Photo credit: Marisa Roman

The use of social media in natural hazard Early Warning Systems

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This short knowledge paper describes some of the ways social media has been used in the context of natural hazard early warning to aid decision making and enable people to communicate and access information.

Summary

The recent growth in technology and use of social media provides an opportunity for additional streams of information for decision making, and channels for disseminating early warning and risk information.

This document outlines some of the ways social media can be used in natural hazard early warning systems, providing examples of where it is already being used.

Introduction

Information and knowledge about a natural hazard event as it unfolds are vital to ensure effective preparedness and response to disasters. Those responsible for making decisions in advance of and in response to disasters need to know as much as they can about what the situation is and how it is unfolding. Citizens affected on the ground need to know how to stay safe or where they can obtain supplies.

Applications developed using Web 2.0 technologies, such as social media sites, blogs, wikis etc., have had a profound impact on people's ability to interact and collaborate, and to generate, share and access content publically and instantaneously through virtual environments.

The growth in technology and use of social media offers an opportunity for supplementary and complementary information alongside existing sources. Social media data can collect additional information to monitor hazards, assess exposure and vulnerability, guide disaster response, assess the resilience of natural systems, and engage with communities (Antilla-Hughes et al., 2015).

"Social media provides opportunities for engaging citizens in the emergency management by both disseminating information to the public and accessing information from them" (Simon et al., 2015).

Social media can complement and support EWS in several ways:

- Providing additional data on real-time monitoring of hazard, vulnerability and risk, often at a higher spatial density than monitoring and observation stations.
- Getting the right information to the right people in the right ways, building on trusted and well-used existing communication channels and platforms.
- Generating new evidence to develop our understanding of the communication and use of risk information in disaster resilience, preparedness and response.

In partnership with:

Flickr for floods

Two cases of the tag 'river' used with Flickr images:

(a) capturing the scenic nature of a rocky, riverine environment; and
(b) illustrating water levels during a flood event

Image acquired from Tkachenko et al. (2017) fig.1.

Gathering and analysing existing data

One method of gathering useful information from social media sources is to passively search social media sites for predetermined key word triggers or to develop algorithms which analyse textual language or images to identify content of interest. These 'social sensors' can be a useful supplement to instrument-based estimates from physical sensors.

Twitter Earthquake Detection (TED) tool

The U.S. Geological Survey's (USGS) TED tool passively analyses social media text data from Twitter based on keywords such as "earthquake" and its equivalent in multiple languages and provides the USGS with an estimate of the location and time at which an earthquake has been felt.

The data that comes through the TED tool can be available much faster than traditional methods of earthquake detection, which can take from two to 20 minutes in sparsely instrumented areas (Earle et al., 2012, Kendrick, 2015).

BGS GeoSocial

GeoSocial displays geolocated tweets about geohazards (e.g. earthquakes, landslides, tsunamis, geomagnetism/ aurora, floods and volcanic eruptions) in near real-time on a heat map. In time, the retrieval of relevant tweets is hoped to be more sophisticated as machine learning algorithms (e.g. Support Vector Matric and Neural Networks) and big data tools (e.g. TensorFlow, Apache Spark or dispel4py) are embedded into the system (Bee et al., 2017).

The principle aim of GeoSocial is to provide operational scientists supplementary information about a natural hazard event as it unfolds but also to gain better situational awareness of the hazard and its impact.

Predicting Natural Hazards with Flickr tags

The photo sharing website, Flickr, has been used in a number of research studies to explore whether certain natural hazards can be forecast or nowcast through examination of the environmental semantics used in the titles, descriptions and tags of the photos on the site.

For example, Preis et al. (2013) analysed data on the site relating to Hurricane Sandy and reported a striking correlation between the atmospheric pressure in the US state New Jersey and user generated content on Flickr during this time.

Tkachenko et al. (2017) used similar concepts to test the theory that by extracting and analysing people's use of language on social media to express their interactions with the environment (environmental semantics) we can predict flooding. They further hypothesised that, in addition to the actual event-denoting tags, it may be possible to denote other semantics that are capable of providing insight into an event before it reaches its peak.

SHEAR research

Increasing resilience to natural hazards through crowd-sourcing in St. Vincent and the Grenadines

Citizen science for hydrological risk reduction and resilience building

Early flood detection for rapid humanitarian response: harnessing big data from near real-time satellite and Twitter signals

Piloting crowdsourcing enhancement for multi-hazard mobile applications

Flood Tags: using Twitter to map flood risk

Real-time urban flood risk data via cellphone network analysis

Actively collecting new data

This method requires the public or identified citizens with special interest or expertise to tag social media content with a specific attribute, or log new data using an app. This tagging and logging creates a database of information from multiple users that can provide additional information to existing observation data (e.g. rain or river level gauges). This information can aid forecasting, preparedness, and response decisions. Often this collated data is available to access by the public, or those who have logged the information. This system requires people to be aware of the existence of the system and to use the tag or the app.

UK Snow Map

UK Snow Map collects structured tweets tagged with #uksnow and plots them on a map to create a real-time crowd sourced visualisation of where it is currently snowing in the UK. This is a crowd-led application which many people use to track where snow is falling and thus predict for themselves when and if they might be personally impacted.

myVolcano

*my*Volcano is a citizen science app developed by the British Geological Survey that enables people to share observations of volcanic eruptions. People can upload photos or descriptions of what they've seen, felt, heard or smelt so they can be shared with the *my*Volcano community.

*my*Volcano also shows people how to collect distal volcanic ash samples, such as from the eruptions in Iceland in 2010 and 2011 which produced widespread ash fall across the UK and Europe. These samples can help scientists gather vital new information about volcanic eruptions.

Supplementary information about volcanoes is also provided through the application's home page. The BGS is currently developing an app called *my*Haz which builds on *my*Volcano to capture impacts from a variety of natural hazards. This should be available in late 2019.

Citizen Seismology

The European Mediterranean Seismological Centre (EMSC) has developed an app that gathers a unique database of testimonies and pictures of seismic events. After an initial review by the EMSC staff, comments and/or pictures are made public so everyone can have access to them. EMSC also collects real time instrument observation data provided by 70 seismological networks of the Euro-Med region.

For potentially destructive earthquakes, the EMSC operates a free Earthquake Notification Service through which email/SMS/fax and tweets are disseminated to the registered end-users within 20-30 minutes on average after the earthquake occurrence.

Issuing alerts

Automated alert services are often based on data from organisation or agency monitoring instruments (e.g. seismographs or river monitoring stations) once they have detected a recording above a threshold. Many alerting services rely on users to 'follow' the service or sign-up to receive warnings. Location-based services within apps are sometimes used to target people within an affected area. In some countries, WhatsApp is used as a way to convey messages between responders and local key actors, e.g. landslide information is shared by Save the Hills, a local NGO in the Kalimpong region of India.

Social media platforms (Twitter and Facebook) have also been used to facilitate public alerts and help to dispel rumours (Alexander, 2014, Bird et al., 2012). Simon et al. (2015) state that social media is largely "self-regulating" in that during disasters, people are exposed to a multitude of information without being aware of its validity, yet users are often swift at correcting misinformation. It is important to note that the spread of misinformation can still occur.

Coordinating response

There are many examples of community driven uses of social media during crises events which enable people to share information, ask for help and advice, or tell relatives they are safe. Facebook launched its "I'm safe" safety check notification tool for disasters following people turning to its service during disasters (e.g. Japan 2011 earthquake and tsunami). Recently, disaster relief organizations have put more effort into collecting data from social media that highlights where aid is needed as well as broadcasting their own needs and perceptions of the situation (Landwehr and Carley, 2014).

International Network of Crisis Mappers

In 2010, the International Network of Crisis Mappers was launched bringing together an international community of experts, practitioners, policymakers, technologists, researchers, journalists, scholars, hackers, and skilled volunteers to leverage mobile and web based applications and the "crowd" to support disaster response.

Facebook Groups - Queensland and Victorian floods 2010/11

During the 2010/11 Queensland and Victorian floods, community initiated Facebook groups were followed by local residents affected by the floods, as well as from their more distant friends and families (Bird et al., 2012). The group became a platform for people to ask questions and obtain information gathered from a number of sources.

AmritaKripa – 2018 Keralan floods

Researchers at the Amrita Centre for Wireless Networks and Applications in India customised their AmritaKripa Android app to help with response during the 2018 Keralan floods. The multilingual, user-friendly mobile and Web app allowed users to both request and offer rescue, medical help, shelter, and supplies such as food, clothing and medicine, as well as services such as water, electricity and telephone and was used in tandem with the Amrita Helpline to link help seekers with relief and rescue operation services.

Twitter Alerts

@BGSLandslides
The British Geological Survey landslides team will tweet and retweet information about landslides in the UK that they are made aware of through this account.

@RiverlevelsUK
A citizen set this Twitter service up because they regarded the Environment Agencies presentation of the data as limited. The service provides a full listing of all river level monitoring stations across England, Scotland and Wales, as well as flood alerts and flood risk forecasts from the Flood Forecasting Centre.

@earthshook
This Twitter service reports earthquakes recorded by the USGS and sent out via their Earthquake Notification Service. It is not associated with USGS.

Social Media in SHEAR

Big Data for Resilience
Eleven case studies and pilots to explore the links between big data (including social media) and resilience were analysed in a synthesis report (Antilla-Hughes et al., 2015).

LANDSLIP
Amrita University and Newcastle University are working together to explore the potential use of social media in landslide early warning systems in India, and developing a prototype app that could be used both for collecting and communicating information related to landslides.

Landslide-EVO
In Nepal, citizen science and participatory approaches are being used to collect environmental data to feed into a local landslide early warning system.

The future

The use of social media in EWS is a growing field of research and application, and best practice, lessons, and guidance still need to be developed to ensure effectiveness and appropriate use in disaster contexts. Vulnerable populations in middle-income countries that are experiencing the greatest increase in disaster risk and, simultaneously, rapid growth in cell and social media technology are potential key opportunities for generating greater understanding of the effective application of this technology.

Social media platforms (and EWS) also emerge and evolve with time. For example, SnapMap, Snap's new crowd sourced mapping feature, could soon be a powerful tool in crises mapping. Feedback loops and continuous efforts to improve emerging systems and accommodate changes in social media technology and its use should be made.

Different socio-economic and cultural groups use social media in different ways, in different forms, and following latest trends. By investing and building on existing technological channels of communication and information sharing platforms specific to each context, appropriate use of social media is ensured.

Whilst the benefits and potential use of social media in EWS are promising, caution is needed when using social media in complex, emerging situations. It is important to be mindful of the following issues when attempting to leverage the data to build resilience: constraints on data access and completeness; analytical challenges to take action and replicate; issues of reliability and representativeness; human and technological capacity gaps; bottlenecks in effective coordination, communication and self-organization; and ethical and political risks and considerations (Antilla-Hughes et al., 2015).

The growing use of social media worldwide, including in middle-income and developing countries, provides an opportunity to source additional information to aid decision making, and also for getting early warning and risk information into the hands of those who need it.

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