Geospatial Influence in Science Mapping

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INTRODUCTION

Sharing and making research data publicly available are increasingly getting attention to academia and research policy agenda. According to a 2014 European Commission guidelines for the re-use of datasets (OJEU C/240-1), geospatial data is of most importance. It raises an invaluable opportunity for libraries to play a dominant role in the not-so-distant-future for managing large collections of open (geospatial) research data. However, the geospatial dimension goes beyond data itself and embraces a wide range of spatial analysis and techniques (Smith et al., 2015). In particular, mapping and visualization techniques of geospatial data may provide endless opportunities to libraries and information science researchers in the sense of exploring the most of large open research datasets from a new perspective. With exceptions, librarians and information science professionals miss an overall perception of the possibilities that geospatial data and tools may bring them to geographically explore, analyze, and mapping research datasets and, especially, science related data. The question we pose in this chapter is whether or not geospatial technologies and mapping techniques have a role in the know–how of librarians and how these technologies and techniques may influence science mapping. Furthermore the chapter aims at drawing attention to the opportunities that the geospatial dimension applied to science related data can bring to the field of science mapping.

In what follows, the chapter briefly distinguishes the notion of mapping between the Geospatial Information Science (GIScience) and Librarianship and Information Science (LIS). Afterwards, an overview about recent initiatives and research work relative to (geospatial) mapping of science is presented. Based on these examples, opportunities and challenges of applying geospatial technology to science mapping are discussed. Finally, based on relevant while evolving geospatial technologies, next steps for increasing up the influence of geospatial technology in science mapping are pointed out.

BACKGROUND

Concepts and Terminology

Science mapping, bibliographic mapping, or mapping scientific bibliography is often defined as a visual representation of how scientific disciplines and fields, authors and institutions, and scientific and technical documents and articles are related to each other (Cobo et al., 2011; Small, 1999). In order to define the aim and scope of the present chapter it is paramount to first clarify what actually science and mapping mean in the expression ‘science mapping’.

Firstly, the focus on ‘science’ in the term science mapping refers to all the data and metadata generated during the gathering and compilation of scientific bibliographic information such as: authors, article titles, source, citations, affiliation, and related scientific data (Chen, 2013). This data will be afterwards processed, analyzed and visualized using different scientometric techniques

DOI: 10.4018/978-1-5225-2255-3.ch302

(Garechana et al., 2012). It is worth noting that bibliography data is only one potential working area to which geospatial technology and GIScience can be applied. Other areas within LIS, such as geospatial segmentation of patrons for marketing purpose and indoor position inside library buildings for space management and for enhancing navigation of patrons, are also of interest to GIScience (Aguilar & Granell, 2013; Granell & Aguilar 2013; Scaramozzino et al., 2014; Aguilar & Granell, 2015).

The second, and most important, clarification refers to the term 'mapping', which may have different connotations from distinct fields and disciplines. As the chapter mixes ideas from two distinct fields or disciplines, namely LIS and GIScience, it is worth delimiting early the scope of 'mapping'. As introduced earlier, science mapping or bibliometric maps of science, under the lens of the Librarianship discipline, is meant to visually represent bibliographic data relative to science. Noyons (2004) provides a clear definition of the resulting science maps in which "the items are positioned in relation to each other in such a way that the ones which are cognitively related to each other are positioned in each other's vicinity, whilst the ones that are not or hardly related are distant from each other". For example, we can have citation mappings, as visualizations of citation networks from scientific documents, or author mappings, as the analysis and visualization of collaboration (joint articles) among scientists. In general, as these mappings explore datasets relative to scientific activities and results, they are altogether referred to as science mapping.

In the current literature, though, the term "mapping" often refers to "record in detail the spatial distribution of (something)" (Oxford definition's map - verb)(English Oxford Living Dictionaries, 2016), which refers to spatially arranging data over an area. For example, network diagrams using force-direct layout are common visualizations for science mapping (Boyack et al., 2015). Despite these visualizations of science maps evoke items displayed on a geographical map, such a meaning of mapping has nothing to do with a geographic map or displaying data on a map. From the GIScience perspective, though, (geospatial) mapping implies to explicitly project data on a (geographical) map. For doing so, data must be georeferenced, in other words, data must contain a clear reference to a position or location, in order to be spatially displayed in a map. Furthermore, the main difference is that science mapping in LIS usually refers to visualizations that do not necessarily include or rely on a (geographic) map. Network graphs are typical examples of visually arranged bibliographic data because they emphasize the connectivity of data, i.e. network graphs provide an easy way to quickly grasp how items of data (e.g. authors, publications, citations, institutions, etc.) are connected. Furthermore, in this chapter, the term science mapping refers to ways of visually representing bibliographic data or science–related data, but paying special attention to technologies, concepts and analysis techniques from GIScience for creating such visualizations. Indeed, as we outline later on, the geospatial influence in the science mapping literature is still anecdotal.

Before going into the literature review, it is important to briefly introduce the concepts of geospatial analysis and visualization which are used extensively later on. Geospatial analysis is concerned with statistical and analytical techniques to process geospatial data, paying particular attention to topological, geometric, or geographic properties of the data. The typology of data (geospatial) calls for slightly different types of analytics than those found in the literature (Chen et al., 2012). In short, there exist two grand categories of spatial analysis techniques according to the dichotomy of geospatial data: vector-based or raster-based data. In the case of vector-based data, typical and basic operations are map overlay (combining two or more maps or map layers), and buffering (identifying regions of a map within a specified criteria (distance, time, etc.) of one or more geographic entities or features, such as buildings, streets, or town). Raster-based data, though, is more often used in disciplines such as environmental sciences