Japan Geoscience Union Meeting 2013
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U02-01 Room:201B Time:May 20 09:00-09:10

Session Scope: Global Data Sciences in the Big Data Era—Global Data Management and System

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In earth, planetary and space sciences, scientific findings and understanding of irreproducible phenomena like earth's climate change etc. cannot be validated with double-check of results by independent scientists which is essential elements of the modern science. Then, "data" is the only proof which scientists can show to the society to secure the scientific truth. The ICSU-WDS (World Data System) progarmme has started its international programme office (IPO) hosted in Japan targets world-scale data-sharing community and framework. New initiatives such as persistent digital identifiers of datasets and authors, as well as data citation are important as a new science infrastructure in this new era. Nowadays when decision-makers requires access to usable information on natural phenomena which impacts the society, joint efforts and possible collaboration, and furthermore fusion are required of advanced information science and technology together with earth and planetary science datasets, so targeted activities like DIAS are proceeding now. In this session, a wide range of data activities of not only earth and planetary sciences but also of social and economic fields are welcome to exchange and interact for the future global coordination of scientific data and information.

Keywords: ICSU, World Data System, GEO, GEOSS, DIAS, WDS

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Science Council of Japan and International Programmes (TBD)

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Activities of Science Coucil of Japan will be introduced in connection with related international programmes.

Keywords: Japan Council of Japan, GEOSS, DIAS, ICSU, World Data System

Japan Geoscience Union Meeting 2013
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U02-03 Room:201B Time:May 20 09:25-09:45

GEO Strategic Objectives and Core Functions

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In order to understand the Earth System and the impact changes in the Earth System have on society we need reliable, sustained and comprehensive observations. The Group on Earth Observations (GEO) was created to bring together diverse community of providers and users of Earth observations in order to create the Global Earth Observation System of Systems (GEOSS) that links together planned and current observing systems, improving the integration of, and access to, data and information.

GEO: a) is a unique global initiative mandated to coordinate and facilitate the integration of, and access to, land, water, sea, air- and space-based observing networks and their associated information systems; b) occupies an upstream position in the international community with respect to the major initiatives requiring observations, data and information about the Earth system; and c) brings together Governments and all relevant intergovernmental, international and regional organizations with an interest in Earth observations under a flexible, voluntary framework for coordinating strategies and investments, as well as developing new initiatives, through the on-going implementation of the Global Earth Observation System of Systems (GEOSS).

GEO has set itself ambitious strategic targets, and is making significant progress towards delivering them. Global and regional initiatives, such as AfriGEOSS, the Asian Water Cycle Initiative (AWCI), Blue Planet, the GEO Biodiversity Observing Network (GEO BON), the Global Agricultural Monitoring (GEOGLAM) initiative, the Global Carbon Observing System (GeoCarbon), the Global Forest Observing Initiative (GFOI), and the Global Mercury Observation System (GMOS), have been created to address gaps in our capability as identified by users. To improve access to data a GEO Portal has been developed, providing an entry point to access Earth Observation information and services held by GEO Members and Participating Organizations and GEONETCast, a near real time, global network of satellite-based data dissemination systems designed to distribute space-based, airborne and in situ data, metadata and products has also been set-up. In the 2010 Beijing Declaration, GEO Members committed to implement the GEOSS Data Sharing Principles by developing flexible policy frameworks that enable a more open data environment, and these Principles have influenced national and regional data policies, including INSPIRE and Copernicus (GMES) in Europe and Landsat in the US, facilitating the uptake of Earth Observation data by a wide range of user communities.

Keywords: Earth Observation, Group on Earth Observations (GEO), Global Earth Observation System of Systems (GEOSS)

Japan Geoscience Union Meeting 2013
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U02-04 Room:201B Time:May 20 09:45-10:05

ICSU World Data System

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[1]World Data System IPO

The ICSU World Data System (ICSU-WDS) primary goals are to ensure the long-term stewardship of quality-assessed data for research and education, and the provision of such data and related data services to the international science community and other stakeholders. New technological options opened by todays management, curation and on-line distribution of multi-disciplinary digital data sets make these goals achievable. The WDS is built as an international federated system of long-term data archives and data related services covering a wide spectrum of sciences. It includes 45 Regular an 7 Network Members dealing directly with data curation and data analysis service. It encourages and enables interdisciplinary data activities, but different disciplines (e.g. seismology, oceanography, astronomy, space sciences, biodiversity, health and social sciences) have developed domain-specific efficient answers to their data challenges. Consequently, WDS will have to evolve as a system of data systems and integration of interdisciplinary data will be dependent on implementation of interoperability arrangements. Although the focus of WDS is on the long-term stewardship of scientific data?so that the value of data holdings might actually increase with time?WDS members must share some overarching principles to achieve the system of data systems. This is realized through promotion of close collaboration between members and more importantly through an accreditation process and certification criteria. For example by the development and adoption of, standards and quality control practices, analysis and metadata services, and data publication services that can be recognized across domain boundaries. The latter will require a strong relationship with science publishers and libraries. Another focus point will be to establish a framework to help scientists in developing a data management plan from the very beginning of science projects and programmes, especially in an interdisciplinary and international context.

Keywords: Data Stewardship, Long-term preservation, scientific data and information, open access, Data Publication, Knowledge Network

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Workbenches developed on the Data Integration and Analysis System (DIAS)

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To create knowledge to be shared among different disciplines, to create knowledge to be shared throughout the world, and to disseminate data and information that brings awareness, we have developed a pilot system for the creation of an information storage infrastructure for public benefit applications and the deepening of scientific knowledge in the areas of climate, water cycle, for application in fisheries, agriculture and biodiversity management particularly through the linking of information across disciplines. This approach has proven to be effective with the successful implementation of our pilot project.

Based on this success, DIAS has begun an Environmental information Integration Program to extend and enhance our services. Through this project, stakeholders in various fields can leverage the fusion of large-scale datasets and applicative knowledge. We are proposing the development of a prototype workbench system for information infrastructure, a workbench for leveraging our implemented information infrastructure, allowing users to develop new results based on our accumulated data and expertise for the solution of global societal dilemmas. Our design strategy is for an operational framework which can provide public benefit in the form of policy-directed data delivery.

Keywords: Earth Observation, Earthe Environment, Data Integration, Big Data

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U02-06 Room:201B Time:May 20 10:25-10:45

Cross-domain interoperability in geosciences for data integration and decision support via Semantic Web technologies

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The research and understanding of complex geoscience phenomena, such as e.g. climate change, space weather or earth plate dynamics require an integrated approach for the combination of data covering different earth and space science domains. The results must be comprehensible for the scientific community, for the interested public as well as high-level decision-making purposes and therefore prepared and presented in very different ways. At present most of the geoscience data which are generated within one domain, e.g. earth gravity data in the geodetic domain are not usable or at least are only difficult to use within other domains, e.g. in seismology, geophysical domain. The problem is even bigger. Sometimes, within one domain, the ”same” data just measured by different instruments are not capable of being integrated. Just think, how difficult it is to combine in-situ earth gravity data measured by e.g. superconducting gravimeters with global gravity field data derived from specific satellite missions such as GRACE or GOCE.

Obstacles for the integration of data are the usage of different data and file formats provided by proprietary data management and information systems using different services. Therefore a lot of effort for the search of data, the understanding of data management systems and services as well as the transformation of data and file formats often done by scientist is necessary. Another challenge for the integration of data often is the lack of information about data provenance and governance. This context of the data and information are absolutely necessary in order to judge whether the specific data can be used in a specific application within a specific field of research. What else prevents data from being used in the same or different scientific domains? Cultural and linguistic differences of scientific work in geoscience and neighboring disciplines often lead to the use of different vocabularies, different understanding of terms for data description and data retrieval purposes.

The Semantic Web, an extension of the World Wide Web possesses the capability for the solution of many questions touched on in the first part of this abstract. First, the Semantic Web is based on standards for domain models and data as well as for vocabularies used for the terminological interoperability. Domain models formed as ontologies related to earth and space sciences conceptualize a specific field, e.g. virtual observatories in space physics (VSTO ontology), the measuring process itself (SSN ontology) or the lifecycle of geoscience data (ISDC ontology). Upper ontologies (SWEET) for the geoscience domain are often the umbrella of the appropriate domain ontologies. Classification, taxonomy or thesaurus vocabularies consist of domain specific keywords and relations between keywords. Within the Semantic Web these vocabularies are modeled as terminological ontologies. Examples for terminological ontologies in the earth and space science domain are GCMD scientific keywords and SPASE ”allowed values”. The GEMET thesaurus ontology also relates to environmental and social sciences. The merging of domain and terminological ontologies enables both to bridge the gap between different scientific fields and different linguistic comprehension. In the Semantic Web realm, the integration of geoscience data, modeled as individuals and/or at least described by all required context information in the domain ontologies is realized ”just” by networking the specific and appropriate ontologies. An example for such an approach is the ISDC ontology network linking domain ontologies, such as FOAF, GeoNames, Bibo, DBpedia and terminological ontologies, such as GCMD science keywords, SPASE ”allowed values” and GEMET thesaurus. Within the near-earth space domain, it is planned to connect Japanese IUGONET, EU-ESPAS and German ISDC data and appropriate data management systems using the same terminological ontology based on an extended SPASE thesaurus.

Keywords: earth and space sciences, data governance, data integration, Semantic Web, domain ontology, thesaurus vocabulary

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U02-07 Room:201B Time:May 20 11:00-11:15

Handling Heterogenous Data to Link Earth Observation with Socio-Benefit Applications

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With the improvement of observation technologies and earth science studies, a large amount of and various kind of earth observation data including remote sensing data, satellite images as well as model simulation data is now globally being produced by many experts and researchers. The size of earth observation data is quite huge even if it is compared with other data in the current big data era.

In these days, such earth observation data is an indispensable resource in order to enhance science researches in the fields of agriculture, hydrology, meteorology, biodiversity, or oceanography. Besides, it is required to deal with real issues such as climate change, typhoon, flood, drought, tsunami, poor harvest, pest damage, and ecosystem destruction. Accordingly, the earth observation data has the characteristics not only as big data but also as diverse data from the viewpoint of data uses.

When we consider the suitable usages for earth observation data with the premise to applying for such wide varieties, it is important to manage vocabularies related earth observation community. The vocabularies are useful for basic functions such as data definition, description, classification and retrieval as well as for extent functions such as recommending or interest matching application with data and users across the interdisciplinary domains. In this sense, we are currently developing dictionaries, arranged vocabularies and ontologies by gathering the existing glossaries or information given through discussions with earth scientists and experts in GEO (Group on Earth Observation) and DIAS (Data Integration and Analysis System).

Currently, our developed ontology and vocabulary related systems are used in GEOSS which is an international system for earth observation data and DIAS which is a Japanese data integration and analysis system handling big data including not only earth observation data but also social and economic data. Then in our presentation, we introduce our trials and developing systems through such activities.

Keywords: Earth Observation Data, data discovery, ontology, data fusion

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Inverse analysis of CO2 emissions from a mega-sized city using satellite and in situ observation data

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The greenhouse gas observing satellite (GOSAT) has functioned normally for more than four years since its launch on 23 January 2009. Although its main purpose is the meas-urement of greenhouse gases globally to reduce the estimation error of source/sink strength in a sub-continental size region, it can measure gas concentrations at multiple targets on a regional scale during one orbital over-flight. We have initiated and con-ducted special observations to monitor CO2 concentrations at sufficiently numerous ob-servation sites and thereby cover all regions of a mega-sized city. The main sensor of the satellite, the ”thermal and near infrared sensor for carbon observation Fourier transform spectrometer (TANSO-FTS)”, has been operated in a ”specific operation mode” to measure CO2 concentrations at 4 x 4 (totally 16) mesh points over the Kanto Plain, the center of which is Tokyo. This specific observation covers about 100 km x 100 km of the plain. These satellite data are used as inputs as well as ground-based and aircraft observation (CONTRAIL) data for the inverse analysis of emission/sink strength of CO2. The AIST meso-scale transport model (AIST-MM), whose highest spatial resolution is 1 km is used for the inverse analysis. Boundary conditions in a large area outside the re-gional target are provided by the NICAM based transport model (NICAM-TM). The system detected a signal of reduction of CO2 emission from some industrial districts just after the Tohoku-Pacific Ocean Earthquake.

Keywords: carbon dioxide, inverse analysis, GOSAT, mega-sized city

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U02-09 Room:201B Time:May 20 11:30-11:45

An integrated approach to evaluate biodiversity and ecosystems conducted by GRENE (Green Network of Excellence) Environm

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The global degradation of biodiversity and ecosystem has became a big concern since the last decade of 20th century. To tackle this problem, several activities including Convention on Biological Diversity (CBD) are now on-going. To carry out these activities, it needs to assess present status of biodiversity and ecosystem.

Biodiversity, ecological, climatological, and environmental data are required for developing indicators that are effective in assessing the states of biodiversity and ecosystems. However, most existing data are inaccessible or unavailable because they are either scattered among many databases or are unpublished. Therefore, our project aimed to collect metadata about biodiversity and ecosystems information at the first. We achieved progressive steps in sharing metadata through cooperation with Japan Long Term Ecological Research Network (JaLTER). JaLTER Metacat (http://db.cger.nies.go.jp/JaLTER/) provides information such as location, availability and format of ecological observation data in Japan. The next step was accumulation of biodiversity and ecosystems data based on the above metadata. We collected observational data from separate layers such as species distribution, community structure, ecosystem and flux. One of the main data sources at the species and community levels is the vegetation survey data conducted by The Ministry of the Environment in Japan. Using the output of this survey, the plant distribution database including 344,718 records for 4,160 species was developed. The data format of this species occurrence database was compliant with the Darwin Core standard (http://rs.tdwg.org/dwc/) in order to maximize reusability. The third step was a spatial interpolation of species and community distribution. Together with environmental data (such as climate, geography, soil type and land cover), we predicted potential species geographic distributions in a broad area using the ecological niche modeling method. These interpolated data for species and community distribution would be an indispensable infrastructure for mapping CO_2 flux, ecosystems function and so on. These mappings are the on going process in cooperation with JapanFlux (http://www.japanflux.org/) and AsiaFlux. (http://asiaflux.net/). We are planning to evaluate the state of biodiversity and ecosystems through integration of these predictions and environmental data stored in Data Integration and Analysis System (DIAS: http://www.editoria.u-tokyo.ac.jp/projects/dias/) for further steps.

Keywords: biodiversity, ecosystem, GRENE, DIAS

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Global Data Utilization for Climatic Changes and Evaluation of Their Effects on Agriculture in Asian Monsoon Region

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1. Introduction

It is important to predict climate change correctly in regional scale and to build adaptation measures and mitigation measures in the Asian monsoon region where more than 60 % of the world's population are living. The reliability of climate change prediction model is evaluated by the reproducibility of past climate in general. However, because there are many developing countries in the Asian monsoon region, adequate documentations of past climate which are needed to evaluate the climate reproducibility have not been prepared. In addition, at present it is difficult to get information on wide-area agricultural meteorological data which affect the growth of agricultural crops when considering the impact on agriculture of climate. This study has been proposed to increase the confidence in future climate prediction of Asian monsoon and to build an information infrastructure in order to develop mitigation measures and adaptation of agriculture to expected climate change.

2. Configuration and goal of the study

In this study, five research institutions which are responsible for climate change and agricultural impact researches, work closely for four sub-themes. (Figure 1)

FIGURE 1: An overview of this study (2011-2015)

2.1. Development of Agro-climatological Data-base in the Developing Countries

In developing countries of the Asian monsoon region, the publication of meteorological data is not sufficient. In addition, it is difficult to use wide-area data with the exception of some low-precision global data because the data is managed separately in each country. In this sub-theme, we will make a database of the paper-based data which were observed from the northeastern part of China to Southeast Asian countries in the Asian monsoon region.

2.2. Impact of Land-Use/Land-Cover (LULC) Changes on the Asian Monsoon Climate

In the Asian monsoon region, there is the Asia-specific surface state such as paddy. The land surface state is affected by climate change and controlled artificially at the same time. By comparing the output of multiple climate models that are generated on the DIAS and using the data of more ground surface, we will make clear the importance of land surface atmosphere interaction including the effects of anthropogenic Asian monsoon.

2.3. Climatic Changes and Evaluation of Their Effects on Agriculture Based on a Field Survey

We will build a simulation system that can grow in various conditions different cultivar, weather, and cultivation management. The system will have the flexibility that can replace the crops and crop model depending on the type and observation interval of observation data available. By giving the effects of climate change in this system, we will assess the impact of climate change to target crops. The researchers and agricultural extension will be able to browse the simulation results from anywhere using the Web application.

2.4. Development of Information Platform to Design Adaptation and Mitigation Strategies of Major Crops against the Predicted Climatic Changes

Rice is a main crop in the Asian monsoon region where is a zone of greenhouse gases such as methane in the agricultural sector. In order to construct future sustainable food production systems in the Asian monsoon region, it is necessary to consider the trade-off initiatives of mitigation and adaptation technology to global warming. In this sub-theme, we will implement the development of information infrastructure and integration related to agriculture meteorology, soil, land use, land management.

Acknowledgements

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References

Climatic Changes and Evaluation of Their Effects on Agriculture in Asian Monsoon Region, http://grene.agrid.org/htdocs/

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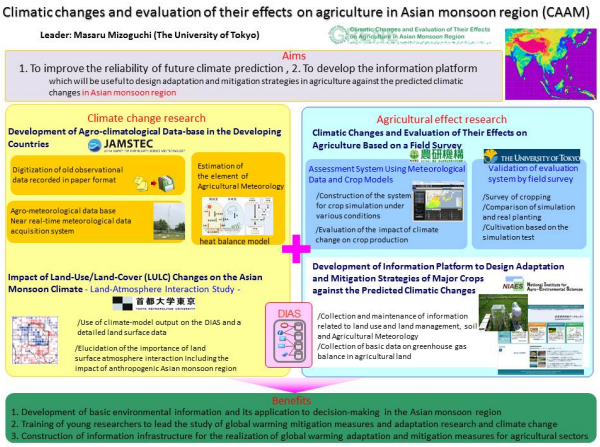
Green Network of Excellence - environmental information 2011, http://grene.jp/

Keywords: Climatic changes, Agriculture, Asian monsoon, adaptation measures, Global data



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U02-11 Room:201B Time:May 20 12:00-12:15

Designing Resilient Cities and National Land - An Application of Environment Information Technology -

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Objective:

This research project aims to construct a methodology to realize ”Resilient cities and national land” with mitigation and adaptation measures for vulnerability of national land and society. This ”resilient” concept is derived from an understanding of ”natural providence” as much as possible. Proposed system takes advantage of broad range information with disaster risk caused by meteorological phenomena and others from DIAS (Data Integration and Analysis System) by the Earth Observation Data Integration & Fusion Research Initiative (EDITORIA), the University of Tokyo. Therefore the system will be developed to ”Progressive Integrated Database” based on various environmental information infrastructure provided by DIAS. In addition, this project aims to cultivate experts who can construct and utilize this database in actual policy making fields.

To achieve this goal, re-design of national land and society for reduplicative system both normal and emergency situations are necessary. Both ”Safety and security” concept which takes account of damage reduction and ”Sustainability” concept which tackles low carbon, energy saving and prevention of climate change are restriction to keep pace threat of predicted huge earthquake and climate change.

Contents:

Natural violence caused by climate change, earthquake and other disasters may be increasing and strikes our vulnerable society with declining birth rate and a growing proportion of elderly people, population decline, urban sprawl and etc. in near future. Based on the common recognition on these problems, this research project sets out to construct a methodology to lead more safe, peace of mind and sustainable national land and society by using DIAS.

At this time, the system needs to use the data on natural and social situations. The data on natural situations include earthquake, climate and disasters. The data on social situation include population structure, economic condition, infrastructure and land use. Additionally, not only present data but also historical data, for example land use and infrastructure change, record of disasters, population structures and other information are collected. Therefore ”Four-dimension GIS” will be constructed to utilize quantitative prediction and to evaluate policies with considering historical facts, past place name and other qualitative information.

In consequence, analysis system will analyze vulnerability of national land and society caused by social, geographical and other conditions and natural variations and disaster risks. This system supports to examine various policies, especially, effectiveness of ”Smart shrink” which stop urban sprawl.

Results and future works:

1) Information archives

This project collected historical data on earthquake, tsunami and other natural disasters from old document and other resources. Especially, records of tsunami damages of the Great East Japan Earthquake are stored. Prototype WebGIS is developed to show these photos and tsunami height with map information.

2) Analyze and design

This project makes the evaluation system about vision of national land and city with a view of safety, security and sustainability. The system introduces ”QOL (Quality of Life)” indicators required data about accessibility, amenity and disaster vulnerability to calculate QOL indicators are collected and stocked to the system. This will be utilized to illustrate a condition of residential amenity and disaster vulnerability in each areas of national land.

3) Utilization and deployment

This evaluation system will be applied to case study cities for verifying its effectiveness. Therefore, the problems and demands of system will be clarified. As a result, the system and database will be developed to accommodate a request from policy planning with city and natural land.

Keywords: resilience, land and city plannning, environment, safety and security, sustainability

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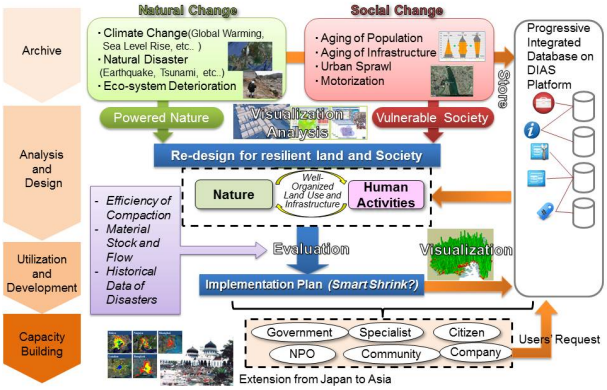

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Grene Ecohealth - climate change, social change and human health

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Among various impacts of climate change, impacts on human health are felt directly by ourselves. While the description in the IPCC chapter emphasizes global aspect of the impact, actual human impacts will vary with the ecological and social settings of the locality/population of concern and show complicated nature. Thus, human population health will be dependent on physical/chemical environment, ecosystem health, and social environment. In addition, the ability of human population to build and/or choose such complex combination of environment exerts substantial effects on the health consequences of given change in physico-chemical environment.

In this presentation, several problems in connecting environmental information and health-related events, which should be affected by many factors as described above, will be discussed, and outline and achievement of the GRENEcoH project, a GRENE-Ecohealth project that is running under the GRENE-environmental information program, will be presented. In the GRENEcoH project, three sub-topics including (1) Health impact of heat and air pollution in urban area taking the daily commuting behavior of the inhabitants into consideration; (2) urban flood and the risk of infectious diseases in relation to the behavioral patterns of affected people; (3) climate change and infectious diseases associated with the land use (forest cover). Thus, each of the subtopics has some component of behavior (commuting, flood-behavior, or land use) that should modify/affect the final consequences of environmental events. All the subtopics focus on Asian developing areas, considering their importance in shaping global environment, their vulnerability to climate change, and their rapid change in the subsistence/life style. Each of these subtopics was chosen as global issues that are not global scale issues (like Climate Change) but rather local scale issues observed in many areas over the world. So far, the interim results suggest the importance of local factors in each of the sub-topics.

Keywords: temperature, air pollution, urban flood, land use, human health, infectious disease

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A high-resolution surface water electrical conductance monitoring network built on the citizen science model

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Flowing water is fundamental to human societies, providing water for consumption, transportation, ecological habitat, and many other ecosystem services. Thus, understanding water sources and dynamics of water quality in flowing water is vital to efficient management of the flowing water as a resource. Water electrical conductance can be an excellent tracer of water sources and surface water pollution. We are implementing a new flowing water sensing network in New Hampshire, U.S.A., focused on high temporal resolution water stage, temperature, and electrical conductance measurements at 100 sites. A novel aspect of this network is that it is built on the citizen science model: we are collaborating with a broad group of agencies, high school teachers, and ordinary citizens who collect data for this network. The collaborators are maintaining relatively inexpensive water sensors that log water dynamics at three to ten minute intervals; the collaborators then download and send us the data on a monthly basis. This approach allows us to collect a very large data set with a modest financial investment. The network is one-year-old and beginning to produce novel patterns of electrical conductance variability, demonstrating hydrologic differences between watersheds across New Hampshire. For example, water sensing during the remnants of Hurricane Sandy demonstrated that the level of watershed urbanization influences groundwater contributions to streamflow during large storm events. The growing data set from this sensing network is novel, the method of implementation is novel, and ultimately, we think the network represents the densest spatial and temporal resolution sensing of surface water electrical conductance built. We will discuss the data collection methods, the data structure, and how the data are being used to advance hydrologic science.

Keywords: water tracing, citizen science, electrical conductance, water temperature

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10 Peta-byte Earth Environment Data Base and its History

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Big Data, which was introduced as one of the national key research investment fields by the President of USA, becomes a hot topic for discussion. The University of Tokyo has been developing an integrated Earth environment data base. The amount of data is now closing to 10 Peta-byte. 4V, including volume, velocity, variety and veracity, are key aspects of Big Data.

Keywords: Big Data, Data Base, Earth Environment

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On registration and retrieval of heterogeneous metadata in DIAS system

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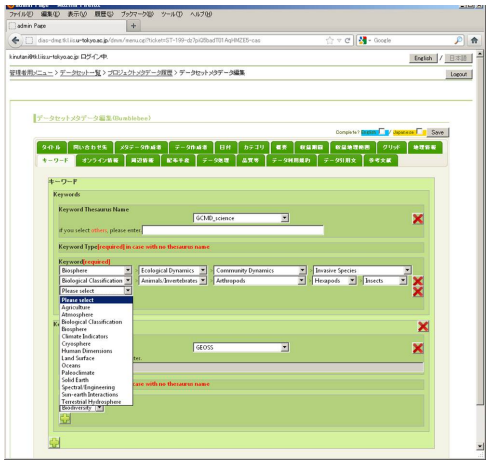
In DIAS system, a wide variety of metadata is collected, and some of them are registered semi-automatically. In this presentation, we will discuss how large number of heterogeneous metadata is registered and retrieved in DIAS system.

Keywords: metadata, data registration, data retrieval



Japan Geoscience Union Meeting 2013
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U02-16 Room:201B Time:May 20 15:03-15:21

Implementation of 4th Paradigm and Beyond

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Total quality control(TQC) of data has been one of most challenging subjects for the data era. TQC of such engineering products as automobiles, trains and aircrafts have been established by big industries after requirements of serious customers. TQC of most original papers have been managed systematically by big publishers and/or voluntary peer reviewers. For the latter two cases, there are stakeholders who elaborate the complicated systems with economical incentives. However the key issue of the 4th Paradigm:

Data Intensive Science, namely TQC of data, has not been established yet, so that a strategic plan for the 4th Paradigm concerns this issue. How to overcome this issue and how to go beyond will be discussed in the presentation.

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Identifiers for academic activities: people, publication and data

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U02-18 Room:201B Time:May 20 15:39-16:00

ScienceBook: A Knowledge Network

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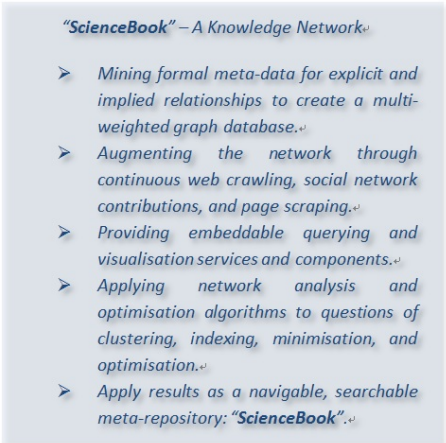
Worldwide standardisation, and interoperability initiatives such as GBIF, Open Access and GEOSS (to name but three of many) have led to the emergence of interlinked and overlapping meta-data repositories containing, potentially, tens of millions of entries collectively. This forms the backbone of an emerging global scientific data infrastructure that is both driven by changes in the way we work, and opens up new possibilities in management, research, and collaboration.

Several initiatives are concentrated on building a generalised, shared, easily available, and indefinitely preserved scientific data infrastructure to aid future scientific work ? with WDS as one of these.

This paper deals with the parallel aspect of the meta-data that will be used to support a global 'Knowledge Network'. There are obvious practical issues (semantic interoperability and speed of discovery amongst others), but we are here more concerned with some of the less obvious conceptual questions and opportunities:

1. Can we use meta-data to assess, identify, and reduce duplication of meta-data?
2. Can we use it to reduce overlaps of mandates in data portals, research collaborations, and networks?
3. What possibilities exist for mining the relationships that exist implicitly in very large meta-data collections?
4. Is it possible to define an explicit 'scientific data infrastructure' as a complex, multi-relational graph database, that can become self-maintaining and self-organising in true Web 2.0 and 'social networking' fashion?

The paper provides a blueprint for an approach to massive meta-data collections, its encoding, and how this can be processed using established analysis techniques to answer the questions posed. It assesses the practical implications of working with standard meta-data in a data mining context, and makes recommendations in respect of extension to support self-organising, semantically oriented 'networks of networks'. It concludes with the efforts underway by the Scientific Committee of the World Data System to implement such a Knowledge Network in support of its membership and stakeholders.



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U02-19 Room:201B Time:May 20 16:15-16:30

Data Sharing and Utilization in Astronomy

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The rapid development of semiconductor technology has lead to large sensitive detectors that enabled astronomers to easily survey large sky areas. Such large-scale observations and surveys cover a wide range of scientific themes in astronomy. Astronomers need to be well-prepared for such a new era of astronomical research utilizing large amounts of data. Since the data production rate will be 100 to 1000 times larger than the past, advanced data analyses combined with statistics and data mining will be essential to derive general “rules” and/or “knowledge” on various phenomena in the Universe, as the data volumes will make human inspection and analysis of the data impossible. The most important and exciting astronomical discoveries of the coming decade will rely on research and development in data science disciplines that enable rapid information extraction, knowledge discovery, and others, combined with sophisticated data management, access, visualization and other technical advancement.

Keywords: Data Intensive Astronomy, Data Management, Virtual Observatory, Statistical Data Analysis, Knowledge Discovery

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International Cooperation within IAG's Geodetic Services ILRS and IVS and the Japanese Contribution

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Space geodetic techniques have drastically expanded what geodesy can do in terms of the global scale and the high precision. It is vital for these techniques to distribute the observation data globally in good order. In this presentation, we shall focus on two international organizations: the International Laser Ranging Service (ILRS) that serves for satellite/lunar laser ranging (SLR/LLR), and the International VLBI Service for Geodesy and Astrometry (IVS) that serves for very long baseline interferometry (VLBI).

SLR/LLR measures the absolute distance between a ground station and a satellite or the Moon. The ground station network consists of a few tens of a geodetic point each of which is equipped with a large-size optical telescope and a laser ranging system. A number of various satellites including the Moon carry a retroreflector array that reflects the incoming laser pulse from a ground station exactly back to the station.

VLBI, on the other hand, receives very faint radio signal from quasars. The ground station network consists of a few tens of a geodetic point each of which equipped with a large-size radio telescope, an atomic clock and an ultrafast recording system. The radio signals from an identical stellar object received at Ttwo or more ground stations, which become a large amount of data exceeding a few terabytes per day, are brought together points the same stellar object at the same time, and the difference of the arrival time is very precisely determined through the correlation procedure.

ILRS and IVS have coordinated the data flow of such a wide variety and a huge amount. It is no exaggeration to say that the significance of existence of these services is based on the supply of the observation data and the product data. The frameworks of the services are therefore organized to manage the data flow. It is nowadays getting important to update the geodetic products quickly and frequently, which is benefitted greatly from ultrahigh-speed communications.

Japan has been involved in the development and the operation of these geodetic techniques since the early days, often leading the key technologies. Partly due to the geographical aspect, Japan has somehow uniquely contributed to the international community in terms of the station placement, the technological development and the personnel contributions.

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Inter-university Upper atmosphere Global Observation NETwork (IUGONET)

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IUGONET is a joint project aiming at establishment of a data exchange system for the Earth's upper atmosphere observations including the mesosphere, thermosphere, ionosphere and magnetosphere. It was started in 2009 as a 6-year project by the five Japanese universities and institutes that have been leading ground-based observations of the upper atmosphere for decades.

In order to investigate the mechanism of long-term variations in the upper atmosphere, we need to combine various types of in-situ observations and to accelerate data exchange. To achieve this, we have built a metadata database (MDB), have been archiving data by means of a global network of radars, magnetometers, optical sensors, helioscopes, etc, and have been producing software to help researchers easily download, visualize, and analyze data provided from the member institutions and cooperative organizations/persons.

Keywords: Climate and Weather of the Sun-Earth System (CAWSES), Metadata, Database, Upper atmosphere, Solar-Terrestrial Environment

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Toward Big Data Sciences: A challenge of NICT Science Cloud

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During these 50 years, along with appearance and development of high-performance computers (and super-computers), numerical simulation is considered to be a third methodology for science, following theoretical (first) and experimental and/or observational (second) approaches. The variety of data yielded by the second approaches has been getting more and more. It is due to the progress of technologies of experiments and observations. The amount of the data generated by the third methodologies has been getting larger and larger. It is because of tremendous development and programming techniques of super computers.

Most of the data files created by both experiments/observations and numerical simulations are saved in digital formats and analyzed on computers. The researchers (domain experts) are interested in not only how to make experiments and/or observations or perform numerical simulations, but what information (new findings) to extract from the data. However, data does not usually tell anything about the science; sciences are implicitly hidden in the data. Researchers have to extract information to find new sciences from the data files. This is a basic concept of data intensive (data oriented) science for Big Data.

As the scales of experiments and/or observations and numerical simulations get larger, new techniques and facilities are required to extract information from a large amount of data files. The technique is called as informatics as a fourth methodology for new sciences.

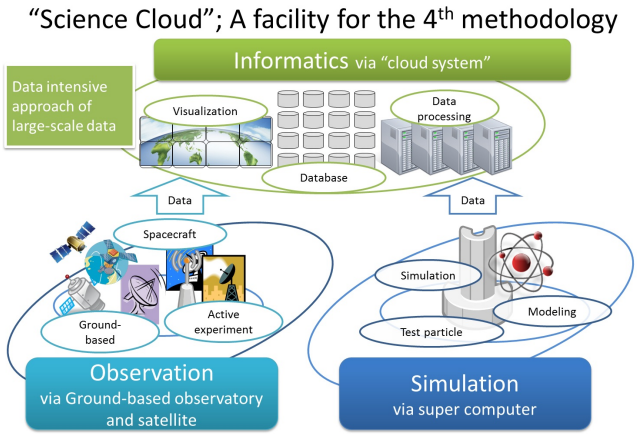
Any methodologies must work on their facilities: for example, space environment are observed via spacecraft and numerical simulations are performed on super-computers, respectively in space science. The facility of the informatics, which deals with large-scale data, is a computational cloud system for science.

This paper is to propose a cloud system for informatics, which has been developed at NICT (National Institute of Information and Communications Technology), Japan. The NICT science cloud, we named as OneSpaceNet (OSN), is the first open cloud system for scientists who are going to carry out their informatics for their own science.

The science cloud is not for simple uses. Many functions are expected to the science cloud; such as data standardization, data collection and crawling, large and distributed data storage system, security and reliability, database and meta-database, data stewardship, long-term data preservation, data rescue and preservation, data mining, parallel processing, data publication and provision, semantic web, 3D and 4D visualization, out-reach and in-reach, and capacity buildings.

Figure is a schematic picture of the NICT science cloud. Both types of data from observation and simulation are stored in the storage system in the science cloud. It should be noted that there are two types of data in observation. One is from archive site out of the cloud: this is a data to be downloaded through the Internet to the cloud. The other one is data from the equipment directly connected to the science cloud. They are often called as sensor clouds.

In the present talk, we first introduce the NICT science cloud. We next demonstrate the efficiency of the science cloud, showing several scientific results which we achieved with this cloud system. Through the discussions and demonstrations, the potential performance of sciences cloud will be revealed for any research fields.



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JAXA's space-based earth observation data archives

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JAXA's earth observation satellites play an important roll in providing essential information for water, food and health security. JAXA operates Greenhouse gas Observing SATellite (GOSAT), Tropical Rainfall Measurement Mission/Precipitation Radar (TRMM/PR), and Global Change Observation Mission-Water 1 (GCOM-W1). These satellites are collecting important information regarding carbon and water cycle. In addition to current ongoing missions, worldwide data users can access quantities of archived data of past missions including high-resolution data of Advanced Land Observing Satellite (ALOS) and water-related products of Advanced Microwave Scanning Radiometer-EOS (AMSR-E). JAXA will launch a series of new generation satellites to observe disaster, earth resources, climate change, water cycle, carbon cycle and global warming, such as ALOS-2/3, GCOM-Climate (C), Global Precipitation Measurement (GPM), Earth Cloud, Aerosol, and Radiation Explorer (EarthCARE) and GOSAT-2. All data obtained by the new satellites will also be archived and distributed. However, it is needed to provide useful information for decision makers and stakeholders in order to contribute to solving global and regional issues. To create such information, integration and fusion of satellite data, in situ data, numerical model outputs, and socio-economic data are essential. JAXA has started close collaboration with various players in various sectors.

Keywords: GCOM, ALOS, GPM, TRMM, GOSAT, EarthCARE

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CEOS Water Portal, one of the DIAS distributed data sytems

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The CEOS Water is a one of the DIAS (Data Integration and Analysis System) data distributed systems.

The CEOS Water Portal system is distributed in the sense that, while the portal system is located in Tokyo, the data is located in archive centers which are globally distributed. For example, some in-situ data is archived at the National Center for Atmospheric Research (NCAR) Earth Observing Laboratory in Boulder, Colorado, USA. The NWP station time series and global gridded model output data is archived at the Max Planck Institute for Meteorology (MPIM) in cooperation with the World Data Center for Climate in Hamburg, Germany. Part of satellite data is archived at DIAS storage at the University of Tokyo, Japan.

This portal does not store data. Instead, according to requests made by users on the web page, it retrieves data from distributed data centers on-the-fly (by OPeNDAP protocol etc.) and lets them download and see rendered images/plots.

The CEOS Water Portal intends to extend its users to include decision makers and officers like river administrators by facilitating a feedback loop. One example of data and information flow centered on the CEOS Water Portal is shown below.

(1)Scientists get various data needed for Model Calculation (WEB-DHM, for example) via the portal.
(2)Scientists use Model output data and do analysis.
(3)Scientists register their use cases into the portal.
(4)Decision makers and officers can refer and acquire use cases and data easily.

Users can access the CEOS Water Portal system at http://waterportal.ceos.org/.

Keywords: Water, Portal, Data, CEOS, DIAS

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Data Integration and Analysis System Program (DIAS-P): Design and Proposal of an Operational DIAS

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Data Integration and Analysis System (DIAS) is intended to create new scientific knowledge and public benefits through integration of various data under collaboration with stakeholders, in order to become a social infrastructure to make new innovations and social growth. DIAS will provide information toward resilient society and mitigation on social problems related to global environment, including resource management, bio-diversity, and natural hazards, by utilizing data on earth observation, climate-variability prediction, socio-economy, and so on.

Data Integration and Analysis System Program (DIAS-P) started in 2011 as the second phase, aiming at (a) designing and proposing an operational scheme (operational DIAS) to realize public benefits through its operational application for global-scale solutions with sustainable scientific cutting-edge advancement, as well as (b) prototyping the operational regime with intelligent infrastructure to create new value, and (c) enabling stakeholders in various fields to together leverage the fusion of super-large-scale various data sets and information.

Japan Agency for Marine-Earth Science and Technology (JAMSTEC) is collaborating with the University of Tokyo EDITORIA, Japan Aerospace Exploration Agency (JAXA), and National Institute for Environmental Studies (NIES) to design the operational DIAS and present a tentative reference model including its roles. The infrastructure and schemes shown in the reference model will be the first practice if realized. This reference model has been designed in consideration with relevant progresses in relating research programs, and will be annually amended.

To achieve the above-mentioned objectives, DIAS comprehensively manages and publishes metadata as an integrated portal to provide and distribute the following data; (1) observation data listed in ”Japan Earth Observation Implementation Plan,” (2) observation data collected in each state to contribute toward nine social benefit areas of ”Global Earth Observation System of Systems” (GEOSS), (3) observation data available in partner states under bilateral or multilateral collaboration, (4) data obtained through Application Workbenches, which are intelligent infrastructure to support projects toward application to each field, and (5) data provided by Function-Improvement Partners, which are inter-organization partnership to sustainably improve functions of DIAS. Their targeted fields include socio-economy, agriculture and fishery, land use and land cover, transportation network on roads and ports, landscape, and hazards. It is to be discussed how to create an environment where archives are acknowledged as research results.

The core infrastructure of DIAS will consist of large-scale storages to archive the data, and of analysis space and tools to analyze large-scale data.

The operational DIAS expects decision-makers (in domestic and developing countries) on resource management, disaster-protection, etc. to be the major users. The major users of integrated data and analysis function of DIAS will be not only researchers (science communities) who provide decision-makers with evidence but also stakeholders who collaborate on Application Workbenches. Moreover, end-users, social movements, and civilian services are also expected to use DIAS through access to the DIAS portal site.

The operational DIAS will gradually extend application fields, by grasping needs of end-users, collecting know-how on best practices through experience, and carrying out continuous prototyping. In the prototyping phase, Application Workbenches develop useful policy tools in collaboration with researchers and relevant decision-makers in each application field. In the following social application phase, the developed system will be installed on undertaking organizations, or undertaking organizations will publish integrated products in the place of DIAS.

Keywords: DIAS, Data Integration and Analysis System Program, operational, data-centric