A GIS does not store maps. Discuss.

ARC2GIS

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Computer-based Geographic Information Systems (GIS) originated in the 1960s (Coppock & Rhind 1991, p. 23; The GiS TiMELiNE 2000a; The GiS TiMELiNE 2000b), and have enjoyed a rapid increase in use since the 1990s (Coppock & Rhind 1991, p. 21). They are, as Curry (1998, p. xi) contends, very difficult to discuss "in ways that are not strictly technical". As such, GIS can be described as an "integrated collection of computer software and data" (*ESRI GIS Dictionary* n.d.) used to view, manage, analyse and model spatial data and processes through the use of database links, which access a variety of source records, encompassing both text and image data. Both types of data are used by the program to produce maps. Yet, as ArcGIS can demonstrate, they do not store the maps themselves, but save files related to the manipulation of the data. GIS is not a tool for storing maps, but a tool used in many different fields of interest to deal with geographic data and spatial analysis.

Although many computer programs can perform similar computational functions, GIS are set apart from spreadsheets and drafting programs due to their focus on geographic or spatial data (Scholten & DeLepper 1995, p. 54). A GIS "is an organized collection of computer hardware, software, geographic data, and personnel designed to efficiently capture, store, update, manipulate, analyse and display all forms of geographically referenced information" (*GIS Best Practices: Forest Carbon Management* 2009). While a spatial database can store anything with a geometry measurement, it normally stores georeferenced or geospatial objects. These objects have attributes answering the 'who, what, where, when, why and how' of the collected information: who generated the source material, what is its thematic data, where it is in space, when the data was generated, why patterns may appear, and how the scale of the data is related (Morris 2008, p. 82). GIS are therefore computer-based systems intended to hold spatial data as objects with attributes related to the earth's surface or the collection of the information itself (Figure 1). While a

digitised map might be used as part of the dataset, the map itself is not saved in the GIS

database, but referenced through a link. All of this data is connected, with 'location' being

the common field for all tables, allowing the information to be organised and manipulated

for further analysis (*ESRI GIS Dictionary* n.d.; *GIS Best Practices: Forest Carbon*

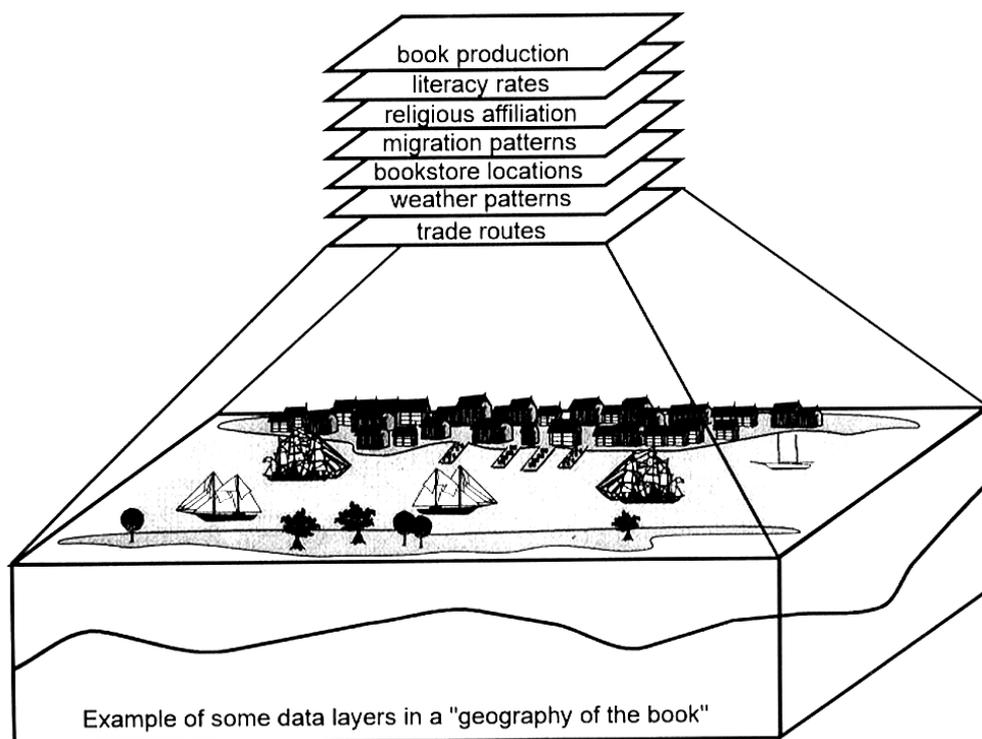*Management* 2009, p. 1; Scholten & DeLepper 1995, p. 54).

Figure 1: Attribute objects stored as data layers which relate to a specific geographic region (Black, MacDonald & Black 1998, p. 18).

This includes the ability to visually manipulate and process spatial data. Whilst GIS can

display visible data in the form of images, the GIS' database creates links to such

graphical files. The true function of a GIS is therefore related to databases, not maps

(Scholten & DeLepper 1995, p. 54). A GIS database is a collection of spatial data

organised into tables linked together by their location (Scholten & DeLepper 1995, p. 54).

A GIS can then manipulate and display table attributes – for example, data on specific co-

ordinates, elevation levels, spatial points, place names, and other information about the locale and its spatial features. The GIS can also import computer-based images of the location. The database attributes can be used in combination with such images to generate a digital representation of the surface of the earth – a map. As the attribute data is created separately from any associated digital images, the role of the GIS is to "provide the link between the location and attribute data" (Sahu 2008, p. 205) which can be used to generate a map. A GIS thus links related data from its database with digital images which are then used to create maps.

A GIS has the ability to produce maps, based on the information within its database. Software such as ArcGIS allows for manipulation, organisation, creation, and publication of maps, and has the ability to represent common map elements such as a "data frame containing map layers for a given extent plus a scale bar, north arrow, title, descriptive text, a symbol legend, and so on" (*ArcGIS 10.1 Help: What is ArcMap*, 2012). The process of working with a map in a GIS is actually a series of data manipulations within the database. ArcGIS incorporates data from multiple sources, including geographically referenced records such as database management systems, spreadsheets, aerial and satellite images, and CAD data, into a single geographic view (*What is ArcGIS?* n.d.; Figure 2). It is this data, then, that defines the map generated by GIS software. After the data has been organised by the GIS, the map generated on the screen can be exported as a computer-based image or printed (*ArcGIS 10.1 Help: A Quick Tour of ArcMap*, 2012). ArcGIS creates a file which holds much more information than a standard map can.
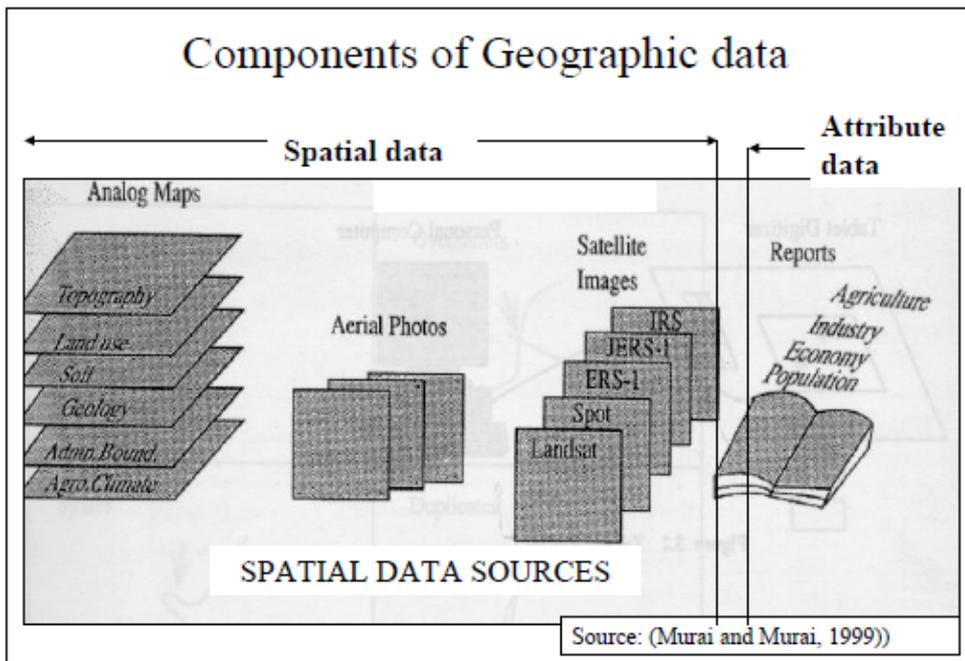
Figure 2: Geographic data to which GIS can link. These include spatial and attribute data of both a graphical and text nature (*Geographical Information Systems: Concepts* n.d.).

The files created by ArcGIS's mapping program, ArcMap, are called 'map documents' which "contain display properties of the geographic information ... such as the properties and definitions of your map layers, data frames, and the map layout for printing—plus any optional customizations and macros" (*ArcGIS 10.1 Help: A Quick Tour of ArcMap*, 2012). This 'map document' file (Figure 3) is not a map per se, but a file referencing the database originally used to create a graphical representation of a location. Basic information about a map can be included, such as the map's title, description and author, as well as links to files and datasets in use when the file was saved (*ArcGIS 10.1 Help: MapDocument (arcpy.mapping)*, 2012; *ArcMap 10.1*, 2012). The difference between a 'map document' and a map is clear – the latter is static whilst the former allows for continual data manipulation.
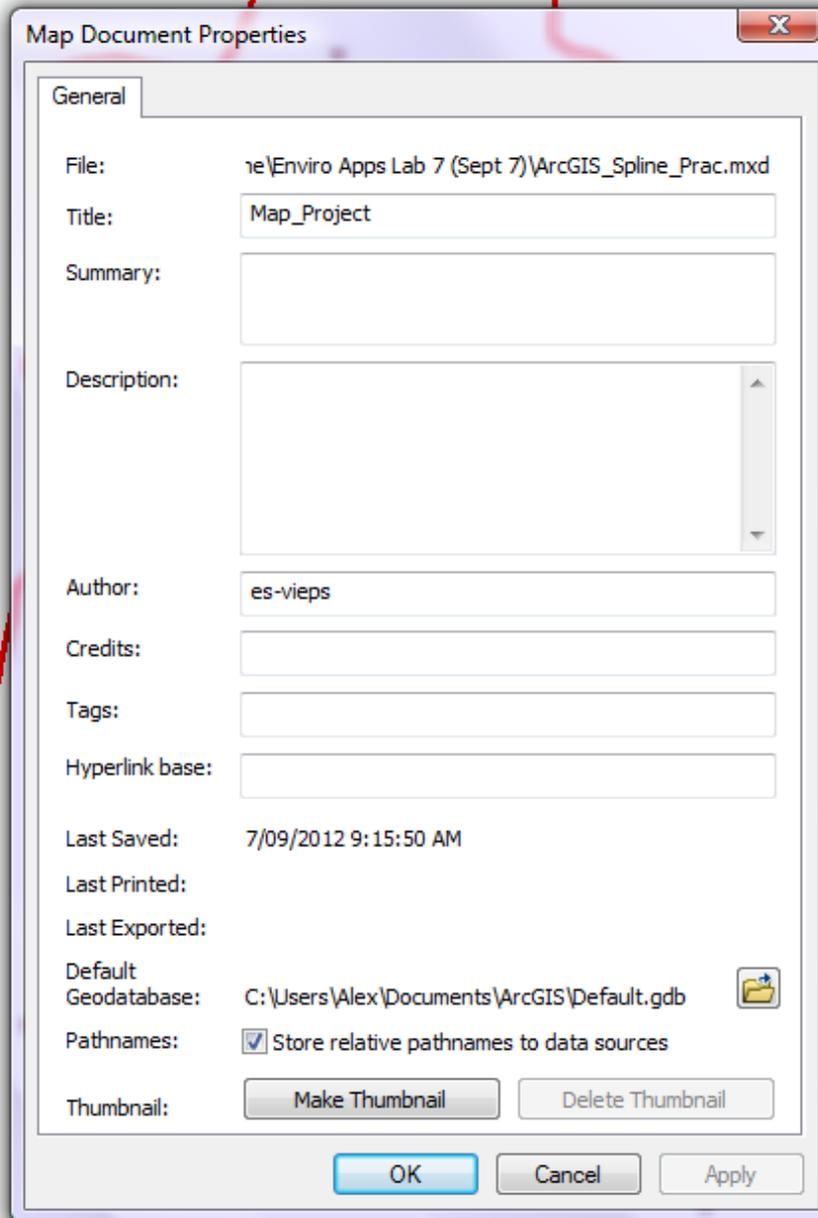
Figure 3: The properties of an ArcMap 'map document' (*ArcMap 10.1* 2012).

GIS offer a wide range of tools for a variety of functions, and map production is but one.

Since GIS can let the user visualise, synthesise, analyse and understand a location (Black,

MacDonald & Black 1998, p. 6), they offer the "ability to associate information with a

feature on a map and create new relationships that can determine the suitability of various

sites for protection, sustainable management, reclamation, and so forth" (*GIS Best*

Practices: Forest Carbon Management 2009, p. 1). GIS is a much more powerful tool than a map alone and has been used for a wide variety of functions: to identify regional concurrences of animal habitats and roads; to study landscape changes over time; to predict animal distribution within an area; and to assist with land management (*Geographical Information Systems: Concepts* n.d.; Veitch 1993, p. 78; Figure 4). They have been used in "archaeology, anthropology, religious studies, urban studies, as well as the more apparent fields of ecology, forestry and oceanography" (Black, MacDonald & Black 1998, p. 5). A GIS is a set of tools which is used for many different reasons, dependent on the user's requirements.
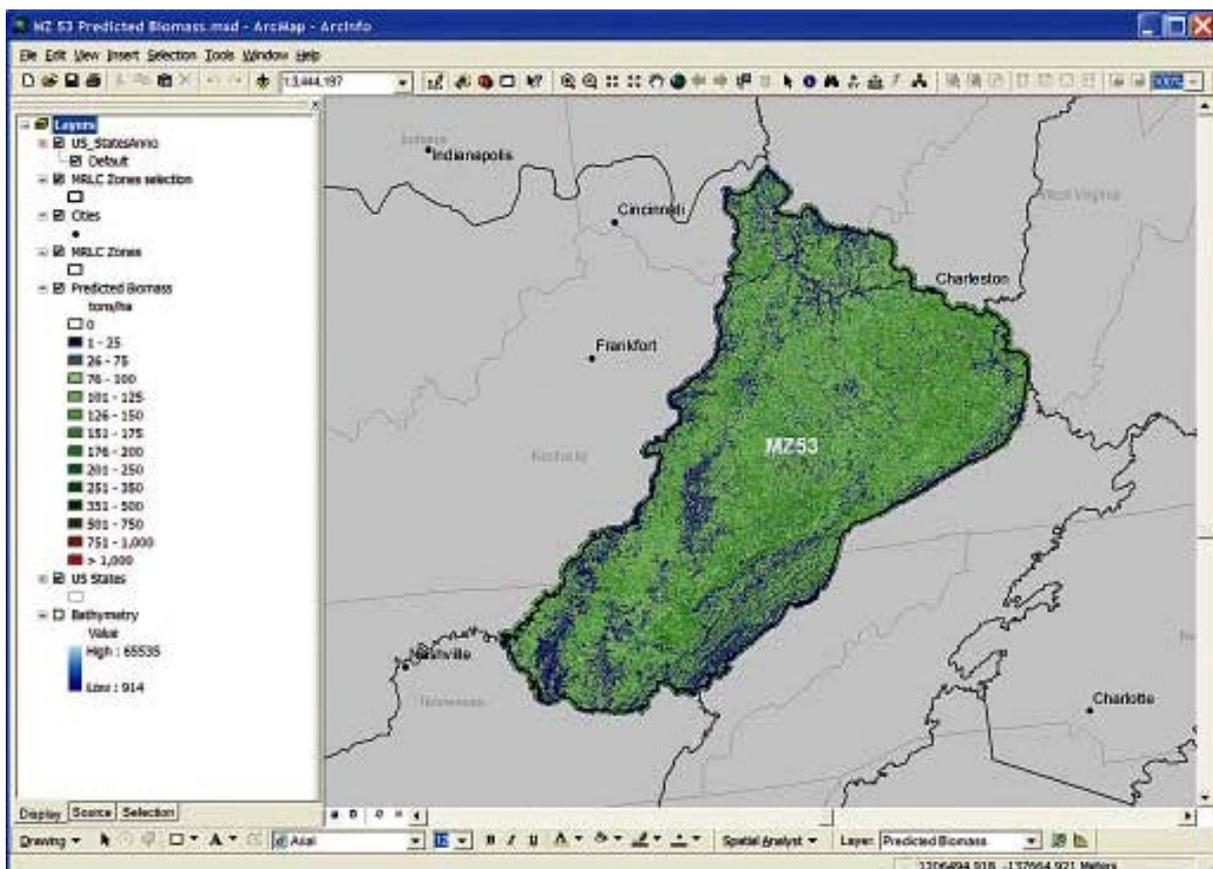

Figure 4: Modelling and prediction activities being carried out with ArcMap GIS software; data layers can be seen in the left hand menu (*GIS Best Practices: Forest Carbon Management* 2009, p. 5).

GIS, originating in the 1960s, was conceived as a computerised tool to assist with the checking, editing, modelling, and classification of geographic data. Although computers and the needs of the users have changed over time, the basis of GIS remains as a computerised tool which utilises databases to perform these, and other, functions. Databases link to a variety of information sources, including digitised maps or aerial photographs of locations, and one of the roles of the GIS is to use these data links to generate a map. Maps created by a GIS have all the features found on a normal map, yet the GIS only stores the information required to regenerate the map, rather than the map itself. These files, called 'map documents' in ArcGIS, allow for continued data manipulation even after a map has been exported. The features of GIS are thus not related to map storage, and far exceed even the task of map creation. A GIS is a tool that both links with, and manipulates, a wide variety of data, from text in the database through to digital images, so as to best represent a spatial location for the particular study being performed at the time.

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