# Regional Analysis of User Interactions on Social Media in Times of Disaster

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## ABSTRACT

Social media attract attention for sharing information, especially Twitter, which is now being used in times of disasters. In this paper, we perform regional analysis of user interactions on Twittter during the Great East Japan Earthquake and arrived at the following two conclusions:People diffused much more information after the earthquake, especially in the heavily-damaged areas; People communicated with nearby users but diffused information posted by distant users. We conclude that social media users changed their behavior to widely diffuse information.

## Categories and Subject Descriptors

J.4 [**Computer Applications**]: Social and behavioral sciences

## General Terms

Human Factors, Measurement

## Keywords

Twitter, online social network, information diffusion, disaster situation, earthquake,regional analysis

## 1. INTRODUCTION

During a disaster, collecting information is important to save lives. Victims require information about shelters or especially dangerous points. Furthermore, rescuers require information such as victim locations or the availability of supplies.

Social media attract attention for their information sharing capabilities, especially Twitter, which is one hugely popular social medium that is used during disasters [1],[2]. By analyzing interaction behaviors on Twitter, we can estimate how people use social media during crises.

In the previous research, we revealed that the use of Twitter was different from area to area[3]. In this paper, we focus on regional differences in user interactions of Twitter during the Great East Japan Earthquake that occurred at 14:46 on March 11, 2011.

We prepared a dataset of tweets by crawling those posted by 1.3 million Japanese Twitter users from March 7 to March 23. We collected $362,435,649$ tweets, which were posted by $2,711,473$ users.


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## 2. REGIONAL ANALYSIS OF USER INTERACTIONS

In case of the Great East Japan Earthquake, the degree of damage caused by it varied depending on the area. We assume that the variety affected the user interaction on Twitter. Therefore, we performed a regional analysis of user interactions on it around the earthquake.

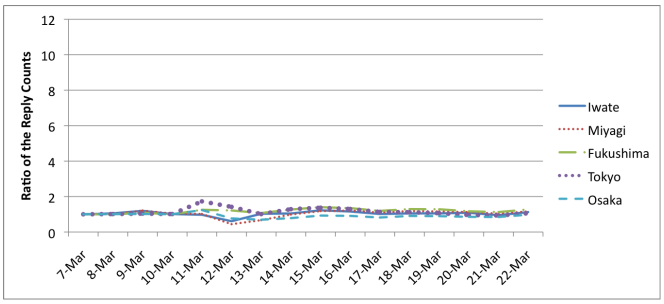
First, we extracted location information of Twitter user and selected target areas for analysis. Second, we analyzed the changes in the number of replies and retweets. Third, we compared them based on the distance between the users making interactions.

### 2.1 Regional Information on Twitter

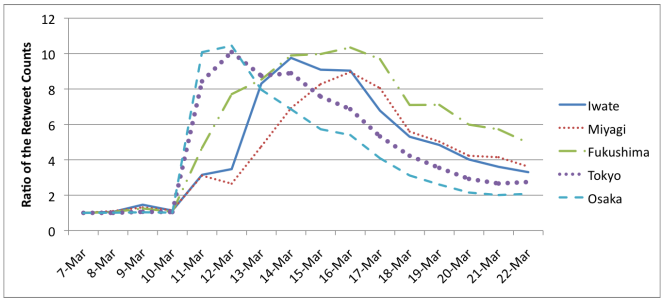
We estimated user locations from their Twitter profiles and analyzed the user interactions by prefecture based on it. However, showing all analysis results is difficult due to space limitations. We chose five representative prefectures based on the degree of damage(Table 1).

We compared the following two types of user interaction:

- Reply : messages for a specific user. We treat a reply as *communication interaction.*
- Retweet : messages to diffuse a tweet to followers. We treat a retweet as *diffusion interaction.*




(a) Replies by selected prefectures




(b) Retweets by selected prefectures

**Figure 1: Replies and retweets by selected prefecture**

## 2.2 Comparison of Number of User Interaction

Figure 1 represents the ratios of the reply and retweet counts posted by users who apparently live in different prefectures. We used all the replies and retweets posted on March 7 for normalization.

First, there was little change in the reply graphs of all the prefectures thorough the analysis period compared to those of the retweets, which maintained higher levels at the end of the analysis period than at the beginning. People diffused more information on Twitter than before the earthquake.

Second, the characteristics of the retweet graphs differ depending on the area. Shortly after the earthquake, in the less-damaged areas and Fukushima, the retweet ratio increased determinately; in the heavily-damaged areas, the retweet ratio only slightly increased. One week after the earthquake, the retweet ratio in the heavily-damaged areas maintained higher levels. After a nuclear accident got worse, the retweet ratio in Fukushima increased much more.

## 2.3 Comparison of User Interaction by Distance

Next, we compared two types of user interactions by their distance in the real world with **interaction distance**, which we define as the following distance between two users who perform one user interaction:

$$d_{ij} = distance\,(user_i, user_j)$$

We used the location information of prefectural government offices for the user location information for simplicity. For example, $user_i$ is in Tokyo and $user_j$ is in Osaka; $user_i$ posted the tweet : *@$user_j$ Are you all right?*, $d_{ij}$ is the distance between the Tokyo and Osaka government offices. If $d_{ij}$ is smaller, it is likely that $user_i$ and $user_j$ know each other, and vice versa.

We used $\bar{d}$ for one day to compare replies and retweets. Fig. 2 represents the changes in their $\bar{d}$, which have similar levels: about 260 km before the earthquake. However, they have clearly different characteristics. $\bar{d}_{replies}$ decreased after the earthquake and maintained lower levels for several days. But shortly after the earthquake, $\bar{d}_{retweets}$ maintained higher levels during post-quake chaos week.

**Table 1: Prefecture circumstances**

| Prefecture | Damage | Population | Others |
|---|---|---|---|
| Iwate | catastrophic | small | - |
| Miyagi | catastrophic | small | - |
| Fukushima | heavy | medium | nuclear power plant destruction |
| Tokyo | light | very large | - |
| Osaka | - | large | - |

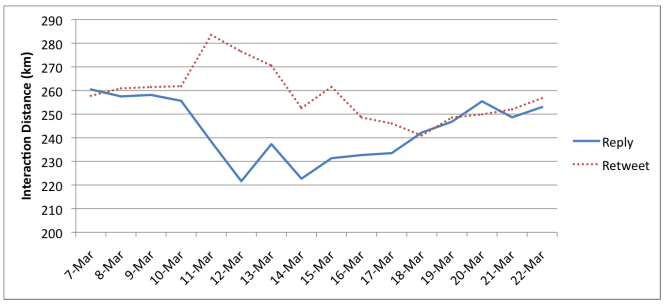



**Figure 2: Interaction distance of reply and retweets**

# 3. CONCLUSION

We analyzed 360 million tweets that were posted before and after the Great East Japan Earthquake that occurred on March 11th 2011 to elucidate how people interact on Twitter during disasters. We arrived at the following conclusions:

1. People diffused much more information after the earthquake, especially in the heavily-damaged areas.
2. People communicated with nearby users but diffused information posted by distant users

From our results, we conclude that social media users changed their behavior and reasons to autonomously use social media after serious events. In the future, we must observe and analyze the changes in social media to ascertain how such disasters affect social media over long periods.

# 4. ACKNOWLEDGMENTS

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