Proceedings of the Fifth IIEEJ International Workshop
on Image Electronics and Visual Computing 2017
Da Nang, Vietnam, February 28 - March 3, 2017

TERM MAP: DEVELOPMENT OF TOHOKU DISTRICT ENVIRONMENT RECOVERY MONITORING MAP

Shoka Kato, Osamu Uchida, Kazumi Terada, Kiyonari Fukue, Kohei Cho†
†Tokai University

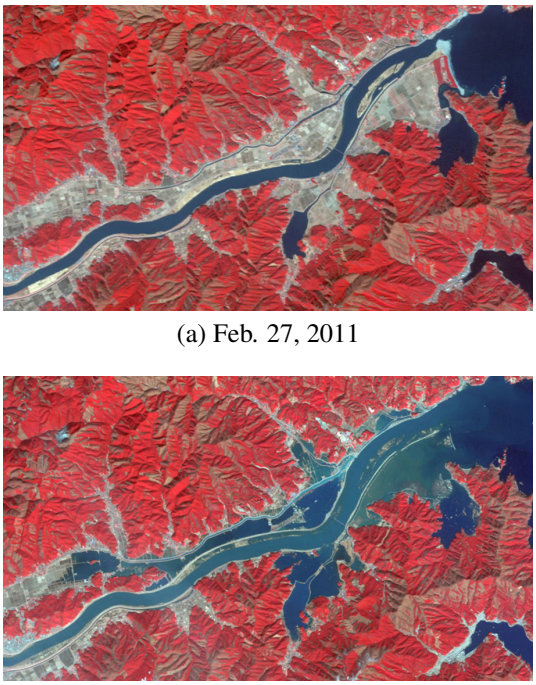
Toshiaki Sato††
††PASCO CORPORATION

ABSTRACT

The Great East Japan Earth quake that occurred on March 11, 2011 brought serious damage in the Tohoku district in Japan. We consider that it is important to monitor how the destructed environment will recover for a long time. From such a background, our research group has been working on a project such as "A project on monitoring environmental recovery of damaged area in Tohoku, Japan from space and ground for environmental education" since 2012. In this paper, the part of the progress of the project, especially the topic of the development of TERM MAP (Tohoku District Environment Recovery Monitoring Map), a Web-based system to present the status of the earthquake disaster recovery is described.

1. INTRODUCTION

The Great East Japan Earthquake that occurred on March 11, 2011 brought serious damage to the Tohoku district in Japan. Images of the Tohoku district taken by earth observation satellites gave evidence of extensive damage. There have been many examples of utilization of satellite image analysis to grasp the situation of damage (e.g., [1, 2, 3]). Figure 1, for example, shows ALOS (Advanced Land Observing Satellite) images of the Kitakami River taken on before and after the disaster, and Fig. 1 (b) shows the damage of the tsunami at the mouth of the Kitakami River comprehensibly. However, henceforth, it is more important to monitor how the destructed environment will recover after the disaster. From such a background, our research group has been working on a project such as "A project on monitoring environmental recovery of damaged area in Tohoku, Japan from space and ground for environmental education" since 2012 [4]. The main purposes of the project are to monitor the status of the environmental recovery from both aspects of satellite image analysis and field work with high school students in the disaster area, and to practice earth environmental education for young people through such work. Moreover, to construct a Web-based system to present the status of the environment recovery and the reconstruction of the disaster area, and to disseminate the information of the disaster area to the world community promptly and correctly by the proposed system are also important purposes of the project. The part of the project can be considered as a construction of digital archives of the earthquake disaster (e.g.,[5, 6, 7, 8]). For example, the project of "Michinoku-Shinrokuden (http://shinrokuden.irides.tohoku.ac.jp/)" [5, 6] promoted by Tohoku University, Japan is representatives of that. However, in these archives, the presentation of the combined information with satellite image analysis and the field work is not intended. Moreover, the viewpoint of earth environmental education for young people, the one of the main purpose of our project is also not intended in these projects.



(a) Feb. 27, 2011

(b) March 14, 2011

Figure 1: ALOS satellite images (provided by JAXA)

To conduct soil investigations of agricultural lands dam-

Figure 2: Soil investigation conducted with the students of Sendai Technical High School

aged by the tsunami, and to insert the results of them into the system can be considered as the outstanding feature of our project compared with similar projects. The damage of agricultural lands from the tsunami was enormous [9]. Then we consider that to monitor the status of the recovery of agricultural lands is of extreme importance.

In this paper, the part of the progress of the project, especially the topic of the development of TERM MAP (Tohoku District Environment Recovery Monitoring Map), a Web-based system to present the status of the earthquake disaster recovery is described.

2. DATA CORRECTION IN THE DISASTER AREA

In this project, we monitor the status of the environment recovery from both aspects of satellite image analysis and field work in cooperation with local high school students and their teachers (Figure 2 shows the situation of the soil investigation conducted with the students of Sendai Technical High School) for a long time. At this time, we have conducted field works for three items below on a regular basis:

(a) Taking photos

(b) Measuring soil salt density

(c) Measuring water quality of oyster farms [10]

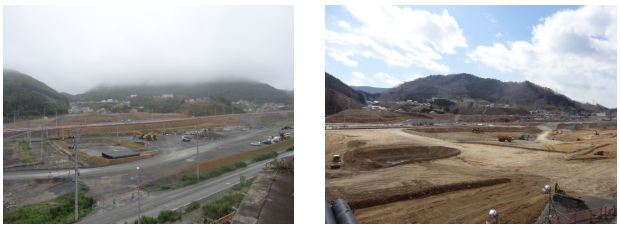
The photographing has been conducted at the predetermined points for a predetermined direction. We can easily compare the recovery status of these points in view of the time-series variation by observing the same points regularly for a long time (Fig. 3).

Oct.14, 2012 March 20,2013

(a) Sendai Municipal Arahama Elementary school

Oct.14, 2012 March 20,2013

(b) Nishi Minato Cho, Kesennuma City



Aug. 22, 2015 March 11, 2016

(c) Onagawa Town

Figure 3: Comparison of the photos taken on the different days

3. TERM MAP: TOHOKU DISTRICT ENVIRONMENT RECOVERY MONITORING MAP

3.1. OVERVIEW

We construct a Web-based system to present various data of the area affected by the Great East Japan Earth quake on a map. The system, which we call TERM MAP (Tohoku District Environment Recovery Monitoring Map), can present, in particular photographic images, soil state density, and satellite images. It can also display the regions of tsunami inundated areas superimposingly. Figure 4 shows an example of the initial screen of the system. Google Maps API is used to implement the system. Red markers on the map indicate the photographing spots and blue ones indicate the spots of measuring soil salt density. When a user clicks a marker, photographic images taken at the place correspond to the marker are displayed under the map. The images are displayed in chronological order. Figure 5 shows an exam-

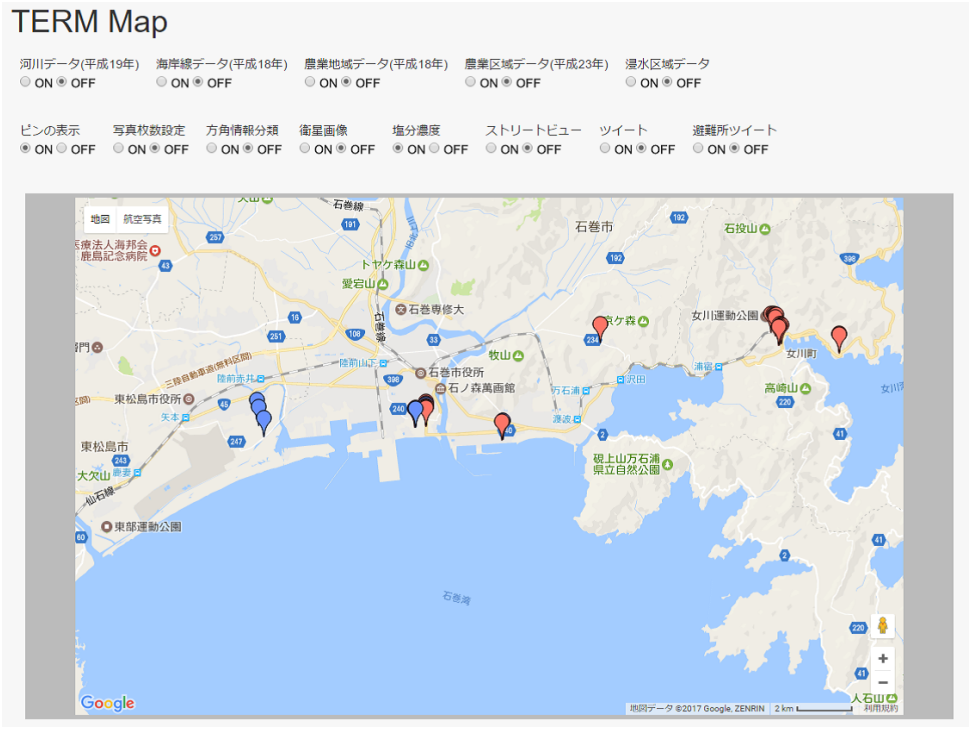


Figure 4: An example of the initial screen of TERM MAP

Figure 5: An example of the displaying photographic images on TERM MAP

ple of the displaying the photographic images. TERM MAP can also display a graph of changes in soil salt density under the map. Figure 6 shows a graph of changes in soil salt density on a certain point (the displaying function is implemented by using Hicharts (http://www.highcharts.com/), a JavaScript library to make graphs). From this figure, soil solt density of this point is on a downward trend plainly.

When the option to display the regions of tsunami inundated areas is checked, the region is displayed superimposingly (Fig. 7).

3.2. AUTOMATIC MARSHALLING OF PHOTOGRAPHIC IMAGES

It is difficult to marshal collected photographic images manually, because the total numbers of images is now over 5,000. Therefore, we try to develop a method for automatic marshalling of photographic images. First, city names are given to all photo images by using Yahoo! Reverse Geo-coding API (all images have Exif data with a latitude-longitude location information). Then, all photos are divided into folders (the name of folders are equal to the city names). Next, images in each folder are clustered (the size of one cluster is 20 meters square). The number of all clusters is about 700 after applying clustering to all collected photo images.

3.3. A FUNCTION OF DISPLAYING IMAGES THAT ARE SORTED BY DATE AND DIRECTION

When a user clicks a marker, the system displays all images taken at the place correspond to the marker in chronological order. However, multidirection images are displayed

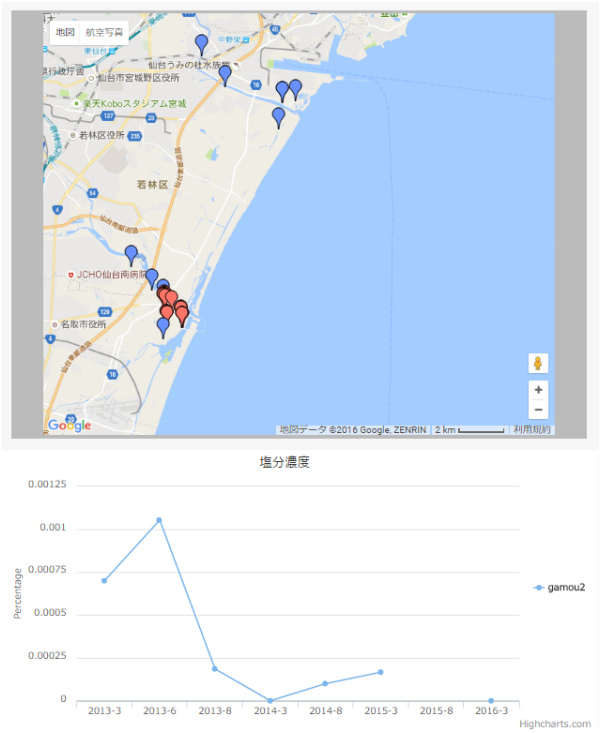


Figure 6: An example of the displaying a graph of changes in soil salt density

simultaneously, then it is difficult to confirm the environmental changes when the number of displaying images is large. Therefore, we implement a function of displaying images that are sorted by date and direction. This function is implemented using bxSlider (http://bxslider.com/), a JQuery plugin. Figure 8 shows an example of the displaying images using this function. Using the function, users can easily compare two or more images in the same direction taken on the different days.

4. CONCLUSION

In this paper, we described the part of the project called "monitoring environmental recovery of damaged area in Tohoku, Japan from space and ground for environmental education," especially the topic of the development of TERM MAP (Tohoku District Environment Recovery Monitoring Map), a Web-based system to present the status of the earthquake disaster recovery. We have not yet conducted the verification of the usability of the system in detail, then we will do it in future work.

Figure 7: An example of the displaying the regions of tsunami inundated areas on the map superimposingly

ACKNOWLEDGMENT

This work was supported by JSPS KAKENHI Grant Number 24300272.

REFERENCES

[1] M. Sato, S.-W. Chen, and M. Satake, "Polarimetric SAR Analysis of Tsunami Damage Following the March 11, 2011 East Japan Earthquake", Proc. of the IEEE, Vol. 100, No. 10, pp. 2861–2875 (2012).

[2] M. Satake, T. Kobayashi, J. Uemoto, T. Umehara, S. Kojima, T. Matsuoka, A. Nadai, and S. Uratsuka, "Damage Estimation of the Great East Japan Earthquake with Airborne SAR (PI-SAR2) Data", Proc. 2012 IEEE International Geoscience and Remote Sensing Symposium, pp. 1190–1191 (2012).

[3] Y. Li, M. Sugawara, and J. Shibata, "Disaster Monitoring of the Great East Japan Earthquake Using High Resolution Satellite", Journal of the Japan Society of Photogrammetry and Remote Sensing, Vol. 50, No. 4, pp. 210–215 (2011). (in Japanese)

[4] K. Cho, K. Fukue, O. Uchida, K. Terada, and C.-F. Chen, "Monitoring Environmental Recovery of Damaged Area in Tohoku, Japan from Space and Ground for Environmental Education", Proc. 34th Asian Conference on Remote Sensing , pp. 709–716 (2013).

[5] F. Imamura, S. Sato, and A. Shibayama, ""Michinoku-Shinrokuden": Digital Archive Project of the 2011 Great East Japan Earthquake Disaster by Industry-academia-government-citizen Collaboration", Journal of Information Processing and Management, Vol. 552, No. 4, pp. 241–252 (2012). (in Japanese)

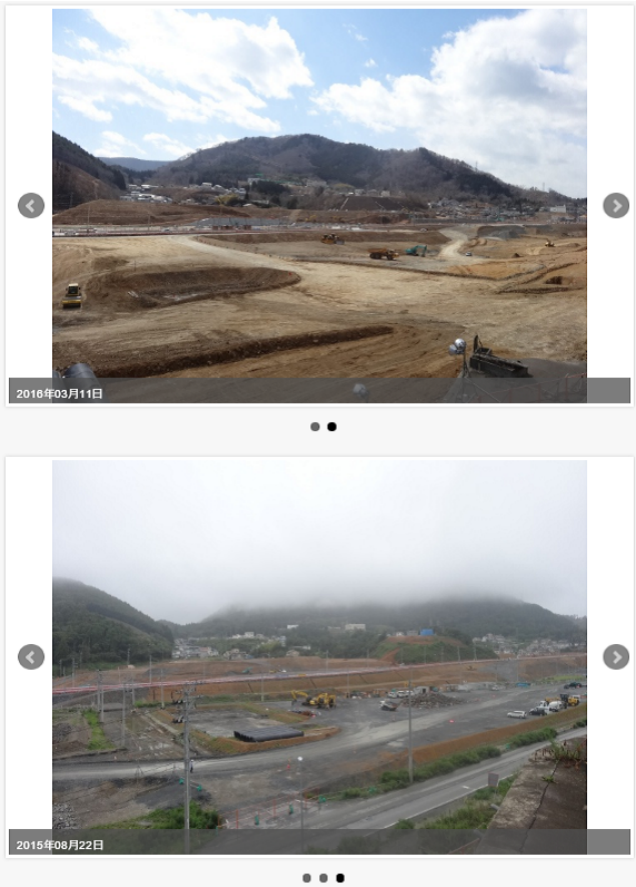


Figure 8: An example of the displaying the images using the image sorting function

[6] F. Imamura, A. Shibayama, and S. Sato, “Digital Archive Project ”Michinoku-Shinrokuden” of the 2011 Great East Japan Earthquake Disaster”, Journal of the Institute of Electronics, Information, and Communication Engineers, Vol. 95, No. 10, pp. 921–926 (2012). (in Japanese)

[7] M. Kawai, “The Archives of the Great East Japan Earthquake by the National Diet Library, Japan”, Joho Chishiki Gakkaishi, Vol. 22, No. 4, pp. 291–297 (2012). (in Japanese)

[8] M. Okamoto, “Disaster Archives – Current Situation and Problem”, Joho Chishiki Gakkaishi, Vol. 22, No. 4, pp. 308–315 (2012). (in Japanese)

[9] M. Nanzyo, “Farmlands Damaged by Huge Tsunami and Countermeasures”, Japanese Journal of Multiphase Flow, Vol. 26, No. 2, pp. 143–149 (2011). (in Japanese)

[10] M. Kutsumi, K. Terada, O. Uchida, K. Fukue, and K. Cho, “Water Quality Characteristic After the Great East Japan Earthquake in Nagatsura-ura Lagoon, Miyagi”, Journal of Japan Society of Civil Engineers, Ser. B2 (Coastal Engineering), Vol. 69, No.2, pp.1096–1100 (2013). (in Japanese)