Disasters and Emergencies in Three Mexican Cities: Understanding the Role of Digital Technologies and Social Stakeholders

Working Paper 3; Work Package 2

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May 2021

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Summary

Disasters associated with natural threats are a major concern in Mexico given the human and material losses they entail. Therefore, the identification of novel and inclusive forms of disaster risk reduction (DRR) is a priority in Mexico. In this context, digital technologies and, ultimately, the smart city have been promoted as key to contribute to DRR. However, there is little knowledge on how digital technologies are or can be intertwined in cities to enhance DRR, particularly in medium-sized cities marked by institutional and financial constraints to cope with risks and climate change. With the aim of contributing to this debate, the paper explores how digital technologies are intertwined in emergency and disaster response in mid-sized cities and what complications this entails. The paper draws on the cases of Ingrid and Manuel in the Acapulco Metropolitan Area (AMZ) in 2013, the 2017 floods in the Querétaro metropolitan area (QMZ) and the 2017 earthquake in the Puebla-Tlaxcala metropolitan area (PTMZ).

Conceptually, the paper is based on the one hand on the understanding of the 'smart city' as a way of experiencing the everyday life through the use of new and widely available digital media; and on the other hand, on the conceptualisation of emergencies and disasters as events, which are constituted through a process of assemblage of human and non-human entities, including digital technologies. Methodologically, the study is based on the elaboration of a dense chronological description supported by written sources (journals, policy documents, reports, grey literature) and semi-structured interviews in the three cities with affected people, governmental stakeholders, organised civil society, and experts.

This paper argues that digital technologies are involved in emergencies and disasters in 5 different ways: (i) in the monitoring of disruptive phenomena such as earthquakes, hurricanes, rains and floods; (ii) in the information processes to governmental and non-governmental stakeholders with respect to warning, preparedness, response and reconstruction; in the attention to emergencies and disasters by the various stakeholders; (ii) in the verification of occurrences in order to act or in the verification of what has already been invested or done as in the case of reconstruction processes; (iv) in keeping events present and alive, remembering difficult moments and moments of solidarity, but also reclaiming abandonment and deficient reconstruction processes. It also argues that digital technologies entail three main complications related to (a) participation and exclusion, (b) efficiency of DRR processes, and (c) connection failures, poor infrastructure, and low penetration.

1   Introduction

Disasters associated with natural hazards are a major concern in Mexico. These have caused 2,367 deaths and more than 15 million people affected between 2000 and 2010 (Government of the Republic, 2014). Therefore, the identification of novel and inclusive forms of disaster risk reduction (DRR) is a national priority (General Law on Civil Protection or *Ley General de Protección Civil*, 2012). In this context, digital technologies and ultimately the smart city have been promoted as key to assist in DRR. However, there is little knowledge on how digital technologies are or can be intertwined in cities to enhance DRR; particularly in small and medium-sized cities where most urban growth is expected to occur and where there are significant institutional deficits and low capacities to cope with risks and climate change (IPCC, 2018).

With the aim of contributing to this debate, the article explores how digital technologies are intertwined in the response to emergencies and disasters in intermediate cities and what are the implications and complications that this entails. The paper draws on the cases of hurricanes Ingrid and Manuel in the Acapulco Metropolitan Area (AMZ) in 2013, the 2017 floods in the Querétaro Metropolitan Area (QMZ) and the 2017 earthquake in the Puebla-Tlaxcala Metropolitan Area (PTMZ).

Conceptually, this document is based on the one hand on the understanding of the 'smart city' as a way of experiencing the everyday life through the use of new and widely available digital media; and on the other hand, on the conceptualisation of emergencies and disasters as events, which are constituted through a process of assembling human and non-human entities, including digital technologies. Consequently, the paper focuses on the unfolding of the aforementioned events in the AMZ, the QMZ and the PTMZ, revealing how digital technologies were intertwined.

Methodologically, the study involved two main phases. The first was dedicated to the elaboration of a dense chronological description supported by written sources (magazines, policy documents, reports, grey literature). This reconstruction provided an overview of each event and paved the way for the second phase, which included semi-structured interviews in the three cities with affected people, state stakeholders (including civil protection personnel), organised civil society, and experts. It is important to highlight that the study did not seek to establish a comparison between the three cities, but rather, from a patchwork ethnography approach (Thieme, 2021), to reveal ways in which technologies are part of the attention to emergencies and disasters, mobilising fragments of the three cities.

This paper argues that digital technologies are involved in emergencies and disasters in 5 different ways: (i) in the supervision of disruptive phenomena such as earthquakes, hurricanes, rains and floods; (ii) in the information processes to governmental and non-governmental stakeholders with respect to warning, preparedness, response and reconstruction; in the attention to emergencies and disasters by the various stakeholders; (ii) in the verification of occurrences in order to act or in the verification of what has already been invested or done as in the case of reconstruction processes; (iv) in keeping events present and alive, remembering difficult moments and moments of solidarity, but also reclaiming abandonment and deficient reconstruction processes. It also argues that digital technologies entail three main complications related to (a) participation and exclusion, (b) efficiency of DRR processes, and (c) connection failures, poor infrastructure, and low penetration.

The document is organised as follows. Section 2 presents the conceptual and referential framework. Sections 3 and 4 present the method and the three cases considered respectively. Subsequently, the

fifth section briefly describes the three events, and the sixth and seventh sections report the findings (forms of entanglement and complications). Finally, section 8 presents the conclusions.

2 Conceptual and Referential Framework

2.1 The life of events and the intertwining of digital technologies[1]

The paper understands emergencies and disasters as events and analyses them from the approach we have developed under the term 'life of events'. This approach is open-ended about what kind of event might become an event and recognises that it can take different forms, including events that were indistinguishable from everyday life until they were assembled in such a way as to constitute an event.

The approach starts from the tradition that has focused on events as singularities, ruptures that produce discontinuity and force something new into the world. Sewell's definition of events (Sewell, 2005, p. 100) is useful as a summary of this starting point: 'Events can be defined as that relatively rare subclass of events that significantly transform structures'. This tradition is important because it avoids simply treating events as side effects, of named and known causes. It gives agency to events, by which we mean that it assumes that events disrupt something and introduce something new into the world. However, under this perspective, events are rare since the focus is on what we might call 'major events' that involve structural transformation. Consequently, it has less to say about the multiple forms that events take as they occur: how they can move from everyday occurrence to dramatic event and vice versa (see Berlant, 2011; Povinelli, 2012; Stewart, 2007).

Based on this, our approach departs from this work on the event as rare and connects with recent work in feminist and critical race research across political science, geography, and sociology that has questioned what counts as an event. Various terms have been invented to signal this expansion of what counts as an event: quasi-events, slow emergencies, slow disasters, ordinary crisis, etc.

From this opening up of what counts as an event, the 'Life of Events' approach is oriented towards the life of events as they are (dis)assembled. By event we mean an occurrence with actual or potential disruptive effects that exists as a problem for those who govern and as such requires a response. By emphasising the event as a problem that requires a response and considering that not all occurrences become events, the approach approaches a corpus on the discursive construction of events as political events. This corpus focuses on the discursive and linguistic conventions and genres through which attention is generated around events with the assumption that, conversely, some events occur and never become political events. By suspending ontological questions about what an event is or is not, unlike poststructuralist work, these approaches focus on how events are constructed as such through the work of situated stakeholders.

While the orientation on how events become political events is shared, the 'Life of Events' approach extends the focus on how events are (de)assembled as political events beyond the discursive or linguistic conventions through which events become objects of attention and action. To become a political event, events must be assembled as problems that require a response from stakeholders, including the public, the state, activists, the media, corporations, and civil society organisations. They must promise or threaten to disrupt something and become a stage for disagreement when a response is demanded. Therefore, the beginning of an event is as important as the subsequent actual or potential disruptive effects, it is the attempts to both continue the events and to end them, *i.e.*, attempts to turn them into recognised occurrences that no longer generate threat or have a disruptive

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[1] This section is comprised of excerpts from the article 'What is an event_', in progress by Ben Anderson, Héctor Becerril, and Alejandro de Coss-Corzo, and the public policy document 'Roadmap' for the project.

effect. What this also means, to repeat the previous point, is that events are not just actual occurrences. They can also be anticipated future events, whether promising or threatening, and past events that persist and become political retrospectively or become political once again.

From this starting point of opening up what counts as an event and emphasising that political events are (dis)assembled as such, an approach to the 'life of events' involves a set of steps in relation to events that are, could become or were events. This is not to treat an event either as a symptom of an identifiable set of causes, or simply as a one-off rupture, but as an ongoing material and affective composition that has a duration and changes through its effects.

This leads us to focus on how an event develops, becomes a problem, and relates to a set of changing conditions and transformations without making it or them the causal agent. It avoids assuming that an event is a single or static thing or that spatial and temporal boundaries of when an event begins and ends are given. It also balances understanding events as having their own momentum and as being made and remade by situated stakeholders.

It is from this perspective of assembling emergencies and disasters as events that the smart city and in particular digital technologies are considered. The smart city can be understood in different ways. First as a model of urban growth led by information and communication technologies (ICT): whereby new industrial, commercial and residential developments are imagined and justified through the use of data and digital technologies, including parking sensors, time transport information, smart energy systems; and the advancement of economic development through the clustering of services and manufacturing skills linked to the digital economy.

A second approach is the 'smart city' as an informal ecosystem of digital technologies that deliver urban services: whereby a wide range of loosely connected digital interventions and practices, some formal and some informal, establish a presence in a city and deliver services to its inhabitants. These are very diverse and include such things as the establishment of open data platforms by coalitions of activists and city officials, or the pairing of flood sensors and smartphone apps by academics to provide flood alerts to citizens.

Finally, the 'smart city' can be understood as a way of experiencing the everyday through the use of widely available new digital media: here an encounter with the digital-urban is imagined and experienced through the informal use of social media and new digital communication technologies, from Facebook and Twitter to WhatsApp and Google Maps. This is a smart urbanism that exists in everyday life and is available to many.

This paper approaches the smart city from the latter perspective, focusing on how in the assembly of the disasters under study digital technologies became intertwined.

2.2   DRR in Mexico: evolution[2]

The year 1985 is widely recognised as a moment of rupture in the way disasters are conceptualised and become a matter of public interest and action. On September 19, an earthquake measuring 8.1 on the Richter scale, originating off the coast of the state of Michoacán, was felt throughout the country, particularly in Mexico City. The following day, an aftershock of 7.8 hit the Mexican capital again (Davis, 2014). The earthquake-related damage and harm was compounded by an extremely

[2] This section is comprised of excerpts from the background paper WP2: Mapping disaster events in three cities by Ben Anderson, Héctor Becerril and Alejandro de Coss-Corzo.

slow, almost non-existent official response, much criticised at the time and whose consequences are still visible today. It has been argued that the grassroots movements that organised during the response and recovery phases gave rise to a new Mexican civil society (Castro, 2004). It is also recognised that the lack of official response was a key concern that led to the creation of the National Civil Protection System (SNPC, per its acronym in Spanish) (Arellano-Gault & Vera-Cortés, 2005).

The SNPC, created in 1986 under the Secretariat of the Interior (SEGOB), established a series of mechanisms and channels for citizen participation and intergovernmental coordination and cooperation. In doing so, it sought to enable forms of response that included the grassroots movements and strategies that had been deployed after the 1985 earthquake and that still characterise much of Mexico's disaster and emergency response. In practice, however, it placed budgetary and operational control in the hands of the federal government, specifically the military (Arellano-Gault & Vera-Cortés, 2005). Coordination between national, state and local governments on civil protection was deepened with the publication of the General Law on Civil Protection (LGPC) in June 2012. The law also aims to create a framework for private sector participation in this field, a new addition to this legal framework.

More recently, the adequacy of the SNPC has again been questioned. In 2017, two earthquakes struck Mexico, one in the state of Oaxaca and the other in central Mexico, including the state of Puebla. The proper use of funding and the suitability of the supposedly decentralised emergency and disaster management and response system have been criticised (Poole & Renique, 2017). Moreover, the challenges could multiply in the coming years as anthropogenic climate change increases disaster risk (Zepeda Gil et al., 2018). Structural lack of capacity and budget constraints at the local level, and strained federal government prevention and response capacities, could exacerbate these challenges, as discussed below.

2.3 Legal definitions

In Mexico, the concepts of disaster, emergency and related notions such as resilience are officially defined in the General Law on Civil Protection (*Ley General de Protección Civil* or LGPC). These definitions allow for certain forms of response and governance, in turn defined in the rules of operation of the Natural Disaster Fund (*Fondo para Desastres Naturales* or FONDEN), more recently renamed the Emergency Response Fund - FONDEN[3] (*Fondo de Respuesta a Emergencias*).

The LGPC creates a common set of definitions, actions, responses and differentiated responsibilities in the case of emergencies and disasters, and in doing so, constitutes a fundamental document for understanding how these events are defined and (ideally) acted upon. We do not claim that all stakeholders involved in disaster and emergency response and action are restricted or subject to this law, but that its definitions can be a productive lens for questioning the specificities of disaster and emergency in Mexico.

As for disaster, the LGPC defines it as an event that is,

> the result of the occurrence of one or more severe and extreme disturbing agents, concatenated or not, of natural origin, human activity or outer space, which when they occur at a given time and in a given area, cause damage and which, due to their

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[3] Extinct in 2020.

magnitude, exceed the response capacity of the affected community (*Ley General de Protección Civil*, 2012).

Disaster then implies a moment of rupture, in which the boundaries between natural, social or other forms of agency and impact are blurred by the inability to respond to rapid change. Disaster here is defined by its temporal and spatial concentration, which creates a relational difference between the areas, populations and flows affected and those left out of this new configuration.

On the contrary, emergency is defined as a

> abnormal situation that can cause damage to society and cause excessive risk to the safety and integrity of the general population, generated or associated with the imminence, high probability or presence of a disturbing agent (*Ley General de Protección Civil*, 2012).

The emergency is characterised here by its anticipatory nature. Here the moment of rupture has not yet occurred, so the possibility of avoiding damage or harm is still available to responders. Like other specific geohistorical definitions of emergency, in Mexico it is also characterised by its exceptionality, by having an interval of and for action, and by the hope that action can make a difference (Anderson, 2016). Emergency, therefore, is a genre of hope that unsettles the future. Moreover, it creates certain rhythms and temporalities, particularly associated with the notion that timely response or preventive action can stop, avoid or at least postpone harm.

Finally, the LGPC also presents an ideal form of response in the form of resilience. There, it is defined as

> The capacity of a system, community or society potentially exposed to a hazard to resist, assimilate, adapt and recover from its effects in the short term and efficiently, through the preservation and restoration of its basic and functional structures. This is achieved by achieving better future protection and improving risk reduction measures (*Ley General de Protección Civil*, 2012).

Here we want to focus not on the ideas of resilience and adaptation, widely discussed in the academic literature. Instead, we want to draw attention to the temporality of this initial response and the limits it might have. By emphasising the short term and highlighting the issue of capacity, this definition assumes that the resilience capacity of any given territorial unit is limited, and that events that exceed it must be governed in other ways.

2.4 Emergency and disaster response

Emergency and disaster responses can draw on all levels of government. The way in which these are involved, particularly with regard to financial and operational resources, as well as coordination issues, is set out in the FONDEN rules, as mentioned above. These regulations distinguish between emergency and disaster declarations, and create different logics, rhythms and timeframes for action. A declaration of emergency is an act by which the SEGOB recognises that one or more municipalities or political demarcations of a federal entity are facing the imminence, high probability or presence of an abnormal situation generated by a disturbing natural phenomenon, which may result in an excessive risk to safety and integrity or, if necessary, harm society. Such a declaration may coexist with a declaration of natural disaster. This, in turn, is a document through which the SEGOB formally declares certain municipalities in the natural disaster area, as well as the political-administrative bodies in the

territorial boundaries of the Federal District (Mexico City), so that resources from the Natural Disaster Fund can be accessed. For this declaration to be formally issued, the disaster must have exceeded the financial and operational capacity of local authorities.

We wish to highlight two aspects. The first, related to both statements, is the fact that ultimate responsibility rests with the federal government through SEGOB. Despite nominal decentralisation, disaster and emergency governance and response remains a highly centralised set of policies and practices, often carried out by the military and other institutions and agencies at the federal level (Arellano-Gault & Vera-Cortés, 2005). Municipal governments, and to a lesser extent state governments, often face severe limitations in terms of the availability of financial resources, have low operational capacities, and are susceptible to capture by either organised crime or other interest groups (Aguirre & Herrera, 2013). These limits are not new and suggest that decentralisation policies have not been implemented beyond legal changes (Zepeda Gil et al., 2018).

The second has to do with the different temporalities that produce and operate each of the declarations. On the one hand, declarations of emergency can provide an anticipatory logic to the event. This is the interval of action characteristic of the emergency as a genre, where the hope is placed that a timely and adequate response can prevent damage. On the other hand, natural disaster declarations, as already mentioned, assume that the moment of rupture has passed, and that various forms of damage and harm continue. Fundamentally, this rupture has already exceeded local capacities, which points to a potential limit to resilience and, therefore, requires the presence and action of the federal government.

3 Cases of Interest[4]

The article is based on the analysis of three cities and three different events: Ingrid and Manuel hurricanes in 2013 in the Metropolitan Area of Acapulco (AMZ), 2017 earthquake in the Metropolitan Area of Puebla (PMZ) and 2017 floods in the Metropolitan Area of Querétaro (QMZ). These areas considered as intermediate cities by size, population and its articulating role in the territory, intermediation between local national and global scales (Becerril et al., 2021). The reason for focusing on these metropolitan areas is the poor understanding of the processes and dynamics in these types of cities in Mexico and elsewhere, as the literature tends to focus on cities in the global north and major cities in the global south such as Mexico City (Kanai et al., 2018; Roy, 2011).

The Acapulco Metropolitan Area (AMZ) is located on the southern coast of the country and includes the municipalities of Coyuca de Benítez and Acapulco de Juárez. The AMZ is the largest and most important urban centre in the state of Guerrero. Although Acapulco is the largest urban area where most of the economic and tourist activity takes place, Coyuca has a high degree of functional integration with Acapulco. Population movements between the two municipalities include workers employed in the city of Acapulco and both consumers and sellers of goods and services (López & Palacions, 2017). The municipality of Acapulco is divided into two main areas: (I) the urban sector (made up of the Anfiteatro, Renacimiento-Zapata, Pie de la Cuesta, Cayaco-Llano largo and Diamante sections), and (II), the rural sector (made up of Tres Palos and Agustín) (PDDU, 2015). The municipality of Coyuca de Benítez is located in the southeast of the metropolitan area, where the greatest threat is the Coyuca River. This river has its origin in springs and streams in the highest peaks of the highland that flow into the sea in the Barra de Coyuca section, contributing to the formation of lagoons in Coyuca and Mitla (Santos, 2018). The AMZ is mainly exposed to hurricanes from the Pacific Ocean. Among the most important hurricanes in recent decades, Paulina in 1997 stands out, during which water levels reached three metres at Condesa Beach, and the Acapulco-Zihuatanejo, Acapulco-Pie de la Cuesta and Acapulco-Mexico highways were obstructed. In addition, more than 50,000 people were affected, 141 were missing and 147 died, while access to water and electricity was suspended. Another hurricane is Henriette in 2007, which generated approximately MX$ 1,940 million in damages, 1,066 people affected, 2,012 homes affected and 6 deaths.

The Metropolitan Area of Puebla-Tlaxcala (PTMZ) is the fourth most important urban centre in Mexico, both in economic and population terms. It is located in the central region of the country in a strategic location between Mexico City and the port of Veracruz and is part of an urban area that integrates 39 municipalities (19 in the state of Puebla and 20 in the state of Tlaxcala). The municipality of Puebla can be understood as the geographic and economic centre of the PTMZ. Mexico is located in a high seismic area due to the interaction between five different tectonic plates: the North American, Cocos, Pacific, Riviera and Caribbean plates. The National Seismological Service reports an average of 40 earthquakes per day throughout the country. The states of Puebla and Morelos are particularly susceptible. The most recent earthquake with a magnitude of 7.1 was on October 24, 1980, and was located 19 km west of the municipality of Acatlán de Osorio in the state of Puebla, with damage throughout the city of Puebla. Its epicentre was located 57 km south of the 2017 earthquake.

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[4] This section is based on excerpts from the draft document 'Initial Reconstruction of Events' produced by the Smart Urban Resilience Acapulco, Querétaro and Puebla teams.

The Metropolitan Area of Querétaro (QMZ) is located in the central region of Mexico and includes the state capital with the same name, as well as the neighbouring municipalities of Corregidora, El Marqués, part of Huimilpan and part of Apaseo el Alto (municipality of the neighbouring state of Guanajuato). It is located 220 kilometres north of Mexico City and is one of the access routes to the north of the country by road and train. Since the 1980s, the geographical and population growth of the city began to surpass its original geographical limits, consolidating QMZ as one of the most dynamic centres of attraction for populations migrating out of the rural areas of the state of Querétaro (as well as towns and cities in other states, including Mexico City) to find work in industry, commerce and services. Like much of Mexico, the QMZ receives most of its rainfall during the months of June through September. Since it has a semi-arid climate, the rainy season is very mild compared to other parts of the country. However, the city is prone to flooding when sudden rains fall hard and fast. During the rainy period, rainfall is about 15 inches, or about 75 percent of the city's annual rainfall.

4   Methods

The paper takes the perspective of a patchwork ethnography (Thieme, 2021, p 6), which 'without losing the rigour or sensitivity of ethnographic praxis ... accepts that some fieldwork will take the form of "short-term field visits, using fragmentary but rigorous data"'. From this approach, we did not conduct a comparative analysis, but rather an analysis focused on revealing patterns around the interweaving of digital technologies, between events and metropolitan areas, and reflecting on their implications and complications for citizen participation in DRR. To trace the life of events and from there understand how digital technologies are intertwined, the method included two stages. The first involved a reconstruction of events from an stakeholder-network theory perspective (Latour, 2005) focusing on tracing and developing the association between human and non-human entities. From these preliminary accounts, a first understanding of the development of the events and the intertwining of technologies was generated, as well as the identification of places and people affected.

The second phase involved conducting 49 semi-structured interviews to gain an in-depth understanding of the life of the events. The people interviewed were people affected by the events in the three metropolitan areas, civil society organisations, state stakeholders, including civil protection personnel and experts. The analysis of the interviews led to the mapping of the different ways in which digital technologies were enabled and the implications and complications they entailed.

5 Events: An Overview

5.1 AMZ: Ingrid and Manuel in 2013

Tropical depression number 13 formed in the early morning hours of September 13, 2013, off the coast of Guerrero. With sustained winds of 55 km/h and gusts up to 75 km/h, the storm was moving north-westward at a speed of 6 km/h. Later that day, the depression transformed into Tropical Storm Manuel, with gusts up to 85 km/h, which would eventually rise to 111 km/h (Rodriguez Esteves, 2017; Rosengaus-Moshinsky et al., 2016). On September 12, in the Gulf of Mexico, tropical depression number 10 became hurricane Ingrid. Two days later, the hurricane reached its maximum gusts of up to 139 km/h (Rosengaus-Moshinsky et al., 2016). This was only the second time in Mexico's history where tropical storms on both coasts impacted the country simultaneously. Ingrid and Manuel caused severe damage and damage throughout Mexico. Dozens of deaths were reported across the country; in the Mexican Pacific, 1,576 homes were damaged, and 27.5 million pesos were lost to damage (Rodriguez Esteves, 2017, p 144). Although the Manual was not as strong as that of the 1997 Hurricane Paulina, the effect of Ingrid, along with issues of social vulnerability, significantly increased its impact.

In Acapulco, 169 people died as a result of this disaster. In addition, the floods left Acapulco isolated and caused food shortages and ongoing damage. specifically, the most affected sector was the region of Llano Largo, Diamante and the settlements closest to the Tres Palos lagoon. These neighbourhoods were built in flood-prone areas with streams, marshes and wetlands (Palacios Ortega et al., 2015). The neighbourhood of Luis Donaldo Colosio, in Diamante, was one of the most affected by landslides. This residential area was built in 1995 to house workers and families relocated after Hurricane Paulina in 1997 (Mendez, 2015). In Coyuca, Ingrid and Manuel were both devastating storms for the La Barra region because of their proximity to the Pacific Ocean and lagoon, compounded by the fact that there is a single overland evacuation access road that does not have adequate barriers or other protections for flooding and landslides (Lopez & Palacions, 2017).

After this event, civil society and neighbourhood organisations protested against government authorities for insufficient information, poor urban planning and infrastructure; and the priority given to tourist infrastructure. Many of these problems were related to the unplanned urban development of Acapulco and the lack of construction, maintenance and repair of infrastructure, beyond the maintenance of tourist spaces (Rodriguez Esteves, 2017, p 144-146).

5.2 QMZ: Floods of 2017

According to the 9Querétaro State Water Commission (CEA), on the night of September 26 and the early morning of September 27, 2017, rainfall was equivalent to 97 percent of what is normally expected to rain in an entire month. It was said to be the heaviest in 29 years. The capacity of the city's drainage system was completely exceeded. Forty-four neighbourhoods and communities in the municipalities of San Juan del Río, Querétaro, El Marqués and Corregidora (the latter three in the QMZ) were flooded after three drainage pipes overflowed their capacity. That night one person died after being swept away by the current and others were rescued alive in different parts of the city. In addition, two sinkholes were generated on the side of Highway 57 (Paseo de la República).

Authorities identified Santa María Magdalena as one of the most damaged neighbourhoods. As every year, the houses made of sheet metal and asbestos sheets in the community of Santa María

Magdalena suffered flooding. But this time, the water level in the avenues reached more than 60 centimetres. Santa María Magdalena is located within the watershed formed by the hills El Tepetate, El Nabo and El Jaral, from where the water drains. The community is also located at the junction between the Querétaro River and its tributary El Arenal Stream (drainage). The torrential regimes of both, their low capacity and the existing structures in their channels cause recurrent flooding in the western part of the city and, particularly, in formerly low-lying agricultural areas such as Santa María Magdalena (ejido regime) and La Piedad. It should be noted that the El Arenal drainage channel carries wastewater from the Benito Juárez Industrial Park, and that flooding is accentuated by the emptying of land upstream.

5.3 PTMZ: 2017 earthquake

On September 19, 2017, the National Seismological Service reported a magnitude 7.1 earthquake on the state border between Puebla and Morelos about 12 km southeast of Axochiapan Morelos (and 120 km from Mexico City). The earthquake occurred at 1:14:40 pm and was felt throughout the centre of the country. The coordinates of the epicentre are 18.40 N -98.72 W, with a depth of 57kms, with 6 aftershocks registered until 6:00 pm. As can be seen in map 5, the maximum intensities were felt in the region of the epicentre, between the states of Puebla, Morelos and Guerrero.

Due to the 7.1 earthquake, the Federal Government Secretariat declared a state of emergency for 112 municipalities in the state of Puebla (including the capital). This action activated resources to provide food, shelter and health needs to the affected population to the relevant authorities and state governments. The following morning, Governor Antonio Gali announced that the three most affected areas were the city of Puebla, Atlixco and the Mixteca region near the epicentre, with a total death toll of 43 (including minors and a student from the Universidad Autónoma Benemérita de Puebla). The final death count was 46, with Puebla (11), Atzala (9) and Atlixco (11) at the top of the list. The state government thus established 9 distribution centres coordinated by three levels of federal, state and local governments in order to generate more effective coordination. Two of these distribution centres were located in the city of Puebla. By September 25, SEDATU announced that with the participation of the three levels of government, it would initiate the census of affected residences in the states of Morelos, Puebla and Mexico, considering the 112 municipalities of the state of Puebla, with the objective of obtaining relevant data on the extent of damage (Registro Agrario Nacional, 2017, Sep. 25).

6 Interweaving Digital Technologies into Event Life

From tracing the life of events, at least seven ways in which digital technologies are intertwined with emergency and disaster response are identified.

6.1 Monitoring

First, digital technologies are entangled in monitoring understood as 'surveillance conducted to ensure that formulated standards are maintained'; such surveillance involves 'conducting repeated standardised surveys so that changes can be detected' (Alexander, 2008). In general, monitoring of natural hazards such as earthquakes, floods and tropical storms involves diverse analogue and digital technologies, as well as state and non-state stakeholders, and is implemented throughout Mexico. While there are significant differences in natural hazard monitoring, they all tend to have a long development trajectory, with the transition to digital being the latest stage.

An interesting feature is that the materiality of this technology goes unnoticed (small stations or devices in the territory connected to a central office); however, this technology generates images and data that are disseminated through different media. This technology is owned and managed by state stakeholders and civil society organisations and is globally connected.

For example, in the case of Acapulco, they have been monitoring temperatures, hydro-meteorological phenomena and fires for decades:

> We have another type of monitoring, because we monitor the temperature, because we have a state with very high temperatures, we monitor hydro-meteorological issues, we monitor forest fires, and if we have enough technology, 15 years ago, 20 years ago, we have a lot of technology that has made our life easier, that's how it is (Civil Protection Acapulco).

Specifically, with respect to hurricane monitoring, this is done from the Gulf of Tehuantepec, as when Ingrid and Manuel occurred:

> From the beginning, I told you that all hydrometeorological phenomena have always been monitored, since they come from the Gulf of Tehuantepec, they have been monitored, especially the one that was going to hit us or the one that was going to hit us from the Pacific, I remind you that at the time of Ingrid and Manuel there were two phenomena, one in the Gulf of Mexico and the other in the Pacific, one in the Gulf of Mexico and the other in the Pacific, then, the State was monitoring the one that was coming from the Pacific, then, it was being supervised, it was coming, the meteorologist was seeing how it was increasing its strength and how the phenomenon was forming, the notification began to be given, the bulletins were sent, and the meteorologist was sending the bulletins to the State.

Digital technologies can support monitoring in the absence of the type of infrastructure mentioned above:

There is another way more than empirical sometimes, sometimes you don't have the necessary equipment, but you can monitor the rivers in that way and in that way that Council could alert the director to tell him, you know what director my river is rising, prepare the temporary shelter, because maybe we are leaving, you have to find a way, sometimes in certain places we don't have the technology, sometimes we still have a landline phone, Well, someone has to talk to the director of Civil Protection and tell him, you know that in my town the river is rising, get ready, that's the way, when in certain places where we have signal and where there is internet, well that's better, now with Facebook every town has its page, the town so and so has its page, then, that information and those bulletins can be uploaded to those pages and people will find out little by little (Civil protection state).

In the case of earthquakes like the one in Puebla in 2017, monitoring is operated by the Centre for Seismic Recording and Instrumentation (Cires), a civil society association created in 1986, which seeks to 'promote the development of technology applied to seismic instrumentation, as a useful means to mitigate seismic risk' (CIRES, nf). In 2012 Cires developed the Mexican Seismic Alert System (SASMEX) that warns (by radio waves) cities when a strong earthquake occurs. This system is supported by sensors that cover 'the seismic subduction regions of the Cocos Plate and the south of the Transverse Neovolcanic Axis in the states of Jalisco, Colima, Michoacán, Guerrero, Puebla and Oaxaca' (SSN, n.d.). There are several applications that transmit Sasmex alerts such as Skyalert and 911 CDMX. In addition, the National Seismological Service disseminates information about earthquakes in Mexico. It is supported by a network of seismological stations throughout the country.

In particular, according to Civil Protection of Puebla, the municipality is the only one nationwide that has seismic alert since all others are states.

Finally, with respect to flood monitoring in Querétaro, since 2003 the state has developed a Hydroclimatological Information System, mobilising 'state-of-the-art technology for real-time information on the water situation of the basin, in order to help decision-making in terms of flood prediction and optimisation of the exploitation of water resources' (CEA, n.d.-a) In this sense, it created the Hydrometeorological Centre to monitor the flows of the basins of the State. The centre has two main tools: the meteorological radar, and an Automatic Hydrometeorological Information System (SAIH), consisting of 30 meteorological stations and 14 hydroclimatological monitoring and measuring stations with satellite telemetry (CEA, n.d.-b).

It should be noted that the National Meteorological System, which monitors both rainfall and tropical storms, among other things, is in place at the national level.

6.2   Reporting

In the life of events, digital technologies are used to inform about emergencies and disasters. While government stakeholders and agencies are usually the ones who inform the population about events based on monitoring, information also flows among citizens through digital technologies.

In the case of Ingrid and Manuel and ultimately in the AMZ, federal, state and municipal governments mobilise digital technologies to spread information.

Yes, I knew that there was at the federal level, obviously in the national news and at the state level as well, the radio news, even by text message [for example] ONE news. But they tell you like in all [media], that the storm is forming, that a hurricane is coming, that

it is going to make landfall on such dates, that you have to be forewarned and if you were warned (Person affected 5).

That's why I tell you that, if technology is useful to us, because it makes our work easier, we started to send bulletins through the WhatsApp groups that we have, I have a WhatsApp group of Civil Protection directors in this region and well, I also have the municipal presidents and in this group of municipal presidents I have more agencies such as: SEDENA, CONAGUA, and all the agencies that help us or that we help them (Civil Protection Guerrero).

But social networks today are definitely a tool, they are going to make it much easier for us, as our colleague said, to reach the population; today anyone has a smartphone, where they can receive warnings and alerts, we are looking for a system that can facilitate this communication. There are attempts right now to install a program like this, but we have not yet been able to set something specific, but I believe that emergency attention, from the operational point of view, is going to go through social networks (Civil Protection Acapulco).

Beyond that, our relationship with society, as our colleague from Puebla said, we have put a lot of [effort] into information technology, into social networks, into websites, to disseminate civil protection actions and everything that has to do with our work (Protección Civil Acapulco).

I'll tell you. Important communication tool those technologies, in fact, when a seismic phenomenon happens, we immediately replicate through WhatsApp groups. We know that the phone lines are immediately saturated, however, the social networks of WhastApp do not, so we are in close communication via social networks with different agencies and public institutions that are essential; they are essential activities in the municipality (Civil Protection Acapulco).

Information reaches people through digital technologies:

Yes, in fact, here I tell you that we still continue to maintain communication, here we are in a group, for example, here in the Centre there is a group that, on behalf of the State Government, is managed by Ms. X and there are the presidents of the associations of the various beaches, Puerto Márquez, Revolcadero, Barra Vieja, it is a chat, in which, for example, in rains they tell us: 'present the images of how the sea is right now and then you send photographs and they are there, the State Civil Protection and the Municipality and it is easier for them to give you that information, because they tell us how the sea is right now and then you send photographs and they are there, submit the images of how the sea is right now and so at the moment, you send photographs and they are there, Civil Protection of the State and of the Municipality and it is easier for them to give you this information, because they tell us that there is a certain event, that there is a swell, be aware, so we pass the notification, now, to the WhatsApp groups and any situation we are monitoring (Pie de la Cuesta Civil Association).

We started to receive [photos], they sent them to us, through television or through people who were there, who spent [those days] there (Affected Person 7).

Then in the river in the central part it began to get into the river, we began to hear that it had gotten into other neighbourhoods and even in the central part as there was a sewer there before, that's where it went. And it got into some neighbourhoods that are around where the city hall is, it got into that neighbourhood and started to flood there. We were finding out everything that was happening through social networks (Person affected 5).

I in particular, I used Facebook, that's where I found out that it was still raining and there was no official communication from the government and I trusted it, but it was Facebook that I managed (Asociación Civil Colosio).

Through the internet and I didn't go directly to the CONAGUA page because of the same lack of knowledge, that same day September 14, 2013, already around, it was about 8:30, I found out through social networks, that the main river of Chilpancingo, the capital of the State of Guerrero, had already overflowed (Asociación Civil Colosio).

We are in the WhatsApp groups, as I told you, Coyuca de los Libres is a united town and in every town the people are very united. So, if there is an alarm, we all communicate, and if there is a disagreement, the commissioner will sound the alarm so that no one is left without this information (Person affected 6).

It is noteworthy that despite receiving information via digital technologies, people tend to verify the information in person:

Through social networks you have on your Facebook page some friends from other neighbourhoods, there they tell you and now they even take pictures, if it is rising [the water] they even take videos, and you get to know more or less everything that is happening. But particularly when you see the river, you personally go to see the river, it is close, you personally go to see it and you don't take social networks or anything very much into account because you are worried that the river is not going to get in (Person affected 5).

Derived from this use of digital technologies, there is an understanding of improving public action:

There were very few human losses, and I feel that it is due to the information that was available in a timely manner, to the technology that was used, because if it had not been used, it is more difficult to have a radio on at 10, 11 o'clock at night, that is, an old-fashioned radio, so, now with the Facebook groups, with the WhatsApp groups, with the social network groups, well, they report, the Secretary of Civil Protection of the State of Guerrero has a Facebook page where they are monitoring 24 hours a day, there are people who are specially dedicated to monitoring the situation, The Civil Protection Secretariat of the State of Guerrero has a Facebook page where they are monitoring 24 hours a day, there are people specially dedicated to monitoring the page 24 hours a day, they are sending information 24 hours a day and they are receiving information 24 hours a day. Technology has helped us a lot, yes it has helped us, it has helped us a lot, nowadays, we also have drones in the Secretariat, where we have drones to take aerial shots of disasters, we use the drones to see how the forest fire is progressing, we use the drones, the technology is working for us (Civil Protection Guerrero).

In the case of Puebla, digital technologies were also used to inform the Civil Protection of Puebla and affected people:

We have a Telegram channel where we are uploading information frequently, we just uploaded in September a YouTube channel, where we are generating information, where we also have the risk warning system of the municipality of Puebla updated every minute. Where we have the seismic warning system, the entire risk warning system in real time and we are informing through that YouTube channel (Puebla Civil Protection).

Some even said, 'Yeah, it warned me a few minutes before!' I tell you, I'm not a big fan of installing these things on my cell phone, but I heard some comments that some of these apps they had downloaded told them that an earthquake was coming (Puebla Researcher BUAP 1).

We saw the damage that was done almost immediately and the aftermath. For the most part, the online media or newspapers documented the earthquake. They started uploading information and so on. That's how we started gathering information. If you read the article, the newspapers are quoted, and they helped us a lot (Puebla Researcher 1).

In Querétaro, the same mobilisation is identified on the part of Civil Protection and non-governmental stakeholders:

On Facebook we also manage a little more than 21,000 followers on Facebook, we also generate infographics, generate information to the population through Facebook, then what are the social networks we know that now is the channel of better dissemination and closer to the population (Civil Protection Queretaro).

In terms of information, yes, obviously we follow up on social networks, more on Twitter, not so much on Facebook, and we also use the emergency line' (Jardines del Valle affected person 5).

There are WhatsApp groups, from Santa María Magdalena, from Jardines and from here in La Aurora. The people in charge, like Claudia Zarazua, like the subdelegate of Santa María, I imagine that in the same group there is a representative of Jardines, so they continue to let people know what is happening. It has always been like this, well not always, but for some time now it has been the means of information regarding the rain (Aurora affected person 6).

Right now, the most basic thing we use in the family or with our neighbours to communicate is WhatsApp (Jardines del Valle person affected 5).

6.3 Attending

Beyond enabling communication, digital technologies are present in the 'care' (McFarlane, 2018) of emergencies and disasters. In Acapulco, digital technologies have supported the work of governmental and non-governmental stakeholders to address emergencies and disasters:

Initially the social networks have helped us a lot in responding to emergencies and we also have a small social network monitoring area there (Protección Civil Acapulco).

Well, when there is a contingency, a disaster in some municipality, well, all those people who are dedicated to reporting and making their pages of the same thing they have, many

people move to places that sometimes we do not even know, in that part if it supports us, because we also learn that more places are affected and we move in that way to the places, for that part, why, because sometimes a journalist has a friend in a community that was not reported to the municipality and they upload it or start transmitting it to them, then, we become aware of it and we go to the place, just like the municipalities, we go to the place and we provide support to the citizens, that is why it helps us, because we have more information about what is happening in a contingency or disaster (Civil Protection Guerrero).

In the case of the earthquake in Puebla in 2017, technologies helped to organise the university's recovery and reconstruction work:

Well, look, I think in the first part of the emergency, after the earthquake, in this issue of the reconstruction support brigades, yes, social media was definitely very important. I mean, I know that, for many, I don't use Twitter, but I know that for many it was important, because they were communicating where there was need and where to take food, et cetera. For this process of the support brigades in debris removal and so on, well, yes, our means of communication with the community, well with both communities, was through WhatsApp. That was how we coordinated who to help and how and what they needed and that kind of organisation and also the youth groups that were going (UPAEP).

Well, obviously the exponential network was Facebook, because they saw us in the houses checking, watching and the students also replicating their experience, sharing their experience and that's what initially allowed more people to join in who wanted to help in this sense. So, I would say that social networks were the main thing and the students who were sharing their experience, trying to help with their grain of sand, but doing something and not standing still, in fact, I am looking for the post so I can share it with you (Puebla Researcher BUAP 2).

'I walked around with my backpack, my chisel, my hammer and my cell phone and if I saw a crack, I would really have to break a little bit. To see if that crack reached the wall, if behind the wall there was a column, because sometimes there are elements that don't reach the wall. Because sometimes there are elements that can't be seen from the outside and also my mobile phone, for example, I used it as a level, because I downloaded an application that helped me to measure the verticality of elements to see if it was more crooked than normal. (Puebla BUAP Volunteer 2)

So, there was a lot of talk about the disaster and the demand was excellent, so the technology, specifically talking about a mobile phone, allowed us, for example, to do reports by mobile phone, by video call, to say, 'Well, hey, my house has two little cracks in one wall!'. 'Well, let's see if we can see them, send me some pictures.' And sometimes in many situations it was just cracks, I don't know about the plaster or the paint, obviously people are unaware of the problem, and they're alarmed, and everybody wants their house to be first, or would have been first, and in these situations, it allowed us to discriminate. Somehow, which properties had priority over others with a simple photo. So, this also helped us to prioritise the work and focus on those who are most at risk and to move forward (Puebla BUAP Volunteer 2).

Yes, in fact we had to take distance metres and GPS to georeferencing and as the university could not cope with all this, we took it upon ourselves to use our phones to get

the geographic coordinates of the houses, through applications and everything. this, practically only with our mobile phones (Puebla BUAP Volunteer 1).

That is to say, we made WhatsApp groups for all of us who were working on the reconstruction project and there we agreed on what day we would go, when we would go, who would go, who would not go, all this part of the organisation. The logistics of the transfers, that was also resolved through this means. But we didn't do any kind of campaign or anything outside the university because of other things' (UPAEP staff).

Finally, in Querétaro, the same type of use of technologies for emergency and disaster response related to floods was identified:

WhatsApp is our first app. We use it a lot and then Facebook and some people have Twitter. I use Twitter. Then for certain things that we need answers for, like a CEA water leak or park maintenance, we use Twitter to get answers faster (Aurora, affected person 2).

So, I think that access to accurate information helps a lot, that people are able to discriminate between the information we are given and be critical and critical. It also helps a lot the creation of WhatsApp groups, not to prevent floods but at the time of the flood because it promotes the organisation of neighbours to say: 'Well, we have to go get the sandbags', and in the end I think (Aurora affected person 6).

6.4 Verifying

Through analysis, an increasing intertwining of digital technologies in DRR is identified in relation to monitoring activities and processes of what is happening so that the State can act (attend an event or its effects). Verification activities also relate to verifying the use of public funds for reconstruction.

In Acapulco, digital photographs are used to assess damage and to provide aid. For example, after Ingrid and Manuel, in order to receive state aid, affected people needed to provide photographs of the damage:

It is through them that we replicate and let us know some of the damages they may have in their properties (Civil Protection Acapulco).

They gave us $10,000 pesos, some of the smaller ones got $5,000 pesos and some got $10,000 pesos, that's all they gave them, that's all, yeah.

In addition, the Secretariat of Agrarian Urban Territorial Development (SEDATU) verified the construction of housing after Ingrid and Manuel. In some cases, SEDATU staff found that nothing was built; however, according to interviewees, nothing happened afterwards. Despite these types of situations, digital technologies seem to contribute to transparency and accountability.

In the case of the State, we do not take responsibility for actions that the municipality does, it is not valid, because it is not possible, because in the social networks they are aware and up to date, so, I cannot say that I put out a forest fire in Taxco when I did not go, simple, or I cannot say that I went to Copalilo to put out a fire when I did not go, why, because we use different uniforms, then you see that the uniforms are not the same, so, no way that I take responsibility for work that I do not do, I simply (Civil Protection Guerrero).

> The only thing I can tell you is that they are asking us for geo-referenced photos, that is by law, and it is a matter of course that they are asking us for these geo-referenced photos.... Before they did ask us for geo-referenced photos, but only of the contingency, that is, from this side to that side, a photo, but now if you go to deliver a pencil to a house, geo-referenced photo of the house, if you go to another house another geo-referenced photo of the house and before it was a geo-referenced photo, but of the centre of the disaster, let's say, and that's it, and now it is not, in each photo, for each delivery it is a geo-referenced photo, it's like they got a little stricter, but well it's the same, if before you were supposed to send a geo-referenced photo of the whole disaster, well that's it, you already knew where the whole disaster was, but now they want a geo-referenced photo of each house (Civil Protection Guerrero).

In Puebla, similar experiences occur with respect to civil protection work and verification processes to respond to an emergency or disaster:

> For example, we have been using Twitter for a long time, we have a little more than 138,000 followers on Twitter, which makes us a very dynamic platform where we receive many reports. It is not ideal, but it is often more effective, for example, the reports of an incident of an emergency through Twitter than having a direct dispatch to 911 (Civil Protection Puebla).

> So, what has helped us a lot through Twitter is to be able to corroborate, to answer and that they send you a photograph of what is happening, that they send you a photograph and that way you can see what is happening, we handle a lot of information for the population in terms of prevention in terms of infographics. All the information is published there, I repeat we have more than 138,000 followers on Twitter which is a very dynamic platform (Civil Protection Puebla).

Specifically with respect to the 2017 earthquake, digital technologies were used to verify and prioritise action:

> Obviously, there were more some cases that were more serious than others, and in the College of Engineers if a recommendation was requested or made by WhatsApp, they sent the request with a couple of photos, as far as I remember, to evaluate as well. Obviously, there were properties that had to be evaluated quicker than others and that was something important to determine from the beginning (Puebla BUAP Volunteer).

> We gave them the information, we asked them if they could take pictures, that is, a series of questions, this was very quick, but the intention was also that they could take pictures when they saw that it was something more serious, so they could determine and Civil Protection would have the priority to give something to those most affected and the speed that was needed (Member College of Architects).

> We found applications that allowed us to georeference where we were. Above all, taking photographs and with the georeferencing data and putting the names, identification, that helped us a lot for the issue of documentation and as I said, we were finding, because we were looking for how to georeference, how to locate them, by SEDATU (Puebla Researcher BUAP 2).

In Querétaro, the same use of technologies is also identified to verify occurrences and from there to act:

Of course, we have a chat for the district of Felipe Carrillo Puerto that consists of certain surrounding neighbourhoods that are affected by the same riverbeds or the same rivers. The protocol is to warn the leaders within the polygon: 'hey, it's starting to rain, watch out, we're starting to see it get worse'. Then we start sending evidence by chat about the situation and we inform first the Civil Protection, then the district. We are the first to alert Civil Protection' (Aurora affected person 2).

6.5   Keeping Alive

Digital technologies contribute to keeping emergencies and disasters alive. For example, in the case of Acapulco, through Twitter and digital news, people remember every year the 2013 event but also demand help since the reconstruction was not completed or was poorly executed.

7 Complications

The intertwining of digital technologies creates a number of complications.

7.1 Exclusion and complicated participation

Despite the idea that digital technologies allow people to access information and connect, not all information reaches everyone, presite exclusion related among others to the tension between people, which makes the flow of information is not so simple:

> The first block was already flooded; the pumps wouldn't let cars in from the second bridge. So, go and see for yourself. I found out about it from the Facebook post, and I also think it was posted on the delegate's Facebook page, although he barely has any followers because he is very selective (Santa María Magdalena affected person 1).

> We as a neighbourhood don't do it, we don't do it, it's part of the history of the neighbourhood, and the lack of participation of the neighbours is also very important. There is only one person who is like the president, he only gets involved in what he does, there is no joint work, then, for example, he has his Facebook page, but they are almost, almost all his friends, the ones he knows who are the closest or who know him. So, no, we don't use social networks as a way of communicating and informing ourselves in a given moment of tragedy or situation (Jardines del Valle affected person 4).

Despite the use of digital technologies, engaging people is not getting easier on its own:

> I think they don't want to, because it's very easy to hit it, hit the mobile phone and enter, because here what happens is that people have the habit of talking a lot. Why don't they do this, why don't they do this, they don't like to participate, they don't like to participate. I guess that's the reason why who doesn't want to join a group, because, well, I used to. The people that I saw as more participatory, I invited them to my group, I invited them, 'you know what, I invite you to participate, to work so you can see how we are working!'. But they didn't want to (St. Mary Magdalene affected person 3).

7.2 Efficiency challenged

On the other hand, although digital technologies help to address emergencies and disasters, and in some cases make response and reconstruction processes more efficient, this does not always happen and the direct relationship with the authorities is still important:

> Sometimes we would like a more immediate response. We'd like to feel like somebody's looking out for us. Like, 'okay, don't worry, I sent you a squad,' or, I don't know, nothing. Right now, we upload evidence, or a report and it takes a long time. What has worked for us is that we're working in coordination with the delegation, and they have Civil Protection personnel. It's faster ... like information over the radio or with their hotline. I

don't know how they process [the information], but yes, we have to go through those filters (Aurora affected person 2).

Moreover, digital technologies help in the response to emergencies and disasters; however, they do not seem to contribute to training processes on how to use the information received:

Yes, yes, although the truth is that we are not using this mode, if we are communicating effectively, because there is no real work going on. For example, what to do in a flood, there's no education, there's no formal program maybe they come and tell us, you have to do this, you have to have these documents ready, etcetera, there's no education as such. So, rather, you act as you think and the information that is given in the WhatsApp groups is more of a communication than a direction, because it is more about it flooded on this side, it flooded on that side, how are the streets, etc. and so on and so forth, but it stays at that level, there is no formal work or designed to deal with an emergency like this (Affected person 6).

This can result in disinformation and disorder, as in Acapulco or Puebla.

Well, I was saying that in this way, the technologies Facebook, WhatsApp and all the social networks that exist, have, have had an effect, or have had an effect on Civil Protection, the technologies have had an effect on Civil Protection, but in the same way the same technology also affects, because sometimes, let's say Facebook, there are many reporters who make their pages, I say reporters, because they are not even journalists, I say reporters, because they are not even journalists, they make their pages and start transmitting or making use of those social networks, sometimes without having the capacity or the knowledge to be able to talk about it, sometimes, that is, it does benefit, because it speeds up the work, it speeds it up quickly, so, here the detail is that, I repeat, let's say reporters, reporters or journalists who have their pages and sometimes they start reporting without having the knowledge of what Civil Protection is, so, that is where I feel that we do get hit. On the part that information flows, well, it is beneficial, because we find out more quickly and we have a quicker response, that is just what I see (Civil Protection Guerrero).

Something that seemed very important to us was to arrive at a place where there was a certain degree of organisation, because we saw that many people were arriving at the collection centre in private cars; that they wanted to take things wherever they heard on social networks that there was a need, and everyone wanted to go. So, it was chaos, I mean we saw it on the social networks, that the roads were saturated (UPAEP).

7.3 Disconnection, poor infrastructure, and limited penetration

The use of digital technologies during an emergency or disaster is limited as they suffer from disconnection, as in the case of telephone networks.

I don't remember what network I had, if it was AT&T or Movistar, it wasn't Telcel, I had Telcel and well, in general the network was down at that time, there was no communication for many people... The ones I had no communication with were my ex-partner and some loved ones, acquaintances who were in other states, I believe that communication returned after approximately three or four days (Affected person 4).

They are also limited by the scarce existing infrastructure, as in the case of Acapulco and Guerrero in general:

> I think that another issue, now the president is taking it up again, is satellite communication, that is something fundamental, we were able to do it in some houses by radio, but because suddenly there was no electricity, communication was lost. But I think that if there is a good satellite link in the communities it will be possible to be up to date with the news and in cases of disasters to be able to react more quickly (Asociación Civil Atoyac).

> Most of the communities had or still have telephone booths, in some, in the more distant ones there were almost none, very few people had telephones, I don't remember, I think they had telephones with Telcel, with Telmex, I'm sorry. But now communication is becoming more fluid, most of them have access to cell phones, the signal has arrived a little more... I mean we also had contact with the communities that had their phone booths, the phone booths. There you ask to speak to such, and such a person and they give you so many minutes. That was the way we communicated before, I think that now most people have cell phones, although with a very weak signal, but they have a cell phone and maybe on the second third day they can see a message, or we can have direct voice contact (Coyuca Civil Association).

Poor infrastructure also emerged as a complication in Puebla for the use of digital technologies:

> Then we got to know the tools, especially the offline ones, the ones that work collaboratively, and we started to have tools that would help us, especially GPS, in communities where there is no internet or signal. We found applications that allowed us to geo-reference where we were (Puebla Researcher BUAP 2).

> One of the most important issues, for example, is the recording of vibrations. I insist because the instruments in the structures, from, for example, when you start to build a building, can be instrumented with accelerographs, and follow the structural behavior of the building, or the dynamics, how it is moving and if it is really what is expected. It should be constantly monitored, but unfortunately, it's not done. It is often overlooked due to lack of economic resources (Puebla Researcher 1).

> Yes, I mean, after this we have had a little bit of rapprochement, for example, with INEGI, the National Institute of Statistics and Geography, they are the experts to be able to handle this. Series of planimetries or digital emissions, which we were not used to. I mean, we are used to working, for example, with a Google, a Google Maps, a Google Earth, but not really. I feel that a lot of technology is missing to really be able to do it, I mean, right now we didn't know the importance of all the efforts that were made at that time (Representative College of Architects).

In addition, there is a low use of digital technologies and low penetration as in the cases of Acapulco and Queretaro.

> I created, with a neighbour we created a Facebook page, which is where they were contacting us, let me tell you that there are also many neighbours who do not use Facebook, now there is the WhatsApp modality which is a little bit, but many of our compañeros do not use Facebook, which I reiterate that they are ladies, housewives who

are the ones who come the most and suffer the most from the problems that we are going through (Asociación Civil Colosio).

Yes, what happened is that at that time WhatsApp didn't exist yet, I think, so we talked on the phone and one of those affected (Colosio Civil Association) spoke to me.

Actually, at that time we, well, my husband and I, we were not in contact with Whatsapp groups, it seems to me that it was still not something that was used a lot, or at least we didn't use it. So, I found out from these schoolmates who sent me a message, and we started to communicate by message, in relation to the fact that we were not going to go to work, that we were not going to arrive (Jardines del Valle affected person 4).

At that time, I tell you, we were not in the WhatsApp groups, then we joined the group here in our street and about a year and a half ago, not like a year, more or less. We are in a group that is Aurora and Jardines del Valle and Conjunto Residencial Santa Magdalena, we are like several neighbours who are in the same group (Jardines del Valle Affected Person 4).

It is worth noting that in the context of lack of infrastructure, there is a recognition of the potential of digital technologies and of these as fundamental:

So, yes, in fact, the incorporation of IT is fundamental, and it goes from being even in a small map, as the doctor said, to register basic information, to achieving things of greater scope, of greater precision to favour and have, control or prevent and help face this type of situations and contingencies that arise and that will continue to arise (Representative of the College of Engineers).

Well, it would be great if we could all communicate with the people who can help at that moment. I don't know if Civil Protection, the Municipal Guard, if there is any association that deals directly with natural disasters. It would be a good option to use networks, maybe to get on a page, maybe Facebook or a specific page with the name of the project where we can all be connected and comment one, before what is happening, two, what people are going through. at that moment, and three, after the rain, people can give their opinion (Jardines del Valle person Affected 5).

8 Conclusion

Through this Working Document it is identified that digital technologies are intertwined to cope with emergencies and disasters and involve both governmental and non-governmental stakeholders. Through this study it is revealed that these forms of intertwining occur in five ways: (i) in the monitoring of disruptive phenomena such as earthquakes, hurricanes, rains and floods; (ii) in the processes of informing governmental and non-governmental stakeholders with respect to warning, preparedness, response and reconstruction; in dealing with emergencies and disasters by the various stakeholders; (ii) in the verification of occurrences in order to be able to act or to verify what has already been invested or done, as in the case of reconstruction processes; (iv) in keeping events present and alive, remembering difficult moments and moments of solidarity, but also claiming the abandonment and deficient reconstruction processes.

Likewise, it is identified that the interweaving of digital technologies entails three main complications. On the one hand, the use of digital technologies alone does not encourage citizen participation and can limit it due to the low penetration that exists in Mexico. Moreover, it can create processes of exclusion in its use. On the other hand, while there is an understanding that technologies enable efficient DRR processes, this is not always the case, and direct contact between governmental and non-governmental stakeholders remains important. Finally, the use of digital technologies is extremely limited by the disconnection that tends to occur during an emergency or disaster as well as by the scarce infrastructure in the country. In addition, as mentioned above, there is still little penetration of digital technologies in certain areas of the country, particularly in poor neighbourhoods and communities.

In this sense, we can conclude that digital technologies are already present and intertwined in DRR processes in the cities studied; however, they present a series of complications that limit and question their use. In relation to the smart city, there is no narrative per se in the cases studied; however, there is a positive idea about digital technologies and little or no questioning about how they could generate negative impacts. Therefore, it emerges as vital to reflect on and question the complications that were revealed from this study. In particular, digital technologies seem to open up new possibilities that could lead to greater accountability and transparency; however, it is unclear how they are institutionalised and how they translate into better use of state aid for reconstruction.

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