Social Media Visual Analytic Toolkits for Disaster Management: A Review of the Literature

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ABSTRACT

The past decade has seen a significant increase in the use of social media for disaster management. This is due especially to the widespread usage of mobile devices and also to the different data types and data formats that social media supports. In recent years, research in the area of social media visual analytics has also gained interest in the scientific community. Research in this area however, lacks a comprehensive overview on social media visual analytics for disaster management. Hence, this paper presents a synthesis of extant research on social media visual analytic and visualization toolkits for disaster management. We survey available literature on these tools with the goal to outline the major characteristics and features, and to examine the extent to which they cover the full cycle of disaster management. Our main purpose is to provide a foundation based on the current literature that can help to shape future research directions to enhance social media visual analytic tools for full cycle disaster management.

Keywords

Disaster, crisis, social media, visual analytics, disaster management.

INTRODUCTION

A disaster is any event that leads to a response beyond which the affected community can deal with locally (Adelman & Gray, 2009). Disaster management involves creating plans through which people can alleviate vulnerability to hazards and cope with disasters. Disaster management does not stop the threats; instead it focuses on trying to decrease the impact of disasters. Disaster management includes activities that incorporate mitigation, preparedness response and recovery. The past decade has seen a significant increase in the use of social media for disaster management (Ngamassi et al., 2016; Denis et al., 2014; Hiltz et al., 2014; Hughes, 2014; Yates & Paquette, 2011). Several studies have identified a number of reasons for the use of social media for disaster management by humanitarian organizations and other stakeholders engaged in disaster relief. These reasons include (i) to seek information - information seeking is a primary driver of social media use during routine times and during disasters (Merrifield & Palenchar, 2012); (ii) to receive timely information – social media provides real-time disaster information, which no other media can provide (Kavanaugh et al., 2011; Spiro et al., 2012); (iii) to determine disaster magnitude – people use social media to stay apprised of the extent of a disaster (Liu et al., 2013; Sutton et al., 2008); (iv) to check in with family and friends (Gao et al., 2011; Semaan & Mark, 2012); and (v) to self-mobilize - During disasters, the public may use social media to organize emergency relief and ongoing assistance efforts from both near and afar (Gao et al., 2011; Starbird & Palen, 2011). With the recent development in social media, lack of data is no longer a major issue for disaster management. One key challenge, rather, is managing the information, translating it into actionable knowledge for effective decision making.

The past decade has also seen a growing interest in visual analytics as a new research field (Scholtz, 2006;

Thom, 2015). Visual analytics is defined as “the science of analytical reasoning facilitated by interactive visual interfaces” (Thomas and Cook, 2006). It can be seen as a set of techniques that use graphics to present information that helps users visually inspect and understand the results of underlying computational processes (Fan & Gordon, 2014). According to Wingkvist et al. (2011), visual analytics can be a useful way to address problems that are difficult to solve using either machine analysis or human analysis, for example due to size or complexity. Visual analytic tools are also on the rise. These tools support analytical reasoning using visual representations and interactions, with data representations and transformation capabilities, to support production, presentation, and dissemination (Scholtz, 2006; Gotz & Zhou, 2009). They also promise to supply analysts with the means necessary to tackle complex and dynamic problems and to support collaboration among analysts (Robinson, 2008). Visual analytic tools enable analysts to interactively explore and derive insights from large corpora of information by exploiting human visual perception and abstract reasoning (Gotz & Zhou, 2009). The combination of visualization, machine analysis and human expertise can prove helpful to reduce both size and complexity of problems (Wingkvist et al., 2011) similar to those inherent to disaster management.

Research in this area of social media visual analytics for disaster management however lacks a comprehensive overview. Hence, this paper presents a synthesis of extant research on social media visual analytic and visualization toolkits for disaster management. We survey available literature on these tools with the goal to outline the major characteristics and features, and examine the extent to which they cover the full cycle of disaster management. The rest of the paper is presented as follows. In the next section, we provide a theoretical background followed by a brief discussion of our research methodology. We then present our data and analyze our findings. This analysis is organized based on insights gained from previous similar studies (e.g. Dorasamy et al., 2013; Pohl, 2013). In closing, we suggest future research directions to enhance social media visual analytic tools for disaster management.

BACKGROUND INFORMATION

We present in this section, some background information for our paper. It includes a discussion on (i) a reference model for the process of disaster management and (ii) the features of social media analytic tools.

Reference Model for the Process of Disaster Management

The literature discusses a reference model for the process of disaster management based on the following phases: mitigation, preparedness, response, and recovery (Lettieri et al., 2009; FEMA, 2010).

The mitigation phase involves the actions aimed to minimize the degree of risk, to prevent disasters and to reduce the vulnerability of both the ecosystem and social system (Lettieri et al., 2009). The goal of the activities in this phase is to protect people and structure and reduce the cost of activities during the response and recovery phase (FEMA, 2010). The main functions of the mitigation phase include hazard assessment, vulnerability and risk reduction (Lettieri et al., 2009).

As it is almost impossible to mitigate all possible risks and casualties involved during a disaster, it is very important to have some preparedness measures that can lessen the impact of disaster (FEMA, 2010). Preparedness involves actions to prepare responders and common people to post-disaster activities (Lettieri et al., 2009). The strategies to be carried out during preparedness should be put in place before the disaster occurs. Planning for strategies in this phase involves ascertaining supplies and resources that may be essential in case of disaster, designating amenities for emergency use, and employing, assigning, and training personnel who can support in crucial areas during recovery and response operations (FEMA, 2010).

The response stage begins when a disaster is imminent or immediately after the disaster occurs (FEMA, 2010). Response consists of actions to manage and control the various effects of disaster and minimize human and property losses (Lettieri et al., 2009). Response also involves putting the strategies developed during the preparedness phase into action (FEMA, 2010). Further, in this phase, depending on the type of emergency, it is very important to prioritize the response activities and also deploy the resources that may be scarce. Irrespective of the type of disaster, the main functions of the response phase include evacuation, sheltering, medical care, search and rescue, property protection, and damage control (Lettieri et al., 2009).

The recovery phase aims at ensuring that the community activities and the systems return back to normal functioning. Recovery consists of those actions that bring the disrupted area back to an often improved normal condition (Lettieri et al., 2009). Recovery is unique to each community or area depending on the type of disaster, the extent to which the community is affected by the disaster and the resources that are available or can be procured by the community.

Social Media Analytic Tool Features

Social media analytics involve a variety of analytical approaches borrowed from different fields (Heer and Agrawala, 2006; 2008; Stieglitz and Dang-Xuan, 2013; Fan and Gordon, 2014). These approaches could be grouped into four broad categories including (i) topic/issue/trend-based approaches (ii) opinion/sentiment-based approaches, (iii) structural based approaches, and (iv) visualization/visual analytics. For each of these categories, we present the features that are most relevant in analyzing and presenting social media data as discussed in the literature.

Topic/issue/trend-based approaches

The most common features in this category include topic modeling and trend analysis. Topic modeling entails employing statistics and machine learning to detect main themes or topics in large body of text (Fan and Gordon, 2014). The themes or topics uncovered can be used to provide consistent labels to explore the text collection further or to build effective navigational interfaces. Trend analysis is used for identifying and predicting future outcomes and behaviors based on historical data collected over time. Trend analysis is based upon longstanding statistical techniques such as time-series analysis or regression analysis.

Opinion/sentiment-based approaches

Opinion mining and sentiment analysis are the main features in this category. Opinion mining is the core technique behind many social media monitoring applications (Fan and Gordon, 2014). It is used to measure the views, and beliefs based on the criteria that depend on the purpose of analysis. Sentiment analysis is used to measure the individual, group, communities' emotions towards an events (Wamba et al, 2016)

Structural based approaches

Social network analysis is the main feature in this category. Social network analysis is used to analyze a social network graph to understand its underlying structure, connections, and theoretical properties as well as to identify the relative importance of different nodes within the network (Fan and Gordon, 2014).

Visualization/visual analytics

Information visualization provides significant help to the human visual system to support the analysis of big data. There are several basic data types in information visualization (Shneiderman,1996 ; Tory and Moller, 2004). The most common identified in the literature include (i) graphs, (ii) trees, (iii) n-dimensional data, and (iv) geospatial and spatio-temporal visualizations. Graphs are any data that contains information that can be represented as nodes or vertices, and edges connecting these nodes (Harger and Crossno, 2012). Trees are a special class of graphs that have explicit hierarchical structure which allows them to be laid out in more ways than graphs in general (Harger and Crossno, 2012). N- dimensional data is a very general data type that includes all information that can be represented as the rows and columns of a table. This category includes bar charts, line charts, pie charts, stacked charts, box plots and views supporting multidimensional data. Geospatial and spatio-temporal category is useful for viewing geographic information.

Visual analytics can be regarded as a collection of techniques that use graphical interfaces for presenting summarized, heterogeneous information that helps users visually inspect and understand the results of underlying computational processes (Fan and Gordon, 2014). It involves a range of activities, from data collection to data-supported decision-making.. The primary goal of visual analytics is the analysis of vast amounts of data to identify and visually distill the most valuable and relevant information content (Keim et al, 2008).

METHODOLOGY

We conducted a review of the literature in which studies were included in three steps. First, we used the ABI INFORM and EBSCOHOST electronic databases as the main sources for identifying studies on social media for disaster management. Only peer-reviewed papers published in the last decade were considered for our study. We focused on three main research areas including (i) social media and (ii) disaster/crisis/emergency (iii) visual analytics/visualization. We included visualization in the research area because we found out that there were few visual analytic toolkits available. For the database search, we used different combinations of the following keywords "social media", "social media technology", ", "social media tools", ", "social media platform", "disaster management", "disaster management phases", "crisis management", "emergency management", "disaster relief", "visual analytics", and "information and communication technology". We considered only papers that had at least both "social media" and "disaster" , or "crisis" or "emergency" and "visual analytics" or “visualization” keywords. An initial screening of the titles and abstracts indicated that not all of the papers retrieved by the keyword searches were appropriate to the study. These papers were excluded from our sample.

Second, in addition to the journals listed in ABI INFORM and EBSCOHOST, we also selected papers from the International Journal of Information Systems for Crisis Response and Management (IJISCRAM), which provides an outlet for innovative research in Information Systems for crisis response and management. We also purposefully searched the conference proceedings of Information Systems for Crisis Response and Management Conference (ISCRAM) a renowned conference in IS. The ISCRAM community is a mix of researchers and practitioners dedicated to the promotion of exchange of knowledge and the deployment of IS for crisis management. ISCRAM has a track on social media in crisis response and management.

Third and finally, we used the ‘‘snowball’’ method to find additional relevant papers. The snowball method involved carefully going through the references of the papers identified in the two previous steps and look for additional papers suitable for our study. We present in **Table 1,** the list of the social media visual analytic tools resulting from our search. They are thirty one (31) in total. For each of the tools, we also provide the main reference and in some cases, additional related references.

TABLE 1: Social Media Visual Analytics Tools for Disaster Management

	Tools	Main Reference	Other Related References
1	AsonMaps	Aulov et al., 2014	
2	Coordinated Engagement Interface (CEI)	Purohit et al., 2014	
3	Crisees	Maxwell et al., 2012	
4	Disasters2.0	Camarero & Iglesias, 2009	
5	Emergency Response Intelligence Capability (ERIC)	Power et al., 2013	
6	Emergency Situation Awareness – Automated Web Text Mining (ESA-AWTM)	Yin et al., 2012b	Yin et al., 2012a; Cameron et al., 2012 ; Power et al., 2013
7	Global Disaster Alert and Coordination System (GDACS)	Stollberg & Groeve, 2012	
8	G-SAW	Croitoru et al., 2012	Crooks et al., 2013
9	Mapster	Liu et al., 2011	
10	Riskr	Farber et al., 2012	
11	Sahana	Careem et al., 2006	Duc et al., 2014; Sahana Software Foundation 2011
12	Scatterblog	Bosch et al., 2011	
13	SensePlace2	MacEachren et al., 2011	MacEachren, 2013; Savelyev and MacEachren, 2015
14	Social Media Analytics Reporting Toolkit (SMART)	Zhang et al., 2014	Zhang et al., 2016
15	SocialSensor	Diplaris et al., 2013	Papadopoulos et al., 2013
16	System for Real and Virtual Volunteers (SRVV)	Reuter et al., 2013	
17	Twitter Earthquake Detector (TED)	Guy et al., 2010	
18	TEDAS	Li et al., 2012	
19	Toretter	Sakaki et al., 2010	Sakaki et al., 2013
20	Tweak-the-Tweet	Starbird & Stamberger, 2010	Starbird, 2011
21	TweetComp1	Zielinskiet Al et al., 2013	
22	TweetTracker	Kumar et al., 2011	

23	TweetXplorer	Morstatter et al., 2013	
24	Twitcident	Abel et al., 2012a	Abel et al., 2012b; Tao et al., 2012 ; Terpstra et al., 2012
25	TwitInfo	Marcus et al., 2011	
26	Twitris+	Sheth et al., 2011	Purohit & Sheth, 2013
27	Ushahidi	Anahi 2011	Okolloh, 2009; Duc et al., 2014; Li et al., 2014
28	Visual Analytics of Microblog Data for Public Behavior Analysis in Disaster Events (VAMPBA)	Chae et al., 2013	Chae et al., 2012 ;Chae et al., 2014
29	Visual Backchannel	Dork et al., 2010	
30	WeKnowIt	Ireson, 2009	Cordis, 2009; Lanfranchi & Ireson, 2009; Lanfranchi et al., 2010
31	XHELP	Reuter et al., 2015	

REVIEW FINDINGS AND DISCUSSIONS

In this section, we present and discuss our review findings. We start with a brief general overview of the important characteristics of the thirty one (31) social media visual analytic toolkits identified in the literature. Then, based on a discussion on the social media activities specific to each phase of a full cycle disaster management, we suggest the features of visual analytic toolkits that we believe would be relevant for that phase.

Overview of the Toolkits Identified

Social media visual analytic toolkits differ in a number of ways. In this paper, we examined the following characteristics: maturity, platform, disaster specific, data source and key features provided.

Maturity

The thirty one (31) toolkits examined in this study have varying degrees of maturity, with a large majority still under development or at most under test. Few of them have been effectively used in real case of disaster management. For instance, findings from our examination of the toolkits suggest that only Sahana and Ushahidi have effectively been used for large scale disaster management. Sahana is an open source and open standards software developed with the aim to enable disaster responders to access and share information in order to reduce human suffering during pre-disaster preparedness and post-disaster response phase (Duc et al., 2014). Ushahidi is also an open source software. It was developed to help automate the collection of incident reports using cellular phones, email, and the web and facilitate the mapping of report locations in an interactive map mashup along with descriptive data to contextualize events. Ushahidi was first deployed in full scale for disaster management during the 2010 Haiti earthquake.

Platform

A large majority of the 31 toolkits examined are web based. The few that are multiplatform include GDACS, Mapster, Sahana and Ushahidi. For instance, Mapster is a mobile+Cloud system designed to provide a set of loosely coupled components, including (i) a citizen reporting tool on the smartphone through a customized Twitter client, (ii) Cloud-based semantic streaming data fetching, processing and republishing services, and (iii) a personalized/localized spatiotemporal visualization and animation tool on the phone that can visualize both citizen-provided data as well as infrastructure sensing data (Liu et al., 2011).

Disaster specific

Some of the toolkits are designed for a specific type of disaster. For example, Twitter Earthquake Detector (TED) and Toretter (Sakaki et al., 2010; 2013) are designed specifically for earthquake. TED is developed to mine real-time data from popular social networking and micro-blogging sites, searching for indicators of earthquake activity directly from the public (Guy et al., 2010). According to Guy et al. (2010), TED also integrates traditional scientific earthquake information, location and magnitude, from the USGS internal global earthquake data stream with geospatial-temporal corresponding citizen reports from popular social networking and micro-blogging sites. The TED system analyzes social networks data for multiple purposes including to (i) integrate citizen reports of earthquakes with corresponding scientific reports, (ii) infer the public level of interest in an earthquake for tailoring outputs disseminated via social network technologies, and (iii) explore the possibility of rapid detection of a probable earthquake, within seconds of its occurrence, helping to fill the gap between the earthquake origin time and the presence of quantitative scientific data (Guy et al., 2010). Based on particles filtering, Toretter analyzes the flow of twitter to detect earthquakes and alert users (Sakaki et al., 2010; 2013). Users can see the detection of past earthquakes (Sakaki et al., 2010; 2013). They can register their e-mails to receive notices of future earthquake detection reports. Toretter alerts users and urges them to prepare for the imminent earthquake (Sakaki et al., 2010; 2013).

Features provided

Most of the tools identified are developed around the concept of a dashboard, or a set of visual screens that provides a summary of social media during the crisis according to a variety of dimensions including temporal, spatial, and thematic aspects. Common elements in these screens include line charts, timelines, time series graphs, maps, pie charts, bar charts, stacked charts, box plots and views supporting multidimensional data (such as scatterplots and parallel coordinates) [See Table 3]. For instance, ScatterBlogs is a system that enables users to interact with the data in a visual, direct, and scalable fashion (Bosch et al., 2011; Thom et al., 2013). Its main objective is to allow analysts to work on quantitative as well as qualitative findings by (i) automatically identifying anomalies, (ii) summarizing and labeling event candidates, and (iii) providing interaction mechanisms to examine event candidates (Thom et al., 2013). ScatterBlogs also provides a workbench allowing the scalable visual examination and analysis of messages featuring perspective and semantic layers on a world map representation (Bosch et al., 2011; Thom et al., 2013). Another example is SensePlace2, a map based interactive application. , SensePlace2 includes features that allow the users to (i) explore and analyze data, (ii) visualize data on a map and as word clouds, and (iii) select time interval and terms of interest (MacEachren et al., 2011). SensePlace2 uses Twitter as the main source of geospatial information. Although some of tools are based on input or feedback provided by emergency responders and other officials (e.g. Ushahidi), we found that the majority are designed as a way to process social media data during crisis situations.

Table 2: Tools Features

	Tools	**Features**							
		A	**B**	**C**	**D**	**E**	**F**	**G**	**H**
1	AsonMaps	√							
2	CEI			√					
3	Crisees	√			√		√		
4	Disasters2.0	√							
5	ERIC	√							
6	ESA-AWTM	√			√	√			√
7	GDACS	√						√	
8	G-SAW			√	√	√	√		
9	Mapster	√			√				
10	Riskr	√		√	√				
11	Sahana	√		√	√				
12	Scatterblog	√			√	√			√
13	SensePlace2	√			√	√			
14	Smart	√							
15	SocialSensor	√	√		√	√	√		
16	SRVV	√		√					
17	TED	√		√	√			√	
18	TEDAS	√			√				√
19	Toretter	√		√	√				
20	Tweak-the-Tweet	√			√	√			
21	TweetComp1	√			√				

22	TweetTracker	√			√				
23	TweetXplorer	√		√	√				
24	Twitcident	√			√			√	
25	TwitInfo	√			√	√			
26	Twitris+	√			√			√	
27	Ushahidi	√	√	√	√	√		√	
28	VAMPBA	√	√				√		√
29	Visual Backchannel	√							
30	WeKnowIt	√			√	√			
31	XHELP	√							

A	Topic/Issue/Trend analysis	E	Timeline (visualization option)
B	Opinion/Sentiment analysis	F	List (visualization option)
C	Social network analysis	G	Statistic Diagram (visualization option)
D	Map (visualization option)	H	Tag Cloud (visualization option)

Data source

The most common social media data source is Twitter. Other data sources include Facebook, Flickr, Instagram, YouTube, Tumblr and SMS.

Relevant Toolkits Features for Full Cycle Disaster Management

As discussed earlier, the full cycle of disaster management is made up of four phases. Each of these different phases has its own information requirements that need to be addressed. We suggest in this section the features of visual analytic toolkits that we believe would be relevant for each of the phases.

Mitigation:

In the mitigation phase, communication between organizations and other stakeholders engaged in disaster management primarily focuses on sharing and disseminating information about possible disaster treats; establishing rules and planning for resources to use in case of disaster (Fischer et al., 2016). A number of social media activities are undertaken to alleviate the harm that may occur from disasters. These activities may include creating and strengthening communication and collaboration networks, disseminating the do's and don'ts in case of disaster, drawing lessons learned from passed disasters etc. The appropriate features for visual analytic toolkits relevant for the mitigation phase of disaster management would include social network analysis, data management and information visualization.

Preparedness:

In the preparedness phase, organizations and other disaster managers work together to develop the processes that could help to effectively manage post-crisis (Fischer et al., 2016). They also need to be aware of communication challenges that may hinder these efforts. Moreover, it is important that disaster responders communicate to keep in touch, plan together for a crisis, and develop trust between organizations (Allen et al., 2014; Fischer et al., 2016). Furthermore, building relationships between all crisis responders through training and timely communication among organizations about plans and actions is critical for good collaboration during a crisis response (Fischer et al., 2016). Social media activities can be undertaken before a disaster strikes to improve the readiness of the community to respond quickly as soon as the disaster strikes; to engage citizens and to share preparedness information from humanitarian organizations. For example disaster related social media online training can be developed and offered to prepare disaster responders. Social media can be used to provide early warning when situations become less predictable and can also be useful in pointing out abnormal event (Fan et al., 2014). Houston et al. (2015) argue that prior to disaster, social media can be used in three different ways including (i) providing and receiving disaster preparedness information, (ii) providing and receiving disaster warnings, and (iii) detecting and signaling disasters.

Features for visual analytic toolkits relevant for the preparedness phase of disaster management would include topic modeling, trend analysis, social network analysis, data management, information visualization and visual analytics. Topic modeling, trend analysis of tweet data could be instrumental in this phase as they could help determine abnormal event and then provide early warning. For instance, several studies show that Twitter constitute a viable early warning system in disaster management (Chatfield and Brajawidagda, 2013; Tyshchuk et al., 2012). Studies also show that crisis response organizations use social media to provide advice directly for crisis preparation, point to other resources with crisis advice, and offer news about the crisis to the community (Van Gorp et al., 2015). To this end, features such as data management, information visualization would be necessary. Social network analysis would be necessary for a collaboratively developed knowledge base with active discussion spaces conducted normally during the preparedness phase of disaster management. In addition, citizens could use social media to share their emergency plans and to coordinate "ride shares" over their network for when there is a need to leave the area at risk (Belblidia, 2010). Moreover, using social media prior to disasters would enable emergency management networks to be built that share the responsibility for preparing for a disaster (Dufty, 2012).

Response:

The response phase of disaster management involves high degree of communication within and between the different organizations and other stakeholders engaged in disaster response (Fischer et al., 2016). Communication in crisis response includes adapting to the situation as quickly as possible, assessing the appropriateness of formal plans, and gathering and processing information for crisis professionals' decision making (Fischer et al., 2016). Social media tools are increasingly used as an information source for disaster response organizations. In responding to disasters (e.g. the 2010 Haiti earthquake, the 2012 Sandy superstorm), social media was used for relaying information, one and two-way communication, offering/requesting assistance and organizing disaster response (Watson and Wadhwa, 2014). Social media can also be used in the search and rescue operations during a disaster. For instance, the pervasiveness of smartphones gives people the opportunity to take photos or videos and upload them to the Web immediately. Survivors in an affected area can report what they are seeing or hearing.

Moreover, social media can also be used to monitor and analyze data generated during disaster in order to enhance situational awareness and the response to the disaster. The need to provide a fast and effective response to disaster victims means that the social media toolkits used for disaster response need to be able to quickly access and analyze a vast quantity of real-time social media data. Furthermore, compared to the disaster preparedness phase, vast amounts of data are generated during the response to disasters. Therefore, for disaster response social media visual analytic toolkits are required to have access to a large body of real-time data through agreements with social media applications such as Twitter.

Recovery:

Research has highlighted the importance of information sharing between organizations during the recovery phase of disaster management to coordinate activities and address tasks such as coordination, rebuilding, as well as dissemination of information about accessing aid (Cumbie and Sankar, 2012; Fischer et al., 2016). In this phase, organizations and other stakeholders engaged in disaster management use social media to publicize information about successful recovery activities, collect lessons learned that can help an organization better prepare for another crisis, and facilitate coordination and collaboration (Fischer et al., 2016). Further, organizations use social media to build relationships with the public and share information and coordination of volunteer activities (Fischer et al., 2016). The appropriate features for visual analytic toolkits relevant for the mitigation phase of disaster management would include social network analysis, data management and information visualization.

Suggested Features per Disaster Management Phase

	Mitigation	Preparedness	Response	Recovery
Topic modeling		√	√	
Trend analysis		√	√	√
Opinion mining			√	√
sentiment analysis			√	
Social network analysis	√	√	√	√
Data management	√	√	√	√
Visualization	√	√	√	√
Visual analytics		√	√	√

CONCLUSION

Research shows that social media is being increasingly used for disaster management. The use of social media visual analytics is also on the rise in disaster management. Social media visual analytics brings a new dimension to disaster management, offering a useful way to address problems that are difficult to solve using either machine analysis or human analysis with the possibility of potentially improving disaster management outcomes. In this paper, we present an overview of research on social media visual analytic and visualization toolkits for disaster management. The goal is to outline the major characteristics and features, and to examine the extent to which these toolkits cover the full cycle of disaster management. Our hope is that the overview presented here can contribute to provide a foundation based on the current literature and help to shape future research directions to enhance social media visual analytic tools for full cycle disaster management. For example, visual analytic tools could be developed to help determining the progress of an emergency (e.g. the rising level of flooding during a tornado or heavy rain) and to help identifying the next possible solutions (e.g. evacuation route) that could be used to alleviate the damages. Visual analytics tools could also be developed to determine the scope of damage and to provide various disaster responders with effective coordination tools for more efficient disaster response.

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