Networked volunteering during the 2013 Sardinian floods

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Abstract:
The article describes how ordinary citizens used Twitter as an emergency-management tool during the heavy floods that occurred in Sardinia, Italy, in November 2013. The case study constitutes an example of digital volunteering in the aftermath of a disaster event. The article applies the connective action framework (Bennet & Segerberg, 2012) for a deeper understanding of the dynamics of self-organized disaster communication activities on social media. Utilizing a dataset of 93,091 tweets that used the hashtag #allertameteoSAR (weather alert in Sardinia), the analysis focuses on: 1) the roles and patterns of influence among the main actors; and 2) the strategies for a peer 'curation' and sharing of a disaster-recovery oriented communication. The article highlights the role of Twitter celebrities and engaged ordinary users as digital volunteers and explains how they succeeded in activating bottom-up disaster-relief oriented communication.

Keywords: digital volunteers, disaster communication, social media, Twitter, connective action.

Introduction
This article describes the user-generated and user-driven emergency management activity that took place on Twitter during the heavy floods that occurred in Sardinia (Italy) in November 2013. More specifically, it suggests adopting the *connective action* framework

proposed by Bennet and Segerberg (2012) for the analysis of bottom-up disaster communication processes and response practices. The hypothesis is that citizen-driven disaster relief activities on social media follow similar patterns (in terms of influence dynamics, strategies for information gathering, verifying and sharing) to the connective action practices carried out by contemporary social movements, organizing bottom-up protests and civic mobilizations. Generally speaking, the article can be included among the studies analyzing the roles of Twitter in the context of major events (e.g. crisis events, political elections, global protests) and, in broader terms, in government communication to the public, as well as in crisis communication (Bruns, 2018).

Through the analysis of the role of digital volunteering in the aftermath of the 2013 Sardinian floods, we want to highlight relevant interactions between two fields of study: Emergency communication and (mediated) political participation. Research on the role of social media in disaster communication has initially mainly focused on *top-down* communication processes (describing how institutions and emergency respondents rely on social media to spread information). Nevertheless, scholars underline that citizens' communication practices deserve broader investigation (Fraustino, Liu, & Jin, 2017). As a result, more research is starting to consider bottom-up response practices, analyzing the participatory practices carried out by so-called *digital volunteers* in the aftermath of a disaster event (Starbird & Palen, 2011; Hughes & Tapia, 2015; Ferguson, Schmidt, & Boersma, 2018). While providing insightful analyses, literature has hitherto disregarded broader conceptual frameworks developed within social movement studies that focus on connective action (Bennet & Segerberg, 2012). This framework, however, generally focuses on large-scale movements promoting political and civic mobilizations, disregarding user participatory practices carried out in the context of disaster communication. It is hoped that applying the connective action framework to crisis communication could offer the conceptual tools for a deeper understanding of communication and coordination dynamics among different social actors' patterns of engagement on social media, as well as of the effectiveness of such processes.

The Case of #allertameteoSAR

On November 18, 2013, an atmospheric perturbation (named 'Cyclone Cleopatra') hit Sardinia, an Italian island in the Mediterranean. In some areas, precipitation exceeded 17 inches during the first 12 hours, almost half the annual average rainfall (39 inches). Torrential rainfall caused serious floods resulting in 16 deaths. Businesses, local agriculture and infrastructure suffered severe damage. Given the hydrogeological instability that characterizes the Italian peninsula, floods are dramatically present in the Italian collective memory[1] and represent a serious vulnerability.

Similar to other recent natural disasters, the 2013 Sardinian floods generated much activity on social media. In line with the social media strategies used during the 2011 Genoa floods, some Italian Twitter users turned to social media to organize bottom-up disaster response activities, creating an intense volume for the hashtag #allertameteoSAR (Allerta

meteo' means weather alert and SAR is used to design the Region (Sardegna)). As our analysis shows, while institutions and media played a marginal role on social media in relation to the 2013 Sardinian floods, local Twitter celebrities and engaged common users organized and promoted the diffusion of the #allertameteoSAR hashtag, turning it into a useful, disaster-recovery oriented conversation. Moreover, due to the lack of media coverage immediately following the flood, for several hours the #allertameteoSAR user-generated stream constituted the most relevant first-hand information available. Indeed, some hours later, media and local institutions adopted the hashtag, making it the (un)official hashtag for Sardinia floods relief-related conversations. Indeed, while this specific hashtag was user-generated, this standardized way of addressing weather alerts ('#allertameteo' + the region affected by the events) was adopted in the following years by several Italian institutions, such as the regional weather service in Tuscany, as well as municipalities and local civil protection accounts (Grasso & Crisci, 2016).

In a growing number of (Western) countries, social media are increasingly used by emergency managers to communicate during natural disasters (e.g., Hughes, Peterson, & Palen, 2014). However, Italian public institutions have not made significant efforts to communicate through social media in recent natural disasters, as relevant barriers to social media usage seem to persist at both a national and local level (Comunello & Mulargia, 2018). Moreover, Italian administrations reported a non-uniform presence on social network sites (Lovari & Parisi, 2011): While some administrations showed a lack of innovation, others fully engaged with digital and social media. Furthermore, social media communication by Italian institutions appears to be still more oriented towards broadcasting, rather than interactive and dialogic models (Lovari & Parisi, 2015). At the same time, social media are pervasive among Italian citizens. At the time this study was carried out, out of 60.7 million Italian inhabitants Facebook had more than 24 million active users monthly (Facebook Statistics, 2013) and Twitter had 3.3 million users (Cosenza, 2012). In the last few years, non-profit and volunteering organizations have played a growing role in Italian society, filling the void left by formal institutions, which is mainly due to budget cuts (Peruzzi, 2013).

In this article, we will examine how social media were used to communicate about the Sardinia floods. The article will first outline the role of social media in activating bottom-up disaster response practices. Next, we will describe the main traits that characterize the connective actions performed by contemporary social movements through digital media, as well as the patterns of information diffusion on Twitter. Then, we present the research questions and illustrates the methods for analyzing the tweets produced during the first week of the 2013 Sardinian floods that used the hashtag #allertameteoSAR. After exploring how the #allertameteoSAR feed evolved over time, the analysis focuses on two main themes: 1) the roles and patterns of influence among the main actors contributing to the #allertameteoSAR conversation; and 2) the strategies for a peer 'curation' and sharing of a disaster-recovery oriented communication. The discussion paragraph links the #allertameteoSAR user-driven response practices with the 'connective action' framework,

showing that networked volunteers' practices share many traits with participative actions carried out during civic mobilizations.

The Role of Social Media in Bottom-Up Disaster Response Practices

Pioneering research on the potential role of ICT in crisis communication can be found in the early years of social media research (Palen & Liu, 2007), while in the following years scholars have started to address the topic more systematically. Such literature often relies on studies into the broader topics of disaster research (Rodriguez, Quarantelli, & Dynes, 2007), and of risk and crisis communication (Coombs & Holladay, 2010). In this context, scholars have adopted both a *top-down* perspective, analyzing institutional communication and emergency management processes (Crowe 2012; Giacobe & Soule, 2014; Hughes, St. Denis, Palen & Anderson, 2014; Fraustino & Ma, 2015; Reuter, Heger, & Pipek, 2013) and a *bottom-up* perspective, focusing on social media-enabled citizen engagement in the aftermath of major disasters (Starbird & Palen, 2011; White, Palen, & Anderson, 2014; Ferguson et al., 2018). Research has also focused on the interactions between organizations and different kinds of publics producing and consuming information during crises (Hughes & Tapia, 2015), underlining that '[s]ystematic knowledge is needed on the relative importance of different kinds of sources' (Sommerfeldt, 2015, p. 19), when relying on social media as a part of the relief effort process.

Indeed, scholars have started to call for more attention to bottom-up communication practices, and have highlighted the importance of understanding the ways in which 'publics make meaning during disasters', especially given that most crisis communication research focuses on information management by organizations (Liu, Fraustino & Jin, 2015), while disasters are intrinsically social phenomena, primarily affecting communities (Fraustino et al., 2017). Fraustino et al. (2017) highlight three kinds of relevant publics: (1) influential social media creators; (2) social media followers who consume the influential social media creators' crisis information; and (3) social media inactives. When discussing the first kind of public, Fraustino et al. underline the need to identify *key influencers*. More specifically, influential social media creators who '(a) have more knowledge or experience regarding a specific disaster issue than others do or (b) are more interested in learning about a specific disaster issue than others are' (p. 6797-6798). Social media followers, in contrast, 'receive disaster information from influential social media content creators either directly or indirectly' (pos. 6800-6801). Social media inactives do not directly receive information from social media, but may be aware of social media content via offline interactions with social media users (pos. 6804). When addressing the practices of digital volunteers, on the other hand, Reuter et al. (2013) suggested specific classifications of Twitter users according to their role: *helper, reporter, retweeter, repeater* and *reader*. Kaufhold and Reuter (2014) additionally proposed the role of the *moderator.*

In crisis situations, emergency managers tend to consider journalists and social media creators as actors that are not exerting any useful activity and should, instead, be seen as their 'opponents', looking for information that emergency managers are not willing

to disclose. Scholars highlight the need to overcome this ''us against them' mentality that exists between some emergency managers and journalists or other social media creators' (Liu, Fraustino & Jin, 2015, p. 60), and argue for the importance of a deeper understanding of bottom-up processes, given the growing amount of disaster-related citizen generated content circulated through social media.

Therefore, in this article we focus on bottom-up processes, exploring how social media can be deployed in citizen-driven disaster relief activities, as they provide 'people-powered, decentralized communication systems [that] could eventually become effective during times of disaster' in order to 'organize missing-persons lists, coordinate relief supplies, and exchange news about the situation' (Potts, 2013, p. 40). During emergencies, for instance, Twitter users show a particularly high propensity to retweet (RT) other users' posts, and to share URLs and multimedia content, with the goal of accelerating the circulation of relevant information (Bruns, Burgess, Crawford, & Shaw, 2012), effectively engaging in processes of 'collaborative curation of information' (Bruns & Stieglitz, 2014, p. 26). Adopting hashtags that are specific to the event significantly increases the share of tweets that are directly crisis-related (Olteanu, Vieweg, & Castillo, 2015). For a broader analysis of predefined hashtags for weather warnings in the Italian context, see Grasso and Crisci (2016). Only in subsequent stages do reactions and discussion play a major role, including tweets related to offers of help and fundraising activities (Bruns et al., 2012).

Another angle to consider is the role played by the *voluntweeters*, i.e., the forms of volunteering enabled by social media, and Twitter in particular (Starbird & Palen, 2011). Research has shown that voluntweeters in the aftermath of the Haiti earthquake 'incorporated a variety of social media and communication tools in their working practices,' including email, Skype and the collaborative reporting system Ushahidi (Starbird & Palen, 2011, p. 7). Moreover, a relevant part of the voluntweeters' work consisted in 'translating' relevant (and verified) tweets into a specific syntax, aimed at producing information in machine readable form, to help gathering meaningful information. Overall, the volunteering Twitter activity after the Haiti earthquake can be described as an *emergent organization* (Dynes, 1970): The creation of groups of people that are normally self-organizing and that did not share any previous standing structure or task. A promising organizational form are VOSTs (Virtual Operations Support Teams), groups 'of trusted volunteers who can assist crisis response efforts by monitoring and archiving social media communications, updating websites and social media streams, and performing any other tasks that can be done online' (Hughes & Tapia, 2015, p. 687; Cobb et al., 2014).

While the emergence of similar organizations in response to disasters is not new to the digital era, it can be argued that digital platforms enable 'individuals with shared concerns to organize across time and space, without the need of co-presence or preexisting formal ties, networks, or organizations' (Ortiz & Ostertag, 2014, p. 52). In particular, given that 'local populations are more likely to follow individuals rather than organizations for crisis news' (Cooper, Yeager, Burkle, & Subbarao, 2015, p. 9), trained local social media users can effectively contribute in spreading information during, and in the aftermath

(Farinosi & Treré, 2014), of a natural disaster. Literature also shows that digital volunteers' activities, while often limited - at an operational level - to online platforms, are able to address concrete needs in the physical world (Comunello & Mulargia, 2018). Indeed, as the Internet has become a growing part of everyday life, the online versus offline dichotomy 'has become increasingly counter-productive in methodological terms' (Jensen, 2011, p. 43). Indeed, even literature adopting the 'virtual' versus 'real volunteers' distinction (Reuter et al., 2013; Kaufhold & Reuter, 2016) concludes that there is a significant overlap between the two (see also, among others, Albris, 2017).

While research to date has provided insights into user activities and motivations as well as patterns of influence through qualitative analysis, metrics and/or social network analysis, we observe a lack of research investigating the communication dynamics carried out by the self-organizing crowds that use social media to disseminate information about their activities. Research has specifically failed to look at the emergence of personalized communication; the roles played by the different actors; main coordination and cooperation strategies. Therefore, expanding our understanding of user social media activities in the aftermath of a natural disaster, with special regard to self-organizing volunteering and disaster-recovery activities, would greatly benefit from adopting the connective action framework that emphasizes the role of communication dynamics.

Exploring connective action in digital networks

Bennett and Segerberg introduce the *logic of connective action* to describe how communication affects the organization contemporary large-scale protests. The term is defined as a participatory process 'based on personalized content sharing across media networks' (2012, p. 739). Two main pillars characterize the logic of connective action: On the one hand, 'personal action frames' (Bennett & Segerberg, 2012, p. 744), that emphasize the role of individuals, instead of broader collective entities; on the other hand, 'personal communication technology' (Bennett & Segerberg, 2012, p. 744), considered as an 'organizing agent' (Bennett & Segerberg, 2012, p. 752).

The logic of connective action is supported by two additional phenomena: Disintermediation and audience engagement through digital media. The disintermediation process enables actors to autonomously publish content online, partially bypassing the traditional mass-media mediation and journalists' gate-keeping role, thus favoring the rise of autonomous individualized activism. Moreover, communicative skills developed in the context of participatory cultures support audience engagement and contribute to accomplish civic and political goals (Jenkins, Ito, & boyd, 2015). This process resembles the organization of open peer-production communities involving a 'vast number of dispersed and differently engaged individuals that come together to create a common goal' (Bennett, Segerberg, & Walker, 2014, p. 235). In the context of *networked individualism* (Rainie & Wellman, 2012) individuals use digital media to take action and temporarily collaborate for a common goal, promoting so-called 'individualized collective actions' (Micheletti, 2003, p. xi). Most of these actions are based on *ad hoc* communities, connected by weak ties. These

developments have altered the characteristics of engagement, especially among young people. Bennett observes a shift from a 'dutiful citizen' model to an 'actualizing citizen' model, the latter 'favoring loosely networked activism to address issues that reflect personal values', based on the rise of experiences such as 'consumerism, community volunteering, or transnational activism' (2008, p. 12).

According to the connective action framework, digital media operate as 'organizing agents' (Segerberg & Bennett, 2012, p. 752) to help people achieve practical and communicative goals. Personalized communication plays a key role in the connective action logic. Indeed, in large-scale protests 'personal action frames become the transmission units across trusted social network'' (Bennett & Segerberg, 2012, p. 755), taking on the role of traditional political organizations. In such a context, a relevant role is played by the rise of so-called large-scale crowd-enabled networks following the modes of peer-production communities (Bennett et. al., 2014), i.e., 'dynamic organizations in which crowds (…) allocate resources, respond to external events, and display transitional changes over time' (Bennett & Segerberg, 2013, p. 13).

Patterns of influence on Twitter

Crucial elements in emergency communication, as well as for activist communication in the framework of connective action, are the patterns of information diffusion. These are specific to each specific digital platform, hinging on its network structure, the prevalence of strong or weak ties, and the general affordances of each platform (Valenzuela, Arriagada, & Scherman, 2014). In both emergency communication and activist communication, indeed, a timely circulation of reliable information constitutes a key element for effective coordination. A related topic is the role of so-called influencers, a broad and fuzzy category that includes different types of users who appear, from time to time, to be able to exert a significant influence over other users and which include so-called Twitter celebrities, off-line celebrities, users showing expertise on specific topics, and 'common users' (Marwick & boyd, 2011; Marwick 2018).

Interactions and influence on Twitter has also to be understood in relation to the three structural layers of communication, as described by Bruns and Moe (2014): The *micro* level (conversations between single users, @reply), the *meso* level (*follower-followee* networks), and the *macro* level (hashtag conversations). In addition, Recuero and Araújo (2012) propose a distinction between natural and artificial trending topics on Twitter. Natural trending topics are those that emerge spontaneously, while artificial trending topics are promoted on purpose by specific user groups. The latter are described as being generally promoted by highly engaged actors and supported by trust and cooperation between those actors.

While early research has underlined the lack of any univocal and direct correlation between the number of followers and the number of retweets and mentions (Cha, Haddadi, Benvenuto, & Gummadi, 2010), structural elements (the structure of each user's network, the broader distribution in terms of in- and out-degree) operate as a pre-condition for

further patterns of influence, contributing to determine a context in which 'some actors have more agency than others' (Potts, 2013, p. 68; see also Cooper et al., 2015). In this regard, 'most influential users hold significant influence over a variety of topics,' while ordinary users 'can gain influence by focusing on a single topic and posting creative and insightful tweets that are perceived as valuable by others' (Cha et al., 2010, p. 11).

Aims and Research Questions

The article focuses on the #allertameteoSAR conversation taking place within several digital spaces, but mainly on Twitter. The #allertameteoSAR hashtag is our focus since it emerged as the main hashtag for disaster relief during the 2013 Sardinian floods. The user-driven emergency management activity produced by the #allertameteoSAR digital volunteers offers an interesting opportunity to describe the roles performed by the different actors contributing to the conversation: Citizens, institutions, politicians and celebrities.

In the remainder of this paper, we analyze the digital volunteering practices carried out by users adopting the hashtag #allertameteoSAR. By applying the connective action framework to our case study, we aim at developing a broader theoretical perspective that can be applied to future bottom-up disaster response practices and, thus, contributing to a deeper understanding of such emergent phenomena.

According to Bennett & Segerberg (2012, p. 739) connective actions differ from collective actions because they are 'based on personalized content sharing across media networks' while media and collective organizations stay in the margins. Moreover, personalized connective actions entail 'greater opportunities for individuals to define issues in their own terms and to network with others through social media, thus distributing the organizational burden among participants' (Bennett & Segerberg, 2013, p. 59). In order to verify if the #allertameteoSAR citizen-driven disaster relief activity follows similar patterns to the connective action framework, we analyzed the case study in relation to the two main characteristics of the connective action framework: The role of the different individuals managing the conversation and the presence of a peer-production process and sharing through digital media. Therefore, our first research question is the following:

> **RQ1**: Who are the actors that mostly contributed to the #allertameteoSAR conversation (e.g. citizens, institutions, politicians, celebrities, Twitter celebrities, media)? Do they belong to media or official organizations?

Moreover, according to Bennett et al. (2014, p. 232) the connective action framework is based on the peer 'production, curation and dynamic integration of various type of information content and other resources that become distributed and utilized across the crowd'. Therefore, we aim to verify if #allertameteoSAR activities are based on a peer-production process:

> **RQ2**: Did digital volunteers succeed in establishing a peer-production process?

Did they effectively carry out a disaster-relief oriented communication that also contributed to coordinate offline support activity? How did they reach this goal?

The latter question also aims to explore if digital volunteers can effectively use digital media to manage disaster relief activities and share useful and verified information

Methods

The article analyzes the entire dataset of the tweets with the hashtag #allertameteoSAR that were produced during the first week of the Sardinian floods (November 18-24, 2013). In total, we extracted 93,091tweets using GNIP's 'Historical Power Track'[2]. The research integrates three methodological approaches: 1) an automated data analysis and activity metrics; 2) a thematic analysis of a selection of tweets; and 3) a network analysis of the most mentioned users.

In regard to the activity metrics, we focused on tweet flow variation over time, 'unique users', tweets per user average, hashtag spread through retweets, and user tweet production. Such analyses are well-established in literature focusing on Twitter, and allow researchers to develop a better understanding of the conversations that take place on the platform in terms of patterns of influence, user engagement with the topic, tweet popularity, tweet flow as related to the unfolding events, as well as to compare this dataset with other datasets focusing on similar topics (see, for instance, Bruns & Moe, 2014).

We also performed a thematic analysis using *close reading* (Brummett, 2010) of the most retweeted tweets (N=93, 100 RT or more)[3] and the tweets by the one user who contributed the highest number of tweets (N=330)[4]. As retweets are ways for spreading a tweet, they can be considered as a proxy for tweet relevance (both because of their overall occurrence in the dataset, and because of user engagement in spreading them). Furthermore, as the user that produced the highest number of tweets emerged as the most influential in the dataset (see the social network analysis results), we also focused on their tweets. So, while an in-depth qualitative analysis of tweet form and content exceeds the scope of this article, close reading of the most retweeted tweets, and those by the most active user, allowed us to gain qualitative insights into tweet content, highlighting prevailing themes and the evolution of the hashtag itself, with main regard to the strategies and the phases for a *peer curation* of the disaster-related conversations.

Finally, we used a social network analysis (Wukich & Steinberg, 2014) highlighting the main actors that contributed to the Twitter conversation. A network graph (in and out degree) of the 70 most cited (RT and mentions) accounts has been generated through the open-source graph platform GEPHI (Bastian, Heymann & Jacomy, 2009[5]).

The presentation of our results follows a thematic organization. It provides a close dialogue between the activity metrics, the social network analysis, and the thematic analysis, in order to try to understand the features and evolution of the hashtag conversation, the roles of the actors contributing to the conversation, the strategies

adopted for a peer 'curation' of the disaster-relief communication.
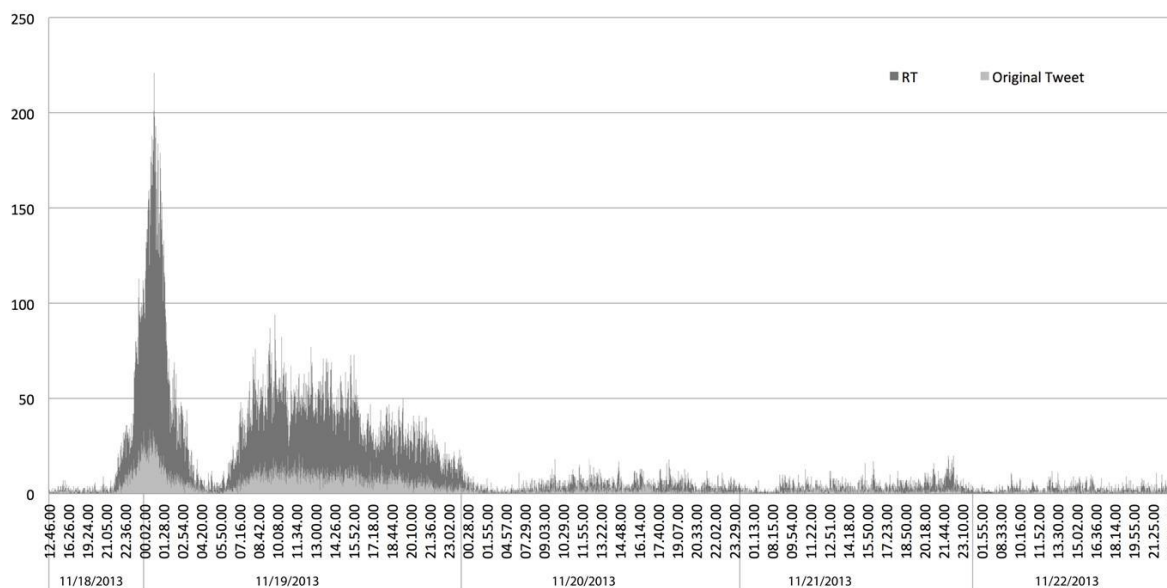
Results

This section is organized as follows: After describing the features and evolution of the #allertameteoSAR conversation, we analyze the role of the actors contributing to the conversation to address research question 1. Next, we focus on whether and how digital volunteers succeeded in elaborating an effective disaster-relief oriented communication which speaks to research question 2. When analyzing the role the different accounts played in contributing to the conversation, we used the number of followers to discriminate between common users and Twitter celebrities, and other information, such as the profile description, to recognize celebrities (mainly pop-stars, actors, other well-known persons from the show business), institutional users (i.e., accounts of public institutions and politicians), and media accounts (accounts referring to media outlets, including news articles, radio and television channels). Our operational definition for Italian Twitter celebrities in 2013 includes users with more than 20,000 followers. Given the dimension of the Italian Twitter sphere, we consider this number a clear indicator of celebrity, at least within a specific community/field. Nevertheless, most of these users are far from being celebrities in a broader sense, as they can be generally distinguished from common users only based on their follower base (and their potential influence in Twitter feeds).

Features and Evolution of the Conversation

A few hours after heavy rainfall began (12:46pm, November 18, Day 1), an Italian Twitter celebrity (@insopportabile) created the hashtag #allertameteoSAR. The user proposed to adopt it given that institutions and media organizations were not active on Twitter during the first hours of the floods. His first tweet was: 'Big troubles because of bad weather in Sardegna. Report them with the tag #allertameteoSAR. Thank you'.[6] This was retweeted 14 times. At the time, @insopportabile (69,000 followers) was a heavy Twitter user; he had produced 72,000 tweets since 2009. Before the introduction of #allertameteoSAR hashtag, users were tweeting about the storm using several hashtags, making reference to weather conditions, such as #pioggia (rain), #alluvione (flood), or different locations (#Olbia, #Cagliari). In our database, the most used hashtags, besides #allertameteoSAR, are #Sardegna (26,983 occurrences), #Olbia (13,052 tweets) and #forzasardegna (Go Sardinia, 8,473 tweets). As **Figure 1** shows, most of the tweets (80.9%) collected during the first week of the Sardinian floods were produced during the first two days (November 18 and 19, respectively Day 1 and Day 2). The temporal distribution of the tweets differs from the Twitter activity that has been observed during other natural disasters; with regard to earthquakes, for instance, Twitter activity peaks occur within a few minutes after major shakes (Bruns & Stieglitz, 2014; Comunello, Parisi, Lauciani, Magnoni, & Casarotti, 2016). In this case, the Twitter activity reflects the temporal distribution of the damages caused by the water accumulation; it significantly increased several hours after it started to rain

(during the late evening and night) and decreased the day after the heavy storm. The adoption of the hashtag #allertameteoSAR was encouraged by its inclusion in the Italian Trending Topics (at 11pm, Day 1), focusing users' attention both on the event and on the hashtag itself. At the same time, the increasing media coverage by prime-time television shows and newscasts may have contributed to increasing the visibility of the flood as well.

The #allertameteoSAR unique users numbered 22,363, among them 12,408 users (55.5%) produced only one tweet; the mean number of tweets per user is 4.16. The most active user (@insopportabile) tweeted 330 times, while the most active 1% of users (*N*=224) created 23.7% of the tweets. Moreover, 33.8% of the tweets refer to a URL and 83.9% of the tweets are retweets (RT). The temporal distribution of retweets follows the tweet distribution. Generally speaking, a high volume of RT characterizes emergency and crisis communication. In this dataset, the RT rate exceeds the average frequency of RT during natural disasters. Bruns and Stieglitz (2014), through a comparative study of more than 40 different cases, found an RT rate during natural disasters of between 55% and 70% of tweets. The disaster-recovery oriented aim of #allertameteoSAR, together with the goal to spread the hashtag, could have produced this result.


Figure 1: Number of retweets and original tweet per minute.

Indeed, the RT represents a gesture of minimal activation that can produce some useful results (e.g. in terms of hashtag diffusion). Therefore, also sporadic users may have decided to contribute to increase the hashtag circulation.

Roles of the Actors Contributing to the Conversation

Mentions and RTs are useful parameters to describe the patterns of influence in a Twitter conversation. As in previous studies (e.g. Murthy & Longwell, 2013), our database lists user

mentions and received RTs together. As Austin, Liu and Jin (2012) outline, it is crucial to identify so-called key influencers who provide crisis information in order to develop a productive collaboration among social media creators and public institutions. **Figure 2** shows that the most influential accounts (in terms of retweets and mentions) belong to Italian Twitter celebrities (@insopportabile, @CriticoCinema), pop-stars (@mengonimarco) and Twitter heavy users (@Virus1979C)[7]. Only two institutional accounts are present: Ugo Cappellacci (@ugocappellacci, former President of the Regional Government) and the Municipality of Cagliari (@Comune_Cagliari, Sardinia's capital city, which was not heavily affected by the floods).
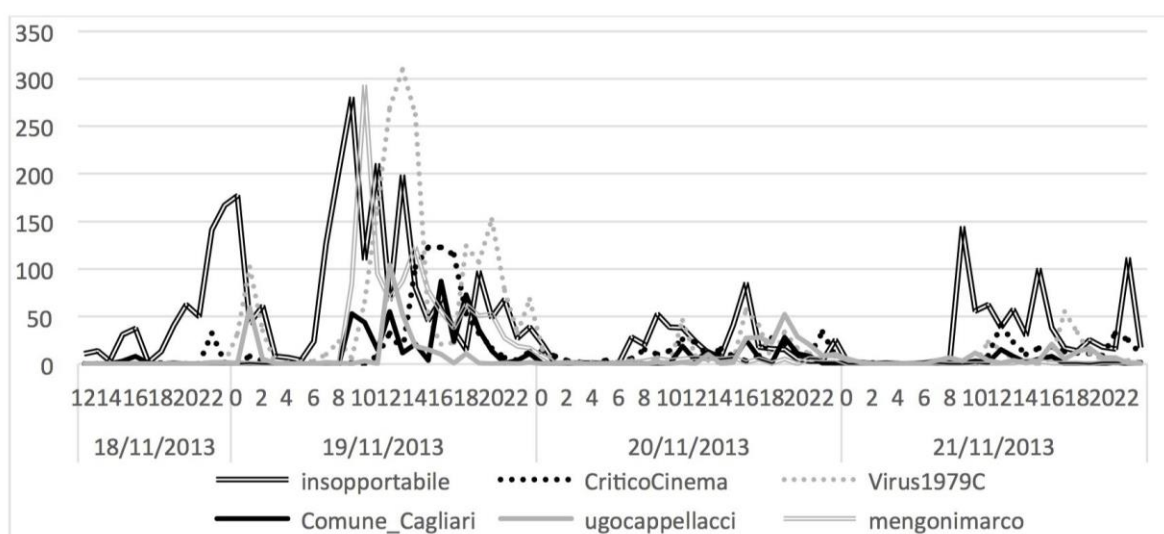
Figure 2: Number of mentions per hour received by most mentioned accounts

A major role in promoting #allertameteoSAR was played by local Twitter celebrities[8], while the three most retweeted tweets were created by Italian pop-stars (Marco Mengoni, EmisKilla and Flavio Briatore). Overall, the singer Marco Mengoni (516,011 followers) authored the most retweeted tweet (1,225 retweets). Italian institutions appear far less influential than Twitter celebrities or common social media users. For instance, the Municipality of Cagliari joined the conversation at 03:56pm (Day 1). During the days of the flood it published 23 original tweets (news and updates; weather bulletins; emergency numbers and information about places where to sleep). Ugo Cappellacci (former President of the Regional Government) joined at 1:00am (Day 2) using his personal Twitter account and published 30 original tweets. Both institutional accounts have been 'invited' by the users (through several mentions and critical remarks) to use #allertameteoSAR. On the whole, excluding celebrities, the most retweeted users are @insopportabile (3,575), @Virus1979C (2,285), @CriticoCinema (1,000), @ugocappellacci (563) and @comune_cagliari (630). The most mentioned accounts are the following: @insopportabile (5,538 mentions), @criticocinema (4,035), @virus1979C (2,381), @egyzia (2,468),

@paolinapitty (1,822) and @emergenza24 (1,693). These belong to Twitter celebrities or to users who are very active on Twitter. Moreover, the majority of them are connected with Sardinia (@insopportabile, @egyzia and @CriticoCinema could be defined as Sardinian Twitter celebrities).

Some Twitter users pointed out that Italian institutions did not play an active role in managing the 2013 Sardinian floods emergency, at least through social media. Moreover, Twitter users invited broadcast media to cover the event, stressing the distance between Twitter and the mass media agenda. Following the connective action framework, the dataset overall showed a highly self-motivated communication driven by local Twitter celebrities and engaged common users that framed the #allertameteoSAR conversation, instead of major organizations and institutions.

Social network analysis was used to highlight the main actors in the conversation. Figure 3 lists the 70 most cited accounts: Users are classified by color according to their roles, and the size of the circle is proportional to the number of followers each user has. Using a force-directed layout algorithm (Fruchterman & Reingold, 1991) the users (nodes) are placed according to their interconnections (edges) in the network. The most important users are located in the middle of the graph. The ones located near the boundaries are less active.The 70 most cited accounts received approximately 40% of the total citations. Indeed, despite the rhetoric claiming the Internet has an intrinsically democratic nature, a small number of actors exert a great deal of influence over the whole network[9]. Indeed, previous analyses of Twitter datasets (Bruns & Stieglitz, 2014), or of Facebook groups (Albris, 2017), show that many of the conversations on natural disasters are driven by a small number of active accounts, which are then supported by a larger basis of less active users. In line with this, the analysis clearly shows the degree of interconnectedness of the central users, who are mostly common users (volunteers) and some Twitter celebrities. Almost all celebrities and media accounts, including online news articles (e.g. @repubblicait), are marginal in the network, having a relatively low impact on the feed.

On the whole, the analysis shows a recalibration of communicative roles among citizens, media and institutions, with the former gaining and the latter losing influence. Italian institutions did not diffusely and systematically rely on social media to provide useful information during the floods. They did not play a visible and active role in steering online conversations and interactions, nor in effectively organizing relevant information spread. On the one hand, they did not seem interested in providing a unified information source on social media (be it through a dedicated account, or through a dedicated hashtag). On the other hand, while some institutional accounts experienced a late adoption of #allertameteoSAR, most of them did not join the user-driver conversation, losing the chance to interact with users living in the affected areas, as well as to gather and provide updated and verified information. In other words, while institutions and media played a marginal role, Twitter celebrities and common users occupied a central position exerting a relevant influence in the feed. In both cases 'personal action frames become the transmission units across trusted social networks' (Bennett & Segerberg, 2012, p. 755). This finding is backed

up by Table 2 which shows that even if institutional accounts carried out a marginal activity, they are intensively mentioned and retweeted, showing that users expect to receive official information by public institutions.
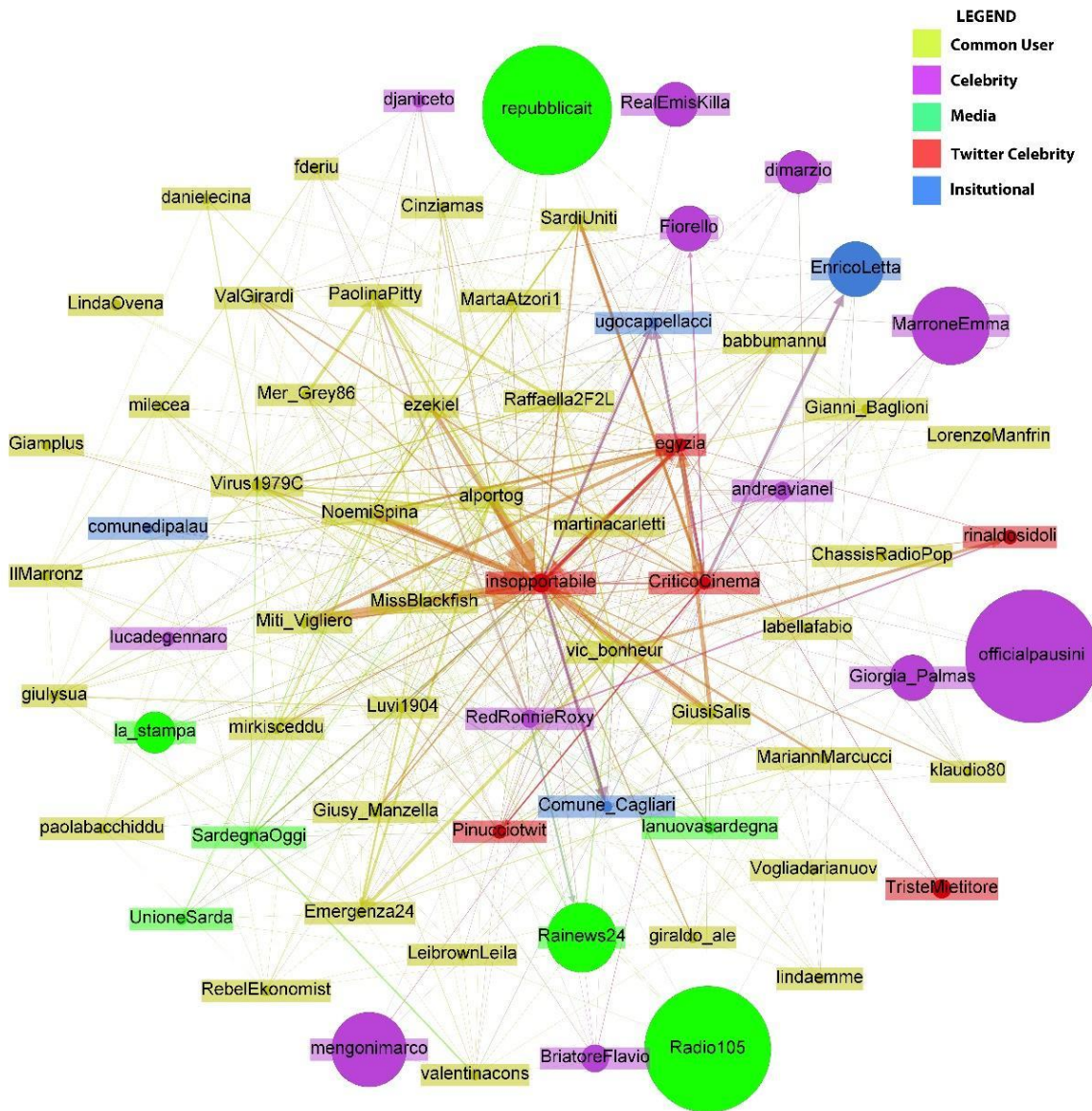
Figure 3: Network of most cited accounts

User	Avg. num. of tweets of users in contact with the Main User	Ego-network statistics					
		Nodes	Edges	Mean degree of nodes [10]	Mean weighted degree of node [11]	Graph density (directed)	Mean clustering coefficient [12]
mengonimarco (Celebrity)	4.21	1,382	1,969	1.42	1.56	0.001	0.11
Insopportabile (Twitter Celebrity)	14.96	2,661	17,618	6.62	10.04	0.002	0.30

Ugocappellacci (Institution)	28.86	590	2,859	4.85	9.91	0.008	0.35
Comune_Cagliari (Institution)	27.67	516	2,678	5.19	9.31	0.010	0.34
CriticoCinema (Twitter Celebrity)	15.95	1,632	8,268	5.07	8.04	0.003	0.41
Virus1979c (Common User)	23.19	1,258	8,570	6.81	11.57	0.005	0.26
Total network	4.16	23,288	82,562	3.55	4.31	0.0002	0.116

Table 1: Network statistics (total network and ego-network of main users)

	Sent		Received	
	Original tweet	RT	Mention	RT
mengonimarco (Celebrity)	1	0	17	1,255
insopportabile (Twitter Celebrity)	172	158	212	4,215
ugocappellacci (Institution)	30	3	47	662
Comune_Cagliari (Institution)	23	15	18	672
CriticoCinema (Twitter Celebrity)	228	71	26	2,378
Virus1979C (Common User)	119	87	20	2,360

Table 2: Tweets sent and received by the main users

Strategies for Peer 'Curation' and Sharing of Disaster-Relief Communication: Evolution of a Hashtag

Mere quantitative methods cannot exhaustively describe how a generic Twitter hashtag conversation can be turned into a more practical, disaster-relief oriented conversation, therefore we applied a close reading technique to the online activity of those users who mostly contributed to the grassroots diffusion of the hashtag #allertameteoSAR in order to analyse the evolution of the hashtag. This meant we analyzed the activity of @insopportabile on Twitter (N= 330) and   performed an analysis of the most retweeted tweets, in order to grasp the most relevant content related to the hashtag.

At the start of the floods, the hashtag was used as a general-purpose hashtag. Later on, (see 'Stage 2' below) some Twitter users tried to transform it into the '(un)official' hashtag for Sardinia floods relief-related conversations. In order to reach this aim, they worked to remove expressions of solidarity and other general comments that social media

users often raise during dramatic events. This process can be split into three main phases: 1) hashtag promotion and diffusion; 2) hashtag 'cleaning' and moderation; 3) the hashtag is used to promote a multichannel strategy for disaster relief.

Stage 1: *Hashtag Promotion and Diffusion*

This stage took place starting at 12 pm on Day 1. Several users actively encourage the use of the hashtag for an operative aim, e.g. 'please report the troubles (dangers, closed streets, etc.,) using the hashtag #allertameteoSAR' (3:06pm). In the meantime, digital volunteers started to invite institutional accounts to join the conversation (e.g. the municipality of Cagliari, 3:47pm), to promote the activity of specific accounts (users tweeting from damaged areas, local media outlets) and to share digital resources conveying practical information. In the evening the hashtag gains increasing visibility (at 10:00pm #allertameteoSAR has been tweeted 800 times); at the same time media outlets and a few Sardinian institutions join the conversation.

Stage 2: *Hashtag Cleaning and Moderation*

This started at 11:00pm on Day 1. In late evening, in order to manage a significant increase in the hashtag adoption and its concomitant inclusion in the Italian trending topics, digital volunteers start to moderate the flow ('#allertameteoSAR is a channel for URGENT information, not for thoughts' Day 2, 3:26pm). Their main concern was to 'clean' the hashtag, avoiding the expressions of solidarity and sorrow. 'No compassionate RT, thanks. It is time to use the net to inform. #allertameteoSAR' (11:17pm). Digital volunteers also start to validate the posted news and encourage the publication of verified information, including sources: 'Please cite the news sources if you didn't personally witness with your own eyes #allertameteoSAR,' Day 1, 10:54pm. Moreover, they ask users to retweet only after they verify the accuracy of the information, avoiding false news amplification ('Always check the news before RT. A rushed RT obstructs helpful news. #allertameteoSAR' Day 2, 8:39pm).

Stage 3: *Hashtag as Promotion for Multichannel Strategy for Disaster Relief*

This stage started on Day 2. On the morning of Day 2 users remark that public institutions' accounts are not posting any official information ('How is it possible that there is no official Civil Protection or Municipality account to get the news? #allertameteoSAR' (Day 2, 9:02am). Several users polemically underline that public authorities are not even verifying the validity of the emergency numbers ('It's crazy that there is no one that verifies 3 damned phone numbers. Unbelievable. #allertameteoSAR' (Day 2, 9:4am). In the afternoon, the #allertameteoSAR Twitter community concentrates its effort to systematically connect all the online platforms that have been used during the emergency: The Facebook Page Allertametosar, a Google Doc kit, and the SardSOS map. Users adopted an ecological approach to digital communication employing different online tools, thus creating an effective multichannel strategy for disaster relief. This process resembles several crowd-

enabled connective actions, 'based on rallying, information coordination and resource seeking' (Bennet & Segerberg, 2013, p. 88). In particular, the crowd map, adopting an Open Street Map layer, has been used to collect 509 different contributions, mainly from users offering their help ('Please put such information on the map. Otherwise they will be hidden by other RTs and no one can use it' @insopportabile, 11/21, 10:13am). As a result, the most cited URL in the #allertameteoSAR conversation refers to SardSOS map (Lovari & Murtas, 2014). In the meantime, from Day 2, the #forzasardegna hashtag exerted a significant complementary role collecting expressions of solidarity, contributing to remove 'useless' information from the #allertameteoSAR stream.

The Power of Retweets

As the RT function generally expresses the willingness of sharing a message (thus revealing, at least during natural disasters, the perceived relevance and usefulness of the tweet) we analyzed the most retweeted tweets (N=93, 100 RT or more), which represent, on the whole, 15% of the entire database. The majority of those tweets communicate useful information: Official emergency telephone numbers, verified information about recovery centers, requests for specific resources (sleeping accommodations, assistance to people with disabilities), crowdfunding initiatives, how to create an open Wi-FI network, etc. Observing that such a relevant part of the whole dataset fully complies with digital volunteers' goals in curating the hashtag, we can assume that they effectively succeeded in turning #allertameteoSAR into a practical, disaster-recovery oriented conversation. Nowadays the tag #allertameteo (weather alert) followed by the name of a given Italian Region has become the standard reference for weather alerts on social media, and is used both by common users and by some institutions (Grasso & Crisci, 2016).

Indeed #allertameteoSAR gained relevance up to the point that even institutions and relevant local public figures started adopting it as the main hashtag for emergency communication on Twitter. In the following days, the Sardinia Region official website invited citizens to rely on the communication platforms created by #allertameteoSAR volunteers. Moreover, as a consequence of the #allertameteoSAR activity, the Sardinia Region became the first Italian public administration to promote a crowdsourced initiative after a natural disaster (Lovari & Murtas, 2014) and, in order to contribute to the development of the SardSOS map, it unlocked the whole regional topographic database adopting an open data approach.

Discussion and Conclusion

Our case study illustrates that, consistent with the connective action framework, during the 2013 Sardinian flood digital technology indeed played an 'important role in the organization of the crowds' (Bennett & Segerberg, 2013, p. 89) for collecting, verifying and sharing information, as well as for supporting disaster-relief actions. Moreover, as highlighted by literature analyzing movements addressing 'geographically restricted' problems, the

Internet and social media helped 'to reach a larger number of people', as 'local grassroots movements need to be supported by a collective voice at a wider scale'' (Ruiu & Ragnedda, 2017, pp. 15-16).

Here, connected crowds carried out a participatory process based on personalized communication where 'personal action frames become the transmission units across trusted social networks' (Bennett & Segerberg, 2012, p. 755). Furthermore, digital volunteers shaped disaster-related Twitter conversations and employed different online platforms, thus influencing traditional media coverage and decision makers' priorities. They effectively distributed relevant and practical information across the crowd, relying on specific Twitter patterns of engagement (mention, retweet) and features (trending topic), and conferring a relevant visibility to the hashtag #allertameteoSAR.

In emergency situations, when public institutions are communicating effectively, mass media exert a relevant role (Bruns et al., 2012). This scenario resembles the 'collective action framework' based on an organization-centered network (Bennet & Segerberg, 2013, p. 46). However, when institutional communication is generally lacking, networked volunteers' patterns of engagement share many characteristics with civic participatory practices carried out in the context of 'connective actions' (Segerberg & Bennett, 2011). Indeed, the #allertameteoSAR analysis confirms that, as happens during self-organized protest events following the connective action framework, mainstream media appear at the margins (see **Figure 3**).

On the whole, the process of hashtag curation on Twitter illustrates how digital volunteers collaboratively filtered out 'counterproductive contributions (including rumors and spam)' and successfully managed a 'cross-platform organizational integration' (Bennett et al., 2014, p. 247). Moreover, with regard to the distinction between natural and artificial trending topics on Twitter, respectively based on bridging ties and bonding ties (Recuero & Araújo, 2012), we could argue that the hashtag #allertameteoSAR stays somehow in between the two poles: On the one hand, ties between the Twitter users involved form a *loose* network. On the other hand, however, a *core* of the most active users emerges, among whom are to be found elements of engagement, cooperation, and trust that characterize online participatory cultures (Jenkins et al., 2015). Those networks do not need to be bound to offline relations, nor to daily contacts, but they origin on momentarily shared goals and emotions, as has been observed in networked social movements (Castells, 2012; Papacharissi, 2014).

In analyzing the user-driven activities surrounding #allertameteoSAR we are witnessing the rise of what we could define as *networked volunteering*, a specific form of *emergent organization* (Dynes, 1970), that follows the specific patterns of sociability described by Rainie and Wellman (2012) wherein people interact 'in shifting networks rather than in solidary groups' (p. 124). The very structure of Twitter as a network provides specific affordances and constraints which enable users' ability to spread relevant information over the network: this is true both at the *meso* level (the follower-followee network, Bruns & Moe, 2014), and at the *macro* level (hashtagged conversations). Users'

chances to influence other users is both related to structural considerations (mainly their centrality in the network, the number of followers, the structure of their ego-networks), and to their credibility among other users, as roughly defined by previous interactions, visibility, and by their contribution to specific tasks or causes, which is a typical dynamic characterizing participatory cultures. Interaction styles and a high familiarity with each platform's features and communicative norms are also influential.

According to the connective action framework, a core group of users (Bennett & Segerberg, 2012, p. 21) exerted a disproportionately high influence over the whole network, being able to start an effective process of collective curation of the hashtag that results into 'impressive levels of coordinated action and planning' (Bennett & Segerberg, 2013, p. 90). Similar to the voluntweeters' experience (Starbird & Palen, 2011), most of these users were strongly connected to the areas that were affected by the floods, while some of them were operating at long distance.

Our case study also shows broader implications for disaster communication research (and practice). First, our analysis showed to what extent, and under what conditions, citizen-generated information could, indeed, be considered as a reliable source to provide situational awareness. This implies that institutions may benefit from compiling, in advance, lists of digital volunteers who are extremely active, credible and influential on different social media, asking them to observe social media trends, monitor issues and concerns expressed by the citizens, and publish key and verified information.

Furthermore, the #allertameteoSAR case study describes how institutional accounts, as well as other organizations, can effectively manage a disaster-relief oriented feed on social media during a natural disaster. Three main steps led the volunteers to reach their goal: 1) promotion and diffusion of a location-based hashtag among the Twitter community; 2) hashtag cleaning and moderation; 3) promotion of a multichannel strategy for disaster relief.

In conclusion, the article shows that the connective action framework can be productively applied to analyzing user-driven disaster response practices. Indeed, during natural disasters, similarly to contemporary social movements, digital media enable the formation of long distance trusted volunteers, operating in a networked fashion, that can be activated for *ad hoc* and close cooperation among users. The connective action approach offers a relevant framework for a deeper understanding of the dynamics of self-organized disaster communication activities (in terms of influence dynamics, strategies for information gathering, verifying and sharing, etc.).

Furthermore, the article highlights how a user-generated and user-driven emergency management activity provides interesting advice to effectively manage a disaster conversation on social media. A better understanding of bottom-up disaster communication processes, moreover, might also help to overcome one of the main barriers perceived by institutional emergency managers in gathering user-generated information through social media, which are essentially 'cultural' and related to mistrust (Comunello & Mulargia, 2018).

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Notes:

[1] The Genoa floods (November 2011) can be considered the first natural disaster in Italy that has been detailed through digital media.

[2] At the time we collected the tweets, GNIP Historical Power Track used to grant access to the whole database of public tweets, without the limitations that currently apply when using Twitter APIs.

[3] The choice of selecting the tweets that were retweeted 100 times or more is motivated by the fact that, taken together (i.e. considering the original tweet as well as the retweets), those tweets represent the 15% of the entire dataset.

[4] The choice of selecting, for close reading, to focus on the tweets written by the user who contributed the highest number of tweets is motivated by the fact that, given the high number of tweets produced by this single individual, and their distribution over the entire time-span we observed, we believe these tweets, together with the most retweeted tweets, can offer insights into the evolution of the conversation.

[5] For constructing the graph two .csv files were produced from the original tweets dataset. The first one listed all the users (nodes) that sent a tweet during the observation period classified by their role, including information such as their followers, tweet sent and mention received count. Every user became a node in our graph. The total network, formed by 23,288 nodes, was filtered to include only the 70 most cited users (more than 200 citations). The second file listed all the connections (edges) between the user who sent a tweet (source) and every other users mentioned (target) weighted according to the number of connections between the source and the target. This type of data construction allows to create a directed weighted graph.

[6] All tweets were in Italian; translations are ours.

[7] We define as a 'Twitter heavy user' a user who does not reach the follower count needed to be defined as a Twitter celebrity and shows an over-the-Italian-average tweet count.

[8] We define 'local Twitter celebrities' those users who declared to live in Sardinia (mainly in their profile description) and who had, in 2013, 15.000 followers or more. According to Social Bakers, the 1000 most followed Italian accounts had 25.000 followers or more (www.socialbakers.com/twitter/country/italy, accessed November 30, 2013). We estimated that 15.000 followers might work as a proxy for 'celebrity' in a smaller context, such as Sardinia.

[9] Similarly, Bentivegna and Marchetti highlighted the relatively small number of actors steering a relevant live tweeting conversation during an Italian political campaign, and stressed the role of so-called "vocal minorities" (2015, p. 645).

[10] The mean amount of connections per node on the graph.

[11] The mean weight of connections per node on the graph.

[12] The degree to which nodes on the graph tend to cluster together.