An experiment of high-speed data transfer technique from Syowa via INTELSAT

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Achieving the quality of service (QoS) is an important requirement in a communication network. Satellite communication is posing many challenges due to the limitation of transmission control protocol (TCP) over networks with high latency. To overcome these issues, the wide area network (WAN) optimization provides the data transfer on such long-distance networks. However, this optimization is not able to utilize the available bandwidth of provided network efficiently since it performs fixed bandwidth allocation. This paper proposes a technique to enhance the available bandwidth utilization for International Telecommunications Satellite Organization (ITSO, or INTELSAT) network. This technique adopts a high-speed data transfer protocol, named high-performance and flexible protocol (HpFP), to transfer data between the satellite and the ground station. The HpFP is a connection-oriented protocol to work on the top of user datagram protocol (UDP) and provides us with a stream-type of reliable data transfer even under high packet loss rate. One of the ingenious attempts in the HpFP is to set an internal target throughput for pace control of sending packets. Since this parameter setting is time-dependent, the target throughput is calculated based on network conditions monitored by the HpFP. The HpFP detects the unused bandwidth in the satellite bandwidth resources at every moment, then dynamically allocates HpFP data transfers. The results of laboratory experiments show how effectively the HpFP utilizes the available network bandwidth in the condition of the WAN optimization control on INTELSAT satellite network.
[1] Praphan Pavarangkoon, K. T. Murata, M. Okada, K. Yamamoto, Y. Nagaya, T. Mizuhara, A. Takaki, K. Muranaga, and E. Kimura, “Bandwidth utilization enhancement using high-performance and flexible protocol for INTELSAT satellite network,” in Proc. 7th IEEE Annu. Information Technology, Electronics and Mobile Communication Conf. (IEMCON), 2016. doi: 10.1109/IEMCON.2016.7746292

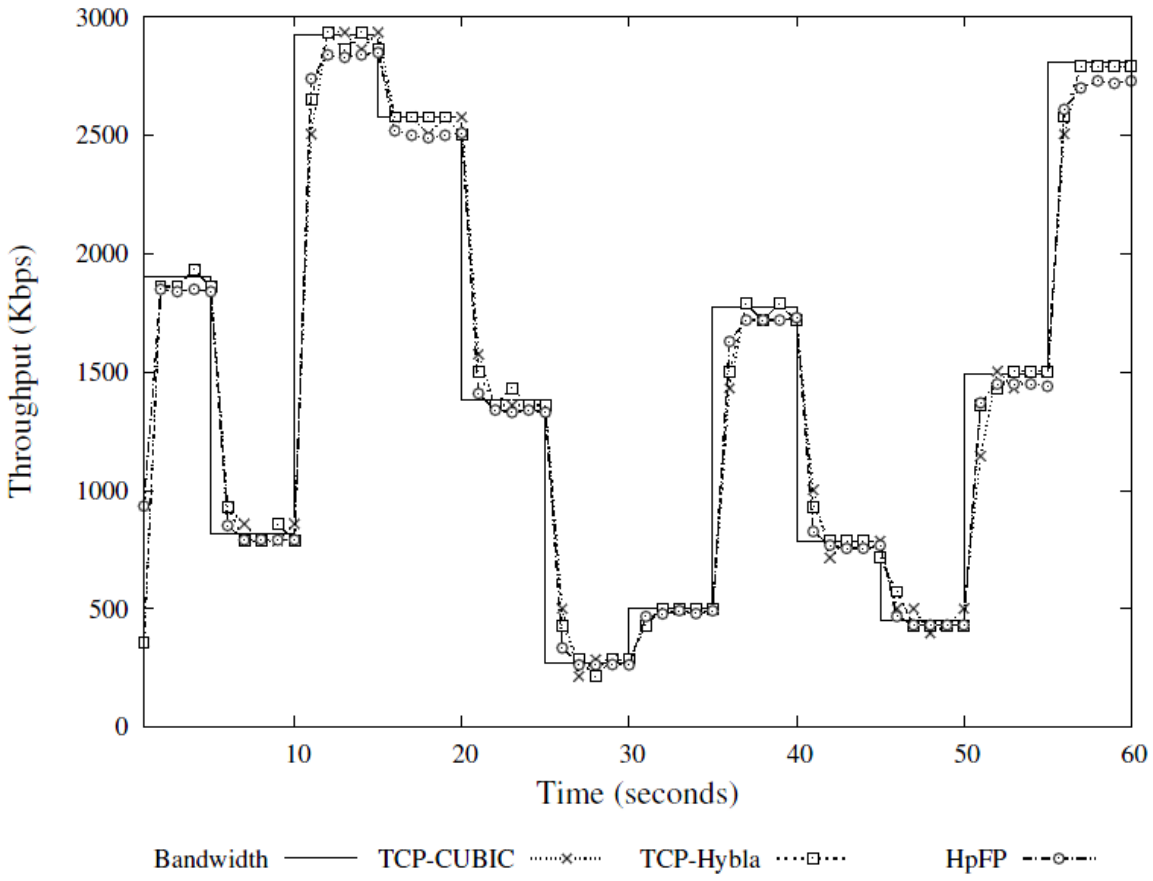

Fig. 10. Comparison of TCP-CUBIC, TCP-Hybla, and HpFP under the situation with the changing interval of the available bandwidths in every 5 sec

An experiment of high-bandwidth virtual remote storage (HbVRS) system on long fat network (LFN)

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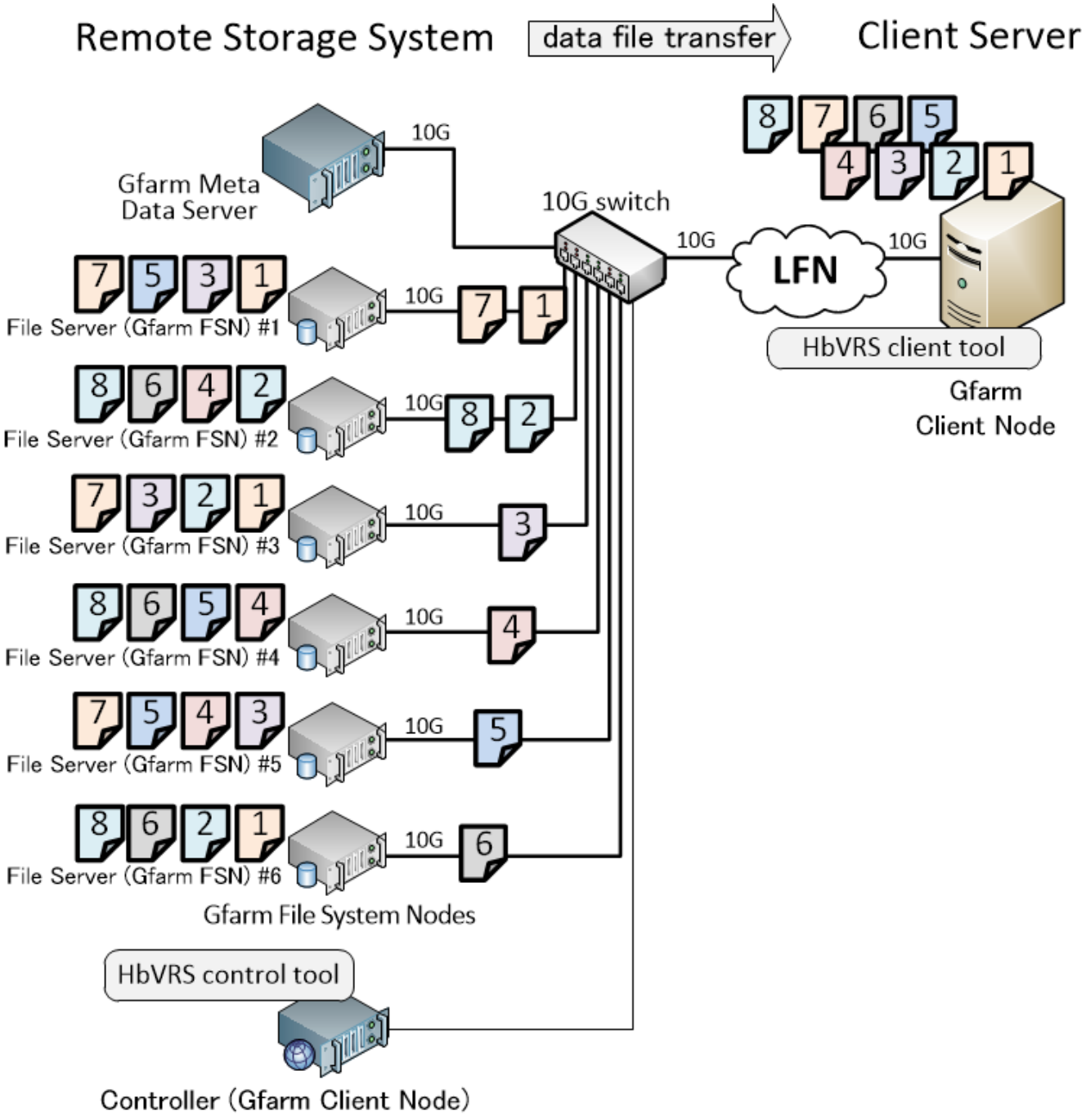
Science cloud is a cloud system specialized for data intensive/centric science, which is based on a concept of the fourth paradigm proposed by Jim Gray in 2009. However, only a few science cloud systems have ever yielded tremendous scientific results so far. High-bandwidth storage I/O is one of the important issues to be overcome for big data sciences. In the study, we propose a high-bandwidth virtual remote storage (HbVRS) tool using a distributed file system (Gfarm) and a UDP-based data transfer protocol (HpFP) [1]. The tool is based on our examination of parallel HpFP data transfer in 10 Gbps using a long-distance 10G network (long fat network: LFN) between Japan and USA crossing the Pacific. We installed an application to draw a set of time sequential graphic files using the tool on the NICT Science Cloud. We successfully read data files in order of time sequence from a virtual storage as fast as more than 20 Gbps. The present results suggest that client hosts connected with a long fat network will be able to access to big data stored in cloud storage wherever over the world it is located. An application is demonstrated using the HbVRS [1].

[1] Ken T. Murata, P. Pavarangkoon, K. Yamamoto, , Y. Nagaya, K. Muranaga, T. Mizuhara, A. Takaki, O. Tatebe, and E. Kimura, “Multiple streams of UDT and HpFP protocols for high-bandwidth remote storage system in long fat network,” in Proc. 7th IEEE Annu. Information Technology, Electronics and Mobile Communication Conf. (IEMCON), 2016. doi: 10.1109/IEMCON.2016.7746276



Real-time 3D Visualization of Weather Radar Data in Full Resolution via Concurrent Processing and High-speed Transfer in Science Cloud

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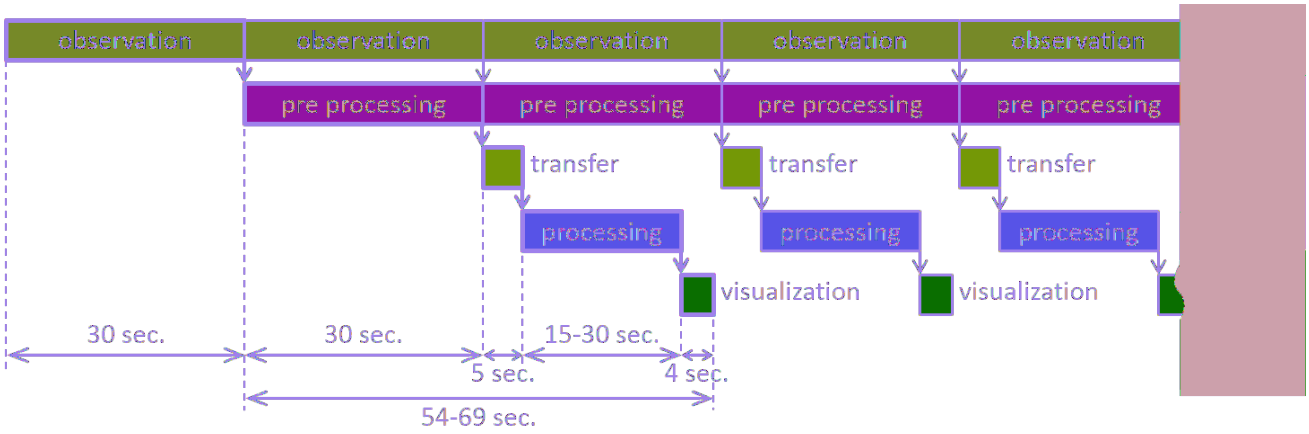
With the tremendous development of remote sensing technologies, a large amount of observation data are generated from sensors. Since each sensor generates data periodically, e.g., every minute, a concurrent data processing using a cloud system plays an important role in the modern design process. This paper focuses on concurrent data processing techniques for an X-band phased array weather radar (PAWR) using high-speed network, parallel data processing system, and large-scale storage system. The PAWR at National Institute of Information and Communications Technology (NICT), Japan rotates in 30 sec to capture a 3D structure of rainfalls within 60 km in radius and 15 km in altitude. In this paper, we develop a real-time 3D visualization system of the observation data of the PAWR. Our visualization is carried out from 54 sec to 69 sec (depending on the weather conditions) after every observation period, which is in the same time scale with other conventional 2D visualization of X-band weather radars. In addition, we discuss a combination of cloud ecosystems for the concurrent processing at low cost. The methodology is considered as a pioneering case study to develop of a variety of real-time data processing systems of big data via remote sensing [1].

[1] K. T. Murata, K. Muranaga, K. Yamamoto, Y. Nagaya, P. Pavarangkoon, S. Satoh, T. Mizuhara, E. Kimura, O. Tatebe, M. Tanaka, and S. Kawahara, “Real-time 3D visualization of phased array weather radar data via concurrent processing in science cloud,” in Proc. 7th IEEE Annu. Information Technology, Electronics and Mobile Communication Conf. (IEMCON), 2016. doi: 10.1109/IEMCON.2016.7746347



An examination of high-speed data transfer on high throughput satellites using novel network protocol

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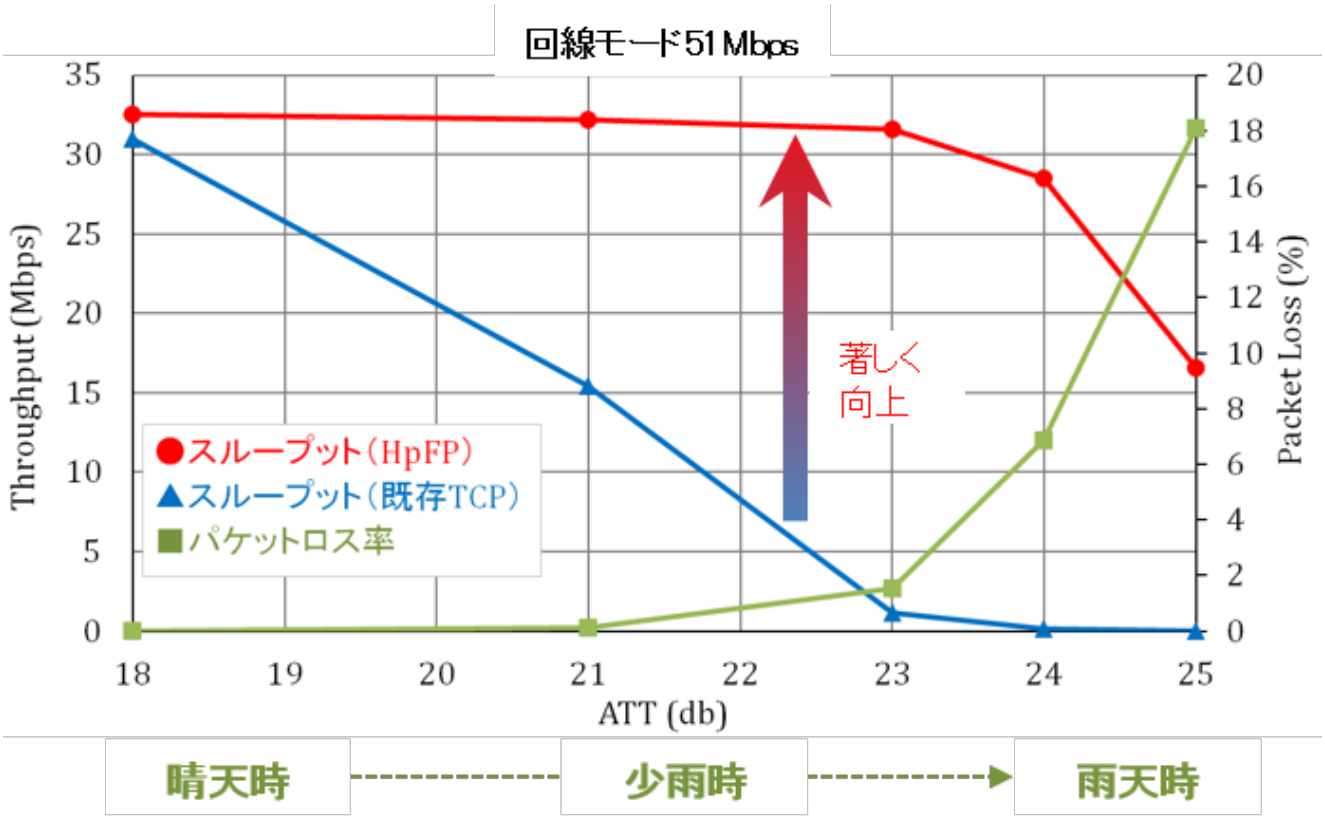
For network communications using modern high throughput satellite (HTS) on geostationary orbits, network throughput of transmission control protocol (TCP), one of the most popular protocols, is limited due to the packet loss on the satellite link. The packet loss is mainly caused by the attenuation of signals in severe weather conditions like heavy rain. It is high time to develop novel network communication techniques on the transport layer in TCP/IP designed for the systems and applications in broadband communications. In this paper, we introduce a high-speed data transfer protocol, named high-performance and flexible protocol (HpFP) [1], to achieve high throughput for the HTS even with packet loss. The HpFP, in comparison with TCP-Hybla and UDP-based data transfer (UDT) protocols, is evaluated on a laboratory experiment simulating a geostationary orbit satellite link of 10 Gbps. It is clarified that the HpFP outperforms both the TCP-Hybla and the UDT showing high throughputs (close to 10 Gbps) when the packet loss ratio (PLR) is 1%, and remains more than 1 Gbps under even 10% PLR condition. Moreover, in case of no packet loss, the HpFP exhibits a quick start-up time (6 sec) at the initial phase to achieve 10 Gbps, while the TCP-Hybla and the UDT take 9 sec and 16 sec to their maximum throughputs, respectively [2].

[1] K. T. Murata, P. Pavarangkoon, K. Yamamoto, Y. Nagaya, T. Mizuhara, A. Takaki, K. Muranaga, E. Kimura, T. Ikeda, K. Ikeda, and J. Tanaka, “A quality measurement tool for high-speed data transfer in long fat networks,” in Proc. 24th Int. Conf. Software, Telecommunications and Computer Networks (SoftCOM), 2016. doi: 10.1109/SOFTCOM.2016.7772111

[2] K. T. Murata, P. Pavarangkoon, K. Yamamoto, Y. Nagaya, N. Katayama, K. Muranaga, T. Mizuhara, A. Takaki, and E. Kimura, “An application of novel communications protocol to high throughput satellites,” in Proc. 7th IEEE Annu. Information Technology, Electronics and Mobile Communication Conf. (IEMCON), 2016. doi: 10.1109/IEMCON.2016.7746274



Cyber Earth: A new technical concept for global investigations of Earth

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In the present paper, the author proposed a concept of the Cyber Earth as a basic approach for the global understanding of the Earth system. In order for our global understandings from a variety of observation and simulation data of Earth sciences, we need a methodology to analyze huge size of big science data. The Cyber Earth is a concept to declare that, for our global understandings, mash-up of information and communication technologies for big data plays an important role. This concept is based on several technological ideas, such as data centric/intensive science, the fourth paradigm, science cloud, big-data science. All of the data, observation data and simulation data, are once transferred and stored on a science cloud system. Data preservation and data stewardship is important since most of the data is so precious that they are never observed again at the observed time and location. Big data processing, including visualization, is also important. The data processing must be applicable for any types of digital data from either Earth observation or simulation. Integrated data processing technology for such variety of data type is preferable.
The Cyber Earth is composed of three methodologies; the Network Earth, the Digital Earth and the Virtual Earth. The Network Earth is a concept that role of network is important for data transfer and collection to the cloud. For global monitoring we often build up global observatories on the Earth. Integrated operations and easy management of the remote sites are significant for labor-saving. The Digital Earth is a concept that long-term data preservation is one of the most expected functions to a science cloud. Data files must be saved and managed under DR (disaster recovery) environment. Easy data publication should be functionally synchronized with data preservation. The Virtual Earth is a concept that every digital data must be processed or visualized to be shown on the same framework with other data. Inter-disciplinary data preview, in space and/or in time, makes our global and functional understanding of the Earth system. Immersive visualization may work effectively to understand or discover any interactions between data.

Three-dimensional Visualization and Web Sharing of Geological Logs using FOSS4G

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Recently, Web sharing of subsurface geospatial information has received increasing attention because of its importance in disaster mitigation / prevention. The purpose of this study is to establish technology to share two- and three-dimensional (2D / 3D) geological information on the Web using Free and Open Source Software for Geoinformatics / Geospatial (FOSS4G). As a first step of our work, we constructed a database of geological logs using PostgreSQL and developed a web mapping system for fundamental geological information, such as geological map and geological logs, using Leaflet JavaScript library. Linking the database and the mapping system enables to visualize geological logs within a specified region in 2D / 3D. This study was supported by JSPS KAKENHI Grant Number JP16K21677.

The study of visualization of dense and large area DEM data with Red Relief Image Map

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1.Introduction
Advancement of aviation laser measurement technology has made it possible to obtain accurate DEM data excluding the influence of trees in a short time. Up to now, laser measurement has been done in the range of 50% of country. On the other hand, because the data is high precise, it was also a big challenge for conventional terrain representation techniques to express an appropriate scale for easy to use in field surveys. The RRIM was developed in 2002 as a method to visualize very complicated and precise topography data by laser measurement (Chiba et al., 2006, etc.). In this study, we report on the principle of the RRIM and recent achievements on application to big data which not from laser measurement.
2.Red Relief Image Map (RRIM)
There are several methods for creating images directly from DEM by calculation, such as shadow plots, oblique maps, and advanced step diagrams, but each has its advantages and disadvantages. The common problem of these methods is difficult to express by one sheet and the 3-dimensional expression will be changed with rotation. The RRIM had been developed as a method for solve these problems. For create RRIM, after obtain the inclination, negative openness and positive openness from DEM, we multiplied the image of inclination which is proportional to the red saturation and the image of ridge valley value which obtained from the positive openness and the negative openness and are proportional to the lightness. Since this image is perceived as ortho, it is expressed stereoscopically, so it was possible to incorporate much information into a small scale figure. The one used for the visualization of the laser measurement data was very effective for the field survey in the jungle area. The beginning of the development of RRIM was the Aokigahara area in Mt. Fuji, but since then it has been used not only for volcanoes in various places but also for landslide surveys and active fault surveys.
3.Expansion of scope of application
We applied it to data with larger mesh size, which proved that it is possible to express the wider terrain clearly. It has been evaluated to be useful for topography understanding by applying to 10 m mesh data in Japan and 4 km mesh data of the whole Earth so far. In addition, this expression technique can be applied as long as it is data having one Z value for a set of YX values. Therefore, we tried to apply relief data of 0.1 micron mesh by laser microscope and data of Mars and Moon. In this poster, we will introduce contrivances of expressions that are tailored to the purpose of each data with respect to attempts to express data other than those.
4.Retardation color palette
The RRIM has a problem that it can’ t get altitude information and tilt direction information. For that confrontation, it has been done to overlay contour diagrams or to overlay weak shadows, but it was difficult to understand. Recently, I attempted to approach this problem by using interference fringe color by using retardation color palette from DEM. I will introduce the current idea here.

Keywords: Red Relief Image Map, DEM, visualization

Development of database system for cruise information of JAMSTEC vessels and statistical analysis of observation downtime

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1. MAT, JAMSTEC, 2. MARITEC, JAMSTEC

Japan Agency for Maine-Earth Science and Technology (JAMSTEC) has seven research vessels and controls the research cruise of these vessels. Each year, several tens of research cruises are carried out, and a large amount of marine observation data is acquired. JAMSTEC has not only the observation data but also a large amount of navigation data of past cruises. There were cruises in which many of the scheduled observations could not be implemented due to various causes. For example, in some research cruises carried out in the fall in the surrounding sea of the Japanese Islands, many of observations were canceled by typhoon. Scheduled observations cannot be performed and sufficient observation results cannot be obtained so that progress of the research will be prevented. However, even though there are navigation data, it has not been examined how many observations were canceled in past cruises and what caused the observation downtime. At present, JAMSTEC has to schedule all research cruises for the next fiscal year one year before, which may prevent efficient operation of the research cruise. In this study, we are developing database system for the cruise information operated in the past several tens years to clarify observation downtime for each cruise and what caused the downtime. We are also analyzing statistically the downtime data to describe the relationship between the downtime and various factors of the cruise such as season, sea area, observation equipment, vessel, etc. The analysis results will provide useful information to plan the cruise. Furthermore we will analyze all information of past cruises by machine learning, and we will predict the downtime of the planned cruise and propose better research cruise plan, which will help to obtain the sufficient observation results and to advance the research.
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Three dimensional Geological Modeling Using Geological Information of Vietnam

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In Southeast Asian area, the environmental problems such as land subsidence, flooding occurs by heavy rain, traffic problem and groundwater pollution have been increasing in recent years. This main reason is rapid urbanization and population increase. Regarding the mitigation and prevention of the environmental issues of urban area, it is important to prepare and analyze with the geological information. For the solution of these issues, it is necessary to provide the geological information accurately and effectively. The 3D (three-dimensional) geological model is an important geological information generated as a result of geological analysis based on the fundamental field survey data and the knowledge of the geologist. The method of 3D geological modeling based on the logical model of geological structure has been developed by Masumoto et al. (1997) and Shiono et al. (1998), and its actual visualization 3D geological modeling has been proposed by Masumoto et al. (2004) using GRASS GIS and Yonezawa et al. (2004) using Visual Basic program Geomodel2000.
In this study, we generate the DEM using the elevation data. DEM is a digital representation of ground surface topography and the most important element of topographic analysis. And, we analyzed the borehole data for the well construction of Hanoi city. Finally, we constructed the 3D geological model of Hanoi city and visualized it using GRASS GIS.
Research area is the center part of Hanoi city, the capital of Vietnam, the environmental problems have been increasing in recent years. The main reason is rapid urbanization and water control. The urbanization of Hanoi city has a relationship with the geological urban transformation as a landfill historically.
The 3D geological model is composed the DEMs of the geological boundary surfaces and the logical model. The spatial distribution and the relation of geological units are expressed in the logical model based on the fundamental field data and the knowledge. Thus the logical model of geological structure and the boundary surface are calculated for the visualization of 3D geological model. The outline of constructing of 3D geological model is as follows.
We can verify the logical consistency from the stratigraphic correlation and generate the geological event using the classify and arrange module (Shiono et al., 1998; Iwamura et al. 2008). It is calculated from the recursive definition proposed in Yonezawa et al. (2005). The logical model of geological structure is constructed by this event using the logical modeling module. Each geological boundary surface DEM is estimated using BS-Horizon method by Nonogaki et al. (2008). In geological function module, 3D geological model is constructed virtually using the logical model and DEMs. In this study, the data of logical model and each DEM of geological boundary are outputted from GRASS GIS of FOSS4G, the 3D geological model can be expressed using the visualization tool NVIZ of GRASS GIS.
The 3D geological model is provided as 2D and 3D visualization. We displayed a geological cross section of the 3D geological model. Future work is needed to identify the actual geological structure of Hanoi city to compare the 3D geological model.

Keywords: DEM, Borehole Data, Logical Model of Geological Structure, 3D geological model, Vietnam

