Geoinformatics in Eco-Climatic Studies

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INTRODUCTION

This section of the Encyclopedia of Information Science and Technology offers an in-depth description of theories, issues, innovations, opportunities and challenges of applying Geoinformatics in the environmental studies. In general, the discipline cover a wider fields of urban spatial dynamics, environmental sciences and engineering, photogrammetry and remote sensing, hydrography and marine engineering, Geoinformatics and geospatial information systems techniques, satellite geodesy, mapping and natural resource exploration and exploitation consultancies, businesses and entrepreneurship. The field of Geoinformatics depends largely on technological development in the disciplines such as Computers and Information and Communication Technology (ICT), Global Navigation Satellite System (GNSS) and Satellite data acquisition and processes, cartography and Digital Mapping Equipment (DME), among others. Therefore, the recent development in the field of Geoinformatics have attract several interdisciplinary research in order to fit into the global evolutions, to ensure a sustainable national development and Inter-disciplinary relevance in solving social, environmental and economic problems across the globe. In this article however, such issues considered include: the concept of Goeinformatics, opportunities and challenges of applying Geoinformatics (e.g. remote sensing and GIS) specifically in landuse and landcover (LULC) change information planning and climate change information communication. The section also provides a comprehensive definition and some recent application of Geoinformatics in environmental studies.

BACKGROUND

Geoinformatics is a modern technology that provides accurate means of measuring the extent and pattern of changes, and other related information about environment (Boakye et al., 2008). The term "Geoinformation" consists of two main words: "Geo" which means earth's surface or the environment; and "informatics" stands for fact about something. Thus, Geoinformation is the science and technology of communicating the evidences about the state of the earth's surface. It is known for technological robustness to assess spatial and temporal change occurring on the earth's surface (Yang & Liu, 2005; Ehlers, 2008). In the recent years, Geoinformatics has been used to provide electronic representation about earth's surface and man's interaction with the earth. Geoinformatics has emerged in the last two decades as an exciting multi-disciplinary endeavour, spanning such areas as Geography, Cartography, Remote Sensing, Image Processing, Environmental Sciences and Computer Aspects of environmental studies.

In general, the science and technology of Geoinformatics encompasses application of remote sensing and GIS data and methodology. GIS is an acronym that stands for *Geographic Information Systems* while the remote sensing data are those data collected through various devices without human (researcher) contact with field. GIS, in actual sense, is not a new development, it is only recently that it has gained widespread acceptance as a tool to assess both spatial and non-spatial issues. GIS was initially referred to as the management of information with a geographic component primarily stored in vector form with associated attributes. This definition quickly became too limiting with advances

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in software and recent digital ideas about earth. GIS involves spatiotemporal data analysis using software, hardware, people and approaches to acquire, store, update and manipulate for presenting information about the human environment. GIS could be seen as a digital computing environment and human interactions with the environment. For environmental change analysis, GIS uses both remote sensing and non-remote sensing data. Non-remote sensing data may include field observation, topographic, geological and edaphic data. It may also include terrain data, as well as socio-economic survey data, and reports relating to human environmental relation. Though non-remote sensing data are those data acquired by other means than remote sensing approach, they are sometimes used in Geoinformatics analysis, for identification and interpretation of environmental features and their significant change over time (Campbell 2002). In general, it has been shown in several other recent studies that Geoinformatics is not only good for preparing precise environmental change assessment, but also for observing changes at regular intervals of time, it is cost and time effective (Kreuter et al., 2011; Ahmad, 2012; Aguirre-Gutiérrez et al., 2012; Avitabile et al., 2012).

The concept of Geoinformatics (or Geomatics), as a science involved with the mathematics of the earth, is quite diverse. It can be described also as the science and technology of the collection, analysis, and interpretation of data, especially instrumental data, relating to the earth's surface (Ehlers, 2008). In the light of this, its applications extend beyond remote sensing and GIS. In remote sensing techniques alone, developments are evolving in the aspects of sensors used in capturing data. A Geoinformatician (or Geomatics Engineer) typically uses knowledge coming from several disciplines, such as:

1. Positioning and Navigational systems (such as GPS)
2. Geodesy (terrestrial, celestial, and orbital coordinate systems measurements)
3. Geographical Information Systems(computer systems capable of assembling, storing, manipulating, and displaying geographically referenced information)
4. Digital Imaging (how to extract useful information from images according to the application, e.g. environmental studies or agricultural studies) and Mapping (how to make the maps of tomorrow) using Photogrammetry (airborne photographs) or Remote Sensing (images taken by satellite sensors)
5. Land Tenure Systems (land information managing, land surveying, land right)
6. Desktop Cartography and Geospatial Data Visualisation; Web Cartography
7. User-friendly scripting or programming skills

Modelling spatial geometry, making observations (either remotely or directly) and estimating spatial positions and their uncertainty is a key component of the functionality in Geomatics. Because the technique is constantly evolving, there is always a general requirement to keep up with the rapid growth of the know-how, methods and tools of this interdisciplinary field.

APPLICATION OF GEOINFORMATICS

Geoinformatics has been applied in many fields of study; such include landuse planning and management both in global and local scales, business location planning, architecture and archeological reconstruction, agriculture, telecommunications, public health, populations study, urban and regional planning, climate change studies and other meteorology assessments, among others. Geoinformatics applications have increased over the past decades, as the wider availability of digital data has encouraged more sectors to invest in geoinformatics technology. Geoinformatics has become essential technology to decision-makers in many fields, not only for researching and academia but it has also been used by local and national government, industries and commercial sector, NGOs and environmental agencies. Geoinformatics has been used in Coastal management. It has been used as integrated with a coastal wave model because it allows easy visualisation of coastline change and other coastal issues. It is also used to simplify coastal environmental modelling procedures for better monitoring of coastal environment. Above all, utility of geoinformatics science and technology is important in this century because the relationship between bio-physical, socio-economic drivers and other components of the land use/land cover play an important role on local and regional environmental conditions of a particular territory. They are also linked to global environmental change.