Chapter XVIII
GeoVisualization and GIS: A Human Centered Approach

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ABSTRACT

This chapter introduces the relationships among geovisualisation, human computer interaction (HCI), geographic information systems (GIS), and cartography as a means of supporting decision-making. It emphasizes the importance of the data modelling and the associated visualisations in terms of what we can do by way of analysis and the methods by which we can undertake the analysis. It also argues that concepts from usability evaluation methods (UEMs) and other HCI techniques offer a potentially more substantive approach to understanding the use of visualisations in collaborative decision-making. Furthermore, the authors hope that understanding the underlying assumptions and relations among geovisualisation, human computer interaction, geographic information systems, and cartography will inform researchers and decision makers of a better design for studying geovisualisation as enabling means of decision making.

INTRODUCTION

Geovisualization is regarded as a means of representing spatial information (where things are on the earth’s surface) visually in a way that allows people to interact, explore, synthesize, refine, analyse, and communicate conclusions and ideas. It is, therefore, an interactive visual language that enables people to make sense of data archives and communicate this sense effectively. One characteristic of geovisualization is that it brings together knowledge and ideas from a variety of disciplines including but not limited to cartography, information visualization, visualization is scientific computing (ViSC), exploratory data analysis (EDA), geographic information science (GIS), and human computer interaction (HCI) (MacEachren & Kraak, 2001). HCI increasingly
plays an important role as new variances of geovisualization such as collaborative geovisualization and geoanalytics, attack research attention. In this chapter, we will briefly discuss how cartography, GIS, and HCI shape aspects of geovisualization that can support decision-making. We first discuss the interrelation of cartography and geovisualization and how this interrelation supports decision making by discussing the concepts such as choropleth, cartograms, spatial dimensionality, levels of measurement, graphic variables, and feature’s continuity, and level of variation. Then we discuss the interrelation of GIS and geovisualization. This section presents three conceptual representation methods—the continuous-field, discrete-object, and object-field representations. It emphasizes the importance of the representations and the associated visualizations in terms of what we can do by way of analysis and the methods by which we can undertake the analysis. We then discuss the relationship between cartography and GIS. The aim of this section is to emphasize the importance of communicating the classification scheme and the number of classes (and any other individual and disciplinary axioms) used for the visualization of the data in order to support collaborative decision making. The final sections of this chapter introduce the relationship between HCI and geovisualization and outline future trends by acknowledging the needs to integrate data and knowledge and to combine visual or exploratory techniques with formal statistical modelling in terms of supporting collaborative decision-making. As the use of usability evaluation methods (UEMs) and other HCI techniques become more prevalent in geovisualization, these future trends can be realised.

**CARTOGRAPHY AND GEOVISUALIZATION**

Cartography has had a profound impact on digital map-based visual representations. It emphasizes the connection between map use and map users with symbolization. Therefore designing an appropriate and effective visual language is of critical importance when information is communicated using both spatial and aspatial visual metaphors. This importance is also emphasized when cartographic visualization is used to summarize complex spatial data. However, this technique can be subjective, as it is dependent not only on personal interpretations, but also on the cartographic techniques involved. This is especially true when minor variations in density are represented. Failing to visualize the distribution of features such as customers or stores results in a poor understanding of the phenomenon under question. The nature of the feature being visualized should drive the visualization techniques, often it is beneficial to provide the user with more than one representation of the same data, this could allow dynamic comparison. For example, Figure 1 uses a choropleth and cartogram to visualize the distribution of census data. In this case, the choropleth map may produce a more meaningful representation than the cartogram for the user. This is due to several reasons, including the fact that choropleth has been a dominant, though flawed, form of mapping in the last decade and because the lack of spatial location preservation in the cartogram, making it difficult to relate geographic areas. However, some users may prefer the cartograms as it provides an easier visual impact and more visualization space is used for larger volumes of data such as population totals per ward. In other words, the data drives the visualization and not the geography, which can be distorted. This can be important as people tend to estimate values better when sizes are compared rather than colour hues or values, as suggested by Cleveland and McGill (1984). We could also visualize census data using continuous surfaces rather than discrete choropleth or cartogram representations. MacEachren and DiBiase (1991) proposed a series of graphic models that exhibit a range of different types of spatial continuity.
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