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Research Trend Information
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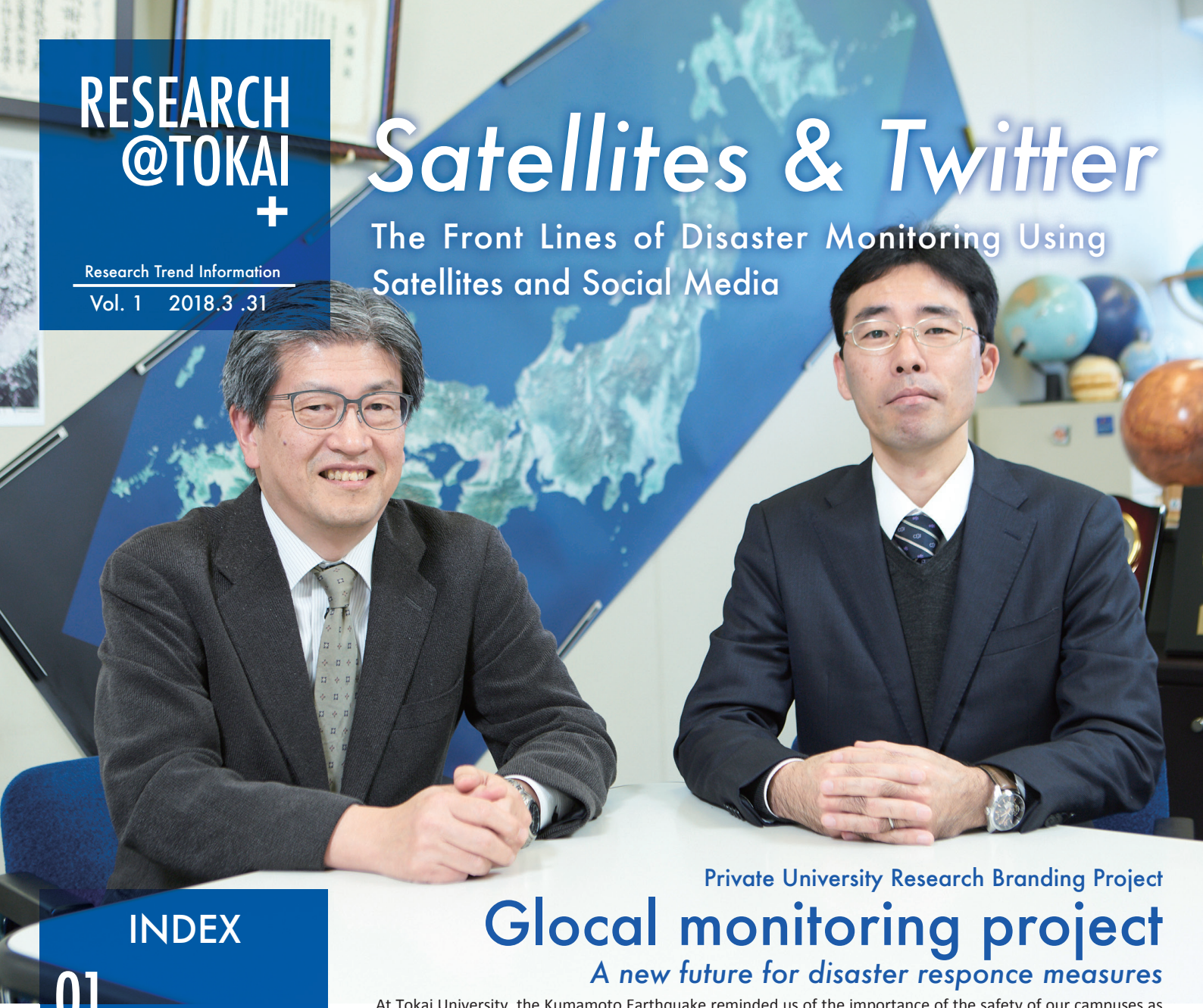
Satellites & Twitter

The Front Lines of Disaster Monitoring Using Satellites and Social Media



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Private University Research Branding Project

Glocal monitoring project

A new future for disaster responce measures

At Tokai University, the Kumamoto Earthquake reminded us of the importance of the safety of our campuses as well as surrounding local communities and led us to the launch of a new project. With the establishment of the unique research theme of “glocal monitoring,” which combines satellite remote sensing research that has been conducted at Tokai University for nearly 40 years with disaster information research using social media developed through community cooperation in recent years, the university aims to realize a society that is prepared for the next disaster. Below, the words of the key players of this project, Professor Kohei Cho and Professor Osamu Uchida, serve as an introduction to this project.

What is the glocal monitoring project?

Cho: The aim of the glocal monitoring project is to combine global observations from satellites with local observations from social media to provide information useful for disaster response measures. After we experienced the Kumamoto Earthquake, there were discussions within the university about putting effort into disaster monitoring research. I had the idea to take advantage of global monitoring technology for large-scale disaster monitoring that has been developed since the 1970s by the Tokai University Research and Information Center (TRIC). However, although observations from satellites are excellent for rapidly understanding information about a disaster across a large area, they have limitations in localized data collection in individual areas. Thus, we started this project with the idea of linking this satellite observation approach to disaster monitoring using social media, which Professor Uchida has been pursuing.

Uchida: On the other hand, I have been involved in disaster prevention research for about five years through a Tokai University community cooperation project called To-Collabo. Using the real-time nature of Twitter, which is my area of expertise, I began developing two linked apps: DITS*, which transmits disaster information including location information in a tweet during a disaster, and DIMS**, which displays disaster information on a map. However, during a large-scale disaster, it may be difficult to understand the whole picture through local information from Twitter alone. So, the idea was to solve this problem in combination with satellite remote sensing. The resulting series of studies from this perspective might be rather unique.

Cho: There have been other researches combining

Kohei Cho
Executive Director, Tokai University Research and Information Center (TRIC)
Professor at the Department of Human and Information Science, School of Information Science and Technology, Tokai University

Cho specializes in satellite remote sensing and is conducting a broad range of research including real-time monitoring via satellite data, analysis of changes in sea ice distribution, and environmental/disaster monitoring.

A fusion of two sensing techniques to achieve glocal monitoring

Global environmental changes are monitored through the analysis of satellite imagery obtained through satellite remote sensing

SNS: Social sensor

Local environmental changes are monitored by collecting text and photo posts from individuals and municipalities in disaster-affected zones

Tokai University established the Space Information Center as the first satellite data receiving station at a Japanese university in 1986, and since then, the university has been independently receiving and processing earth observation satellite data. The university has a record of collaborative research with a variety of institutions inside and outside of Japan, including the Ministry of Land, Infrastructure, Transport and Tourism, JAXA and NASA. A new satellite receiving antenna was installed on the roof of the newly constructed Building 19 at the Shonan campus.

GLOBAL

We would like to obtain usable results with this system when any disaster strikes next.

satellite remote sensing with social media. However, we think that this is one of the very first researches that is equally combining both technologies specialized for disasters.

Two "sensing" techniques linked by the shared purpose of disaster monitoring

Cho: "Remote sensing" is a technique for monitoring the global environment using sensors onboard satellites and/or aircrafts. Wide-scale disaster monitoring is possible using various kinds of sensors covering visible light, infrared, microwave, and other spectra.

Uchida: On the other hand, information transmitted by individuals using social media during disasters can be considered environmental sensing information output by humans, unlike so-called physical sensors. DITS and DIMS take advantage of that information.

Cho: In remote sensing, we use spectral sensors to monitor the wide area of the earth surface. By contrast, if there is a flood, for example, and somebody posts on social media, "The river near my house is overflowing," with a picture attached, we consider social media as a kind of "social sensor" that collects very local information. The union of the two techniques of remote sensing using satellites and social sensing using social media will enable a broader and deeper monitoring of disaster information.

Uchida: This is the meaning of "glocal." Before there were smartphones, there was no way to collect eyewitness information from individuals, but now that there is a smartphone in every pair of hands, we can collect and use that information.

My motto for finding unique themes and making research interesting

Cho: Research environments have many constraints, but my motto is that individual researchers have equal chances for doing good researches. I have been engaged in remote sensing research since I was a graduate student, and one of my important research themes has been sea ice monitoring. In this field, NASA has tremendous funding and human resources with overwhelming research achievements. When I wondered how I could stand a chance against NASA's research capabilities, my attention turned to sea ice in the Sea of Okhotsk, which is close to Japan and can be monitored in detail. There is no ice in the Sea of Okhotsk in the summer, but I noticed that NASA's analysis results showed sea ice along the coastlines even in the summertime. NASA researchers' main target is the entire globe, and at the time, they did not pay much attention to small errors in local areas like the Sea of Okhotsk. When I focused on such local phenomena and presented a method for reducing such errors at an academic conference, the NASA researchers were kind and fair enough to evaluate my method. Since then, I started to exchange ideas with the NASA researchers. I think this is the fairness of doing researches. This episode strongly reminded me the importance of having a unique perspective on doing a research.

Uchida: I am a newcomer to the field of disaster research. It was actually a statement from a student that spurred my study of disaster information using Twitter. At the time of the 2011 Great East Japan Earthquake, Twitter was very useful for gathering information about the affected area. A student of mine, for the research topic, chose to examine how to make social media useful for disaster prevention. While giving guidance to that student, I ended up being the one more engrossed in the topic. My lab has the motto, "Achieving a safe, worry-free, and comfortable society through the power of information science." I want my students to conduct their research with the intention of improving society even a little bit, so I have them choose their research topics based on this slogan as an operating policy for the lab. DITS and DIMS were also created based on ideas from students.

Cho: It is also important for university faculty to conduct research that attracts the attention and interest of students. Changing your research themes to match the themes and needs that are of greatest interest to students and society seems rather passive at first glance, but it is actually quite important.

Interdisciplinary fusion and international cooperation made possible at Tokai University

Uchida: The development of DITS involves not only myself, but also scholars in a number of fields at the university. Junior Associate Professor Tomita at Department of Arts, the School of Humanities and Culture, contributes to UI design; Professor Kajita at Department of Civil Engineering, the School of Engineering, contributes as an expert in urban engineering; Professor Yamamoto at Department of Mathematics, the School of Science, contributes from the perspective of data visualization; Junior Associate Professor Tajima at the Center for Liberal Arts contributes from the perspective

The idea is to produce a research output that is fundamentally useful and is supported locally.

of psychology during disasters; and Junior Associate Professor Utsu at Department of Communication and Network Engineering, the School of Information and Telecommunication, contributes from the perspective of mobile communication. I believe that this level of interdisciplinary fusion has been made possible because we are at Tokai University, where scholars in the sciences and the humanities share the same campus.

Cho: Taking further advantage of being a university consisting of various schools, we are gradually starting to cooperate with the School of Medicine as well. For example, changes in physical condition like heart rate and body temperature can also be measured and collected by smartphone sensors and can be useful in health management and emergency medicine. We are considering including such information in our glocal monitoring system.

Uchida: We have also produced an English version of DITS so that it can be used abroad as well.

Cho: We are conducting joint research in cooperation with the Institute of Remote Sensing and Digital Earth at the Chinese Academy of Sciences, as well as the University of the Philippines. The biggest advantage of this project is that its results can be used in any country and region around the world. We are quite optimistic about the expansion of this project in the future.

Towards implementing glocal monitoring

Cho: One of the goals of this research is to be able to use satellite data and Twitter data overlaid together within DITS and DIMS. Specifically, a map is overlaid with a satellite imaging layer depicting disaster conditions, and individual tweets and images from the affected area are represented as points on top of that and can be selected to display the text or picture showing specific circumstances.

Uchida: The idea is to produce a research output that is fundamentally useful and is supported locally. Disaster response measures are an important task for municipalities and are the subject of a high level of interest. In our activities, we have also been spurred to work harder because our efforts will be useful to regional areas, and we have gained confidence from the feedback we have received. For example, I was on a train during the large snowstorm in Tokyo this past January when there was an announcement over the speakers that “service has been interrupted due to a breakdown.” I spontaneously posted to DITS in that moment, and my tweet was actually faster than the official railway company website [laughs].

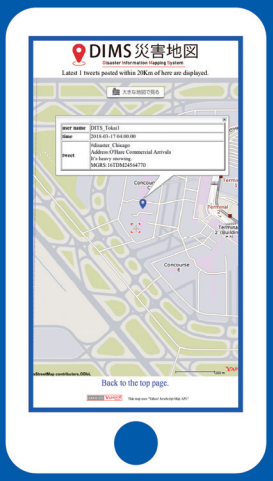
Cho: We would like to create an environment in which people living in regional areas tweet this type of information using DITS as part of their everyday lives. Even a well-made system for disasters, if we don’t use them habitually, it won’t be used during disasters. If a major disaster occurs, regular practice may allow users to use DITS even when they are in a panic. We would like to put much efforts to spreading the use of DITS among people living in regional areas. Japan is a country with many natural disasters, so it is inevitable that there will be one somewhere sometime. We would like to obtain usable results with this system when any disaster strikes next. We are in the middle of a trial-and-error process to make that a reality.

Osamu Uchida
Professor at the Department of Human and Information Science, School of Information Science and Technology, Tokai University

Uchida's current specialization is in disaster information systems, natural language processing, and image processing. With an interest in the social implementation of research for improving safety and peace of mind in society, he is working to construct a disaster information system using social media.

DITS and DIMS

DITS and DIMS can be used by anybody at any time through a web browser without requiring member registration or app download during emergencies. From the start screen, select DITS to make a disaster report and select DIMS to view disaster information on a map.



Information reported using DITS can be viewed by anybody who selects it using DIMS.

*DITS = Disaster Information Tweeting System
**DIMS = Disaster Information Mapping System
http://saigai.main.jp/en

About 70 residents gathered in the meeting hall at the Hiratsuka Museum of Art. With an unexpectedly large turnout, the staff brought out additional chairs.

Professors Cho and Uchida gave a presentation on the latest research on disaster prevention monitoring, and Professor Kajita presented examples of local cooperation.

Akira Mukaida of the Remote Sensing Technology Center of Japan moderated the panel discussion.

During the panel discussion, opinions were exchanged from the perspectives of scholars, the municipal government, and citizen's groups.

University, Region, and People: City planning for disaster resilience by integrating these three forces

Disaster prevention forum @ Hiratsuka: Aiming to make Hiratsuka City resilient against disasters

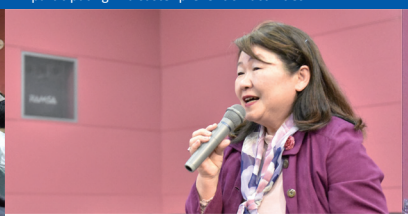
Researching disaster countermeasures is both fascinating and difficult because everybody who lives and works in a given region is a stakeholder, including people who have an interest in disasters and those who do not. Hiratsuka city and Tokai University which cooperate for disaster countermeasures held an event called "Disaster prevention forum @ Hiratsuka" on January 13, 2018, for Hiratsuka residents as a forum to report research results to date and to discuss future disaster response measures directly with locals.

Hiratsuka Mayor Katsuhiro Ochiai provided the opening remarks for the forum, which continued with guest speakers Ichiro Naito of JAXA and Masami Nemoto of the Geospatial Information Authority of Japan. Next, Professors Kohei Cho and Osamu Uchida, who are the driving forces behind the Tokai University disaster monitoring system research and global monitoring project, gave a presentation on the front lines of disaster prevention research as well as examples of actual implementation in regional areas.

The latter half of the proceedings was devoted to the topic of local disaster prevention efforts. Tsutomu Sano of the Disaster Prevension and Crisis Management Division, Hiratsuka City, discussed the current status of disaster prevention measures in Hiratsuka City, and radio personality Yamada Michiko of FM Shonan Napasa introduced examples of local disaster prevention efforts by city residents. Professor Yoshitaka Kajita of the School of Engineering, Department of Civil Engineering, is involved in a "Safety and Peace of Mind Project" that is a part of Tokai University's To-Collabo Project, and he introduced examples of workshops, events, disaster prevention education, and public awareness activities in cooperation with the local residents.

The hall was at full capacity, with nearly 70 residents in attendance. A strong interest in the theme of disaster prevention was evident, and during the panel discussion, the residents asked many questions to the experts, including the following: With the rise in two-income households, if a disaster strikes during working hours, children and the elderly would be the ones left in the local area. What kinds of preparation and training are necessary for them to be able to respond to such disasters? How can the latest disaster response systems become rooted in the daily lives of each and every resident? What measures are necessary to ensure that even the younger generation and residents with a low interest in disaster prevention will participate in evacuation training and disaster prevention activities? These discussions with locals revealed new issues as well. The challenge of disaster prevention is only just starting to be tackled.

During the Q&A, participants with a high interest in disaster prevention asked questions about the research that has been conducted.



Radio personality Michiko Yamada of FM Shonan Napasa gave her opinion on the importance of young people participating in disaster prevention activities.

Hiroshi Akiyama, chairman of the Hiratsuka City Resident's Liaison and Discussion Association, discussed the importance of analog data in an aging society.

Ms. Koshimizu, representative of "Hiratsuka Powers," a disaster prevention volunteer group talked about the importance of promoting participation by young people.

QOL Close Up

New Regenerative Medicine Encouraging Self-Healing

Regenerative medicine using iPS cells places a large burden on patients as a result of stem cell transplantation. Stem cells grow in a variety of organs of the body in regenerative environments known as "niches," and reduced niche function in patients can prevent sufficient cell growth. To solve this issue, a research team from Tokai University launched the entirely new concept of "drug-based regenerative medicine" and, with particular focus on "niches" as sites of cell regeneration, began developing new, original drugs that encourage the natural self-healing capabilities of human bodies. The goal is to improve the quality of life (QOL) of patients suffering from disease by achieving minimally invasive regenerative medicine through the use of drugs.

As the first step towards new drugs that promote a regenerative reaction by acting on niches, a research team centered around Tokai University Professor Kiyoshi Ando and Associate Professor Takashi Yahata has succeeded in developing a "blood regeneration promoter" used after transplanting hematopoietic stem cells as seeds for human blood. Clinical trials at the university are already underway.

This concept of using an approach from regenerative medicine to conduct drug development and then making the results directly useful in the clinical setting could only have been possible at Tokai University, which has specialists on basic research, drug development, and clinical application on a single campus, facilitating cross-disciplinary cooperation.

The investigation is also unique in its basis on an engineering approach, such as in the efficient selection of new candidate drugs by an in silico drug development approach using cutting-edge computer science. The study gathers together the combined intellect of the entire university through cooperation amongst multiple departments including those involving science, health, physical education, and the humanities. This leads to the development of new drugs that promote the regeneration of all tissues and organs in the human body without being limited to any one in particular.

Since a common mechanism often holds the key to both regeneration and cancer, the results of this study are also promising for applications in cancer treatment. Professor Ando has stated that the significance of this research is that, "We seek medical treatments that contribute to the improvement of patient QOL."

Kiyoshi Ando (right)
Executive Director of the Institute of Medical Sciences, and Professor at the School of Medicine, Department of Hematology and Oncology, Tokai University

Takashi Yahata (left)
Associate Professor at the School of Medicine, Research Center for Regenerative Medicine, Tokai University