Investigating the influence of Web-Media in disaster situations by analyzing diffusion of tweets

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The goal of this research is to prevent unnecessary information diffusion at the time of disaster that can be a cause of confusion among victims. To meet this goal, this paper focused on the possibility of information diffusion being influenced by web media. Following such a situation, this paper examined tweets at the time of Typhoon Hagibis struck Japan in 2019 investigating ratio and temporal changes of tweets containing URLs that transit to news articles sent by web media. Our examination revealed that total numbers of tweets and tweets containing such URLs were positively correlated. Moreover, as a result of referring the source of those URLs, specific Web-Media or news article tended to post.

1. Introduction

Since the Great East Japan Earthquake, information transmission on disaster damage and rescue using social networking services (e.g. Twitter, Instagram, Facebook, Line) has increased. Effective use of SNS information and posts can help save victims during a disaster. In addition, building archives of posts that include disaster explanations and media reports posted on SNS by experts can lead to the reduction and prevention of disasters.

On the other hand, one potential problem with using SNS as a means of collecting information while a large-scale disaster is a need to counteract information diffusion and fake information[1]. In general, the cause of the rapid spread of information in SNS is that anyone can immediately post information. During a disaster, there is a concern that the strong transmission power of the medium may promote information diffusion. To verify such concerns, this study focuses on the how web media affects information diffusion and what causes the diffusion. By focusing on how information is diffused on Twitter, this study investigates tweet which share the URLs of news articles which are posted at the time of the disaster.

2. Related research

2.1 Relationship between SNS text and people's decision making

Enomoto quantitatively investigated how Twitter posts influence people's decision making regarding returning home during a disaster [3]. Enomoto mentioned that previous studies only investigated the understanding present at the time of the disaster, and did not consider measures which could reduce damage from a disaster. This demonstrates that they have attempted to extract information that could reduce disaster damage from tweets. In particular, when tweets about transportation are mostly pessimistic, a high percentage of people tend to stay at the

office. This study showed that, even if the reliability of SNS-derived information is not guaranteed, it may still strongly affect people's decision making at the time of disaster. Information provided on SNS may help avoid some confusion. Finally, it suggested that an analysis method for long-term data is needed to improve analytical accuracy.

2.2 Position of This study

The previous study investigates how to effectively use of tweets during a disaster. The ease of tweeting and strength of diffusion, however, make it difficult to gather and effectively use information from Twitter. The main purpose of this study is to clarify whether Web-media can be a factor in unnecessary information diffusion. In our study, we compared the total number of tweets about a specific disaster with the number of tweets including a link to web-news. In addition, from tweets about a specific disaster, we observe the transition of the number of tweets, word counts, and which site the URLs transit to.

3. Target Data of Tweets

3.1 About Typhoon Hagibis

Typhoon Hagibis was the 19th typhoon of the 2019 Pacific typhoon season. According to the Japan Meteorological Agency announcement, Typhoon Hagibis occurred neare the Minamitorishima on October 6th, 2019; it landed on the Izu Penisula just before 19:00 on October 12th. After Typhoon Hagibis passed through the Kanto region, it became a temperate cyclone on the Pacific Ocean on October 13th. The typhoon caused heavy rainfall, especially in the Kanto, Koushin, and Tohoku regions; record rainfall significantly exceeded the expected rainfall. On November 1st, the government issued and the enforced a Cabinet Order specifying the event as a serious disaster and tool appropriate measure for the disaster. According to the report "About the damage situation by Thyphoon Hagibis(No.50)."*1 over 71 rivers had levees collapse in more than 140 places. We collected tweets about "Iruma River," "Sagami River," and

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*1 `https://www.mlit.go.jp/saigai/saigai_191012.html`

"Chikuma River" to analyze word occurrences and URLs occurrences.

3.1.1 Iruma River

Iruma River is part of the Arakawa Ricer systems flowing through Saitama Prefecture. Arakawa Upper River Office and Kumagaya Regional Meteorological Observatory announced that a river overflow occurred in the Iruma River basin at 21:30 on October 12th.

3.1.2 Sagami River

Sagami River is the main river in the Sagami River system which flows through the Yamanashi and Kanagawa prefectures. Kanagawa prefecture announced that it would release emergency water at the Shiroyama Dam at 17:00 on October 12th, calling on residents to evacuate because of the possibility of flood damage. The discharge time was postponed at 22:00 due to the water level being lower the expected, but the emergency discharge eventually began at 21:30 because the subsequent rainfall conditions exceeded the forecast.

3.1.3 Chikuma River

Chikuma River is the main river in the Shinano River system which flows through Niigata and Nagano prefecture. It is called the Shinano River in Niigata prefecture and Chikuma River in Nagano prefecture. According to announcements from the Chikuma River Office, nine floods occurred between October 12th and October 13th.

3.2 Gathering Tweets

The main analysis of this study is the damage caused by Typhoon Hagibis in October 2019. Tweets related to Typhoon Hagibis that were posted between October 10th and October 16th and related to the damaged Iruma River, Sagami River, and Chikuma River were collected via Twitter API. Retweets were excluded because they duplicate tweets. The collected tweets were divided into morphemes using MeCab (ver. 0.996), and nouns and URLs contained in the text were extracted. A total of 13,676 tweets were collected about the Iruma River, 39,585 about Sagami River, and 77,994 about the Chikuma River1. The data were divided and counted in units of 30 minutes throughout October 12th and 13th; these dates had the largest number of tweets regarding each river. As a result, in all three rivers, the time zone where the number of tweets increased rapidly was confirmed (Tweet Burst). The number of tweets per unit time in each river was compared with the number of tweets in the last per unit time of tweets. The Tweet Burst was observed on each river: Iruma River related tweets increase 844.2% between 19:30 and 20:00 on the 12th; Sagami River increased 258.9% between 14:30 and 15:00 and 323.9% between 21:00 and 21:30 on the 12th; and Chikuma River increased 1062.7% between 20:30 and 21:00 on the 12th and 368.6% between 06:00 and 06:30 on the 13th.

3.3 Word Occurrences

The investigation of words occurrences regarding each river was conducted based on words appearing in tweets during bursts. Figure 11 shows an example of the words which appeared during the Tweet Bursts for Sagami River (Words are originally Japanese, then translated to English).

Table 1: The Total Number of Tweets

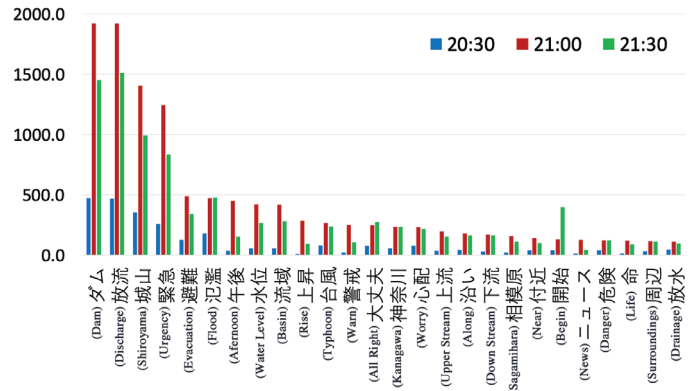| Date	Iruma	Sagami	Chikuma
10/10	22	81	40
10/11	55	198	71
10/12	10416	31741	17277
10/13	2569	6177	47598
10/14	350	753	7027
10/15	163	451	3985
10/16	71	185	1996
Total	13676	39586	77994

Figure 1: Words in Sagami Rivier at second Tweet Burst

Sorting was performed in descending order of the number of words appearing 30 minutes before and after the time when the Tweet Burst occurred. At sorting, the words "River," "Iruma River," "Sagami River," "Chikuma river," and words in Slothlib Lists[4] are excluded.

3.4 The transition of number of URLs

URLs included in tweet data were extracted to investigate the number of tweets that include links to news articles. Since the URL posted on Twitter is automatically shortened, the original URL was expanded using urllib3(ver.1.24). There are three types of tweets that include URLs: a tweet including a photo or video[2]; a QT or tweet that quotes another tweet; a tweet with a URL directed to an external website. URLs that link to news article are included in the third conditions. At expanding URLs, URLs that transit to Web media articles often contained "news" or "article", and a total of 2960 items were confirmed from the 12th to the 13th. Figure 22 shows an example of the relationship between the number of tweets per unit time and the number of posts linking to news articles in the case of Sagami River.

4. Discussion

From the observations of tweets transition from the previous section, it was confirmed that the number of tweets increased as the number of URLs that linked to news articles increased, and the number of tweets decreased as the number of the URLs decreased. The correlation coefficient
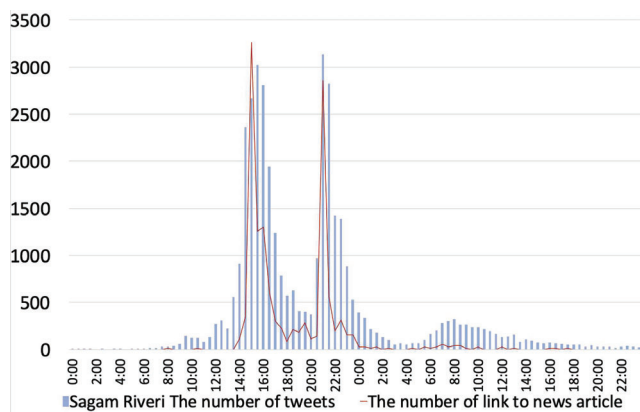
Figure 2: The number of tweets and the number of URLs which link to news articles

between the number of tweets regarding each river and the number of URLs linking to news articles was 0.77 for Irum River, 0.780 for Sagami River, and 0.79 for Chikuma River, indicating a strong positive correlation. These are still spurious correlations because the Tweet Bursts of Sagami River and Chikuma River tweets occurred before the burst of URLs that linked to news articles. In other words, there is not a clear causal relationship between tweets and URLs. There may be another possible factor that influences Tweet Bursts other than Web-media. Besides, the URLs tend to link a certain news article. that link to news article (e.g. Yahoo! News, Sankei Digital). By using words from tweets which were not among the top 20 words in the Tweet Burst for each river, we were able to find words which related to the actual events. For example, the words "dam," "discharge," "emergency," and "Shiroyama," which appeared many times in Sagami River tweets, all related to the emergency release of the Shiroyama Dam at 21:30 on October 12th. The word "shinkansen," which appeared many times in the Chikuma River tweets were based the flooding of the Hokuriku Shinkansen Vehicle Center due to the river flooding. In particular, the usage of "shinkansen" increased from 24 to 490 times between 07:00 and 07:30 after the Tweet burst that occurred between 06:00 and 06:30 on October 13th. For this reason, we investigate tweets that include URLs among tweets that included "shinkansen." As a result, 104 corresponding tweets include URLs. 92 in those tweets were camera shots of video broadcasted on TV news "NHK News Good Morning Japan." This result signaled the impact of the social media presence on broadcast media.

5. Conclusion

In this paper, we collected tweets about Typhoon Hagibis in 2019 and quantitatively investigated the number of tweets and tweets including URLs that link to news articles. As a result, a positive correlation was confirmed between the number of tweets and URLs, suggesting the effect of Web-media of information diffusion. However, this does not indicate that there is always a causal relationship be-

tween tweets and the URLs; these results suggest that there are other, additional influences on rapidly increasing numbers of tweets. The URLs linking to news articles tended to be a specific article. When manually checking the photos tweeted by the user, many Twitter user individually took a photo of TV screen which was shown broadcast media's news were confirmed. This indicates the potential influence of broadcast media. In the future, investigating the number of tweets that have taken photos of broadcast media and comparing the number of tweets with the number of URLs that link to news articles would be beneficial.

References

[1] Fujishiro, H., Matsushita, M., Ogasawara, M.: Effective Use of Social Media in Large-Scale Disasters: The Applicability of Information Triage (in Japanese) , Socio-Informatics, Vol. 6, No. 2, pp. 49–63 (2018).

[2] Watanabe, H., Kirimura, T.: An analysis of temporal change of interest in a tourist spot; using SNS's Photograph data (in Japanese), Proceedings of the General Meeting of the Association of Japanese Geographers, pp. 198 (2018).

[3] Enomoto, H., Kuwano, M., Koike, A.: ANALYSIS OF RELATIONSHIP BETWEEN SOCIAL MEDIA INFORMATION AND RETURNING HOME IN DISASTERS (in Japanese), Journal of Japan Society of Civil Engineers, Ser.D3 (Infrastructure Planning and Management), Vol. 70, No. 1, pp. 102–112 (2014).

[4] Ohshima, H., Nakamura, S., Tanaka, K.: SlothLib: A Programming Library for Researches on the Web (in Japanese), DBSJ Letters, Vol. 6, No. 1, pp. 113–116 (2007).