

Chapter 11

Citizen–Driven Geographic Information Science

Thomas J. Lampoltshammer
Danube University Krems, Austria

Johannes Scholz
Graz University of Technology, Austria

ABSTRACT

This chapter shows how global environmental changes put society in front of new challenges, and how immediate and intense actions have to be undertaken in order to foster necessary progress in global sustainability research. The technological infrastructure has reached a status of ubiquitous computing and virtually unlimited data availability. Yet, the dynamic nature of the global environment makes continuous and in-situ monitoring challenging. Citizen-driven geographic information science can bridge this gap by building on inputs, observations, and the wisdom of the crowd, represented by the citizens themselves. This chapter argues for the important role of citizen science in geographic information science, presents its position in current research, and discusses future potential research streams, based on the participation by and collaboration with citizens. In particular, the chapter sheds light on three major pillars of the future of citizen-driven geographic information science, namely: big geo-data; education; and open science.

INTRODUCTION

Global environmental changes put society in front of new challenges. According to Craglia et al. (2012), immediate and intense actions have to be undertaken in order to foster necessary progress in global sustainability research. According to them, five major research challenges have to be addressed:

1. **Observation Systems:** To monitor environmental changes on all geographic scales (local, regional, and global)
2. **Forecasts:** Have to be improved in order to react timely regarding future changing environmental conditions and related direct and indirect consequences

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3. **Key Thresholds:** Have to be identified in order to act properly on rapidly changing conditions or the occurrence of abrupt phenomena
4. **Impact Factors:** Have to be identified in a transdisciplinary approach to cover institutional, economic, and behavioral aspects in order to reach global sustainability
5. **Encouraging Innovation:** To boost the development and application of new technologies, as well as political and social progress; always paired with solid evaluation methods

In order to be able to realize solutions towards these presented challenges, new ways of digitalization and networking on a global scale throughout society have to be put in place. Former U.S. Vice President Al Gore first presented such an overall concept back in 1998 titled “Digital Earth” (Gore, 1998). At the time of being presented, the concept was criticized as not being realistic due to problems such as interoperability issues of existing geographic information systems, data accessibility, or overall Internet connectivity and available bandwidth (Craglia et al., 2008). However, major improvements have been made since then and the currently available technological infrastructure is ready to take a big step forward towards making the vision once expressed a reality.

Geographic Cyberinfrastructure

The first time that the term cyberinfrastructure appeared was in 1998. It should describe a generic information infrastructure that is able support actions such to collect, archive, share, analyze, visualize, and simulate data throughout all scientific areas. While each scientific field features its own kind of common types of data, data with included or attached geographic references can largely be found throughout all disciplines (Yang, Raskin, Goodchild, & Gahegan, 2010). A cyberinfrastructure dedicated to the resulting challenges is called geographic cyberinfrastructure (see Figure 1). These challenges relate, for example, to the necessity of specific methods and tools for the data to be processed, due to their inherent spatial characteristics (see, e.g., de Smith, Goodchild, & Longley, 2007). The required calculations can be quite demanding as spatial dimensions increase from 2D to 3D and even beyond, if time-base analysis has to be considered as well. But the newly available infrastructure presents more than just pure computational resources.

Based on the underlying technology, especially the distributed networking capability and the high grade of interconnectivity, knowledge exchange between various stakeholders, working on the cyberinfrastructure, becomes possible. Knowledge exchange can be performed, e.g., via the application of ontologies (Gruber 1993), describing environmental phenomena and their spatial and temporal dimension as fundamental cornerstone to ensure semantic interoperability (Harvey, Kuhn, Pundt, Bishr, & Riedemann, 1999; Klien, Lutz, & Kuhn, 2006). Taking the next step, these shared concepts can then be linked together (Heath & Bizer, 2011) in order to provide a web of knowledge for interdisciplinary and transdisciplinary exchange. Maybe the most important addition to the technical part of the cyberinfrastructure comes in form of the community. This essential way of contribution comes in two forms. The first form relates to users providing additional services on the cyberinfrastructure. With the establishment of standards, e.g. for web services, users can set-up their own services and offer them to be integrated in other platforms. Furthermore, communities can use the cyberinfrastructure for exchanging ideas and concepts, which can be immediately linked with data, interpretations, and visualization on the very same platform. The second form is for users to take up the role as data providers. They can act as proxies for sensors (Goodchild, 2007) and therefore collect data, in situ and in a dynamic way, arrays of sensors

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