Chapter 106
Distributed Geospatial Data Management for Entomological and Epidemiological Studies

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ABSTRACT

Geographical Information Systems (GIS) are now considered a valuable and essential tool to epidemiology. Epidemiological phenomena are strongly associated with spatial and temporal factors, and, as such, the use of GIS for epidemiological data recording and management may help health professionals to better understand spatio-temporal disease patterns.

Bluetongue (BT) is an infectious disease of domestic and wild ruminants that has recently expanded to northern areas where it was never recorded. As a consequence, several entomological surveillance programs were implemented in European countries. Since these surveillance programs are natively distributed along countries, the supporting software platforms should handle the distributed nature of the program and its related data.

The authors have studied the feasibility of a distributed web based application able to support the spatial nature of the entomological data. In fact, they designed a completely new thematic Spatial Data Infrastructure (SDI) where all components, data, metadata, services, policies, etc., and actors from the different institutions are considered. Their aim is not only to support the BT surveillance program but also to contribute to a more detailed knowledge about the epidemiology of the disease.

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Since the authors were able to design all the supporting software, all syntactical interoperability was guaranteed by the use of Open Geospatial Consortium (OGC) standards. The semantic interoperability was assured by design, by developing a unique data model. Data invariants are guaranteed either by the interface, with validation routines written in Javascript, or by the data constrains included in the database. Integration and interoperability with other BT programs might require some additional effort, but all the necessary semantic translation could be encapsulated into the WFS component.

INTRODUCTION

GIS is now considered a valuable and essential tool to epidemiological studies. Spatial analysis through visualization, exploration and modelling allows for a deeper comprehension of the spatial and temporal dynamics of diseases and may be used to suggest and support epidemiological hypotheses. Epidemiological investigations gain strength from being able to incorporate information about the proximity relationships between animals at risk, and also about the context relating to spatial distribution of risk factors (Pfeiffer & Hugh-Jones, 2002).

The Internet is nowadays the preferred means for the electronic communication and sharing of data and it is still evolving rapidly. Its advent has enabled the exchange of knowledge, experience and information to an increasingly broader range of geographically distributed users, and thus, it is contributing to a real democratization of the information. This development has also pushed for the development of powerful proprietary and Open Source (OS) technologies capable of supplying the necessary support to the deployment of GIS web-based applications. WebGIS has the potential to provide a standard platform for the management and visualization of spatial epidemiological data to health professionals with no prior expertise in spatial analysis (Maclachlan, et al., 2007). Furthermore, distributing and sharing disease maps via the Web could help decision makers and authorities collaborate in preventing, controlling and responding to specific disease outbreak (Gao, et al., 2008).

Bluetongue (BT) is an infectious, non-contagious, arthropod-borne viral disease of domestic and wild ruminants that is transmitted by several Culicoides vector species. Portugal has implemented a BT Entomological Surveillance Program in May 2005 as a result of a partnership established between the National Veterinary Authorities (DGV) and the Faculty of Veterinary Medicine of Lisbon (FMV).

Having a distributed information system for the recording, management and sharing of spatial and alphanumerical data related with entomological activity and bluetongue epidemiology is a desirable and valuable contribution in supporting decision-making and sanitary strategy planning. Such a system allows for the near real-time data sharing under the form of maps, charts and tables and thus, generating new opportunities for BT surveillance and prevention. More detailed goals will be listed ahead.

The main objective of this chapter is therefore to highlight, through a small description of spatial epidemiology and BT disease, how web-based GIS management and analytical capabilities may be useful to health professionals in their daily lives. To accomplish this, a complete system architecture and Open Source (OS) software will be discussed in detail.

BACKGROUND

GIS and Epidemiology

The literal translation of the greek word Epidemiology is “the study of what is upon the people.”