Chapter 9
Geographical Information Systems in Modern Citizen Science

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ABSTRACT

This chapter shows how citizen-science initiatives have been known to exist for a long time, but only recently they were further enhanced thanks to technological and societal developments, such as the availability of mobile devices, the widespread use of the internet and the low cost of location devices. These developments shaped the geographic information system (GIS) world as it is known today: a group of technologies that allows retrieving, storing, analyzing and sharing spatial information, by people who are not necessarily GIS professionals. This chapter starts with a general background about GIS, adding then more detail in topics of particular relevance in the context of citizen science. The rest of the chapter is focused on reviewing and classifying the use of GIS in citizen-science initiatives; and some use cases are described in order to provide practical examples of the use of these technologies for solving specific spatial problems. The chapter closes with a brief discussion of the future of GIS in citizen science, in the light of current technological trends.

INTRODUCTION

Citizen science has a great focus in environmental issues such as pollution, habitat and biodiversity (Castell et al., 2014; Uhrner et al., 2013), and thus it has an eminent geographic component. The phenomena that concern citizen scientists do occur in a certain place and at a certain scale, and they are often interrelated with other phenomena that are also linked to places and scales. GIS is the "glue" which

enables us to relate these different places, scales and phenomena in a system where the information can be effectively stored, managed and analyzed.

Scientists have been known to use spatial analysis for a very long time. In 1854, British epidemiologist John Snow (Goodchild, 2007), plotted the reported cholera deaths onto a street map (a technique similar to what is currently called a *mash-up*), in order to find out the source of the infection: the public water pump on Broad Street.

Although this early example already illustrates the application of GIS principles to solve a societal problem, it was not until recently that the use of GIS became generalized among the citizen science community, along with other communities. Undoubtedly, modern GIS developments such as interoperability, the growth of Free and Open Source Software (FOSS) and digital Volunteered Geographic Information, amongst others, have played an important role for this widespread technology adoption. These aspects are discussed within the "Background" section, which aims at familiarizing the reader with GIS technologies. Unfortunately it would be too ambitious to provide a complete introduction to GIS in the scope of this chapter, so the authors focused instead in the most recent events, and in particular in those technologies, movements and ideas which are more relevant in the context of citizen science.

Figure 1. Original map by John Snow, depicting the clusters of cholera cases in the London epidemic of 1854
Drawn and lithographed by Charles Cheffins (Snow, 1854).
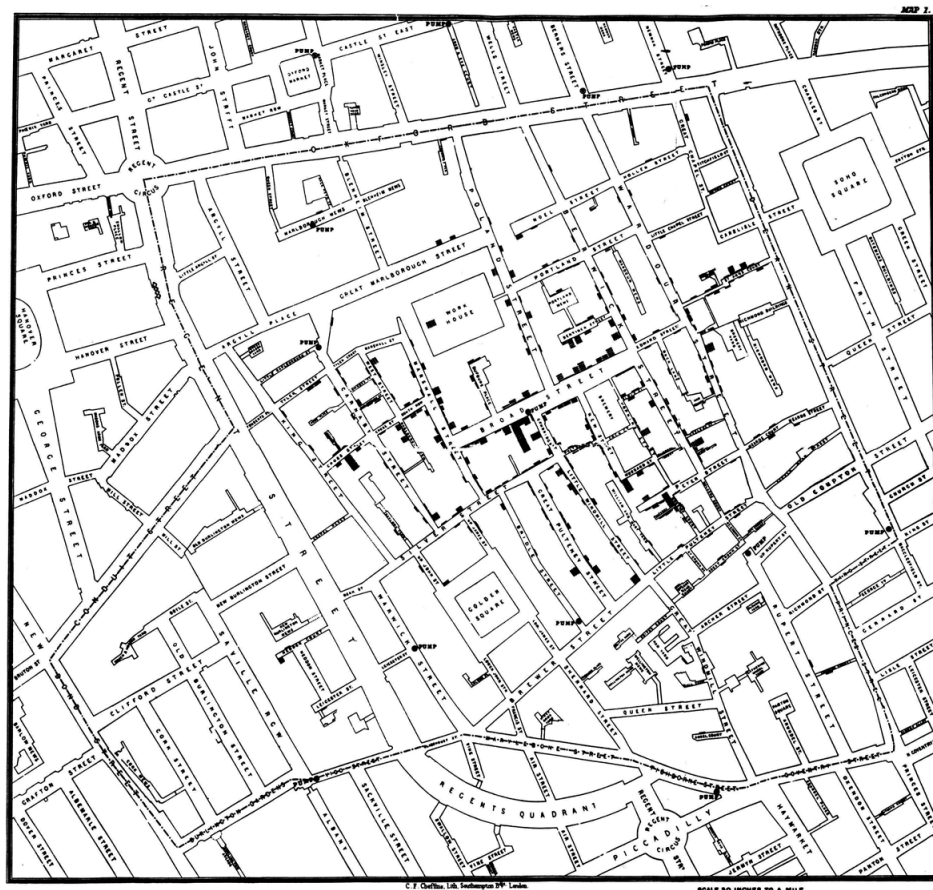
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