The role of social media-led and governmental information in China's urban disaster risk response: The case of Xiamen

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ABSTRACT

Social media is an emerging communication channel in natural and climate change-induced disaster situations. Yet, its role is context dependent and may not be as effective in all settings. This article examines its use in China. In cities and in the domain of environmental risk, social media is playing an emerging role in Chinese citizens' efforts to voice concerns and express critique to state actions. At the same time, our case-study shows how its use remains limited in cases of natural and climate change related disasters. We have examined this in the case of Typhoon Meranti that hit the city of Xiamen, China, in September 2016. Based on an online survey with 630 respondents and an analysis of social media blogs, this case-study shows how Xiamen citizens value official information (transmitted via warning texts or mainstream media) over individual perspectives shared through social media. In the Typhoon Meranti case, much of the information shared was official warnings and information taken from government websites or media reports. Comparing our results with other relevant literature on China suggests that, in cases of disaster emergencies, particularly in natural disasters—where immediate and accurate information is needed— citizens value China's top-down information structure over informal information from social media.

1. Introduction

Social media is seen as the new communication channel in natural and climate change-induced disaster settings. It allows for a greater variety of information sources to be spread, for communities to assist each other through information sharing and emotional support, and to stay in contact if traditional communication channels stop functioning [1]. Despite this, social media is no panacea and many uncertainties about its added value remain. In particular, the wide number of case-studies done on this subject highlight that the role and effectiveness of social media in disaster settings are context-specific. Findings from different places are contradictory regarding, for example, levels of trust in social media versus the role of more traditional government-led sources and outlets of information [2,3].

This paper examines its use in urban coastal China. China's general approach to natural disasters, and to environmental issues more broadly, is predominantly top-down in nature [4–6]. Adding on to that, it is very restrictive in its internet policy [7], curtailing a wide number of applications and using internet functions to enhance societal control [8,

9]. At the same time, however, the Chinese government has taken several steps to enhance levels of participation and transparency in environmental policy [6,10–12], and uses digital applications to achieve that [13]. Also, particularly in urban areas, Chinese citizens are increasingly using social media to protest against issues of environmental risk and pollution.

Within this complex socio-political context, and considering the various roles of social media within China, this article seeks to further delve into social media use during disaster situations that affect urban coastal China. We ask: Is the information acquired via social media valued and used by Chinese citizens during disaster situations and in what manner? How do Chinese citizens value it in relation to the information received by government authorities or more traditional government-led media outlets?

We focus specifically on the typhoon, Meranti, that hit Xiamen city on September 15, 2016, located in the south-eastern province of Fujian. Conducting a large-scale-online survey, complemented with an analysis of social media blogs, we assess the citizen-based usage and perceptions of social media and of official (government provided or supported)

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information sources in the days and weeks around Typhoon Meranti. Our analysis of this event shows that social media has specific informal and community-based functions, but has not (yet) surpassed the use and value attached to official governmental-led and mainstream media sources. We discuss this result in relation to other literature on social media use in China. We conclude that in cases of disaster emergencies, where direct action and quick information is needed, citizens value China's top-down information structure over the informal information retrieved from social media.

We proceed as follows: Section 2 reviews recent literature on the role of social media in disaster settings and discusses the Chinese context in more detail. Section 3 elaborates on the case of Typhoon Meranti, and outlines the methods and data analysis used. Section 4 presents the results, which are then discussed further in section 5 within the context of wider literature. Section 6 concludes.

2. Social media in disaster settings: a literature review

Effective and reliable communication is paramount in mitigating the impact of a disaster [1]. The lack thereof has grave implications. As Tandoc Jr and Takahashi [14] write, the disruption of communication has a deeply paralyzing effect, as it prohibits people from understanding what is going on and to communicate with their family and friends. Indeed, "[d]isasters [themselves] often are the result of a crisis in the communication process or a result of a communication breakdown" (Rodriguez 2007 in Ref. [1]: 3).

This has led to informational support being considered equally as important to hands-on support in disaster situations [14]. Traditional means of information distribution, such as radio, TV or telephone are often not sufficient to meet all communication needs, and are often disrupted by the disaster itself [15]. As such, in recent years there has been an increasing focus on the role of information and communication technologies (ICTs), and, in particular, on internet and mobile phone-based social media for effective communication in disaster situations [1,14]. Social media, which includes, amongst others, blogs, messaging services, wikis, micro-blogs, social networking platforms such as Facebook and Twitter [16], is considered particularly useful in disaster situations as, unlike traditional media, it allows for multidirectional and multilevel communication [14].

Policy and academia have often adopted an optimistic approach to the use of ICT (for a critique see Ref. [17,18]. For example, it has been stated that microblogging (e.g. on Twitter) and social networking "have *empowered* the public to share experiences and information during emergency and disaster response activities" [15]: 2, emphasis added). This is achieved through the various advantages of social media in disaster situations that have been described in academic research: The "potential for higher information capacity, dependability, and interactivity," while being generally low-cost and easy-to-use ([1]: 1); the two-way communication and instant information sharing it allows, eliminating the distinction between information producers and receivers by enabling creation, consumption and dissemination by all users [3]; as well as the characteristic of being a highly flexible medium that can be adopted to fit the different information needs people have in the different stages of a disaster [19]. It can even be used to circumvent or to replace the traditional top-down knowledge distribution, which in disaster situations is often lacking or inaccessible [19].

Despite the optimism about these important roles of social media before, during and after disasters, there are, however, many pitfalls and disadvantages of the increasing reliance on ICT and social media. One significant risk is the high potential of inaccurate or misleading facts being disseminated, particularly in situations of chaos. This might also lead to less trust in information received through social media [16,19,20]. Furthermore, the characteristics of social media are prone to lead to an overflow of information, which makes it difficult for users to find the relevant information [16]. Additionally, like traditional media channels, the physical infrastructure needed for ICTs systems (e.g. cell phone

towers) is often also affected by disasters and could even stop functioning. One of the largest failings identified in ICT by social media scholars is the prevailing issue of digital inequality, also referred to as the "digital divide" that excludes those most vulnerable who cannot access the information shared through social media [16]. Indeed, research highlights that those having no or limited access to ICTs (e.g. only a basic phone, no internet, or not able to read or write) risk being left out from aid and disaster recovery networks, as they are not able to connect to the right social networks or information channels (Medianou 2015; [21].

2.1. The Chinese context

An important outcome of research on the use of ICT and social media in disaster situations is the high level of context-specificity [3]. While some general conclusions about the advantages and disadvantages can be made as outlined above, research findings are often quite contradictory regarding, for instance, levels of trust in information spread by social media or regarding its usage by government institutions to inform the public [2,3]. For example, in the case of the Philippines, the local government did not use social media (*ibid.*); however, case studies from Hurricane Sandy in the USA show that, particularly during the disaster, the social media outlets of local government authorities and traditional media were the most important nodes in social networks [22]. This context-specificity makes exploring the case of China interesting as it is a country characterised by a top-down organisational approach in disaster management, making social media's role for distributing information less clear.

Indeed, much of China's environmental risk management, including its disaster planning, follows a traditional top-down process [5]. China's Integrated Coastal Management policy centring on natural disasters is considered top-down and reactive, lacking the integration of policy efforts and resources, and, above all, lacking public participation. Social media, meanwhile, plays an active role in disaster situations in China. For example, in the aftermath of the 2010 Yushu earthquake, citizens actively used Sino-Weibo, a Chinese Twitter-like microblog, to share updates and express emotions, but also to critique governmental responses [23].

More generally in the domain of environmental policy, the government of China has been trying to enhance the role of public participation in its decision-making. Since 2002, the Environmental Impact Assessment (EIA) Law requires increased public participation, and the 2015 Environmental Protection Law includes an extensive chapter on enhancing participation and transparency on environmental information [6,12,24]. The Chinese government has invested in online government facilities, and while various types of environmental data have been made publicly available online, such data is still riddled with biases and inaccuracies [10,25]. Additionally, especially in cities, an increasing number of Chinese citizens use social media—such as WeChat or Sina Blogs and microblog (Sino Weibo in Chinese)—to protest and report on environmental risk and pollution [6,13,23,26]. Sometimes this is in collaboration with governmental agencies. For example, under the programme "Urban Black and Odorous Water Information Platform," the Chinese government is working with Chinese citizens to monitor water pollution via WeChat [13]. Its aim is to track and put pressure on local government implementation efforts. In 2007, there were several social media-induced public protests against government-supported industrial projects, such as the protest against toxic chemical paraxylene (PX) plants in Xiamen [26]. More recently, there have been social media-influenced protests against the Liulitin waste incinerator [6]. In the context of environmental policy-making, China therefore has been identified as "a society in transition, in which public (environmental) activism is emerging and the relationship among various public and private stakeholders is increasingly tense" [6]: 188).

But implementing social media in information distribution and encouraging citizen participation has not necessarily helped to open-up

debates about governmental policy. Social media, and the data society more generally, functions as another surveillance technique [27]. For instance, the Chinese government utilizes digitally stored information to evaluate and control its individuals' social behaviours [9]. Many applications on the internet are censored, such as Google and Facebook [28], and supported with active censorship regulations for Chinese-based social media platforms [29]. Many of the Chinese internet users are, to an extent, aware that information is censored and filtered by the government, and is used to enhance control over the public [30]. This may differ, however, between rural and urban areas. Chinese citizens in Beijing who took part in a recent survey see much value in ICT tools (incl. social media) to enhance public participation in the domain of environmental sustainability; at the same time, they are conscious that its influence on decision-making processes has, so far, been limited [6]. In contrast, a study by White and Fu [2] shows how citizens from rural Sichuan following the 2008 earthquake perceived social media as the source of rumours (e.g. about kidnappings) and, instead, put their faith in the government information spread via TV news stations.

This particular socio-political context makes China an interesting case to further study the role of social media in disaster situations. We will do so by examining the case of Typhoon Meranti in Xiamen, China.

3. Methods

3.1. Case selection

We study the case of Typhoon Meranti - one of the world's strongest storms of 2016 [31] - which hit Xiamen city on September 15, 2016. It was amongst the more recent typhoons to make landfall in China, and thus well suited to examine social media and information usage and responses to the typhoon. Meranti is classified as a super typhoon in Taiwan with wind speeds of more than 300 km an hour, but it reduced to a category 2 typhoon while making landfall in China [32]. Flooding effects were limited and the main damages were caused by strong winds, resulting in only one casualty in Fujian province [33]. In these circumstances, several power cuts and unstable network connections took place, but internet and social media did not become completely inaccessible.

The urban setting of this case also makes it an appropriate setting to study the role of social media in citizen responses and preparedness to disaster situations. Urban areas are at high risk of climate changes, including extreme weather events. Moreover, compared to citizens from rural areas, city dwellers in China have more access to smart phones and make more active use of social media. Citizen-led protests involving social media most often take place in cities [6], including Xiamen, when in 2007, there were social media-influenced protest marches against the toxic chemical paraxylene (PX) plants [26].

3.2. Data collection

To conduct this case-study, we rely on a large-scale online survey of Xiamen inhabitants, and on a qualitative analysis of social media blogs. The online survey focuses on the emergency state of the typhoon - including the days before, during, and just after the storm. The social media blogs, and their analysis, largely focus on the post-disaster phase.

For the online survey, we composed the questionnaire in the summer of 2017. The development of the survey was informed by an informal set of interviews conducted in February 2017 with Xiamen citizens (n = 13) and with a small group of academics from the Institute of Urban Environment, Chinese Academy of Sciences. These interviews were aimed at obtaining preliminary information about the typhoon, its damages, and the type of information and information infrastructure that was used before and after the typhoon hit. On this basis, we composed the questionnaire as follows: one context-based section asking about the primary damages and the implications for digital connectivity during the typhoon, supplemented with three sections focused on the information

used, valued, and shared in the days before, during, and after the typhoon made landfall. The online survey was targeted at six districts of Xiamen city and conducted between 10 September to 15 October 2017 via the GR survey company. Respondents were recruited randomly among residents from different districts of Xiamen. A total of 950 residents were selected and surveyed, resulting in 630 valid questionnaires returned (average response rate of 66%). The participants included an equal distribution of males and females, were mostly between ages 21–40, and had completed secondary school or university education (see Table 1 for details). The quantitative data was subsequently coded and processed with SPSS 22.0. We conducted a descriptive analysis and correlation analysis of the survey data.

For the online survey, we limit ourselves to those having access to the internet in order to focus on the role that social media has played compared to traditional sources of information. Therefore, our study is not meant to offer further insights into the digital divide that still exists in China nor into the information used by those not having access to more advanced ICTs.

To supplement the survey results with a more in-depth insight into citizens' perspectives on information used and valued, we analysed a set of social media blog posts. We selected these from Sina Blogs (blog.sina.cn). These blogs can contain personal opinions, experiences or pictures of the disaster, or function as a means for citizens to share official media information. The blogs analysed vary from 77 Chinese characters to 3677 Chinese characters. They are usually relatively short when they forward information from media channels or a set of pictures. Personal blogs tend to be comparatively long. We searched on "Xiamen" and "Meranti Typhoon" in Sina Blogs using Sina Blog's own website and Google Search. Google search resulted in 18 Sina blogs.[1] The search on Sina Blog's own website resulted in 893 blogs of which the first 100 were analysed in order of relevance. From the 118 blogs analysed, 39 accounts were no longer available[2] and 2 blogs were excluded as nonrelevant. This resulted in a total of 77 blogs – 60 directly retrieved from the Sina Blog website and 17 Sina Blogs retrieved via Google. The majority of the blogs retrieved from the Sina Blog website were blogs that forwarded information – information from media channels or from other bloggers. The majority of the Sina Blogs retrieved from Google were personal blogs sharing individual experiences and opinions. All blogs analysed were from different accounts, though several forwarded the same information (e.g. information from new sites). We have examined whether the selected 77 blogs reflect opinionated pieces (and if so, what their opinions were about); personal accounts of experiences around the typhoon (including personal photos of damages, emotions, concern for others); or whether they mainly set out or forwarded information from official and mainstream media sources.

4. Results

4.1. The perceived impact of the typhoon

Via the survey, we first examined how the survey participants experienced the impact of the typhoon through questions concerning injuries, damages, shortage on supplies, and electricity or mobile network cuts. The results demonstrate that most participants were either not injured by the storm (46%) or insignificantly injured (50%), and only 4% of participants were badly injured. Of those who had

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[1] Because of the Chinese internet restrictions, we considered it to be important to use different ways to search for Sina Blogs. Interestingly, Baidu search showed only three of these blogs (as such we did not further use that). The Sina Blogs that appeared on Google were different to the most relevant ones found on Sina Blog's own website, and were more personal in their focus.

[2] It is not clear whether the 39 unavailable accounts in our search are examples of censorship. The titles were often still visible. A random analysis of these titles did not suggest these blogs to reflect anything sensitive.

Table 1

Socio-demographics of the respondents in Xiamen, China.

Item	Status	Percentage (%)	Item	Status	Percentage (%)
Gender	Male	50.2	Profession	Retired	0.3
	Female	49.8		Farmer	0.6
Age	≤20	3.0		NGO staff	1.6
	21–30	51.8		Media practitioner	1.8
	31–40	39.7		Researcher and scientist	2.5
	41–50	5.2		Student	5.4
	51–60	0.3		Teacher	12.1
Education	≤Middle school	1.9		Government employee	13.0
	High school	16.5		Self-employed	24.9
	College & university	75.6		Business and enterprise staff	36.2
	Graduate	6.0		Others	1.6
Access to internet	Yes	98.6	Monthly income (thousand	≤2.0	3.2
	No	1.4	RMB)	2.1–5.0	17.6
Access to smart phone	Yes	99.5		5.1–8.0	49.5
	No	0,5		8.1–10.0	20.3
Disaster-sensitive person	Critically ill patient	2.9		10.1–15.0	4.3
	Pregnant woman	7.5		15.1–20.0	2.7
	Aged 65 or over	41.1		>20.0	2.4
	Children under 12	48.5			

experienced property damages, the majority perceived these to be light (over 80%). Close to 50% of the participants reported having no access to tap water for a few days. 42% of the participants reported to have received water and food from government authorities on the day after the storm. This gives a context of the typhoon having led to serious disruptions to public and private life, but being reasonably mild in terms of the damages to both people and property.

The vast majority of participants experienced power cuts or an unstable mobile phone network for a few hours or a full day. Only a small number experienced longer cuts or unstable phone networks (around 10%). Most reported having unstable internet and phone networks during the hours around the storm, with fewer than 10% having no access to their mobile phone network.

4.2. Ranking central information sources on typhoon Meranti

To examine the role of social media in relation to the use of more government-led information, we asked the survey participants about the most used, authoritative and trustworthy information sources prior to, during, and in the days after the typhoon Meranti made landfall. Regarding source use, the results (Fig. 1) show that for all three phases the face-to-face information received by friends and family was most used (received the majority first option scores). Nonetheless, when looking at the total numbers (receiving most scores in total), mainstream state-owned or government controlled media sources feature most prominently, such as TV News and forecasts, or government provided warning alerts (send by text message). Face-to-face meetings with friends and family and WeChat messages were reported in third and fourth place. When looking at the first-option scores, WeChat or other social media functions are considered considerably less useful for information in all phases of the disaster compared to more traditional or government-led sources.

Examining what information sources the respondents considered the most authoritative (Fig. 2) and most trustworthy (Fig. 3) has similar results. For both questions, TV news and warning alert text-messages feature most prominently. Social media sources score much lower, comparatively. Furthermore, as will be discussed in more detail in section 4.3, much of the information shared via social media equally relied on governmental and mainstream media reports, reiterating the

important role of government-led information during that time.

Pearson analysis indicates that the respondents with high levels of education generally score broadcasted news or weather forecast as most authoritative information sources (P < 0.001), whilst information from the radio is seen as least authoritative (P < 0.05). Interestingly, the respondents who receive high levels of education consider warning alert text message from the government (P < 0.05) as most trustworthy information sources and consider information from Sina Blog (P < 0.05) to be least trustworthy. The correlation analysis results also show that, generally, the respondents trust comparatively less in information sources from face-to-face meetings with friends or family (P < 0.05).

### 4.3. Information exchange via social media

Pivoting toward the more informal usage of social media during the different phases of the disaster, Fig. 4 shows how the internet – including social media – was the most important medium used by the participants to reach others during all three phases of the storm. This is also visible in Fig. 5, showing that the survey participants did not just try to reach good friends and family, but also colleagues and acquaintances, including even those with whom they weren't particularly close. Around 30% of the participants tried to reach those lose connections, especially before Meranti made landfall. Close friends and family remained, however, the key target group.

Fig. 6 shows that most of the information shared by the survey participants was official information or media reports (both above 70%). Similar to earlier outcomes in the above sub-section of information sources, this result shows the importance attached to more official and government-supported information sources. Personal views, experiences or experiences from friends and families were also sources that were shared, but comparatively less. For all phases of the disaster, this was below 45% - being the lowest in the days prior to the landfall of Meranti (39% for personal views and 35% for information from friends and family) and highest in the days after (44% for personal views and 43% for information from friends and family).

When examining what information, specifically, the participants shared, more diversity in the information types and sources becomes obvious (Fig. 7). In the days prior to the storm (Fig. 7a), most shared (78%) is information on how to prepare for the storm (e.g. by protecting houses, sharing information on where shelters are or on how to get access to water and food), followed by weather updates (66%). These could consist of a mix of official government-provided and mainstream media information, and personal knowledge and experience. But content was also shared to express concerns about others (e.g. about the need to evacuate someone), which has a more personal and informal

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[3] The total number of respondents for Figure B is lower compared to A and C. This is because we first asked the participants whether they were able to receive information at all when the typhoon made landfall. If they opted no, they did not have to answer this question.
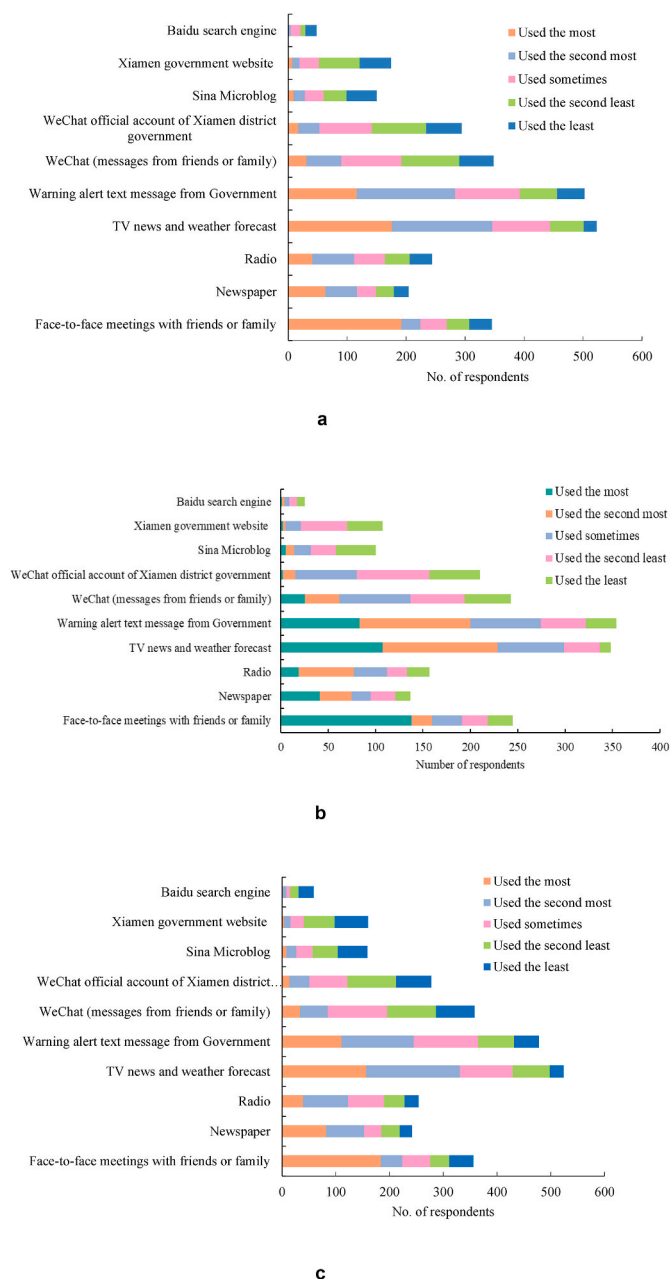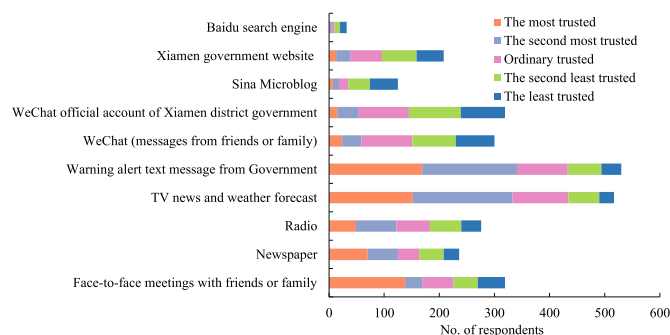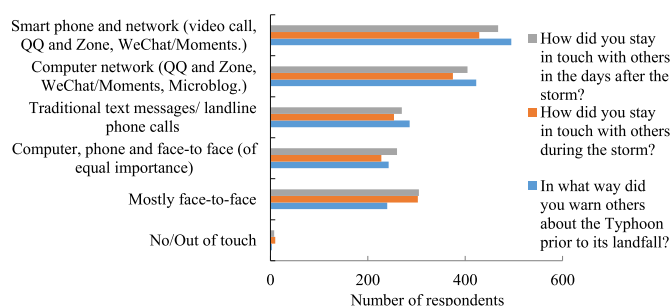
Fig. 1. a, b, c. Information sources in the days before, during and after Meranti made landfall. [3].
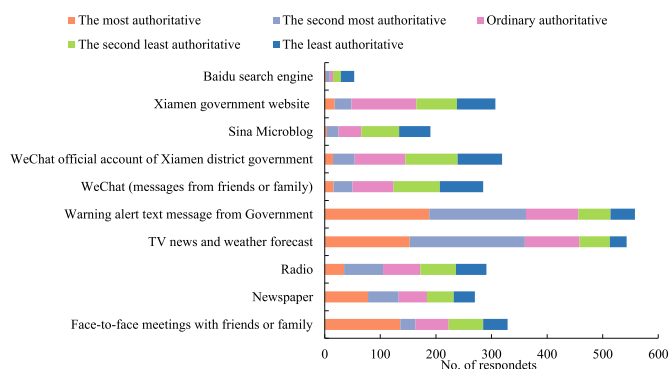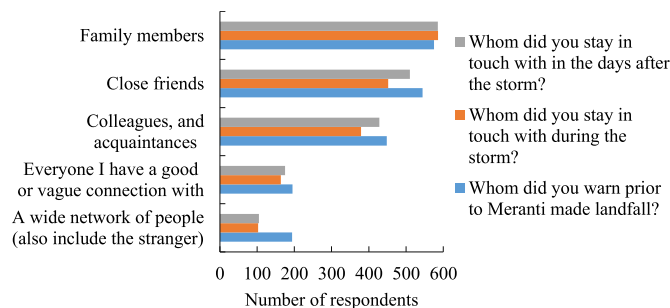

Fig. 2. Source of information considered most authoritative before, during and after the Typhoon Meranti made landfall.
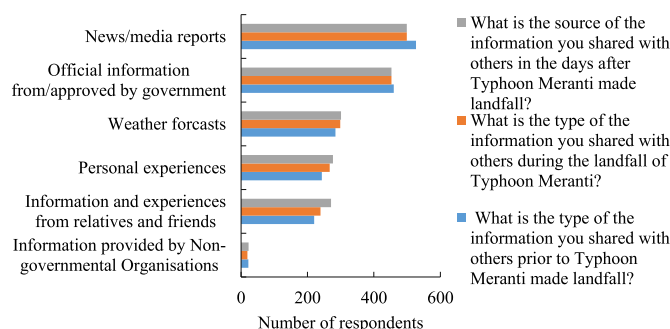

Fig. 3. Sources of information considered most trustworthy before, during and after the Typhoon Meranti made landfall.

Fig. 4. Information medium used to warn others before, during and the days after Typhoon Meranti made landfall.
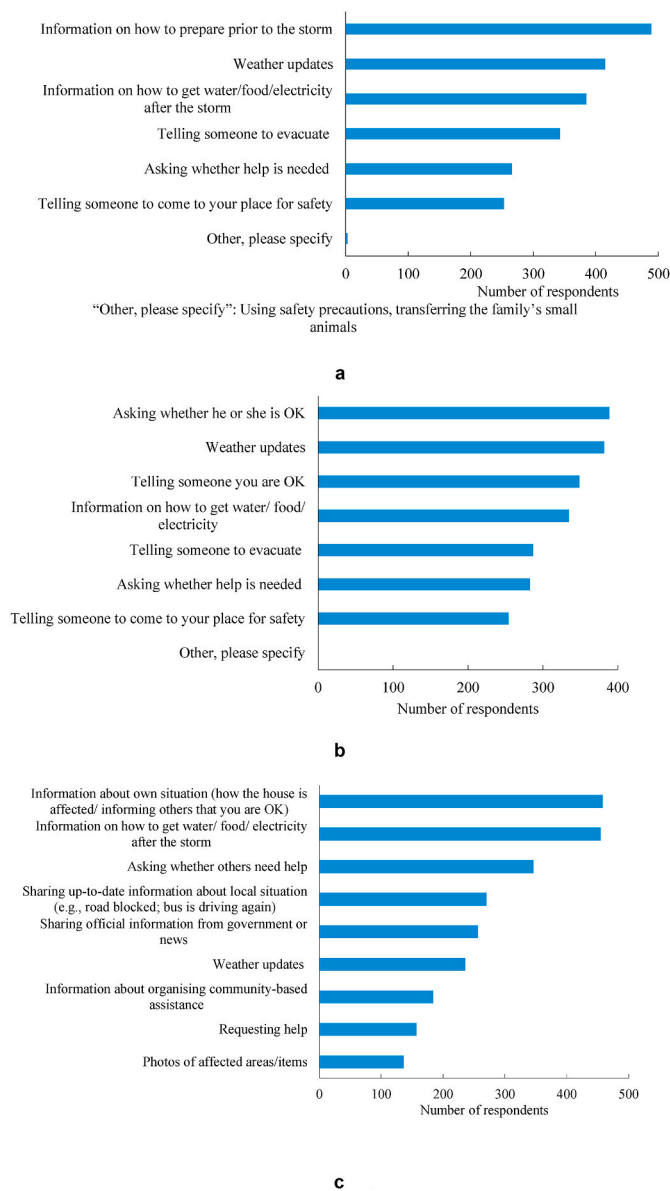

Fig. 5. Contacts/target audience of the information shared.

Fig. 6. Type of the shared information prior, during and after Meranti made landfall.

character. During the storm, sharing formal weather updates (61%) remained as important as information on how to get supplies (53%). Yet, when asking more explicitly what information people shared, personal expressions of concern rise to the surface. Such information exchanges

"Other, please specify": Using safety precautions, transferring the family's small animals

a

b

c

Fig. 7. a, b, c. Type of information shared prior, during and after Meranti made landfall.

concern inquiring on the safety of others (62%), followed by sharing information about one's own safety (55%) (Fig. 7b). In the days following Meranti, we see a similar picture (Fig. 7c). When asking more explicitly what people share by offering them examples, participants rate personal information (e.g. information about how you are affected – 73% -, or offering help – 55% –, sharing updates about local situations – 43%) higher than official information from the government or news (41%).

Moreover, Pearson correlation analysis indicates that those with lower levels of income made significantly less use of smart phone networks in warning others prior to Meranti's landfall (video call, QQ and Zone, Wechat/Moments) (P < 0.000). During its landfall, the respondents with lower education were more likely to warned others face-to-face (P < 0.05). In addition, younger respondents mostly used Internet (QQ and Zone, Wechat/Moments, Microblogs) in warning others (P < 0.05). Respondents with higher education were less prone to warn others through face-to-face interaction; the more educated the respondents are, the more likely they are to warn others via smart phone and network (video call, QQ and Zone, Wechat/Moments) in the days

after the typhoon made landfall.

4.4. Citizen perspectives expressed in social media blogs

Whilst we did not restrict the timeline in the search for Sina Blogs, almost all blogs come from the days directly following the typhoon – in the period of 16–23 September 2016.[4] In line with the survey outcomes, the majority of the total posts analysed (43 out of 77) outline or forward information collected from official government sources or from the mainstream media. This further supports the above findings that traditional information sources were valued most in the reporting on the typhoon and its management.

Most opinionated pieces or personal accounts of the event that we analysed did not contain any negative criticisms about the government's actions or about the information made available by the government and/or traditional media sources. Instead, if comments were made, these were usually positive. Meanwhile, anger was directed at the typhoon itself, describing it as an "attack" on Xiamen. Posts positively noted the actions of the local and provincial government. In particular, local government departments, firemen, ambulance drivers, policemen and soldiers were depicted as heroes. This sentiment is well reflected in the following blog:

> When the disaster occurred, many people ran outside to watch, including me, holding mobile phones and cameras … Not many people spontaneously cleaned obstacles, as if it's all about your own business. The armed police officers and soldiers were in the front line, the government agencies, the sanitation security personnel, etc. Often at this time, only the orders of the superiors can salvage this post-disaster. The city still retains a glimmer of hope … Don't watch the fun … At this moment, we should rebuild our homes and rebuild hope!

In contrast to this sentiment, however, many bloggers however commented positively on both the community's and local government's actions. Often the bloggers conveyed pride in how both Xiamen officials and citizens helped to repair damages, assisted injured people, cleaned and maintained road accessibility, etc. The feeling was that the disaster had brought everyone closer together: "After the typhoon, the people of Xiamen are stronger! The typhoon is nothing! Meranti just made the people of Xiamen more united …. "

There were only a few exceptions to this sentiment. One blog argued that the typhoon Meranti reflects the climate crisis as global warming acerbates the intensity of extreme storms. It emphasized the need to lower greenhouse gas emissions to prevent more disasters from occurring. Yet, in doing so, the blogger did not make any specific references to actions from Chinese government or companies to take such action.

Two other bloggers did put forward a more direct critique to local and provincial governments. One negatively commented on the type of protection measures of affected trees, signalling that certain measures could hurt them further. Another warned that the impacts on villages should not be ignored, and that the government should have preventive measures in place prior to a typhoon making landfall. It remained unclear, though, from the blog to what degree the government had failed in providing such preventative measures. However, by and large, such comments were the exceptions rather than the rule.

Interestingly, there were few blogs that explicitly focussed on refuting any suggestions that could make it seem the official weather forecasts could have been in any way inaccurate. Some of these blogs were relevant, for instance in explaining difficulties in making highly accurate advance predictions about exact typhoon landfall locations. But some of these also read as if an employer from the meteorological department had written the blog aiming to justify each of the steps and

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[4] Few came from after September 2016, but these were usually reprints.

choices made.

5. Discussion

The results of this case-study suggest that in disaster settings, Chinese urban citizens use and value traditional and official sources of information over that of social media. Even in the use of social media, the information shared is still primarily taken from official information sources (e.g. weather forecasts) or media reports. The analysis of the social media blogs gives a similar picture. The majority of posts analysed outlined or forwarded information from official government sources or from the mainstream media. Personal accounts and opinionated pieces did not signal any substantial critiques on government information or governmental action, and, as such, reflect the relatively high levels of trust the citizens of Xiamen express to have in official and traditional lines of information during a disaster.

This result is in particular reflective of citizen groups in Xiamen with relatively high levels of education and income, which represented the majority if the survey respondents (see Table 1). Although the participants of the online survey were randomly selected from six districts of Xiamen, most enjoyed secondary or university education, and the income of 70% respondents is between 5000 and 8000 RMB each month compared to only 3885 RMB per month for an average Xiamen resident. This resulted in some bias, meaning that the survey responses mostly reflect more affluent citizen groups. At the same time, however, as noted by He et al. [6] and Hsu et al. [13]; the domain of environmental risk is a relatively less political sensitive one in which the Chinese government is actively seeking to make e-innovations.

To further contextualise and assess the meaning of our findings, we will discuss these in the light of other academic studies conducted on social media usage in natural disaster settings in China [2,23,34–36], and those examining the role of social media and ICTs by Chinese citizens in the broader domain of environmental risk [6,13,37]. In this effort, we limit ourselves to studies from 2010 to 2019 published in international conference proceedings or international refereed journals. The selection was done through the following keywords: "China", "social media", "ICT", "e-participation", "digital", "citizen", "people", "disaster", "typhoon/cyclone/hurricane", "earthquake", "flood", "environment", "pollution". We also examined the citations of those articles selected. We found eight relevant studies that conducted an analysis of the role that social media has for citizens' information exchange and participation in issues of environmental risk [2,6,13,23,34–37]. We limit ourselves to a small field of research and to recent studies in internationally-refereed journals, and do not intend to be exhaustive in this review. Instead, the aim is to reflect on the wider integration, meaning, and relevance of our findings.

5.1. Trust in official information sources

In contrast to suggested rise of social media as a key information enabler in disaster situations, one of our key findings is that official information (from government, weather forecasts, text warning alerts) is regarded as more trustworthy and authoritative than information from social media and interpersonal networks. Exceptions are face-to-face communications with strong ties (meaning family, close friends).

This finding resonates with a study by White and Fu [2] who have compared the cases of the Wenchuan earthquake in China (2008) and hurricane Katrina in the US (2005) to study political and social trust in relation to information that affected groups obtained from social media, official media or government. They find that in rural China (studied through the case of the Wenchuan earthquake), levels of political trust – especially in the national government – are higher compared to the United States. Meanwhile, in rural China social trust in their own community is relatively low. As a consequence, people trust the information from TV and government more than the information from social media. In fact, people responded rather sceptically towards unofficial

and unsolicited information, which they referred to as mere rumours, while using traditional mass media and information from governmental institutions to confirm or dismiss "other messages through the timely dissemination of information from the government, acting as a pacifier." [2]: 135). The levels of trust in governmental information was different for Hurricane Katrina, where there was not much faith in governmental responses. Instead information exchanged was much more community based, relying on interpersonal social networks. "In this sense, an authoritarian government like that in China may be seen as more effective in shortening the 'credibility-seeking cycle', while in the US, relatively high levels of distrust in government may result in the need for more time and more confirmation in order to establish information reliability." [2]: 138).

Our analysis shows that similar dynamics of trust occur in *urban* China during a disaster situation, which suggests that there is no rural-urban divide concerning high levels of trust in the Chinese government in case of disasters. As White and Fu [2]'s analysis suggests, it is rather the top-down command and control information structure of the Chinese government which enables trust in disaster emergency settings in both rural and urban areas. A recent analysis by Cheng and others (2019) of an urban flood disaster in Wuhan City from 2016 (see also [35], examined through Sino Weibo, supports these conclusions. The authors find that for seven out of the ten accounts, the most frequently reposted messages were authored by news organisations. In contrast, "the opinions of the general public were drowned out and were not taken seriously in the vast number of messages" [36]: 13).[5]

Interestingly, this level of trust in governmental information in China is lower when considering broader issues of environmental risk [6]. Social media has become a key medium used to protest and report on environmental pollution, especially in cities [6,13,23,26]. Several public protests against government-supported industrial projects have been fuelled by the spread of information and activism via social media – including in Xiamen itself [26]. Van Rooij [38] emphasises that awareness is a precondition for activism. In case of a number of environmental problems such as air pollution or chemical waste, Chinese citizens are increasingly aware of the effects and role the government and companies play in causing these problems, and use social media to both express these concerns and to monitor government [6,13,37]. Indeed, the analysis of Kay and colleagues (2015) shows how much of the social media activism concerning air pollution only emerged after citizens learned about the discrepancies between official monitoring data and the data from the US embassy in Beijing.

In contrast, in the case of Typhoon Meranti, there was little awareness of, or engagement with, other societal and political factors that may have influenced the cause or effect of the disaster, such as limitations in disaster preparedness or the role that climate change plays in enhancing the severity of these very events. In the analysis of Sina Blogs, there were only very few that took such an angle. Instead, the majority of bloggers praise the actions of government and place the blame of destruction squarely with the disaster. This limited engagement with other socio-political causes in the case of Xiamen may well explain the high level of trust in governmental and mass media information in these disaster situations. Moreover, awareness resulting in social media-coordinated protests or other online activities may increase if the targeted issue progresses over a longer period of time, giving people more space and time to reflect on wider causes and related factors. Discussions on a new industrial park take time, and pollution does not disappear in a day. As such, social media interactions or online monitoring on these issues take a long period of time (e.g. Ref. [13,37], which may stimulate more

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[5] Though news organisations featured prominently in Cheng et al. [36]'s analysis, accounts belonging to governmental or non-governmental agencies were also not actively shared and reposted. Still, official (governmental) information remains influential via the sharing of news and media sites that are controlled by the Chinese government.

discussions and awareness. Meanwhile, in case of a typhoon or an earthquake, especially if not having a long-lasting impact, the social media timeframe is relatively short. Indeed, several studies (including ours) show that, in China, social media attention to these disasters quickly drops after a few weeks [23,34,36]: 13–14.

Finally, high levels of trust in government, and the information it provides, can in part be explained by the limited severity of the disaster. In case of Meranti there were only few casualties. In comparison, in the aftermath of the Sichuan earthquake in 2008, which caused many casualties, people did express critiques towards government via Microblogs arguing, for example, that the government could have done more to ensure the safety of buildings [23]. Yet, also in the case of the Sichuan earthquake, only a small percentage of Microblogs was used to critique governmental sources (33% was opinion-related and only a part of that concerned negative critique – [23]. As such, even with these big disasters, there continues to be relatively high levels of trust in the Chinese government and mainstream media sources [2].

Comparing our findings with related literature suggests that in short-term disaster emergencies in China, people are relatively positive about governmental information sources being fast and top-down in nature [2]. (Online) citizen activism in China against the government tends to increase when there is more awareness of the role of political factors in causing the event or in worsening its impact [38] – which, according to our social media blogs analysis, was limited in the case of Meranti. Instead, social media largely depicted Meranti as an a-political event – with the natural hazard to blame – and positively reported on the swift and effective actions of the local government in their disaster response.

6. Conclusion

This article demonstrates a more limited role of social media in natural disaster communication, compared to what optimistic literature often portrays. In particular, the impact and usage of social media are very context dependent. This case study shows that in China, government-supported or provided information (transmitted via warning texts or mainstream media channels) is used and valued more than information shared via social media. Social media also served as a medium to spread official information from those government or mainstream media sources. Comparing our results with other relevant literature supports our findings that in the case of natural and climate change-related disasters (being rural or urban), where immediate action is required, social media is deemed less vital and trustworthy compared to official information, fitting China's top-down approach to disaster management.

The analysis did show an important role of more informal information exchange between citizens via social media in the days following Typhoon Meranti's landfall. In this phase, social media was used to share personal experiences, to check on each other's safety or to offer help. Further research on social media use in China's disaster management may target this post-disaster phase.

While social media has an emerging role to play in the domain of China's environmental policy and environmental risk [6,13], this has not yet spiralled into the domain of natural or climate disaster situations to a similar degree. This shows how social media usage and impact is still very dependent on the setting [36], the problem faced, the type of information people accept, and, most importantly, on how Chinese citizens perceive the role of the government and its responsibility in managing the issue at hand.

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Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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