Prototyping a Data Sharing System for Flood Forecasting:
A Case Study on Sri Lanka

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Abstract : In the basin where the flood disaster have occurred or may occur, we are developing web-based data sharing systems for flood forecasting. In this paper, we focus on Sri Lanka. In Sri Lanka, a large flood occurred in late May 2017, and many residents were sacrificed. For the secondary disaster precaution and the basin reconstruction, our proposed system with various data has been developed immediately, and the data providing has been started to the local stakeholders.

Keywords: Data Sharing, Data Visualization, Flood Forecasting

1. Introduction

In recent years, a large number of people were dead or missing by large-scale floods in various regions. Because it has been reported that the frequency of heavy rain increases due to climate change, the people are concerned about more disasters from the floods in the future. Though a lot of the observation data are necessary to reduce the disaster, the observation networks about rainfall and river are scarce in developing countries, and it is difficult to catch the sign of flood occurrence at present. Thus, the preparation of data infrastructure is pressing need in developing countries.

On the other hand, in the DIAS (Data Integration and Analysis System), various data such as field observation data, satellite observation data, global warming prediction model output, etc. is being accumulated, and various applications using these data are being developed.

In the basin where the flood disaster have occurred or may occur, we are developing web-based data sharing systems for flood forecasting. In this paper, we focus on Sri Lanka. In Sri Lanka, a large flood occurred in late May 2017, and many residents were sacrificed. For the secondary disaster precaution and the basin reconstruction, our proposed system has been developed immediately, and the data providing has been started to the local stakeholders.

2. Construction Method

For constructing a prototype of data sharing system for flood forecasting, the following requirements were determined:
a) Enable to view the data about weather in real time
b) Reproduce the situation of heavy rain and flood
c) Construct the website for data sharing promptly

For filling the above-mentioned specification, we decided to develop the proposed method on the DIAS. The DIAS started from 2006. The goals of DIAS are to collect and store earth observation data; to analyze

such data in combination with socio-economic data, and convert data into information useful for crisis management with respect to global-scale environmental disasters, and other threats; and to make this information available within Japan and overseas [1].

Architecture of the proposed system on the DIAS is shown in Fig. 1. Using the data uploader tool, the earth observation data from data provider is archived on the storage. When users access to each data page by using Web browser, users can view the data by the data visualization API and download the data.

Table 1 shows the used data in the proposed system. It has field observation data, satellite observation data, and simulation output. Rain gauge data is time series on observation point, the other data is time series on spatial data.
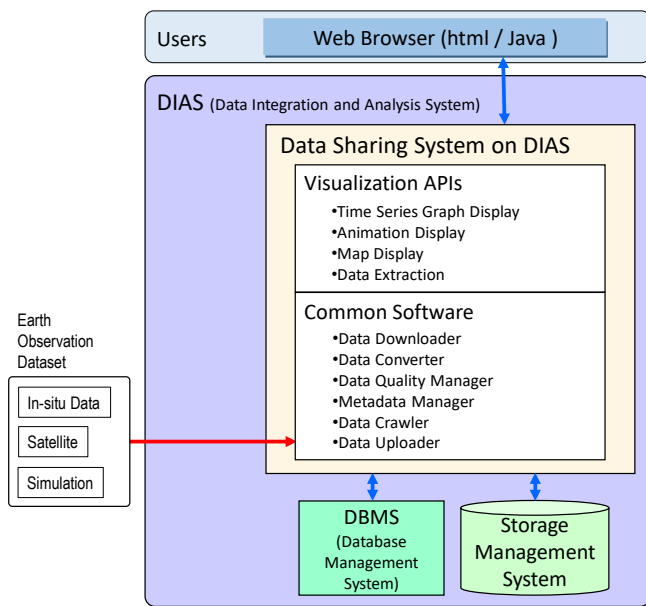

Fig. 1. Architecture of the data sharing system.

Table 1 Used data.

No.	Name	Type of data	Interval	Provider
1	Rain gauge	In-situ (Rainfall)	Hourly	Sri Lanka
2	Himawari-8 [2]	Satellite (Cloud)	10 minutes	JMA, Japan
3	GSMaP [3]	Satellite (Rainfall)	30 minutes	JAXA, Japan
4	Weather forecasting	Simulation (Rainfall)	Hourly	NCEP, US
5	Flood reproduction	Simulation (Inundation depth)	Hourly	ICHARM, Japan

As the first step of the system construction, the weather data (No. 1 – 4 of Table 1) is being accumulated in real time on DIAS, and the proposed system enable to view the data covering Sri Lanka.

For the visualization of the weather data, the web-based visualization APIs that have been developed on DIAS project are used. Specifically, the rain gauge data (No. 1 of Table 1) is visualized by the time series graph display API of Fig. 1. The weather data (No. 2 – 4 of Table 1) is extracted to the target area by the data extraction API, and visualized by the map display API of Fig. 1.

The flood reproduction model output data (No. 5 of Table 1) is visualized by the map display API of Fig. 1. The website is constructed in a short time by incorporating the above APIs. Regarding the reproduction of the disaster in late May 2017, the data of the target period is extracted from the accumulated data, visualized in the above same way, and displayed on the Web browser.

3. Result

Based on the method in the previous section, the prototype system has been realized within 3 days from the start of construction. The factor of this construction in short term is based on utilizing the beforehand developed APIs and using the template of web design. In other words, it means that the system can be constructed in a short period of time about the other basin, if the specification of the target basin is determined.

Next, the results of the constructed website is described. Fig. 2 shows the snapshot of rain gauge data page. Fig. 2(a) is the real-time display for all rain gauge site. Map of the rain gauge site, summary of rainfall (1 hour, 24 hours, 3 days and 30 days), and time series charts (hourly) of rainfall in each site have been displayed. We can confirm the status of each site. Fig. 2(b) is the display of a site in late May 2017. Location of the rain gauge site, summary of rainfall (24 hours, 3 days and 30 days), and time series charts (1 hour, 24 hours, 3 days and 30 days) of rainfall have been displayed. We can understand the rainfall of over 500mm/day in Kalawana.
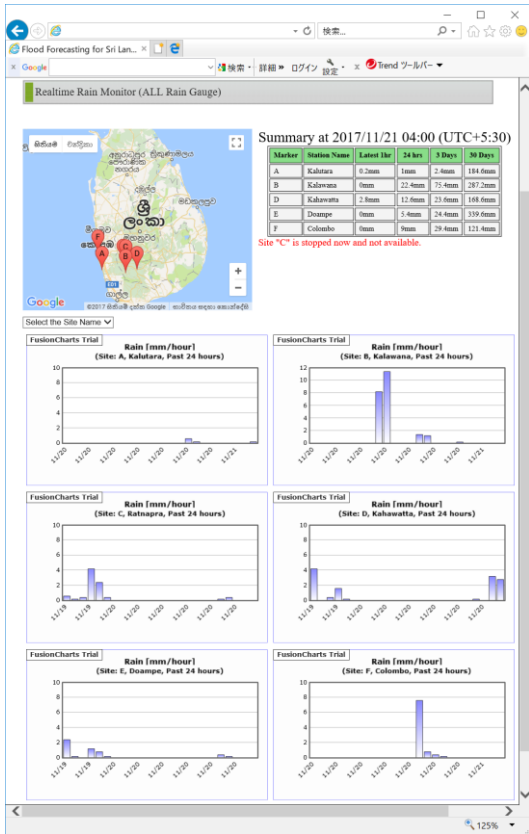
(a) All site display.
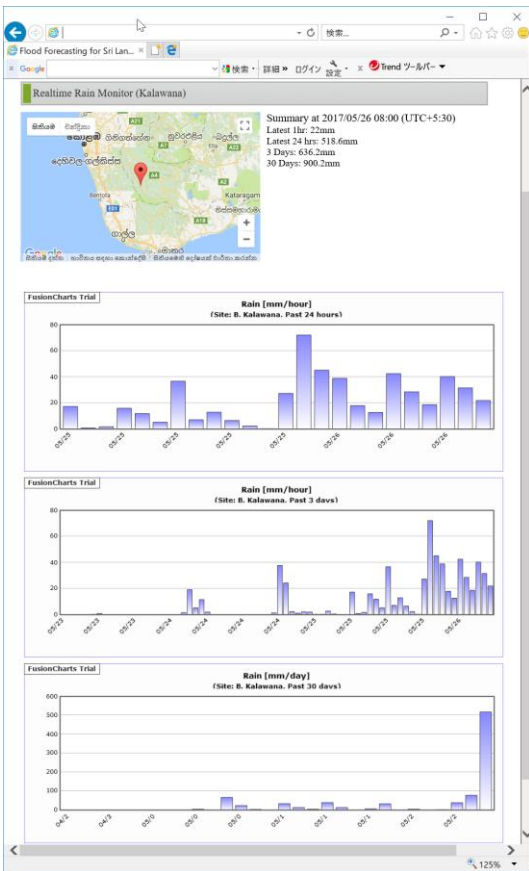
(b) One site display.

Fig. 2 Display for rain gauge data.

Fig. 3 shows the display of the cloud observation by the satellite Himawari-8. The left image is visual channel, and the right is near-infrared channel. This page can not only display the latest image but also the animation of 24 hours. From this page, we can understand the appearance and the flow about cloud.
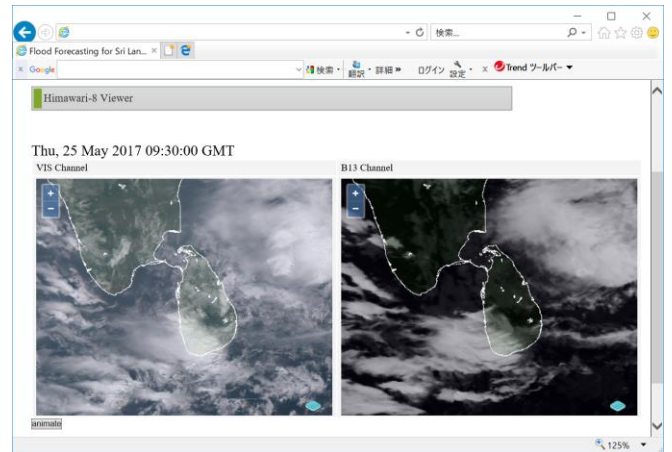

Fig. 3. Display for Himawari-8.

Fig. 4 shows the display for rain map from the GSMaP. The red area means heavy rainfall. This page can display the animation of 24 hours. This is useful as the input of the flood forecasting.
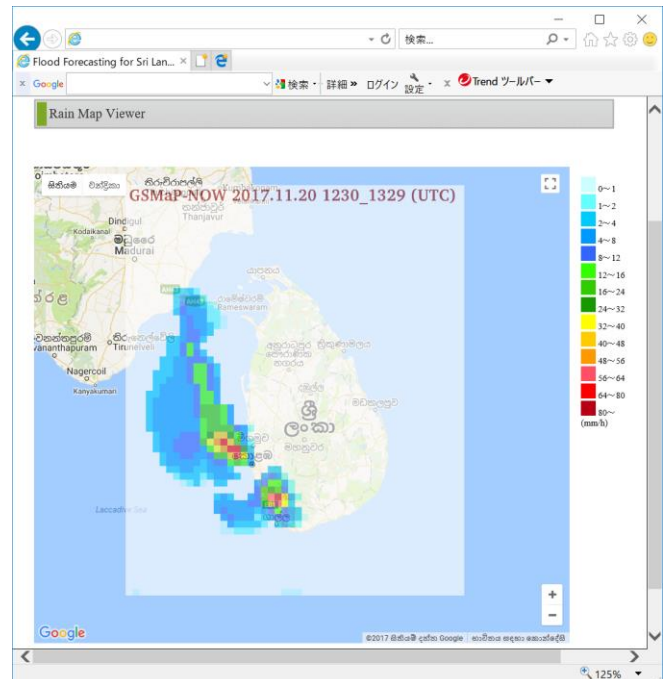

Fig. 4. Display for rain map.

Fig. 5 shows the display for weather forecasting. The red area means heavy rainfall. This data is downloaded from NCEP, corrected by in-situ data, and displayed in this page. This page can display the animation of 72 hours. This is useful as the input of the flood forecasting.
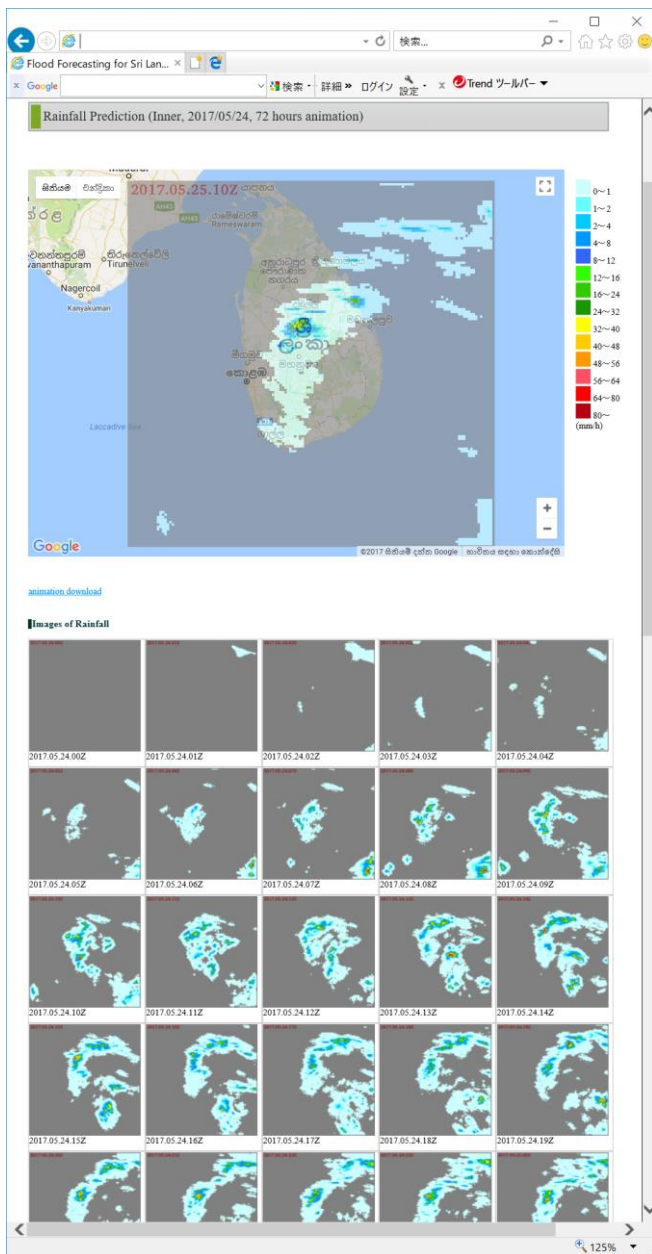

Fig. 5. Display for weather forecasting.

Fig. 6 shows the display for flood reproduction in late May 2017. The pink area means high inundation depth. This data was produced from rain gauge data, GSMaP data and digital elevation model by RRI (Rainfall-Runoff-Inundation) model [5]. This page

can display the animation every one hour. We can understand the change of flood area along the time series.
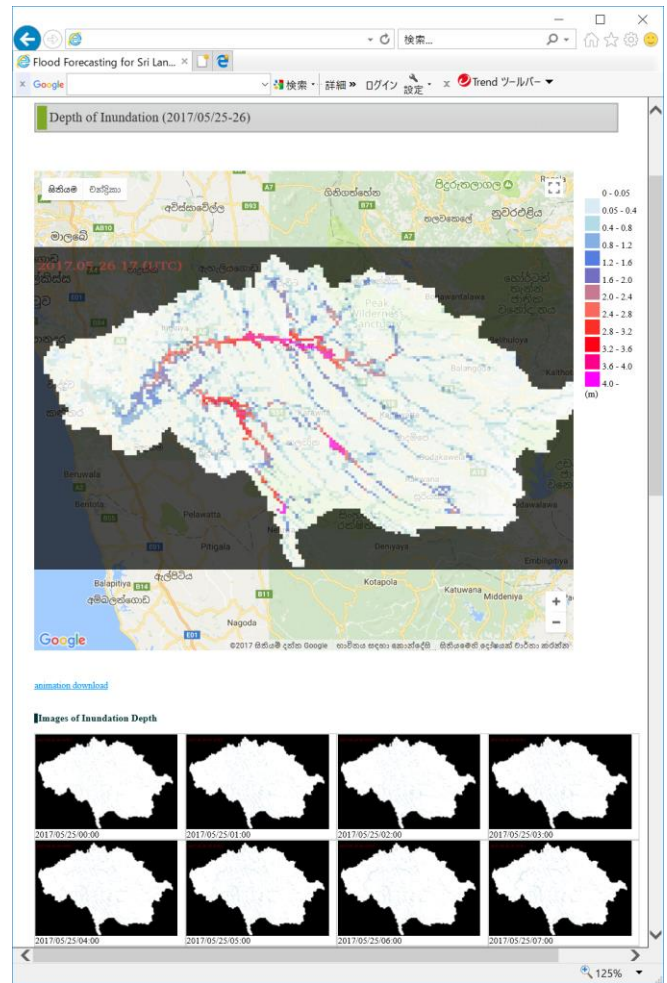

Fig. 6. Display for flood reproduction.

This system can correspond to real-time weather data, it is possible to view the latest data, and it became possible to visually understand whether the target area is safe or not. Actually, this system is used by the local stakeholders to understand weather conditions.

On the other hand, it is available to view the data at the time of the past disaster, so that it became possible to reproduce how the flood occurred with heavy rainfall. The display of the past disaster is used as a training material by the local stakeholders.

4. Conclusion and Future Work

In this paper, the development of a web-based data sharing system for flood forecasting as a case study of Sri Lanka is described. By incorporating various

APIs into this system, this system has been constructed in a short period of time, and the web-based data sharing has been realized. This system is used by the local stakeholders, and being improved by feedback.

In near future, to enhance this system, the real-time processing of the flood prediction model will be realized, and the output will be visualized in this website.

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