Getting Insight into Soils and Land with M.A.S.I.S. : a Proposed Methodology in a Remote Sensing - GIS Environment: a Case Study of the Manga Area, Burkina Faso

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Abstract

The present work is an example of how to take much profit out of a very powerful GIS, using data from different sources without any previous knowledge about the particular way of working with any software package. It may serve as a method supporting the work of scientists and engineers active in studying the environment.

Résumé

Le présent travail est un exemple qui montre comment tirer profit d'un puissant SIG en employant différentes sources de données sans aucune connaissance préalable de l'utilisation d'un logiciel de ce type. Il peut servir de méthode pour aider le travail des scientifiques et ingénieurs qui étudient l'environnement.

Introduction

Every soil-scientist appreciates the role of airphoto-interpretation for soil mapping and land evaluation. Nevertheless, especially when large new areas need to be surveyed and little information is available, satellite imagery can play an important role when planning the

field work (BUITEN and CLEVERS, 1993) in order to save time and money, but also for improving the accuracy of the final results. The use of Geographical Information Systems (GIS) for the storage, management, analysis and presentation of geographic and thematic data is a powerful tool in the process of "getting insight into soils" and their position in the landscape. A soil scientist should know about the possibilities of GIS, and take the maximum profit out of them, but cannot be expected to spent much time in learning a very complex commercial software package.

Objectives

The present work is the result of a research with two main objectives:

- The development of an easy way to handle much information taking profit out of a very powerful GIS using data from different sources without any previous knowledge about it. It may serve as a method supporting the work of scientists and engineers active in studying the environment;
- Evaluate the possibilities of GIS for erosion modelling and assessment. Surface analysis and hydrologic modelling using a DEM (Digital Elevation Model) are studied in order to be combined with remote sending data.

Methods

Airphoto-interpretation was made according to the traditional practices (MULDERS, 1987); thematic field work was stored in a database installed on a portable computer, and later on included in the GIS geographic database; remotely sensed data was processed and classified with ERDAS (ERDAS, 1991). In ARC/INFO v.6.1.1, a Digital Elevation Model (DEM) was created and analysed, not only for surface but also for hydrologic modelling (MARTINEZ, 1994). The coverages were digitized in ARC/INFO, as well as the program M.A.S.I.S. (Manga Area Soil Information System) was written. It was also the environment where all the data were combined and read.

Information generated by airphoto-interpretation, fieldwork, processing of satellite imagery and derived from a DEM are combined in a GIS environment. The result is a program that enables, with the use of only one key on a computer mouse, the display of remotely sensed data, the overlay of digitized coverages (maps, drainage network, roads and villages,...) both on the processed satellite data and on the DEM and most important, the making of queries by attribute or by location, and generating statistics about the extracted information.

Main results

- Remote Sensing used in combination with Geographic Information Systems is a useful data collection system to provide accurate information on the variables controlling the land degradation processes. Erosion assessment can be improved using a Digital Elevation Model.

- Information generated with remote sensing, GIS and other well proved techniques can be combined and made easily accessible. M.A.S.I.S. is an easy program written with the Arc Macro Language of ARC/INFO. It is a simple but effective soil information system with the following main options:

- About the study area : Topographic information on Burkina Faso, Zoundweogo (province) and Manga (study area).
- Display of ERDAS formatted imagery (ERDAS .LAN, .GIS) on screen;
- Display ARC/INFO coverages on screen;
- Query the information system by attribute : The program allows to use a backenvironment to guide the queries. With specific overlays on physiography and vegetation, the terrain data base with field characteristics can be consulted, formulated by logical expressions.
- Query the information system by location : Select backenvironment and overlay and make queries by location (points or area).
- Information about M.A.S.I.S.;
- End the session;
- Fly over the study area : Specific views derived from the DEM can be selected for inspection.
- Study some topographic profiles : Selected cross sections derived from DEM processing.

Some examples are given below to illustrate the program.

A DEM was developed from existing cartographic data. It was converted into a raster in order to calculate slopes and aspects (slope and water flow direction); then the water flow accumulation and as a result the drainage pattern.

Fig. 1 shows the drainage pattern derived from aerial photo-interpretation as well as estimated from the Digital Elevation Model by ARC/INFO software. The latter has high potential for analyzing the preferent directions in the system to get knowledge about the relationship of drainage pattern with geology.

ARC/INFO has a lot of possibilities for producing informative maps, such as a flow accumulation map (characterizing runoff) and sunshaded relief (Fig. 2). This view of the area is manipulated to exaggerate the height differences and serves geomorphic interpretation.

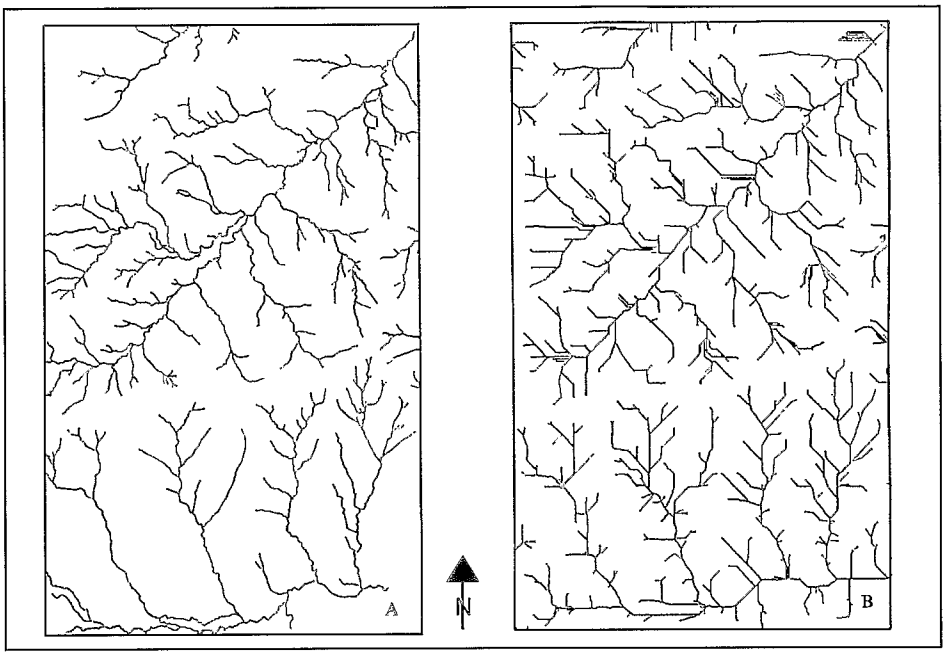

Figure 1. Drainage network of the Manga area (Kaibo) derived from aerial photo-interpretation (A) and from the DEM in ARC/INFO (B). *Le réseau de drainage dérivé du MNT comparé avec la photo-interprétation aérienne.*

Figure 2. The Manga (Kaibo) area seen from the south-west, visualized by draping a sun-shaded relief grid and drainage network from aerial photo-interpretation. *La région d'étude vue du sud-ouest, par la superposition du relief ombré et du réseau de drainage.*

Conclusions

Different coverages are made easy accessible in the program. Queries may be done to study land cover and soils, e.g. the % of coverage of trees, shrubs, herbs and soil characteristics are given by location since these data are made accessible.

The program proved to be very useful in the preparation of preliminary land cover and physiographic maps, the testing of validity of the available data on soils and land cover and in the preparation of a second phase of field work in planning sites for field observations.

References

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