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SOCIAL MEDIA DURING MULTI-HAZARD DISASTERS: LESSONS FROM THE KAIKOURA EARTHQUAKE 2016

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ABSTRACT

Social media provides channels of communication during emergency events such as earthquakes. Such sites may be utilised for a range of emergency response strategies providing that data is processed rapidly and management strategies employed effectively. The processing of social media data presents many challenges for emergency responders: information overload, organisational communication and information reliability remain prevalent issues. Furthermore, there is a growing need to improve the management of multi-hazard disasters (sometimes referred to as 'cascading disasters') due to an increase in their frequency and severity, exacerbated by underlying global problems such as climate change. This is especially important to geographical regions that are prone to particular hazards – New Zealand for instance recorded nearly 33,000 earthquakes in 2016 alone. Similarly, there is an increasing need to evaluate developments in technology and social media sites themselves as they are progressively being relied upon during emergency events. In this study, we examine the crisis communications of the Kaikoura earthquake (New Zealand, 2016) using mainstream media content such as new stories, and online content such as Twitter data. A mixed method approach was employed, which combined content analysis with the application of a conceptual framework. The paper then presents (i) an analysis of crisis communications during the event, focusing on changes in media content and theme, (ii) the structure of online emergency response in the country and its affect on management and (iii) the barriers effecting emergency response in this case study.

Keywords: conceptual framework, content analysis, disaster management, earthquake, emergency response, multi-hazard disaster, social media.

1 INTRODUCTION

Social media are increasingly utilised for the dissemination of information during emergency situations [1–3]. Individuals may use social media as a source of information to make personal and complex safety critical decisions during such events [4]. Social media offer a range of supporting features which may reduce risk during crises: real-time monitoring and evaluation can be used for targeted action purposes [1], generalized monitoring and evaluation may support policy-making [5] and as a means to establish situational awareness [6]. Specific to disaster management, social media may provide warning systems throughout the disaster lifecycle phases [7], identify or track potential hazards or problems [8] and strengthen human interaction, coordination and crisis communications [9].

Using social media to disseminate time-critical information does however face obstacles. Information overload transpires when there are high volumes of accessible information which may not be relevant or useful [10]. Often this occurs when information is not entirely related to a situation, is not targeted at individuals or networks, or is simply outdated [11, 12]. Poor communication and uncoordinated dissemination from emergency responders may exacerbate these problems [13]. Despite a rise in global connectivity through developments in technology, such as the World Wide Web ('the Web'), accessibility to social media remains a significant obstacle [14]. Factors such as social class, gender, ethnicity, income and geographical location may all impact access to social media and other online resources [2, 15]. Reliability of information created or shared via social media during disasters can also be

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questionable as disseminating information requires little to no authentication, and often individuals do not site original sources of data [12, 16].

The challenges of using social media in emergency response evolve alongside the development of new applications, services and uses either provided by or taken up by social media themselves [10, 17]. Consequently, a number of emergency responders have sought to address such limitations. The American Red Cross for example launched a 'Digital Operations Center' dedicated to global humanitarian relief by utilising social media [18]. The uptake of crowdsourcing public information has in recent years offered emergency responders with valuable insight into disaster situations, as well as empowering the citizens who experience a disaster [8, 19]. In such situations the challenges of information reliability and credibility are prominent [20]. The inability to verify information during crisis situations can be highly dangerous: especially as this may form the basis for emergency decision making processes, both for individuals and organisations, where poorly planned consequences may potentially be dire to citizens [2].

Utilising social media for emergency response additionally faces challenges presented by complex, multi-hazard events. During such crises, it is even more difficult to provide reliable, tailored, and time-critical information due to more unpredictable nature of the disaster and subsequently triggered hazards. As a result, there is a growing need to analyse the causes of high magnitude multi-hazard disasters especially as they are becoming more common and devastating than previously expected [21–23]. New functionalities, services, software and tools are continually evolving to meet this demand, and often use social media as a lens for analysis. Twitter in particular has been a popular focus for research in crisis communications, and remains extensively used during emergency events by individuals and responders alike. Micro-blogging platforms such as this offer rapid situational awareness – an aspect that has become vital to many studies seeking to utilise online networks for effective information dissemination.

2 THE STUDY

2.1 The Kaikoura earthquake

According to the USGS Earthquake Hazards Program (2016) the Kaikoura earthquake occurred on the 14th of November, 2016, on the South Island of New Zealand. The geographical setting of the earthquake is illustrated in Figure 1 below. It recorded a magnitude of 7.8 and a duration of roughly two minutes, making it the second largest earthquake to be recorded in the country since its colonisation. The epicentre was recorded at 60 kilometres south-west of the town of Kaikoura, thus providing its name, and at a depth of around 15 kilometres. The intensity of the earthquake has partly been attributed to a series of ruptures occurring on multiple fault lines in a complex sequence. The initial earthquake hazard then triggered nearly 12,000 aftershocks along multiple fault lines, as well as causing a 5 m tall tsunami wave which affected thousands of kilometres of coastline.

3 METHOD

3.1 Twitter data

Twitter data was collected for the Kaikoura earthquake case study using the Twitter streaming API. Tweets were collected for featuring two or more of the terms 'Kaikoura', 'Earthquake', 'New Zealand' and 'Tsunami'. The data collection ran from the 13th of November 2016 (the

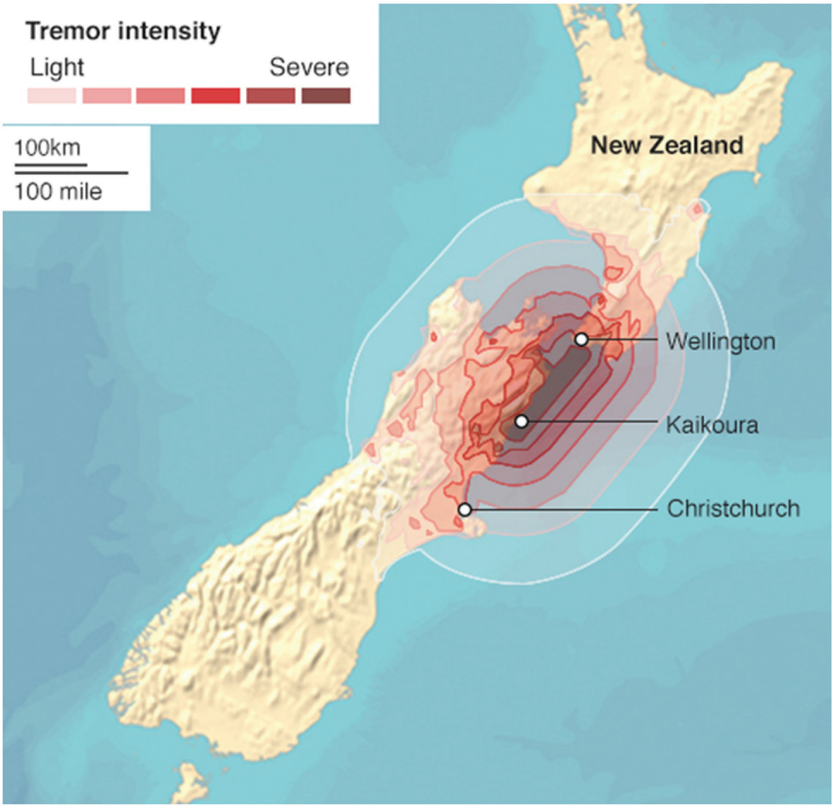

Figure 1: A map showing the epicentre and distribution of the Kaikoura earthquake, 2016. (*Source: USGS, 2016*).

day the earthquake occurred, GMT), and ended on the 13th of December 2016. This produced a data set of roughly 30,000 tweets. The dataset is hosted on the Southampton Web Observatory at a 100% sample size.

3.2 Content analysis

Manual content analysis was conducted on the dataset to indicate the most used hashtags, phrases, and popular re-tweets. This demonstrated how online media content changed over the duration of one month, and illustrated the larger picture of crisis communications on Twitter. Following this, tweets for a 24-hour period were then systematically selected at 7-day intervals. This formed four smaller datasets throughout the course of the event. These smaller datasets highlighted how specific hazards and micro-variations in hashtag and term trends manifested on the social media site, providing a more detailed insight to the event. Additionally, analysis of smaller datasets avoids common problems with the large size and velocity at which content is created and re-tweeted on Twitter during crises [24]. Similarly, manual content analysis was applied to indicate the most used hashtags, phrases and popular re-tweets, where each smaller dataset could be compared with one another to determine changes in content over time.

3.3 Conceptual framework

The conceptual framework proposed by Gray *et al*. [25] shown in Table 1 was applied to the systematically sampled datasets to show change in social media content over time. Application results indicated that the uses of social media, categorised from existing disaster literature, were present in the case study.

Table 1: A conceptual framework of the uses and users of social media during the disaster lifecycle phases.

Disaster lifecycle phase	The uses of disaster social media
All stages	Evaluate the reliability of information
	Identify and/or contain false information
Pre-event	Provide and seek general disaster preparedness information
	Provide and receive general national and regional disaster warnings
Pre-event → During	Detect and warn of disasters and specific hazards locally
	Identify the differences between actual and potential uses of social media
During event	Send and receive requests for help or assistance
	Inform others about ones condition and location
During → Post-event	Provide, receive and analyze big data generated by the event
	Provide, receive and encourage information sharing in multiple formats
	Document what is happening during a disaster online and offline
	Consume or create news coverage of the disaster
	Provide and receive location based real-time warnings
	Express public and/or individual emotion or empowerment; reassure others
	Raise and develop awareness; donate and receive donations; list ways to help or volunteer
	Seek to inform and support existing disaster management strategies
	Provide and receive specific disaster response, rescue and evacuation information
	Seek and assess mental, behavioral and emotional health support
	Filter, categorize critically analyze information
	Understanding how online and offline situations differ
	Provide and receive information regarding disaster response, recovery and rebuilding; tell and hear stories from the disaster
	Understand how ones access to the Web has had an effect on their experiences
Post-event	Discuss socio-political causes, implications and responsibility
	Re-connect community members
	Discuss the accessibility of the Web as an intermediary to social media
	Discuss the accessibility and reliability of specific social media; discuss perceptions
Post-event → Pre-event	Consolidate lessons learnt to develop new/improved social media applications

4 RESULTS

4.1 Crisis communications during the Kaikoura earthquake

Communications on Twitter during the Kaikoura earthquake, although generally following an expected pattern for communications previously recorded by other studies (see for example Houston *et al*. [26] official, and scientific literature was carried out in 2012–13 to develop a framework of disaster social media. This framework can be used to facilitate the creation of disaster social media tools, the formulation of disaster social media implementation processes, and the scientific study of disaster social media effects. Disaster social media users in the framework include communities, government, individuals, organisations, and media outlets. Fifteen distinct disaster social media uses were identified, ranging from preparing and receiving disaster preparedness information and warnings and signalling and detecting disasters prior to an event to (re) were more focused on the recording and spread of news relating to individual hazards within the overall, larger event. The hazard-specific news primarily referred to a tsunami which followed the initial earthquake some two hours later, a large aftershock recording a magnitude of 6.8, another aftershock at 6.2, and finally an aftershock at 5.8: all of which occurring within one month of the first quake. The changes in online content was noted in variations of popular hashtags, demonstrated in Table 2 below. The table compares 24 hour systematic samples beginning on the day of the first quake. Although the first three most popular terms in each dataset refer to generalised terms, the subsequent terms illustrate the changes in events that are both represented online as well as offline.

The term '#Tsunami' is more extensively used in the first dataset of Table 2 which corresponds with the occurrence of the hazard in the real world based on media content. Similarly, the term '#Argentina' is popular within the same sample. This refers to the fault triggering a similar earthquake with roughly the same magnitude within quick succession of the Kaikoura quake. In the second sample, '#HMCSVancouver' recorded a high volume, which referred to a series of offline events where HMCS Vancouver aided with unfolding of disaster management strategies in the local area. Similarly to Argentina, in the second sample '#Japan' become popular, representing a plethora of warnings through news and media channels warning of potential risk to the country based on the recent seismic movements. In the third sample, '#BREAKING' and '#waiau' were prevalent, referring to particular large aftershocks in the area. Finally, in the

Table 2: The most used terms during a 24 hour period during the Kaikoura earthquake.

14/11/2016	21/11/2016	28/11/2016	05/12/206
#NewZealand	#NewZealand	#NewZealand	#NewZealand
#earthquake	#Kaikoura	#Kaikoura	#earthquake
#nzearthquake	#earthquake	#Earthquake	#Kaikoura
#Argentina	#nznews	#NZ news	#geochat
#sup	#eqnz	#BREAKING	#nznews
#eqnz	#HMCSVancouver	#prophecy	#weather
#Tsunami	#imwithher	#Geology	#wx
#NuevaZelanda	#Japan	#Waiau	#cli
#NZQuake	#Erdquake2011	#Wellington	#Auckland
#supermoon	#Tsunami	#Kaikoura earthquake	#humanitarian

last sample '#geochat' illustrated the transition of online activities from being heavily centred on news stories, to shifting towards a lively online debate that considered the causes of earthquake and multiple hazards, as well as the socio-political and economic considerations.

4.2 The structure of emergency response in New Zealand

The Kaikoura earthquake experience relatively low levels of information overload. This may in part be attributed to the set-up of online media channels, as there are a number of dedicated news and media outlets specifically set up to distribute real-time information regarding earthquakes (for instance, @WeatherWatchNZ, @USGS, @LastQuake etc.). As this is most likely due to the fact that the country, well-practised in coping with seismic hazards as a result of their geographical location, has much higher preparedness and resilience strategies and infrastructure in place. This, combined with a comparatively strong global economic standing, means that a large proportion of the public are able to access the Web during times of crisis, access online resources, which include that of social media and are generally able to maintain cohesion between offline and online sites.

The structure of New Zealand's emergency response is arguably therefore well managed: online media, as well as the dedicated Twitter accounts for specific geographic information more often than not re-tweet and disseminate emergency warnings and responses from local and Governmental authorities, as opposed to creating their own. This means that information is often clear, structured to a particular platform, and automatically disseminated through automatic systems set-up by certain twitter accounts (i.e. @LastQuake make the most recent earthquake information publicly available as and when something occurs, adding other time-critical information which is dictated by Governmental bodies and emergency responders). The application of the conceptual framework has demonstrated how online content changed over the following four weeks of the disaster.

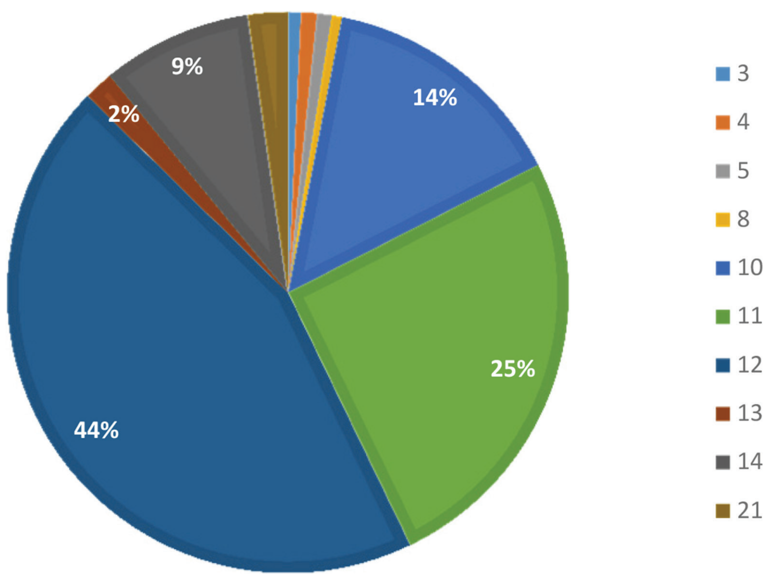

Figure 2: The count of framework categories during the first 24 hour sample of the Kaikoura earthquake (14/11/2016). Framework category numbers are listed on the right hand column.

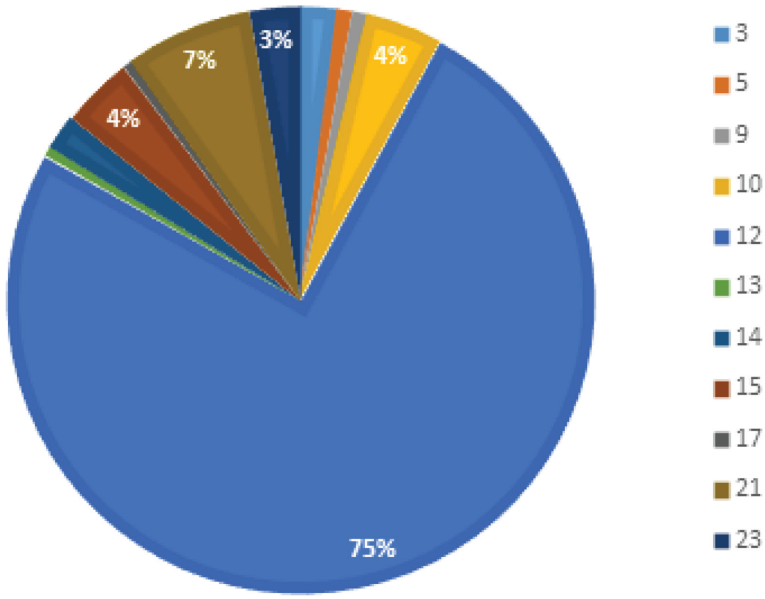

Figure 3: The count of framework categories during the second 24 hour sample of the Kaikoura earthquake (21/11/2016). Framework category numbers are listed on the right hand column.

5 DISCUSSION

As evidence by Figures 2–5, there are significant changes in the framework categories, which indicate changes in the online content of twitter. The first sample shows a dominance of categories 10, 11, 12 and 14, demonstrating that although a large hazard had just occurred there was relatively little online information actually created to help with decision-making processes. This, combined with the low death toll and casualty rate, suggests that time critical information was instead disseminated effectively and across a range of media channels, reducing the confusion often caused by information overload. In the second sample categories focused on smaller, regional hazards became dominant. This was an unexpected result as often this occurs in the preliminary stages of a disaster as opposed to during. This indicates that emergency responders were disseminating information regarding smaller specific regional events and potential hazards at targeted areas, which proved to be an effective way to mitigate the effects of the multi-hazardous nature of high magnitude seismic events.

In the third sample the framework category contents transitions into a well-documented response to natural disasters: large volumes of people begin expressing emotions or stories about the events, which often increases in volume once the larger triggered hazards have subsided. Finally, following this in the final sample a full month after the initial earthquake, the framework category content begins to shift back to the earlier stages of the life cycle phase. This is reflective of geographical regions that experience frequent seismic events as preparedness efforts and public information to effectively tackle these is highly encouraged and supported. The quick transition back to these early stages is arguably one of the main reasons that online emergency responders in New Zealand have reduced risk to the population in areas prone to risk.

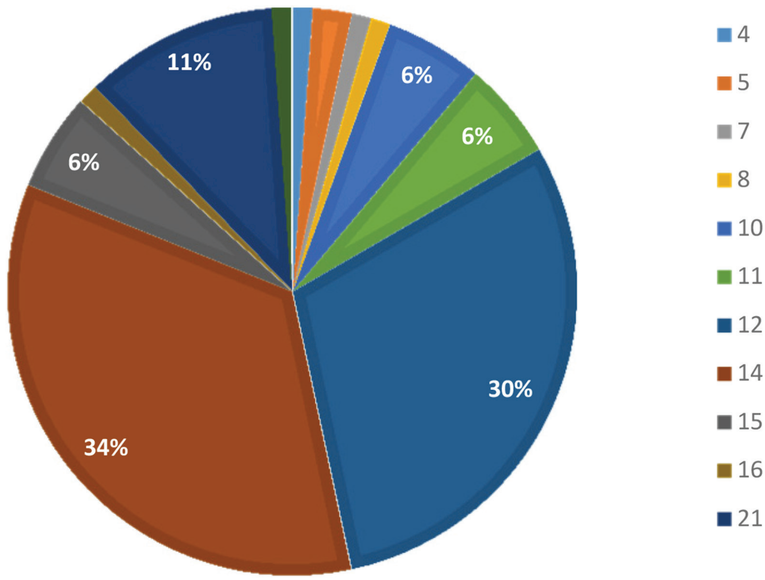

Figure 4: The count of framework categories during the third 24 hour sample of the Kaikoura earthquake (28/11/2016). Framework category numbers are listed on the right hand column.

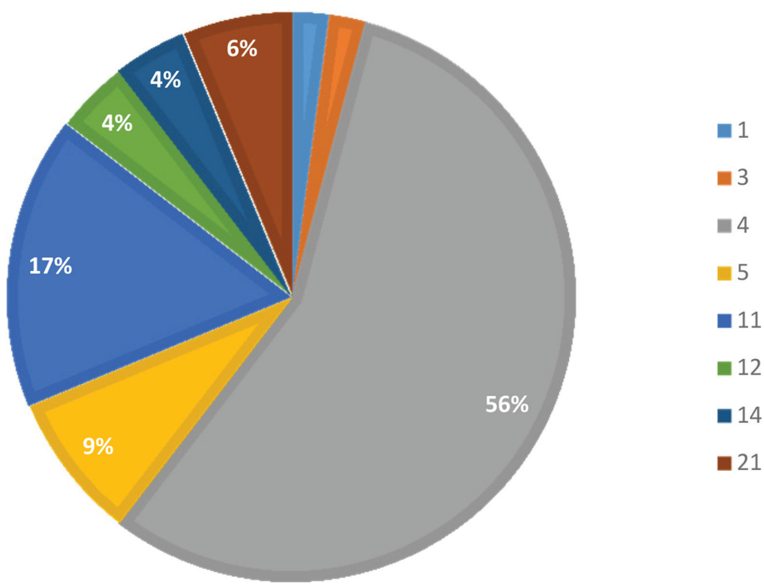

Figure 5: The count of framework categories during the fourth 24 hour sample of the Kaikoura earthquake (05/12/2016). Framework category numbers are listed on the right hand column.

6 CONCLUSION

In conclusion, multi-hazard disasters are becoming more frequent and devastating than previously expected. Social media and other forms of online crisis communication are increasingly being used to help reduce risk and the negative associations of such events. New Zealand, as an area prone to seismic hazards, has invested heavily not only in effective emergency response in the physical world, but has also developed effective online strategies for information dissemination. In these, series of accounts are dedicated to passing on vital information, while avoiding creating new information themselves. This avoids common issues such as information overload. The ability of these channels to move from generalised time-critical information to producing tailored, region-specific information means that smaller areas that are more prone to particular hazards, for instances mud-slides, can be targeted to reduce risk further. Finally, the ability of these channels to rapidly transition back into sharing information associated with the early stages of the disaster lifecycle phases ensures that preparedness and mitigation is strongly supported online, thus making future hazards easier to respond to.

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