Chapter 80
Leveraging Volunteered Geographic Information to Improve Disaster Resilience:
Lessons Learned From AGORA and Future Research Directions

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ABSTRACT

Volunteered Geographic Information (VGI) has emerged as an important additional source of information for improving the resilience of cities and communities in the face of natural hazards and extreme weather events. This chapter summarizes the existing research in this area and offers an interdisciplinary perspective of the challenges to be overcome, by presenting AGORA: A Geospatial Open collaboRative Architecture for building resilience against disasters and extreme events. AGORA structures the challenges of using VGI for disaster management into three layers: acquisition, integration and application. The chapter describes the research challenges involved in each of these layers, as well as reporting on the results achieved so far and the lessons learned in the context of flood risk management in Brazil. Furthermore, the chapter concludes by setting out an interdisciplinary research agenda for leveraging VGI to improve disaster resilience.

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INTRODUCTION

Disasters caused by natural hazards such as floods and landslides have caused significant material damage and human losses worldwide, and particularly affected countries in the Global South. Future extreme environmental events are likely to become more frequent and their patterns less predictable due to climate change. These events have immediate and longer-term socio-economic impacts on both an international and national scale (Jha, Barenstein, Phelps, Pittet and Sena, 2010). In 2013, disasters incurred financial losses of approximately US$135 billion worldwide and caused 20,500 fatalities. Moreover, 44% of these reported disasters, 49% of the fatalities, and 37% of the financial losses were linked to extreme hydrological events (Munich RE, 2013).

These facts show the need to carry out activities with a view to building resilience against disasters and extreme events, i.e. to enable communities to resist, change or adapt in face of a disaster (Norris, Stevens, Pfefferbaum, Wyche, & Pfefferbaum, 2008). Disaster management is an important adaptation strategy to achieve this goal, since it consists of a cycle of tasks that involve the mitigation of risks, preparatory measures, effective response and post-event recovery. Accurate and up-to-date information is essential for supporting the tasks of disaster management throughout this cycle. For instance, the continuous monitoring of a flood risk and the real-time mapping of flood hazards require local information such as rainfall data and water level observations to evaluate the risk of potential flooding. Moreover, the monitoring often requires an extensive spatial coverage to be efficient, which can be a considerable challenge for most cities in emerging and developing countries, like Brazil, where updated local data about the current state of the rivers is rarely available.

Volunteered Geographic Information (VGI) – i.e., user-generated information that is crowdsourced and relies on collaborative web platforms, specific web applications and/or mobile phone apps (Goodchild, 2007) – has emerged in the past few years as an important additional source of information for disaster management (Goodchild & Glennon, 2010; Horita, Degrossi, Assis, Zipf, & Albuquerque, 2013). The combination of VGI with traditional sources of information (e.g., environmental sensors) to explore complementarities, offers a great potential for building resilience against flooding, since they can be used for improving the availability, coverage and accuracy of the information needed for disaster management (Horita, Albuquerque, Degrossi, Mendiondo, & Ueyama, 2015).

However, there are still a number of serious challenges to be addressed to make VGI an effective means of supporting disaster management. With the aim of making sense of these challenges and investigating approaches to tackle them, this chapter presents AGORA - **A G**eospatial **O**pen collabo **R**ative **A**rchitecture for building resilience against disasters and extreme events (AGORA, 2016). This is a conceptual architecture that is being designed by a group of interdisciplinary projects hosted at the University of São Paulo at São Carlos, Brazil, and involving international partners at Heidelberg University (Germany), the University of Münster (Germany) and at the University of Warwick (UK). AGORA is aimed at improving flood risk management in Brazil and works in close collaboration with the National Center for Monitoring and Early Warning of Natural Disasters (CEMADEN). The conceptual architecture of AGORA structures the task of using VGI for disaster management into three layers: acquisition, integration, and application. In this chapter, we will explore the challenges and current state-of-the-art about each of these layers, as well as the lessons learned from the corresponding AGORA projects.

The remainder of this chapter is structured as follows: Section 2 outlines the theoretical background of this work, as well as related works and identifies gaps in research. The components of the AGORA