposing information has become possible to peruse. AIST is advancing its preparation in order to display in the aforementioned two systems, superposing the information of other databases. In addition, if the satellite graphics data transmission with GEO Grid is included, environment utilizing features of geological information combined with other databases can be spread further.

## Integration of geological information

As people say "Looking underground is more difficult than looking at outer space," there is a limit in elucidating underground structure from a single type of information. Integrating and utilizing various information such as geological

map, boring data, geophysical data and satellite information is necessary. The database maintained by each agency is connected by a network, a system has been constructed where mutual utilization and releasing of the data is possible, and research in order to promote the application of the data is being pursued. Also utilization of the open-source software is one of the major features. In addition, research for constructing 3 dimensional geological model by integrating a lot of geological information is also going on. By GEO Grid, we can fuse geological information and grid technology and the 3 dimensional geological structure model will be released on the Internet in the near future.

Institute of Geology and  
Geoinformation.  
**Yasuaki Murata**  
Geoinformation Center  
**Shinji Takarada**

## Utilizing the experiences of natural disasters to reduce damages in the future

As one of the applications using GEO Grid, for the purpose of reducing volcanic disaster, we made a pyroclastic flow computer simulation which used the high accuracy data of the earth observatory satellite ASTER sensor (15 m precision) above sea-level. In this way GEO Grid is also tackling the simulation technology development for such reduction of natural disasters.

### 1991 - 1995 Unzen pyroclastic flow

Pyroclastic flow occurred 9500 times or more in 5 years, from 1991 - 1995 in the Unzen volcano of Nagasaki Prefecture. There were 43 victims in the pyroclastic flow of June 3rd, 1991. Pyroclastic flow of the Unzen volcano is considered one of the most dangerous as the unstable part of the growing lava dome collapsed and flowed down at high temperature (above the 600 °C) and high speed (above 100 km/h).

### Next-generation hazard map

For reducing the damages caused

by volcanic disasters, "map (paper)" was drawn in the form of disaster maps (hazard maps) for volcanic prevention, from the past activities of the principal active volcanoes in the entire country. In the future, this information of "the geographical information system (GIS)" will be used in superposing function of various data and drawing "real time hazard map" corresponding to the circumstances of the local area is demanded.

### Pyroclastic flow simulation

With the pyroclastic flow simulation of GEO Grid, it is possible to do simulation by the energy cone model on the Web browser (Fig. 1). This simulation fixes the point of column collapse height (Hc) with equivalent coefficient of friction of the pyroclastic flow (H/L) by inputting the two parameters, appraising the range of the energetic arrival of pyroclastic flow is possible. Presently, simulation can be executed with nine volcanoes: the Merapi volcano (Indonesia), the Fuji volcano, the Unzen volcano, the Kirishima volcano,

the Sakurajima volcano, the Yotei volcano, the Usu volcano, the Tarumae volcano and the Bandai volcano (Fig. 2). By adding the observation information of earth observatory satellite such as 3 dimensional elevation model, even in midst of eruption, it can always use the up-to-date topographical data according to the circumstances of volcanic activities. It is possible to execute high speed processing with grid technology. Processing of data in a brief time of 10 seconds - 3 minutes is also possible. Application of this simulation is not just restricted to the pyroclastic flow, but also to various volcanic and geological disasters such as avalanche and landslides. Opening to general public is planned from 2007.

It is aiming towards enabling the use of this simulation with any volcano in the world by researchers and prevention disaster in-charges anytime and anywhere in the world.

Executing numerical simulation by granular flow model of lava flow is planned in the future. By this granular flow model of lava flow, quick correspondence in case of volcanic eruption becomes possible and it is expected to be useful as a deciding material for evacuation of inhabitants.

Geoinformation Center  
Shinji Takarada

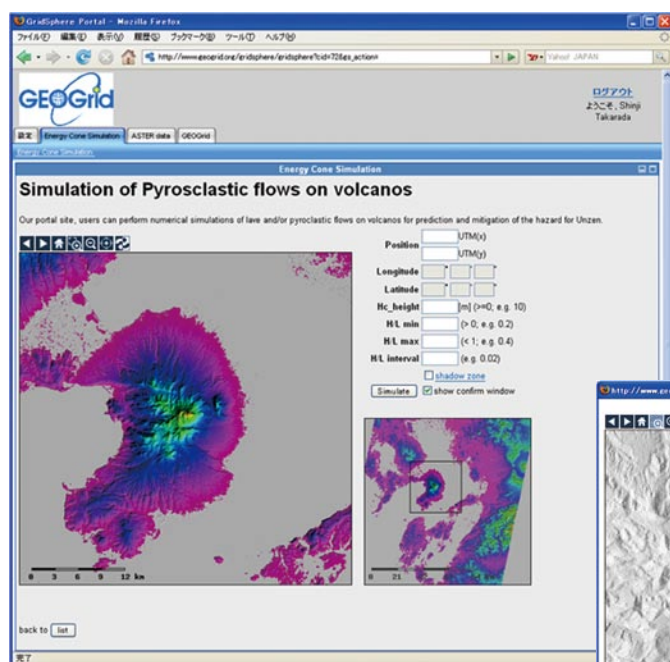


Fig. 1 The initial screen of the pyroclastic flow simulation by the GEO Grid system (Nagasaki Unzen volcanic area)

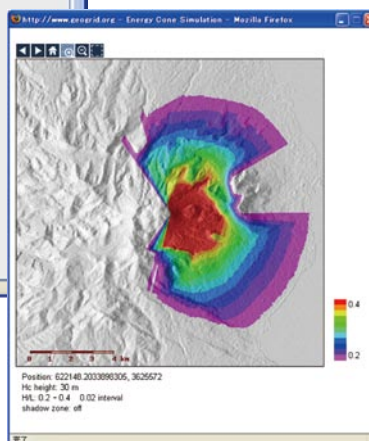


Fig. 2 Example of Unzen pyroclastic flow simulation result (Red area indicates expected danger zone for 10,000 m<sup>3</sup> scale pyroclastic flows. Purple area for 1,000,000 m<sup>3</sup> scale pyroclastic flows)



# Connecting smooth resource supply to the future

## Underground resources supporting citizen's life

If we look around us, it can be easily understood that our lives depend on the mercy of underground resources. Especially, petroleum is an irreplaceable raw material for fuel and petrochemicals. Because of that, it is one of the important national policies to maintain stability of the supply of petroleum resource, until alternative source of energy and substance to substitute will be developed. It is said that there is a proportional relationship between the petroleum consumption and the income per person. Compared to the worldwide mean value of petroleum consumption, our country is on the higher side. Petroleum, which is non-renewable resource, is unevenly distributed only in specific areas. Actually the consumption of petroleum has increased, but the discovery of the new oilfields is not progressive. Effort on discovery of petroleum is continuing worldwide, but it has become difficult to continue with the discovery of new oilfields so as to compensate the increase in consumption.

At least in this decade, so called giant oilfields have not been discovered. The securing of petroleum resource is becoming difficult at the any stages of exploration, exploitation and production.

## Satellite data which contributes to smooth resource supply

When we think about the present condition in which we are dependent on more than 70% of energy from the fossil fuel (petroleum, coal, natural gas and others), it is necessary to continue with the discovery of the resources for a while. Suppose the enormous oilfields, which have produced approximately 90% of the gross petroleum production, has already been discovered, thus prospecting and developing the middle /small-scale oilfields are major target in the future, so it is necessary to prospect many such places. In development of an oilfield, a series of long-time process of reconnaissance geological survey, securing a mine-field, precise geological

survey and geophysical exploration, trial drilling, development drilling and production is necessary. Preparatory geological survey is extremely important, at the same time should be done in a short period.

For efficient preparatory investigation, satellite images are often utilized as one of the tools to support prospecting. As for utilization of satellite images to investigate prospects of petroleum resource, it has been utilized in decipherment of geological structures and lithologic units with the satellite images since the early 1970s. Compared to that time, high-quality satellite data can be available now. Spatial resolution, stereoscopic viewing function and spectral resolution of optical sensors have rapidly improved. The Synthetic Aperture Radar can observe earth's surface during day and night, even over cloud-covered areas.

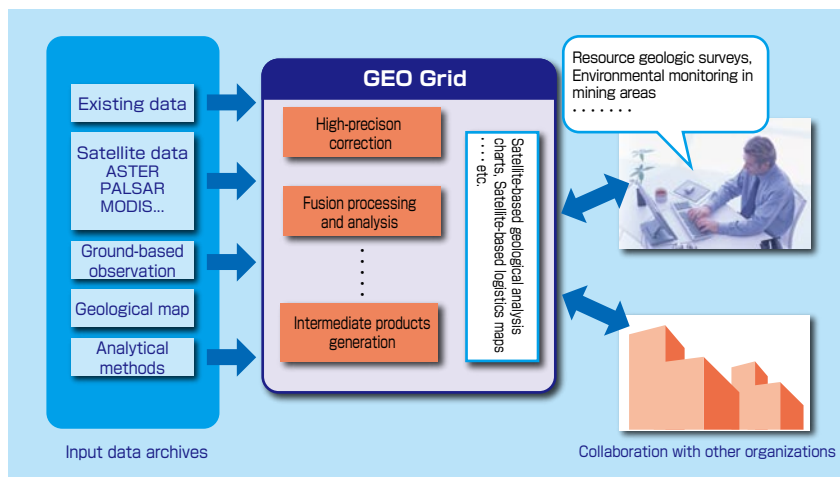
In addition, information mining technology from the satellite data is progressing steadily. There is no doubt in using satellite data for logistics purpose instead of the topographic map, but state-of-art analytical technology in order to obtain more detailed geological features is in strong demand.

## Fusion technology is indispensable

Recently, information integration is greatly required for prospecting and exploration of resources. Thus

information mining and fusion from large amount of data are focused today. In AIST, we aim towards the development of a novel multidisciplinary platform called GEO Grid. With GEO Grid based on grid technology, we aim to provide the data archives (such as ASTER and PALSAR) and their search tool, along with highly accurate image correction system, including the geological information such as geological map, also with the ground observation data. Thus, we can possibly provide the highly-reliable information, which will be contributing to preparatory geological survey, exploration, etc. (figure above).

The GEO Grid has productive functions for various information. The most important aspect of it will be a flexible testbed system, which allows try-and-error approach to accomplish a variety of product production. For this purpose, cooperative framework and interoperability with various data archives and similar distributed systems are extremely required. AIST, while cooperating with intra and inter-systems closely, promotes a future innovative framework based on GEO Grid, then will contribute in the field of securing underground resources for our lives.



Overview of GEO Grid-based resource exploration subsystem

Institute of Geology and  
Geoinformation  
**Isao Sato**

## Dispatching global geological information “from Asia to the world”

### Present conditions of Asian geological information service

So far Geological Survey of Japan (GSJ) of AIST has been cooperating with various Asian countries to construct different earth science information maps and databases. As main ones, it can provide 1/2000000 east & southeast Asian geological map, tectonic map, sedimentary basin map and 1/5000000 East & Southeast Asian heat flow map, 1/4000000 east Asian magnetic anomaly map, 1/7700000 East Asian geological hazard map and the East & Southeast Asian city geological information database etc. GSJ directed most of them, and it is the results of the projects of the Coordinating Committee for Geoscience Programmes in East and Southeast Asia (CCOP) through which it cooperates with the geological surveys of various Asian countries.

### Standardization and integration of Asian geological information

But, there are various problems related to these results depending on the fact that the time when it was made differs from each result. The data is paper based, and

assuming that it was digitalized, there are various forms of reduced scale precision and data format etc. Thus, as the standard topographical data differs, there is a big problem in order to use it as an integrated data. Integrating and re-constructing it as a database and updating the old geological information is necessary. Standard topography and the data format, reduced scale (precision), the database for standardized projection and geodetic survey system etc. should be constructed, and it is our urgent task to offer data possible to use with GEO Grid.

### Servicing the up-to-date geological map of Asia

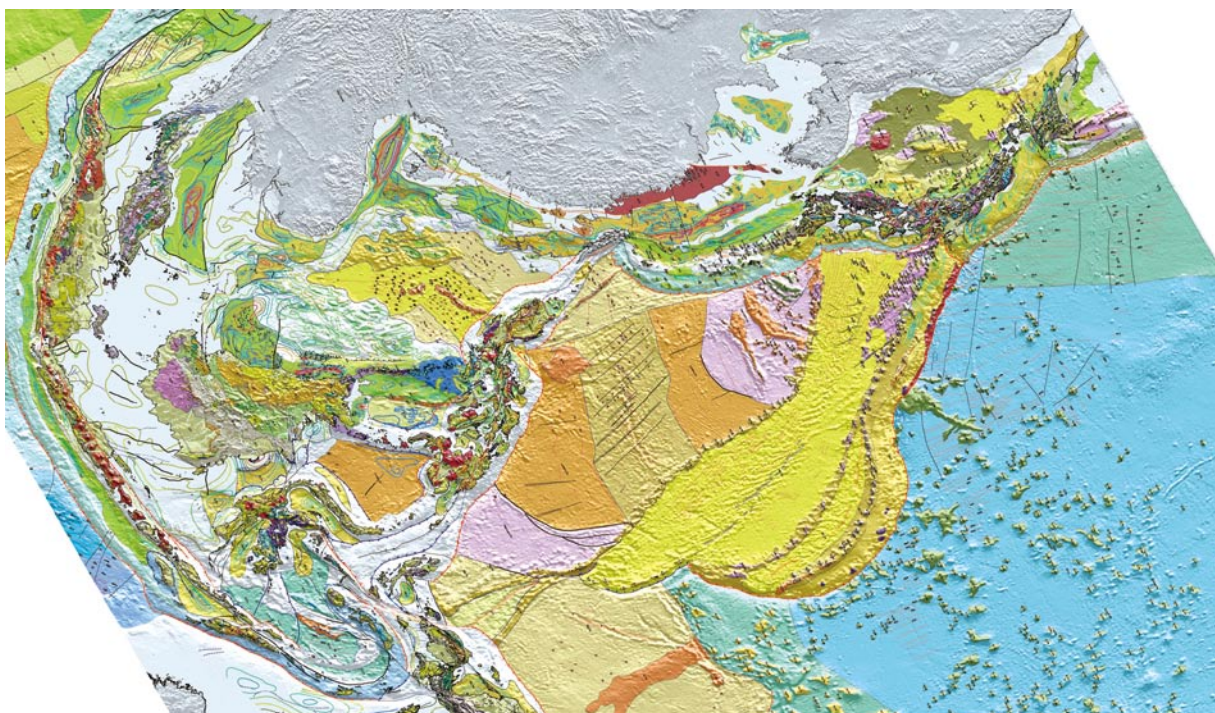
As a start-off we have begun the renewal of the geological map from 2005. Geological information is integrated with the satellite data and other geological information and geological map is the standard in order to utilize them. The latest edition of the geological map in regard to the drawing of the Asian region was carried out in “The international digital geological map of Asia (IGMA5000: 1:5M International Geological Map of Asia) project”. With

this project, 1.5M Asia-wide geological map was drawn up under the committee of geological surveys of countries from the whole Asia from west Asia such as Iran to Japan. It was facilitated with a digital geological map database which confirms to worldwide standard of 1/2.5M.

GSJ is in-charge of 1/5 of the entire area (the islands section and the sea area) of the East Asian region, and drew the digital geological map accordingly. As it prepared the common guide of Asian region in order to carry out a leading role, it was requested to compile a standardized guide of the ocean area.

GSJ, along with this geological survey map as the base, integrates and maintains various geological information of Asia (especially East & Southeast Asia). Actualizing and dispatching information of high interoperability with GEO Grid is also being planned.

Institute of Geology and  
Geoinformation  
**Koji Wakita**





# GEO Grid Promotion on International Stage

## Strategy of the GEO Grid Promotion

In this pamphlet, GEO Grid is introduced as a tool to utilise various kinds of information on the earth like satellite images. In this chapter are indicated measures and framework construction for the overseas promotion.

What strategy is needed to make GEO Grid to be recognised and harnessed widely abroad? Let us refer to a part of the management policy established by the AIST, prime mover of this programme. It reads “AIST will work toward a sustainable society by taking a leadership role in industrial technology innovations in Japan.” In addition, AIST decided to encourage international deployment, especially by relating entities in Asia (AIST Management Policy and Research Strategy 2006). It is on this basis that we have initiated our actions in Asia.

## Science and Technology Diplomacy through CCOP

When something should be appealed on international stage, the task becomes easier if it has impact such as implication to international policy or construction of mechanism which is useful to every country. And in order to realize intended easiness the issue should be brought to a level as high as possible. Fortunately GEO Grid finds a strong advocate. It

is a Bangkok-stationed international organisation CCOP (Coordinating Committee for Geoscience Programmes in East and Southeast Asia).

Japan is a Member Country of CCOP. The Ministry of Foreign Affairs serves as permanent representative and AIST as deputy permanent representative of the nation. It is of paramount importance that CCOP is placed as an institution for science and technology diplomacy. It is reminded that all of the international cooperation cannot be regarded diplomatic but cooperation with CCOP is approved to be of the diplomacy. According to this position, our research products can be brought to higher levels if channels through CCOP are used appropriately. It is envisaged that cooperation with CCOP can be a nucleus to disseminate GEO Grid in Asia.

## Appeal to Asia

The idea to promote GEO Grid in Asia was already proposed and approved by the CCOP Steering Committee meeting. During the meeting, it was explained as follows.

– As GEO Grid manufactures virtual infrastructure and does not need expensive facilities such as super-computer, every Asian nation can participate in the programme in spite of

the economical gap.

– GEO Grid contributes to bridge digital divide which is a serious issue in Asia.

– It is considered that GEO Grid development is a common challenge among nations to solve issues in Asia, while specific application resides within each nation's responsibility.

– GEO Grid ranges from resources, environment, hazard mitigation to geo-information. Thus it can be used to thrust sustainable development and human security in Asia (human security is a diplomatic pillar of Japan).

## paroway Forward of GEO Grid in Asia

Welcome responses to the presentation were observed at the CCOP Steering Committee meeting, which means the idea of GEO Grid was supported by the Member Countries. And the Member Countries present in the hall agreed to cooperate with this initiative. At the Steering Committee meeting they also approved a plan to send a liaison officer from AIST to the CCOP Technical Secretariat. GEO Grid promotion in Asia will be for the time being conducted by the officer who consults with AIST staff responsible for the initiative.

Specific plans were already proposed by Thailand and Vietnam. GEO Grid is expected to achieve good promotion and to show rapid dissemination in the Asian region.



A Japanese delegate who makes a presentation on GEO Grid at the 48th CCOP Steering Committee meeting in November 2006. Rules and procedure of the meeting are in accordance with the UN system and the items agreed in the hall become international engagement.

Geoinformation Center  
**Satoshi Murao**



# UPDATE FROM THE CUTTING EDGE

**Jul.-Sep. 2007**

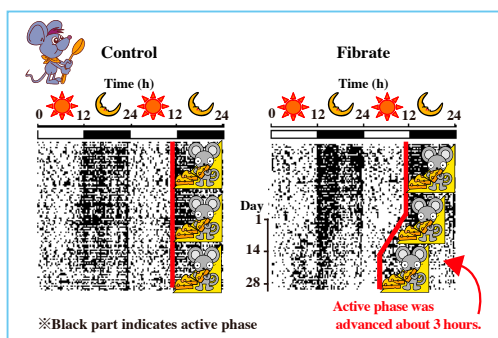
The abstracts of the recent research information appearing in Vol.7 No.7-9 of "AIST TODAY" are introduced here, classified by research area.

For inquiry about the full article, please contact the author via e-mail.

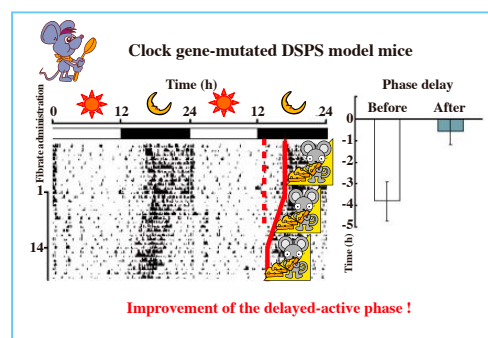
Life Science & Technology

## Hypolipidemic drugs regulate the circadian clock

We found that fibrate, a hypolipidemic drug, has a strong potential to treat sleep disorders. Delayed sleep phase syndrome (DSPS) is a circadian rhythm sleep disorder characterized by extreme evening preference. We discovered that fibrate administration affects the circadian clock and normalizes the phase of circadian behavior of DSPS model mice. Nuclear receptor PPAR $\alpha$  could be a potent target of drugs to treat circadian rhythm sleep disorders including DSPS, because the fibrate is a specific ligand of PPAR $\alpha$ .



Fibrate administration advances the phase of circadian activity rhythm.



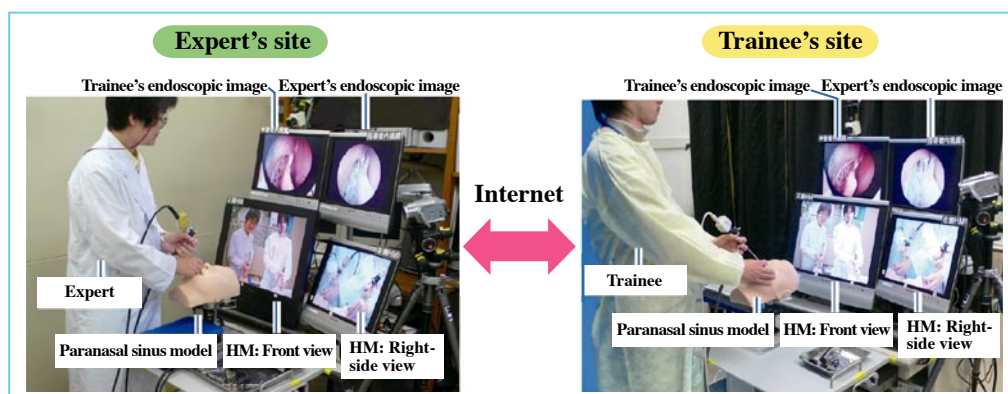
Phase-advancing effect of fibrate in mouse models of delayed sleep phase syndrome (DSPS)

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AIST TODAY Vol.7, No.7  
p.12 (2007)

## An endoscopic surgical skill training system using HyperMirror

We have developed a surgical skill training system for endoscopic paranasal sinus surgery which supports remote training and self-teaching. The key technologies of this system are HyperMirror (HM) and precise models of the human paranasal sinuses. HM is a virtual mirror wherein one's own reflection and a remote partner's reflection are displayed as if they are standing side by side. During training in surgery, the instant feedback from HM enables the trainee to clearly see the differences between his own movements and those of the remote expert.



Remote training system of manual skills in endoscopic paranasal sinus surgery

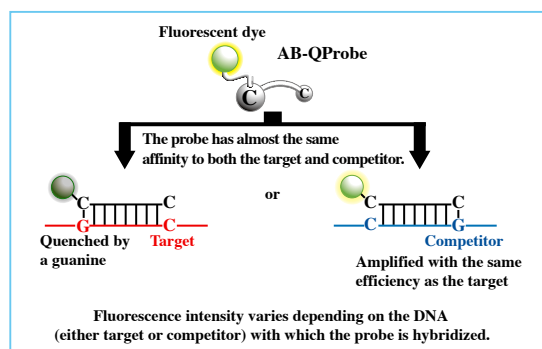
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AIST TODAY Vol.7, No.8  
p.18 (2007)

## A new method for a quantitative analysis of DNA

A novel technique for a simple, rapid, and reliable quantitative analysis of specific DNA sequences was developed. The technique uses an alternately binding quenching probe that binds to either the gene of interest (target) or an internal standard (competitor), in combination with loop-mediated isothermal amplification (LAMP). The difference in quenching abilities of target and competitor DNAs leads to quantitative analysis and the technique was named alternately binding quenching probe competitive LAMP (ABC-LAMP). We quantified *amoA* gene, as a model target, by ABC-LAMP and real-time PCR. The accuracy of ABC-LAMP was similar to that of real-time PCR. ABC-LAMP also enables the accurate measurement of the gene in the presence of DNA amplification inhibitors such as humic acid and urea which lower the values measured by real-time PCR.



Schematic presentation of ABC-LAMP

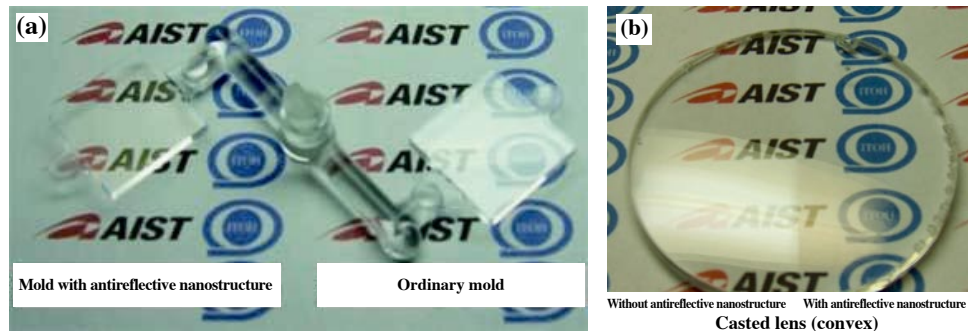
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AIST TODAY Vol.7, No.9  
p.14 (2007)

## Mass production technology of antireflective lens

We have fabricated a novel antireflective technology that utilizes a nanostructured surface. A unique aspect of this approach is the possibility of fabrication of optical lens incorporating this antireflective technology using injection molding. Thus, low-cost, large area, and mass production of components has become possible. An antireflective nanostructure was prepared using metallic nanoparticles with an average particle diameter of 50 nm and a spacing of 100 nm as masks for etching. By using this technique, a complicated surface structure can be easily made with strong antireflective characteristics by all-dry process. This process is expected to be applicable to a wide range of mass-produced optical elements such as digital camera lens, car control panels and flat panel displays.



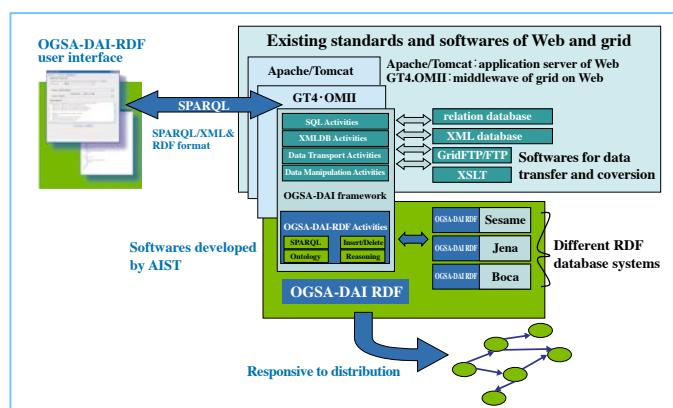
Injection-molded products  
(a) injection molded with flat die (b) injection molded with lens die

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AIST TODAY Vol.7, No.7  
p.13 (2007)

## R&D of RDF databases in Grid environment

As the semantic web application grows, the amount of semantic data with the RDF(Resource Description Framework) format is rapidly increasing worldwide. A scalable and robust access mechanism for distributed RDF data is necessary. To solve the problem, we developed a middleware called OGSA-DAI-RDF, which is based on the grid standard architecture OGSA(Open Grid Services Architecture). By using OGSA-DAI-RDF, users can easily federate distributed RDF databases using the SPARQL standard language. This R&D activity is tightly linked with the OGF(Open Grid Forum) working group activity to set the access specification of RDF databases.



The Architecture of OGSA-DAI-RDF

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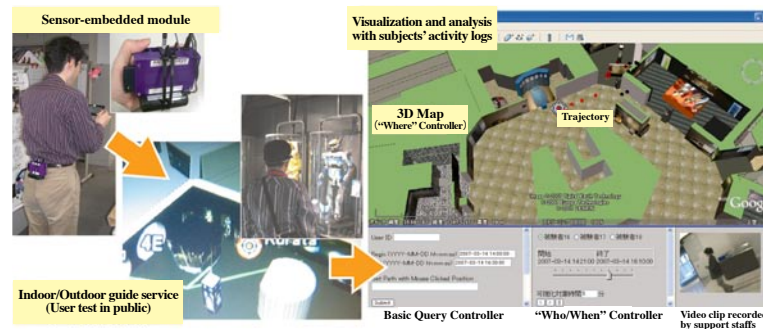
AIST TODAY Vol.7, No.8  
p.19 (2007)



## A 3-D pedestrian guide system usable indoors and outdoors

We have developed a 3-D pedestrian guide system using a dead-reckoning method based on walking locomotion measured by wearable self-contained sensors in combination with the error compensation method with GPS, RFID, and map information. This system is promising for making a ubiquitous information society more sustainable since it can provide indoor and outdoor location-based information services not only seamlessly, but pervasively without excessive dependence on infrastructure-side sensors. A pilot user study of the system was conducted at the Science Museum (five floors, 2500 to 2700 m<sup>2</sup>/floor) in cooperation with twenty-two subjects. This was an unprecedented indoor 3-D guide experiment in terms of the scale. In addition, we have developed an augmented-reality log browser capable of retrieving and visualizing the trajectory, voice, and video

of each subject in a cross-sectional way using queries such as time, place, subject ID, etc.

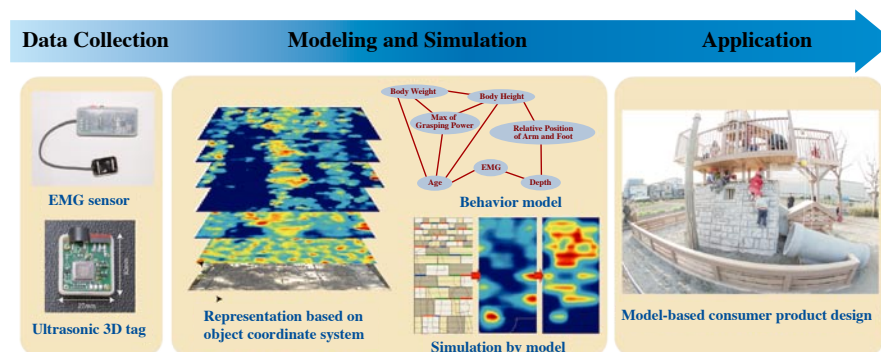


Left: Sensor-embedded module for measuring the user's position and orientation, Middle: Case example at the Science Museum, Right: Augmented-reality log browser.

## Design of safe and enjoyable playground equipments for children

Serious injuries at playgrounds where children play and exercise occur frequently in Japan due to playground equipments. This leads to the removal of a large number of inappropriate playground equipments from parks. The removal of playground equipments has three kinds of implications: less chances for children to play which can be an invaluable experience, a decline in the manufacturing technology of the equipments, and a resulting economic loss.

To solve these problems, a new design methodology for safe and enjoyable playground equipment is necessary. The Playground Equipment Project was set up for studying this certain design methodology and applying it to the development of new playing equipments. This article introduces the activities of the Playground Equipment Project.



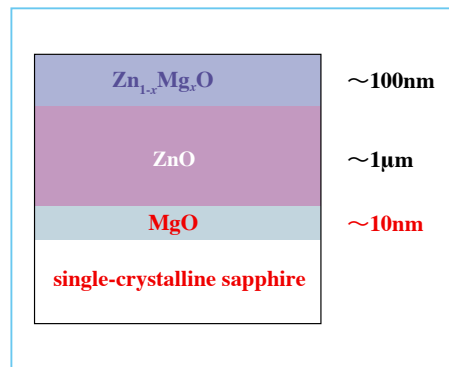
A process for making design of safe and enjoyable playground equipment

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AIIST TODAY Vol.7, No.9  
p.15 (2007)

## Development of a semiconductor for highly-efficient emission of ultraviolet light

High-quality  $\text{Zn}_{1-x}\text{Mg}_x\text{O}$  alloys are found to be very efficient UV light emitters, even more efficient than ZnO, particularly in the high-temperature region. The emission band width and strength of the photoluminescence from  $\text{Zn}_{1-x}\text{Mg}_x\text{O}$  alloys increase remarkably with increasing Mg concentration. We have revealed that the increase in the strength is mainly due to the increase in the activation energy required for the nonradiative recombination process. Therefore, it is suggested that the localization of excitons due to spacial fluctuation of the Mg concentration in  $\text{Zn}_{1-x}\text{Mg}_x\text{O}$  alloys takes place, and that the degree of the localization increases as Mg concentration increases.



Schematic illustration of the cross section of the samples

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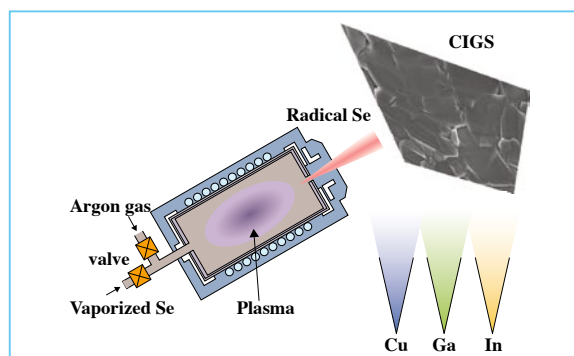
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AIST TODAY Vol.7, No.9  
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Environment & Energy

## A resource-saving method of manufacturing CIGS thin films for solar cell

We have developed a novel technique to grow device-grade  $\text{Cu}(\text{In,Ga})\text{Se}_2$  (CIGS) thin films using a radio frequency cracked Se-radical beam source. A Se-radical source meets the technical challenges of high-quality CIGS film growth, efficient use of Se source, and precise control of growth conditions and film properties. Using a CIGS absorber grown with a Se-radical source, an energy conversion efficiency of 17.5 %, which is comparable to conventional CIGS solar cell performance, has been achieved. Se source material consumption by the Se-radical source is significantly reduced to be less than 1/10 compared with a conventional Se-evaporative source. This result will lead to reduced production costs of CIGS solar cell modules and sharply reduced levels of industrial waste generation.



Manufacturing of CIGS thin films using a Se-radical source

**Shogo Ishizuka**

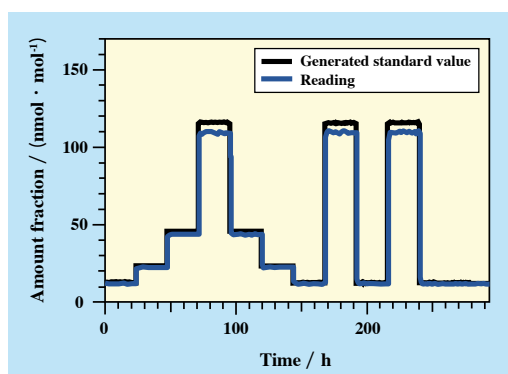
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AIST TODAY Vol.7, No.7  
p.14 (2007)

## Development of humidity standard in trace-moisture region

We developed a magnetic suspension balance/diffusion-tube humidity generator (MSB/DTG) with the aim of establishing a primary humidity standard in the amount-of-substance fraction of moisture down to 10 nmol/mol. A comparison between humidity generated with the MSB/DTG and humidity measured with a moisture analyzer based on cavity ring-down spectroscopy was performed. It was demonstrated that the MSB/DTG is capable of steadily producing a trace-moisture gas down to 10 nmol/mol, and of quickly changing the amount-of-substance fraction of the gas generated.



Comparison between generated standard values from MSB/DTG and readings of moisture analyzer

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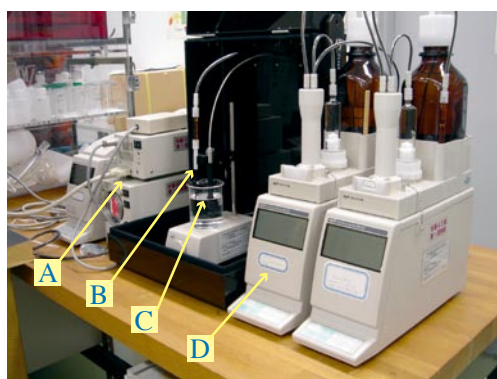
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## Development of metal ion standard solutions via spectrophotometric titrator method

In the field of standard material development, there is a demand for a primary method of measurement, which is based on calculations relying on applicable physical and chemical laws, and whose results are directly related to the International System of Units. Though titrimetry has a potential to be a primary method, it is required to detect an accurate equivalence point with low uncertainty depending on the titration system. The equivalence point of a chelatometric titration was determined by analyzing a titration curve with a theoretical equation, in which equilibrium among metal ions, metal chelates and an indicator were taken into account. While absorbances at a single

wavelength during a titration are observed with usual photometric titrators, absorption spectra can be observed with a spectrophotometric titrator. Using our method, it became possible to determine a much more precise equivalence point by analyzing the three-dimensional titration data.



Equipment for spectrophotometric titration

A:spectrometer, B:titration nozzle, C:photometric sensor, D:electrically-operated burette

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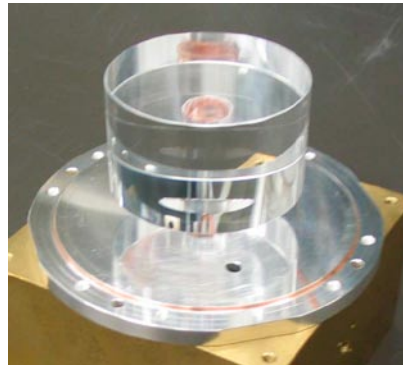
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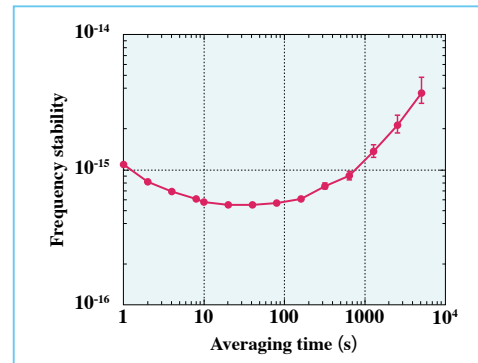


## Development of ultra-stable microwave oscillators

We have developed ultra-stable microwave oscillators using extremely low-loss sapphire crystals in collaboration with the University of Western Australia. The sapphire resonators are cooled with liquid helium to around 6K. At this temperature, frequency of the microwave radiation confined in the crystal exhibits zero temperature sensitivity. Two identical oscillators were built to evaluate their stability at short averaging times. They exhibited a fractional frequency stability of  $1 \times 10^{-15}$  at an averaging time of 1s. Optical frequency synthesis from the oscillator has been implemented using an optical frequency comb. The oscillator will soon be installed as an ultra-stable local oscillator for a cesium atomic fountain frequency standard (NMIJ-F1).



Single-crystal sapphire (diameter:5 cm, length:3 cm)



Frequency stability of the developed oscillator

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AIST TODAY Vol.7, No.9  
p.17 (2007)

## A Visit to Tsukuba by Senior Vice Minister of Education, Youth and Sports of Czech Republic, President Yoshikawa becomes a Member of the Industrial Academy of Czech Republic

On May 22nd, the Third Czech-Japan Science and Technology Days took place at Ark Mori Building in Tokyo. After greetings by Pavel Komárek, Czech Senior Vice Minister of Education, Youth and Sports, and by Shotaro Yauchi, Vice Minister of the Ministry of Foreign Affairs of Japan, several talks followed, and from Japan, Yoshikawa, President of AIST, gave a lecture titled "Innovations for Sustainability". 33 Czechs and 102 Japanese attended the event.



Petr Zuna gives a diploma to Yoshikawa

On May 24th, many members of the Czech delegation visited AIST Tsukuba Center. First, Katsura, Senior Vice-President of AIST and Czech Senior Vice Minister Komárek gave their greeting speeches, and after some discussion, the party visited the Science Square Tsukuba where they saw recent studies done in the fields of metrology and measurement, robotics etc.



Discussion at Tsukuba Center

Furthermore, on May 23rd, Yoshikawa was given a diploma by Petr Zuna, Chairman of the Czech Engineering Academy (Honorary Rector of Czech Technical University) and has become a foreign member of the Czech Engineering Academy. The academy was founded in February 1995 in order to tie research with development, to increase the competitiveness of Czech economy, and to help enhance the technical education. The academy members include 128 Czechs, 22 foreigners, of which 4 are Japanese including Yoshikawa.

Presently, there are active collaborative research being done between AIST and Czech research institutions in fields as water treatment, and organic chemical reaction control. After this visit, we hope for a further development with our collaboration.

## A Joint Symposium between AIST and Taiwan Industrial Technology Research Institute (ITRI)

A joint symposium between AIST and Taiwan Industrial Technology Research Institute (ITRI) was held at Tsukuba on May 30th, 31st, and Johnsee Lee, President, and about 20 others from ITRI, and Katsura, Senior Vice-President, Yamazaki, Vice-President in charge of International Affairs, heads of joint research projects and many others from AIST attended.

AIST and ITRI signed a package agreement in September 2005, and since then, there are joint research projects being carried out in various fields. The first joint symposium was held before the agreement in February 2003, and the second in September 2005.

At the third symposium held this year, there was an

active exchange of information in the four workshops of nanotechnology, energy technology (photovoltaics, biomass, photocatalyst, and new fuel), optoelectronics, and intelligent system. At the conclusive session, the summary and future



Katsura, Senior Vice-President of AIST

collaboration plans for the workshops were reported. In the fields of photovoltaics and photocatalyst where collaboration is well underway, there were specific suggestions on the ways to further strengthen the collaboration. In other new fields, there were discussions on possible directions of collaboration.

ITRI is a research institution which is the parental base of the Taiwan industry which is highly competitive in the production of high-tech products such as semiconductors. The institute is highly keen on product realization of research results, and, with the President, much discussion was done on this matter as well as on innovation management.



Johnsee Lee, President of ITRI



# A Visit by Pascal Couchepin, Vice-President of the Swiss Federation

On July 9th, Pascal Couchepin, Vice-President / Federal Councillor of the Swiss Federation visited AIST Tsukuba Center along with the Swiss Ambassador, Paul Fivat and Konrad Osterwalder, President of Swiss Federal Institute of Technology Zurich and others.

One of the main purposes of their visit was to see the progress being made in research for renewable energy and new energy. Kamimoto and Yamabe, both Research Coordinators Environment and Energy, Owadano, Director of Energy Technology Research Institute gave presentations of the works being done at AIST, and afterwards there was an active exchange of questions and answers.

After hearing a presentation by Kondo, Director of Research Center for Photovoltaics at the center itself, they

visited various other research facilities. The party left the center leaving words that they were highly impressed with the research being done at AIST.

From this visit, we hope for a development in research collaboration between AIST and Swiss research institutions in fields related to the environment and energy and others.



Kondo explains to Vice-President.

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