Section 3

Atlases / Atlas

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Towards High Standard Interactive Atlases
The ”GIS and Multimedia Cartography” Approach

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Abstract
High standard interactive atlases are mainly basing on two approaches: ”GIS in Multimedia” or ”Multimedia in GIS”. Reviewing their power and limitations, a new approach ”GIS and Multimedia Cartography” is suggested, combining the advantages of GIS and multimedia with specific cartographic aspects. Particularly, this new approach requires appropriate tools for the import of geographic data and the creation and presentation of versatile interactive maps. To further establish truly interactive maps, we propose a multimedia map file format standard and present a set of useful extensions for graphics and authoring software to make interactive mapping more efficient. Examples will be shown from the current development of the Atlas of Switzerland.

1 Introduction
Multimedia atlases are evolving from basic view-only atlases with limited flexibility to interactive spatial information systems. This transition affects not only how spatial information is displayed but changes fundamentally the way how multimedia atlases handle spatial information. As the content of a multimedia atlas grows, it is getting more and more interesting to use GIS as additional data input if an appropriate interface can be provided. Powerful interactive atlases should be able to analyze, process, and model multi-dimensional (2D/3D) and spatio-temporal data. Furthermore, the visualization of these processes must run in an intelligent way and consider sound cartographic principles.

To meet these requirements, different approaches basing on GIS and multimedia technology have to be discussed. Important questions to be answered are the following:

- Does the approach support an effective data workflow to integrate GIS data sets into a multimedia environment?
- Does the workflow permit the transformation of GIS data to cartographic data while preserving GIS functionality?
- By which way can we guarantee or even improve cartographic quality?
- Which cartographic modifications for dynamic map display are reasonable?
- Does the approach improve map and atlas production efficiency?
2 Two General Approaches for Interactive Atlases

For the development of interactive atlases there are two main approaches which base on different techniques: GIS and Multimedia. The first approach relies on existing GIS extended with multimedia functionality. Such systems are also referred to as Multimedia in GIS. Contrarily, the second approach tries to integrate GIS functionality in authoring systems, also referred to as GIS in Multimedia (Craglia and Raper 1995).

2.1 The "Multimedia in GIS" Approach

The first approach seems to be the favored solution by GIS developers to produce powerful interactive maps and atlases. Using the Multimedia in GIS approach will be the fastest way of bringing full GIS functionality to multimedia, since it can benefit from the built-in GIS (Moreno-Sanchez et al. 1997). Functions for data acquisition, preprocessing, data management, manipulation and analysis as well as product generation are already predefined. In addition, the integration of "Multimedia technologies will enable GIS to afford the time dimension and more realistic representations of spatial objects and phenomena" (Fonseca et al. 1992, p. 1100). Even for computer networks (Local Area Networks or Internet), an overwhelming amount of so-called Multimedia-GIS, although with almost poor GIS functionality, is presented (Bill 1998). Without disregarding these facts, there are also several disadvantages. Originally designed as GIS, such systems often have limited multimedia functionality, do not allow a system-independent overall atlas graphics design, and lack of the integration of powerful tools with an intuitive and user-friendly interface. The current degree of data integration is not sufficient, because it does not enable the storage of many data types on a single theme (Fisher 1998). In addition, Multimedia GIS may not be extended, are not efficient enough, and – as a strong argument to our opinion – may produce maps of inferior cartographic quality.

2.2 The "GIS in Multimedia" Approach

Atlases using the GIS in Multimedia approach are taking a somewhat different point of view. Their conceptual framework is primarily not data-oriented or expert-driven, but basically focuses on communication, human-computer interaction, and (media) integration. By means of established proprietary multimedia authoring tools support is strongly given to different data types (sound, video, text, images, maps), graphic user interface, and spatio-temporal visualization techniques like succession or animation. To integrate any even low level analytical functionality, data structures and GIS techniques have to be explicitly defined and implemented by the authors (Schneider 1999, Blat et al. 1995). In fact, most of the present products destined for public use (atlases, environmental monitoring, urban and regional planning, etc.) are basing on platform-independent runtime versions of multimedia packages.

Besides the advantages of easy multimedia data integration from different sources, predefined interactivity and user-centered presentation, current applications of the interactive and expert atlas type (Ormeling 1995) are faced with several restrictions. Most of multimedia atlases still lack of adequate versatile visualization and of GIS functionality that goes beyond simple measuring techniques. Neither graphics nor authoring software provides much support for cartographic purposes. To get use of the whole information provided by GIS systems and to overcome the „dead end“ situation of atlases, data structures for efficient GIS data integration, tools for exploration and data re-use are needed. As Romao et al. (1996, p. 145) stated, further developments should therefore be concerned with “… adding new data types and analytical functions”. Disadvantages in cartographic visualization concern basically the significance of maps within an atlas. Visualization techniques often do not consider high quality aspects of maps for screen display (Mersey 1996), and rarely use a flexible, dynamic cartographic concept as it is the case with intelligent maps (Sieber and Bär 1997).

Reviewing the facts of these two main approaches, a new approach is suggested, combining the advantages of GIS and multimedia with cartography.
3 A New Direction for Interactive Atlases: The ”GIS and Multimedia Cartography” Approach

Although both, the GIS in Multimedia and Multimedia in GIS approaches implicitly deal with cartography, none of these approaches specifically respect cartographic aspects. We favour a variant of the GIS in Multimedia approach which we will call GIS and Multimedia Cartography. It is intended to overcome the cartographic limitations of the GIS-based approach while it preserves most of its analytical functionality. This concept implies that an additional interactive step is required in the process of preparing spatial data from GIS or other sources for use in a multimedia atlas system. Ideally, this step will occur in a graphics environment and provide means for cartographic generalization, symbolization, geo-referencing, and map object identification. Instead of the original raw GIS data, cartographically edited map graphics will then act as a data base in the multimedia atlas system. In the following, we will propose the outline of a multimedia atlas development environment and discuss its required components.

3.1 Outline of the Multimedia Atlas Development Environment

As with the GIS in Multimedia approach, GIS, the authoring system and its attached multimedia map extension build the central parts of the multimedia atlas development environment. In addition, a graphics application takes care that the GIS data does not enter directly the multimedia system but undergoes a cartographic sublimation process (figure 1). This application provides import filters in order to access GIS data and to convert its geometric objects into a graphic representation. Map graphics output is directed to the authoring system using a special multimedia map file format.

![Figure 1. Development environment used for the GIS and Multimedia Cartography approach.](image)

The role of the graphics application in cooperation with its multimedia map extension is to transform GIS objects into cartographic objects while preserving GIS attributes. This is essential because geometric GIS objects differ from cartographic objects. In GIS, geometric objects are in most cases approximated by straight lines whereas in cartography, curves such as Bézier curves or splines are to be preferred. Curves do not only keep the number of points required low but also allow a larger range of graphically acceptable zooming. Transforming GIS data to graphics data, there is a more comfortable way for map generalization. By means of geo-referencing the map graphics, real world coordinates may be derived at any time. Despite this transformation, a subset of GIS functions can still be applied to the cartographic data base.

Unfortunately, none of the publicly known GIS or graphics data formats was found to meet all requirements of a multimedia atlas. Therefore, as a new data format the multimedia map file format has been worked out that will be able to transfer the data from the graphics to the multimedia environment. In addition to common graphics formats, the multimedia map file format specifically must support the export of cartographic relevant
features such as original scale, accepted range of scales, and geo-references. Each cartographic object shall also be able to hold attributes such as identification number and names. Considering the map graphics, the export of curves, stroke and fill formats, but also of point symbol objects, which will act as placeholder for map symbols or diagrams, is indispensable. Finally, the format should allow fast data input and map display, must be compact and platform-independent.

A counterpart of the multimedia map extension is also found in the multimedia environment. It is mainly responsible for the final map data assembling, visualization, analysis and interactivity. Figure 2 shows the principal functional parts of this extension.

![Figure 2. Modules and tools of the multimedia map extension component.](image)

The communication between the multimedia authoring system and the multimedia map extension is entirely performed by the authoring system’s built-in scripting language. On an upper level the multimedia map extension manages the maps built up from an ordered set of map layers. Each layer has its own settings such as the current visibility, the degree of transparency, or the acceptable range of scales. A layer may consist of a simple image as for instance a background relief or a multimedia map layer, containing map graphics who’s attributes such as colors and line styles can dynamically be changed according to a given attributes table. Furthermore, statistic data as well as name data bases may be attached to each multimedia map layer. The statistics module incorporates a spreadsheet calculation program and thus acts as a data provider for the thematic mapping module. A number of different statistic map types may be generated such as choropleth maps or point symbol maps. While the statistic maps come pre-configured by the map authors, a data analysis tool allows a direct graphical manipulation of the histogram in real-time, provides support for classification and colorization, and performs statistical data analysis. The analysis tool will further be presented in the next chapter.

The concept presented above has the advantage that it allows the use of commercially available graphics and authoring software. In cooperation with the multimedia map extensions they build up a complete multimedia atlas development environment that is flexible enough to be adapted to the various needs. It not only allows full graphic and cartographic control but also increases map and atlas production efficiency considerably.
4 The "GIS and Multimedia Cartography" Approach in the Atlas of Switzerland

Since the beginning of prototyping, the Atlas of Switzerland followed a GIS and Multimedia Cartography approach (Bär and Sieber 1997). The modules developed so far are responsible for thematic mapping, 3D visualization, classification, analysis, searches and queries. GIS, graphics programs and authoring system are linked closely together: data that originate from GIS are cartographically modeled and passed on to the multimedia system. Thus, the authoring system retains the final control over all graphic variables. In connection with an object-related database, this leads to a flexible and intelligent cartographic visualization.

To proof the power of the GIS and Multimedia Cartography approach, a number of tools and techniques have been implemented in the Atlas of Switzerland. Focus has been on intelligent visualization techniques and on analysis using GIS functionality and expert tools.

Intelligent visualization is based on dynamic vector graphics and permanent data base access, considering cartographic principles for screen display. An important aspect of intelligent visualization deals with the appropriately generalized display of maps. Graphic elements of intelligent maps as e.g. color or line styles can either be altered directly, or scale-dependent according to a previously defined set of rules as is the case with line width. In analogy to key frame animation techniques, a continuous range of map scales is achieved by a small number of key maps and rules to produce the intermediate maps.

For object-oriented analysis in a GIS and Multimedia Cartography environment, 2D and 3D graphics are interrelated with a structured data base and a set of dedicated GIS functions. Expert tools allow customized data presentation and further exploration of statistical maps and 3D topographic models. These expert tools were developed to be used most easily yet provide a maximum of visual feedback. They can universally be used for both, statistic and topographic data, to change classification and colorization, or modify the illumination of 3D models.

To create customized maps, the expert tool allows to add or remove classes and to change class intervals. It is also possible to choose predefined distributions such as equal-distant classes or classes of equally distributed number of observations, as well as to apply color scales. This enables a user to discover hidden structures in the map and to get deeper and even better insight in the data. Classification is performed graphically by means of a histogram, which shows class intervals and frequency distribution in real time. Figure 3 illustrates map and corresponding expert tool in the process of adding a few new classes and colors in order to emphasize specific thematic structures.

The Atlas of Switzerland is probably the first professional product using the GIS and Multimedia Cartography approach. It demonstrates the intended direction towards a highly interactive, easy to use and cartographically well-designed atlas.
Figure 3. Changing classes and colors by means of the expert classification tool.

5 Trends and Future Developments

Future work on intelligent interactive atlases will mainly focus on their explorative and interpretative character, combining analytic functionality with well structured access and easy information retrieval. Methods to manipulate GIS data in a multimedia environment are of great importance in order to access information using dynamic visualization tools. There are also strong trends towards real-time presentation and integration of online Internet capabilities in the atlas. The integration of the update procedures in an existing atlas shell should provide full interactive functionality of the maps. Together with a shift from 2D to real 3D presentations, digital atlases will increase the user’s motivation and let him immerse deeply into the topics presented. The proposed concept of high standard interactive atlases is well suited to follow these trends and lead to a powe-
ful multimedia spatial information system. The research and development of the project Atlas of Switzerland has shown that the implementation of a fully-featured interactive atlas can be done best by using commercial software in conjunction with specially tailored mapping modules. Further related interactive atlas projects will be able to benefit from these experiences and developments.

References


Integration of analytical GIS-functions in Multimedia Atlas Information Systems

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Abstract
In the implementation of adapted GIS-functions lies a great potential for the future development of multimedia atlases. This paper presents the first results of a study that explores the possibilities of integrating GIS-functionality in multimedia atlas information systems. GIS-functions have to fulfil certain requirements to be successfully applied by atlas users. Primarily, they must be user-friendly and easy to utilize. They should not include data handling or editing, but remain analytical. Examples for suitable analytical GIS-techniques such as database queries, spatial analysis and statistical functions are presented. They will be integrated according to the «GIS in Multimedia» approach: A multimedia authoring system is extended with additional functionality by using external C++ xtras. GIS-functions will be implemented by means of environmental vector data sets. These data must be stored in a topologically adequate way in order to allow analytical techniques to be performed efficiently. In addition, they must offer a high-quality cartographic display. For this purpose, an extended multimedia vector data format is developed, based on existing GIS data structures and cartographic software.

Introduction
Recently, rapid technological development of digital cartography has led to a change of design in atlas cartography. In several countries, traditional paper atlases have been replaced by electronic versions offering a high degree of interactivity. The potential of these electronic atlases lies in the implementation of visualization and navigation techniques, multimedia and adapted GIS-functionality.

Although considerable research was conducted on the development of electronic atlases, the integration of user-friendly analytical GIS-functions has not been sufficiently considered so far. The first digital national atlas, the Electronic Atlas of Canada [Siekierska and Palko, 1986] which was developed as early as the eighties, was already based on a GIS concept. The atlas contained important analytical GIS-techniques such as database queries, overlay functions and statistical calculations but revealed some deficiencies in visualization quality and graphic user interface. These limitations were mainly caused by software available and limited quality of display devices at the time. More recent products, such as the digital atlases of Austria [Ditz, 1997], China [Taylor, 1997], Japan [Kanazawa, 1996], Sweden [Ögren, 1997; Wastenson and Arnberg, 1997] and the USA [Guptill, 1997] strive to overcome these limitations by combining high visualization quality and an interactive user-friendly interface with analytical GIS-functionality. However, there is still a great need to improve the analytical capabilities of multimedia atlases.
The present study investigates the possibilities of integrating GIS-functionality in multimedia atlas information systems (AIS). The final goal is to implement suitable functions in the multimedia version of the *Atlas of Switzerland* [Bär and Sieber, 1997] thus extending its analytical capabilities.

### Relation between GIS and multimedia AIS

Geographic information systems (GIS) and multimedia atlas information systems (AIS), also called electronic or multimedia atlases, are both computer-based information systems that handle geographically referenced data. Whereas GIS enable capture, modelling, manipulation, retrieval, analysis and presentation of geographic data [Worboys, 1995], the emphasis of AIS is especially on the presentation of these data. Likewise, AIS often refer to a certain area or topic in conjunction with a given purpose and have an additional narrative faculty [Ormeling, 1995]. Table 1 shows the main differences between modern existing systems. It should be noted that in reality, the contrasts are never as strict as shown in the table.

**Table 1. Main differences between GIS and multimedia AIS**

<table>
<thead>
<tr>
<th></th>
<th>GIS</th>
<th>multimedia AIS</th>
</tr>
</thead>
<tbody>
<tr>
<td>use of interface</td>
<td>complex</td>
<td>easy</td>
</tr>
<tr>
<td>users</td>
<td>experts</td>
<td>non-experts</td>
</tr>
<tr>
<td>computing time</td>
<td>long</td>
<td>short</td>
</tr>
<tr>
<td>control by</td>
<td>users</td>
<td>authors</td>
</tr>
<tr>
<td>main focus</td>
<td>handling of data</td>
<td>visualization of topics</td>
</tr>
<tr>
<td>data</td>
<td>unprepared</td>
<td>edited</td>
</tr>
<tr>
<td>output medium</td>
<td>paper</td>
<td>screen</td>
</tr>
</tbody>
</table>

### Requirements for GIS-functions in multimedia AIS

One can infer from Table 1 that GIS-functions have to satisfy certain criteria in order to be successfully applied in multimedia atlases. Initially, the interface has to be user-friendly and allow for a maximum of interactivity. All functions should be understood intuitively by expert and non-expert users without extensive explanation. In addition, tasks must be performed within a short time. Actions and settings have to be controlled by the authors to a certain degree to prevent the users from creating useless or even erroneous maps. In contrast to GIS where the emphasis lies on data handling (e.g. data capture and editing, see next chapter), operations in AIS are centered around topics. Accordingly, atlas users can employ previously prepared data and visualize them. Finally, since the output medium is the screen, maps would look good on the screen rather than on paper.

### The «GIS in Multimedia» approach

Basically, there exist two approaches for the integration of GIS-functionality in multimedia atlases. The first entails basing the atlas development on commercial GIS software and extending the existing functionality with multimedia tools. This approach is referred to as «Multimedia in GIS» [Craglia and Raper, 1995; Bill, 1998]. The second approach attempts to integrate GIS functionality in multimedia authoring systems («GIS in Multimedia»). Both the concept of the *Atlas of Switzerland* [Bär and Sieber, 1997; Hurni et al., 1999] and the present study are based on the second approach which, though more costly, is more flexible. The graphic user interface can be designed system-independently, and cartographic as well as GIS-functionality can be adapted individually.
GIS-functions

In this section, GIS-operations are classified, and their suitability for multimedia atlases is evaluated. GIS-functions can be grouped according to different points of view. There is no comprehensive theory relating to and grouping the various techniques [Berry, 1987; Albrecht, 1996]. The following classification, derived from Goodchild [1990], distinguishes between four main GIS-functions:

- Data capture (e.g. digitizing, scanning)
- Data manipulation (e.g. editing, raster-vector conversion, data integration, generalizing)
- Data analysis (see below)
- Data presentation and output (e.g. map making, printing)

The purpose of data capture and manipulation is the preparation of the data for the actual analysis process. It has already been mentioned in the previous chapter that, in contrast to GIS users who can carry out all these four main functions, atlas users should neither be occupied by data entry nor by data manipulation. In fact, they should rather concentrate on data analysis and presentation. However, data presentation is not part of the present study. Therefore, emphasis is put on data analysis functions.

In the following sections, a list of suitable 2D data analysis functions is presented, to be implemented in the multimedia version of the *Atlas of Switzerland*. It has to be noted that 3D functions are not considered here because they are treated by Stähli [1998] and Terribilini [1999] within the range of the Swiss national atlas project.

Database queries

By performing query operations, information is extracted from the database while the geometry of the data remains unchanged. Basically, queries are not proper analytical functions. Nevertheless, they are discussed in this study as their spatial component is GIS-specific and therefore unique for databases.

Thematic and spatial as well as topological queries are considered. Users are able to scan the database for objects that contain particular attributes and visualize them on the screen. They are also able to search for objects lying within or next to other objects. Questions such as ‘which areas does this river cross?’ are answered. Further investigations focus on reclassification of existing attributes based on a set of user-specified rules.

Spatial analysis

Spatial analysis functions are the most familiar and commonly used GIS-operations. New data sets with altered geometry are deduced from the existing ones. First, aggregation functions are considered. Adjacent polygons with identical or similar attributes are merged together while boundaries between them are dissolved. Moreover, buffer functions are implemented. For instance, users are able to determine agricultural soils potentially contaminated by lead around industrial zones or along motorways. Further investigations focus on geometrical overlay. Thus, by combining geology, soil, vegetation, climate and terrain data, the erosion and landslide potential of mountain areas can be determined. Furthermore, maps can be cut out along individually specified lines such as administrative borders.

Measurement and statistical functions

Distances between two points or along a path as well as perimeter and area of polygons can be measured. It is also possible to determine statistical values such as sum, maximum, minimum and standard deviation of map attributes and to chart their distribution. In addition, statistical analysis of temporal data can be performed. For instance, users are able to calculate the loss of agricultural soil due to the expansion of built-up area, and visualize it by means of animation.
Data

Data sets
GIS-functions are implemented by means of environmental vector data sets. In the first stage, the digital soil aptitude map of Switzerland [Frei et al., 1980] is used. This map has a large attribute table, containing information about soil types and properties and is therefore suitable for database queries. In the second stage, when spatial analysis functions are performed, more data layers like geology, vegetation, climate, terrain, landuse and infrastructure (roads, settlements) are required.

Data structure
The successful implementation of GIS-functions in AIS relies largely on a convenient data structure. On the one hand, measurement and advanced analytical techniques should be conducted efficiently. Therefore, the data must be stored in a topologically adequate way including explicit adjacency information. Moreover, attribute information must be linked to the geometric entities. On the other hand, the data structure must enable a high-quality cartographic display of the geographic data. For the second purpose, a versatile multimedia vector file format has been developed for the Atlas of Switzerland [Bär and Sieber, 1999; Hurni, Bär et al., 1999]. It features a dynamic representation of cartographically updated GIS data in a multimedia environment. As attributes can be linked to map elements, this format is suitable for simple database queries. If, however, operations get more complex and require explicit adjacency information, the format does not suffice any longer and has to be extended with additional topological information.

Hence, efforts are made to develop a data structure which enables both graphic and analytical processing (see Figure 1). Topologically correct vector GIS data with additional attribute information will be imported in the cartographic system Freehand where the geometric information is divided into a graphic and a topological part. For this separation, an external C programming extension (xtra 1) is used. The graphic information is cartographically edited whereas the topological and thematic information are kept apart. Possible changes in the topology are recorded by xtra 2. Finally, the separated geometric information of the cartographically updated data is joined and exported to the extended multimedia file format using xtra 3.

Implementation
As previously mentioned, the implementation of GIS-functionality in the present study is based on a multimedia authoring system («GIS in Multimedia»). For the design of the graphic user interface, the multimedia authoring software Macromedia Director is used. All GIS-functions are programmed by the atlas authors themselves. In Macromedia Director programming can be achieved on three levels. On the first level, standard tools can be used to display the graphic components of the atlas. On the second level, to extend these rather limited possibilities and to control the interactive user input by means of buttons and windows, the software provides a built-in scripting language. On the third level, external programming xtras in C and C++, which communicate with the scripting language and are stored as shared libraries, can be written to complete the existing tools. GIS-functions will mainly be implemented by means of C++ xtras. In Figures 2 and 3, geometric overlay and statistical analysis are presented schematically by applying these three programming levels. Figure 2 shows the graphic components of the Atlas of Switzerland with the thematic map layer (first level). The atlas users can select an administrative border line. This action is controlled by the built-in scripting language (second level). Figure 3 presents the results of the analysis that was carried out using external C++ extensions (third level).
Figure 1. Cartographic updating of topologically correct vector GIS data for multimedia AIS
Figure 2. Display of a thematic layer of the Swiss soil aptitude map and selection of an administrative border

Figure 3. Intersection of the thematic map layer with the administrative border and display of statistical results
Conclusions

The extension of multimedia atlases with analytical GIS-functions offers new perspectives to atlas and geographic information science. Spatial database query and spatial analysis, as yet mainly performed by GIS-specialists, are now also available for a broader range of users. People who neither have a GIS technical education nor do dispose of spatial data sets and GIS systems will have the possibility to analyse spatial data, gaining insight into environmental processes and their complex interactions. In the present study, the first steps towards a sophisticated atlas information system have been taken. The suitability of GIS-functions for AIS was evaluated and a convenient data structure was designed. The next important step is to design a suitable graphic user interface for these functions. Analytical multimedia atlases are successful only if they are easy to handle.

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Internet Atlas of Switzerland - New developments and improvements

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Abstract

The Internet is a rapidly growing medium. Since the introduction of the WWW (around 1991 at CERN), with its possibility of presenting combined graphics and text and the ability of linking to other documents, it seems to be the ideal medium for presenting scientific (and other) information. From the very beginning maps played an important role in presenting spatial information. Unfortunately, many of them are of poor graphical quality and lack of consistent, easy to use interfaces. Furthermore many are static and do not provide much more interaction than just simple clickable image maps. We are now at the threshold between the fourth and fifth browser generation. Since the 4th generation many new technologies have been added to the web browsers (HTML 4, CSS, improved scripting, event models, new plugins etc.) that make those browsers ideal platforms for presenting cartographic data in a distributed, platform-independent but still highly interactive manner. This paper reports about the current project of the “Internet Atlas of Switzerland”, the technology we use and our plans for the future.

1. The current state

GUI (Graphical User Interface)

The work on the project started in 1996 by Daniel Richard. [Richard - Oberholzer, 1997] He worked primarily on a consistent GUI which he divided into several segments: Navigation, interactions, map and information. (See Fig. 1) Those 4 main elements should be consistent and available throughout the whole project. The standard navigation toolbars (address bar, menu bar etc) are suppressed for getting more of the valuable screen space. The status bar is used for coordinate output and hints for the user. At startup a small script checks the screensize and opens a new window using the maximum screen area. A reasonable screensize starts at 1024x768. The atlas doesn’t work well below this resolution. To implement the 4 different segments the frame concept is used. Each menu bar, as well as the other screen elements are independent frames, whose contents are changed by using javascript. The menu bar (1) is hierarchically structured (up to 3 levels), small triangle icons indicate the active theme. In the upper right corner of the menu bar there are the entries “Home”, “Index”, “Help”, “Feedback” that should be always available - though the index- and help sections are not implemented now. (see Fig. 1)

The interaction segment (2) holds data in a more detailed form (text, pictures, additional graphics etc) as well as links to other information. In future versions this segment will also include form elements and small java-applets with user interface elements. The size of the main part, the map segment (3), is adapted to the proportions of Switzerland. Last not least the information-segment (4) is used to present additional information,
mainly for the selected features in the map area. If necessary we open a new window, e.g. to present larger pictures. The frames of the menuebar (1) are fixed in height, the Map Frame (3) is fixed in width and height, the other information segments (2, 4) are of variable size to fill up the rest of the screen area. Using this technique we guarantee that the map elements are not distorted or blank areas appear at the map edges.

**Embedded external webpages**

One of the major advantages in using www-technology is the easy integration of external data sources. One can easily integrate up-to-date information like weather, time tables, upcoming cultural events, etc. either in the main “map frame” or as links to a window of its own. This way your data is always up-to-date without taking care about it. What seems to be like a great improvement can also be an inconvenience: as information changes rapidly, links are not permanent. As a result of this fact one is permanently checking whether a link is still alive and presenting the data intended. This link-checking can be at least partially automated by perl scripts. Another concern about embedding or linking external data is that one might run into legal problems if any copyrights are hurt or if the references are incorrect. Those legal problems concerning copyrights on the www are not really solved up to now, and it seems that the lawyers have found another new field of operation ...

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*Figure 1.* Layout of the “Internet Atlas of Switzerland” with its four main segments (Relief © ADS + LT 1999)
2. Technology

Development platform, Webserver and Databases

The development platform has been Windows NT so far, but it will be Linux in the future, for several reasons: Linux is highly reliable, offers a broad spectrum of integrated internet services (www, mail, ftp, etc.), is well documented, cutting edge technology, most of the software is open source and therefore generally of good quality and last not least free or at least very inexpensive. The www services are provided by Apache [Apache Organization, 1999] in conjunction with perlscripts (mainly cgi-scripts) and a sql database (mysql).

Mysql [DataKonsultAB, 1999] is a very fast, sql-compatible database that offers several programming interfaces such as perl, Java and C (the linux version is free). SQL is an international database query language standard that offers good search capabilities and allows easily porting from one to another sql compatible dbms (if one is not satisfied with a product). Many applications either support sql directly or via odbc which means that access and updating of the involved data is easy (f.e. one could use spreadsheets or word processing software in conjunction with the database). The database approach allows a separation from data storage and the application layer. Data can be converted to different file formats by scripts and is not limited for use in conjunction with a specific application. Among the standard datatypes mysql also supports blobs (binary large objects) that might be interesting for storing image or other large data. The current version of the Atlas doesn’t support databases at all, but at the time of the congress, database functionality will hopefully be integrated.

Figure 2. The framework of the Internet Atlas and its main components
(Three layers: Data preparation, Server side software, Client side software)
The browser dilemma, scripting, additional plugins, Client vs. Server

Unfortunately most of the javascript code and also the use of Java Applets is not compatible among the two major browsers, Netscape Navigator and Internet Explorer. As the author doesn’t have time to write code twice all the time the preferred browser will be Netscape Navigator, because it is available on most common operating systems, is open source and supports both javascript and Java quite well. A lot of the javascript functions in Internet Explorer are implemented differently and it might be possible that Microsoft prefers vbscript and ActiveX-elements in the future. This tendencies don’t make it easy to write browser independent scripts. We hope that the 5th browser generation will be more compatible than the 4th and that the W3 Organization will gain more influence on the browser manufacturer resulting in the introduction of well documented open standards rather than of proprietary industry standards. In addition to the reasons mentioned above it seems to us that it should be easier to download a different www browser rather than changing the operating system ... The use of plugins is not very popular, but for some purposes inevitable. We consider using it for the presentation of 3D data (vrml plugins) and possibly for the integration of vector data. Netscape and Microsoft use different strategies for the communication between plugins and javascript. Netscape provides the EAI (External Authoring Interface), Microsoft uses its own technique “ActiveX”.

One solution to provide browser independent interactivity would be to do as much as possible on the server by using cgi scripts which take certain parameters, evaluate them, run certain programs or scripts on the server and send the output back to the client. This way would work with almost any of the current browsers. But this browser independence would result in poor performance, because data has to be transferred via the internet, which is not really the desired effect. This means that we should distinguish for each separate case wether communication between server and client is really desired or necessary.

Currently used Data Formats and Standards

Of course we use the official open Internet Data Formats, whose specifications can be read at http://www.w3.org. [W3 Organization, 1999] For structuring documents we use HTML (Hyper Text Markup Language), for specifying the final layout and format we use CSS (Cascading Style Sheets). The advantage of using style sheets is that structuring and formatting are separated, that means that one can change the appearance of many HTML pages by simply modifying one style sheet file, a technique that is well known from common word processing software.

For raster graphics we choose the common internet graphic formats gif, jpeg and png depending on the required color depth, color variance and compression technique. Files with larger homogenous areas are preferably stored using gif or png. The png format extends the features of the gif format by adding alpha channel support, gamma correction and two way interlacing. Other differences are that png supports higher color depths than gif but is a single image format which means that it can’t be used for animations. This drawback will be compensated by the future “mng” format which uses similar, but slightly differing storing and compression methods. Images with higher color variation and color depth (f.e. photos) which do not necessarily require lossless compression are stored with jpg format.

Future Data formats: Vector files and 3d, SMIL, XML

One of the largest problem of the current browser generation is the lack of supporting any standardized vector file formats. There are existing diverse plugins (Flash, acrobat, ...), but most of them are proprietary. They can though display vector graphics very fast, use state of the art compression technologies and allow basic zooming and panning functions, but are either not open graphic standards or can’t be controlled via scripting. Furthermore they need yet another plugin that must be downloaded and installed. However the solution seems to be in
the near future: SVG (Scalable Vector Graphics). At least the format specification sounds very interesting and makes us confident that there will be a useful format and tool in the near future for displaying and manipulating hybrid cartographic data on the web. SVG will be a hybrid format that supports both vector and raster graphics (similar to today's embedding of gif-, jpg- and png-files into HTML).

SVG objects will be represented in XML, can be named, reused, transformed, positioned and manipulated by scripts. Graphical primitives include lines, rectangles, circles, ellipses, polylines, polygons, pie-slices and paths. A number of stroke and fill styles (e.g. gradient, vector fills, patterns, etc) stand by disposal. Images can be manipulated by using different basic filter operations. Vector shapes can be clipped, masked and blended, rotated, scaled and so on. Basically there is most of the functionality required by a graphical application considered in the current (early) specification. Most important: SVG fits in and cooperates with XML (HTML), CSS and the DOM (Document Object Model) and can therefore easily be manipulated by scripting languages. Unfortunately the draft is (at the time of writing this document) still in an early stage. We don't know yet when the first browsers will appear that support SVG. Almost simultaneously to the SVG specification the W3C organization published another specification for Vector Graphics in the Web: WebCGM is a binary format and one of the different CGM profiles (like CALS or ATA), supports layers, links and the included text can be indexed by search engines. Finally Vector data could also be displayed using the Java2D API and self written Java classes.

The successor of HTML 4 will be XML. As the name assumes (XML stands for Extensible Markup Language) this new standard will be extensible, that means the author can introduce his own tags and formats. XML is in close relationship to SGML (Standard Generalized Markup Language) which is a metalanguage that describes a document definition - how a document is structured. XML Files can contain both data (storage units - entities) and DTDs (Document Type Declaration - markups) that describe how the storage of the data is structured. XML files should also include processing instructions for the application that reads the data.

Three dimensional data, no matter if it is terrain data or statistical data, can be visualized and examined using VRML. VRML, stands for “Virtual Reality Modelling Language”, is a file format for describing interactive 3D objects and worlds and can easily be embedded into webpages using plugins. The most popular among them is Cosmo Player (from Platinum), probably the only browser that complies with almost all nodes of the official VRML-specification (which is not really easy to fulfil). The only platform where all features of Cosmo Player are available is currently Windows. A beta for Macintosh exists and due to the fact that cosmo player had been released in an Open Source License recently we can expect that it will be ported to other platforms also. The concept upon VRML relies is a scene graph, that contains nodes and grouping nodes (geometry, sensors, scripts, etc.). The file format builds on main concepts of the Open Inventor file format by Silicon Graphics. VRML allows free navigation in different walk and examine modi, description and visualization of three dimensional features as well as interactivity via scripting. VRML worlds can use sensors that trigger events, that can be used for further information processing, such as displaying data if a user enters a certain predefined space or clicks on or drags an object. Another interesting feature is to link different windows while the user navigates through the VRML world. E.g. one could permanently check the users position and display it in a two dimensional map. That makes navigation, which is not always easy (especially people new to VR), a bit easier and predictable. Due to the EAI (External Authoring Interface) one can communicate between the VRML plugin and the WWW browser, in both ways. One can change nodes of the VRML e.g. by entering parameters in an HTML form and vice versa. This is done using Java classes.

One of the author started (together with students of Vienna University and Technical University) experimenting on an interactive cave information system (see Fig. 3) [Almeder - Neumann, 1999] and on a simple model of the inner district of the city of Vienna [Neumann - Winter, 1999] using the VRML technology. Some of the experiences encountered while being involved in the above projects could be used for visualizing and examining terrain data as well as other more abstract (e.g. statistical) surfaces. Perhaps it would also be useful to
extrude simple choroplethe maps and extrude them to the third dimension. A draggable plane would support the user comparing the values between the different spatial entities. Other graphical attributes, f.e. color could still be used for representing other variables or for emphasizing the main theme that should be expressed.

Figure 3. VR Visualization by example of a cave system, embedded Cosmo Player plugin that works in conjunction with HTML, Java and Javascript (http://www.karto.ethz.ch/~aneumann/caving/cis/)

It seems like the VRML 97 specification would not be followed for further development in 3d web graphics. In some aspects the requirements where too ambitious and most browser could not implement the whole palette of nodes and features. Additionally some requirements can not be implemented on the current concept of VRML without reorganizing it from scratch. (e.g. streaming, better integration into the web, use of DOM and powerful programming API’s, etc) Using X3D will not require additional plugins. Like SVG the specification is still in an early stage and we don’t know when the first browsers will appear that support X3D.

SMIL stands for “Synchronized Media Integration Language” and allows time based sequences and integration of different media (audio, video, text, graphics) with extensions for layouting (similar to CSS), animation, transitions and resource management (f.e. bandwidth and streaming control). SMIL will also be implemented using XML syntax.
3. Contents and Map Types

Currently available maps

Following is a short summary of currently available maps. Concerning the political structure there exists a map comprising the boundaries of the 26 “Kantone”. On the right segment (interaction segment) you get information about the most important data concerning Switzerland (e.g. area, population, languages, etc). If the user clicks in the area of one “Kanton” he’ll get a zoom in of the currently selected Kanton and the most important appropriate data as well as links to the official webpages of the local authorities.

Another map category deals with geology, soil usage and phenology. The maps are only static right now but will be enhanced with interactive elements in the future. One outstanding feature is the lense function, that allows the user to get a zoom in of another, more detailed image, in a small rectangle, while he moves the cursor above the map area. This is done by using dynamic html and different layers. The higher resolute image is clipped by a small moving rectangle. (see Fig. 4)

![Figure 4. Example for one of the already implemented maps: Soil Types. Notice the lense function: Small rectangle with higher resolved image following the mouse cursor. (Relief © ADS + LT 1999)](image)

Embedded external www pages primarily apply to up-to-date weather information. Those are provided by SMA (Swiss Meteorological Institute) [SMA, 1999] and include the current Meteosat Satellite Image, incl. animations, the current weather radar indicating areas with precipitation as well as precipitation intensity, an
isoline map containing the up to date air pressure, and last not least the todays weather forecast. Another interesting embedded external webpage is the “Earth and Moon Viewer” [Walker, 1999], a www page that shows the current sunset on an satellite image of the earth. One can also extrapolate in future time to what will be the day and night regions then. Different views and satellite images as well as ones position (longitude and latitude) can be selected. In the expert mode one can select between a broad spectrum of different satellites and see the earth from their current position. Orbital parameters can be entered. Other related pages show the moon phases, additional information on the moon and tools and info concerning other planets and the solar system.

Future plans and map types

The current maps will be enhanced with different javascript functions. The current coordinates will be shown using the mouse move events. A point in polygon function will be added to indicate the active polygon the mouse cursor currently points to and display appropriate data. One map type we want to add are simple choroplethe maps that show different statistical variables. Those maps should react on mouse and key events and display different diagram types when the user points to a specific polygon. Ideally the user should have much influence on the appearance of the maps (e.g. color, stroke and fill types, scale, threshold values etc.) while still providing him with good default values and barriers for preventing him from doing nonsense with statistical data and its visualization. Currently this interactive map type can only be realized by using Java, with the Java 2D classes. In future time we will also be able to use the SVG format specification for generating such dynamic maps. As mentioned above we also think about experimenting with VRML for visualizing statistical data and maps.

Very interesting would be the implementation of a topography module that allows the user to produce different types of terrain visualization. One of the authors works on this topic as part of his master thesis. The approach would be to use vrml for previewing low resolution terrain models, let the user rotate, scale and translate the model, define additional parameters, such as image overlays, material settings and then send the parameters to a higher quality rendering engine such as povray, rayshade, Renderman or self written modules (f.e. the modules used by the CD-Rom version of the Atlas of Switzerland [Baer - Sieber, 1997]) for getting high-quality images. The rendering could be done either on the server (which would require powerful servers) or on the client which causes problems with copyrights of the terrain data (at least in Europe where most of the geographical data is very expensive). As different representation types we could imagine simple hillshadings, panoramic views, block diagrams and silhouette line representations. The generation of elevation profiles would be an interesting addon to the above representations.

Additional multimedia elements (pictures, text, movies, animations, sound) will round up the information content of the selected theme. For including these multimedia elements we will use SMIL, the standard described above, as it will be supported by the common browsers. Producing specific maps and illustrative text of course requires teamwork between the cartographer and the scientists of the different related subjects, an approach that is sufficiently known from traditional cartography.

The use of Java Applets and the Java Media API’s (Java2D, Java3D, Java Speech, Java Animation, etc.) would also significantly contribute to getting more interactive and therefore more interesting maps. [Lehto - Kaehkoenen - Kilpelaeinen, 1997] Some goals could be reached by using similar, partly competing approaches: f.e. SVG and Java2D, X3D and Java3D or SMIL and Java Media Framework. Sometimes it is not very easy to determine which of the competing technologies suits best for satisfying our requirements.

Cookies provide a way to save state on a client computer. This way one can save user specific settings (e.g. preferred color schemes, fonts, etc.) or save a shortcut to a specific page (similar to bookmarks) that lets him return to the same state where he left the atlas last time. Cookies are unfortunately limited to one client (or a users profile). A workaround to this problem would be to alternatively let the user store his settings on a database of our server, thus providing him with more mobility.
4. Conclusion

The WWW is an interesting new medium for distributing and presenting cartographic data. The current implementations of both, our Atlas project and other implementations, show only the very beginning of a broad range of new interactive possibilities in 2D, 3D and real time 3D. The authors are looking forward to the new XML implementations SMIL, SVG and X3D that would excellently fit into the current WWW environment. Having these technologies available we could implement almost everything what is possible with conventional authoring systems (f.e. Macromedia Director) with the additional advantage that the applications would run on almost every platform and can easily distributed throughout the world. These confidence about the future of WWW applications comes close together with the hope that the future implementations of web standards will be as free, open and well documented as the previous drafts had been. Furthermore we hope that the future browser generations will be more compatible than the previous generations had been. Hopefully the web will stay as open and available to everybody as it is now and won’t be commercialized and controlled by a few big media companies as it happened with other technologies. Our project shows that it is possible to develop, maintain and serve high quality internet maps by using primarily free and open source software as well as self written modules.

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An Overview of the National Atlas of Canada

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Abstract
The National Atlas of Canada has been in existence for 100 years with the first edition published in 1906 and the latest paper edition closing in 1993. With the closing of the fifth edition came a period of experimentation with changing content approach and vastly different communications avenues. The National Atlas was one of the very first interactive atlases on the web and this is still the major media for distribution of our information. The changing technology and content approach has lead to a new conceptual approach for the National Atlas of Canada. The Atlas is no long a stand-alone paper product but an integral part of the Canadian Geospatial Data Infrastructure (CGDI) and the government of Canada’s contribution to the CGDI, GeoConnections.

Part of being the link between people and geographic information is offering varying levels of interaction with visualization tools. The new software developed for the National Atlas of Canada using ESRI Map Objects offers the ability to provide different interfaces for varying audiences with appropriate functionality for each user group. Sophisticated users may want to complete complex searches and be able to combine a wide variety of information to make their own unique maps. A person at home wanting to find out about Climate Change may want already composed maps with only pan and zoom with a simple query function. These different interfaces are possible, using the same database and the same set of function.

Fundamental to the National Atlas will be a set of framework and base layers. Up to now the National Atlas has always produced its own small-scale base maps. With access to reliable, larger scale bases such as the Digital Chart of the World the need for in-house base maps is no longer necessary. Algorithms are being tested that will link the National Atlas to a reliable world base map. Users can visualize geographic information based on common base maps and frameworks, but they need ways to access data and find ways to further resources.

GeoGratis provides access to free data and CEONet a means for locating other related geospatial data. The National Atlas of Canada is well connected into the Canadian Geospatial Data Infrastructure and therefore the world. Through a review of the CGDI and its interconnections, the current concept and future direction of the National Atlas of Canada will be discussed.

Historical Introduction
The National Atlas of Canada has published five editions since 1906. Each volume represents an evolution of information and format. Profound changes have taken place in our national development since the first Atlas was published. As the economic and human characteristics of the country have evolved, our need for information and knowledge about the geography of Canada as a whole has increased. The great size and the geographical diversity of Canada will always challenge those who seek this understanding. Five of the atlases are collections of maps, graphs and tables on paper that provide an overview of the geography of Canada and reflect the state of knowledge and concerns of the nation at a given time. The sixth edition represents a departure from the paper atlas to data access and analysis which goes far beyond the maps themselves.
The 5th edition, completed in 1993, was comprised of 92 maps available in both French and English versions. Maps were presented at a larger scale than previous editions (primarily 1:7 500 000) and, for the first time, digital cartography and remotely sensed data from satellite images were used. The completion of this latest edition offered the opportunity to explore the developing technologies to seek the most efficient way to portray spatial information about Canada in a cost effective manner so that it would reach the widest possible audience. At the same time, the popularity of the Internet was beginning to explode and through the enthusiasm of several people at the National Atlas Information Service the idea of putting the National Atlas on the net was born.

After proving the concept of interactive mapping on the Internet, Geomatics Canada was contracted to develop geography content for SchoolNet based on the information available in the National Atlas data base. The National Atlas on SchoolNet has evolved from containing the same small holdings as National Atlas on the Net to having hundreds of layers available. The content and information access tools have been developed in consultation with the educational community through a Teacher Advisory Group, representing teachers from across Canada. It contains a quiz about the geography of Canada, a resource section for teachers, and much more textual background information on the maps and for the geographical names. Many of the suggestions made by the Teacher Advisory Group were put into place before the site was launched.

GeoAccess Division, within which the responsibility for work on the National Atlas falls, is launching in August of 1999 the sixth edition of the National Atlas of Canada. The Atlas has become more than just a representation of geographic information about the country at a particular point in time to an integral part of the Canadian Geospatial Data Infrastructure (CGDI).

CGDI is being developed to provide the geographic information component of the “information highway”. The initiative involves all levels of government, industry and academia in the activities, which will bring about access to geographic information and services. The initiative has the following five thrusts:

1. Access to digital geospatial or geographic information and expand usage;
2. Develop common data frameworks for geospatial information to bring about easier use;
3. Participate in the development of standards;
4. Promote partnerships for data gathering;
5. Foster a policy environment, which promotes the broadest possible use of geospatial data.

The federal government involvement in CGDI is called “GeoConnections”. The GeoAccess Division, naturally, is committed to developing the access component of this initiative with several ongoing activities including CEONet, GeoGratis and the National Atlas of Canada.

The sixth edition of the Atlas provides access for the broadest audience. Users can come in to browse interpreted information to better understand the geography of Canada, they can interact with the data being made available through the Atlas and they can access the sources of data. The National Atlas of Canada is being developed to reach a broad selection of users and to encourage the use of spatial data amongst a new audience. The role is as an entry point for spatial data and analysis.

**The Technology**

The technology used for the National Atlas of Canada has evolved over the past 5 years and this latest edition is the culmination of much experimentation. In 1993/4 there was no “off-the-shelf” software available for interactive mapping on the Internet. In house staff developed the NAISnet software specifically for use at the National Atlas. In 1997 the Atlas began work with Statistics Canada to use ESRI’s MapObjects software to develop a prototype, and GeoAccess has proceeded with a second sole effort. We have more recently worked with private industry to successfully create the software for the 6th edition of the National Atlas of Canada Using MapObjects.
The functionality has continued to expand since the early Internet atlas. The same user selection of layers is available. The newer features include:

♦ a default map for every subject area,
♦ zooming and panning,
♦ an identify function with attributes available for each component,
♦ a locator map that can be used for panning around the map,
♦ a simple query tool, and
♦ the ability to change colour and potentially, class intervals as well.

The new Atlas was developed for three levels of users:

♦ the novice user who only wishes to view predefined maps,
♦ the advanced user who wants to chose their own layers, and
♦ the most advanced user who will define their own layers and query their information.

The early Internet atlases were technology driven and content was developed to test the capabilities of the software. The Internet atlas ideas were still being sold and the “flashy” functions were emphasized to help sell the concept. Currently, there remain technical limitations that defy good mapping on the Internet, but these are fewer and the tools are starting to serve the needs of the information rather than vice versa.

Although there is renewed focus on the information being portrayed on the map, cartographic challenges of mapping on the screen are many and practitioners are researching subjects such as browser safe colours, appropriate map symbology, map perception on screen, etc. Some of the challenges include the limited number of colours available that can be distinguished on all browsers poses many problems for the number of class intervals, what does the user see at various scales while zooming, and placement of text.

The paper map was an entity onto itself and it stood alone with few needs to link to more than the overall look of the product of which it was part. In the electronic world, the desire to minimize work in the long run requires that much work be done at the outset. All of the layers that are used to create maps for the National Atlas of Canada have metadata that resides in the National Atlas inventory. The data in the inventory are used as part of the mapping tool to explain the layer. Rather than recreate the information the mapping tool looks into the metadata inventory to retrieve the information. The metadata describe what exists in the data inventory for the National Atlas of Canada. These data are used to create the actual layers. GeoAccess also has a site called GeoGratis where free data are available including some of the National Atlas layers, which are described in the metadata inventory. The linkages have to be there and as we develop they become more complex.

**Frameworks**

Beyond the importance of connecting the Atlas within the organization is the need to be able to link externally. The Atlas does not collect data for representation internally, but relies on other government departments at various levels to supply data. Fitting the frameworks to the National Atlas of Canada base provides the fundamental building blocks for many maps. For example, much of the social data to be mapped comes from Statistics Canada and the census divisions and subdivisions have been matched to our base to enable this mapping to occur. There are many other frameworks available including populated places, roads, rail, rivers, ecoregions, postal regions, etc. All will be maintained and gradually fit together with each other.

In future, the frameworks will be physically located at the Atlas office and the data will remain at the source agencies. When a user requests a map a unique key will be used to link the data at the source agency with the framework at the National Atlas of Canada to create the map. The source agency will update their information and this will automatically be available for mapping. The realization of this goal is not so far away.
Part of the framework project at the GeoAccess Division is the derivation of the base map components from a standard source. The source chosen for the initial work is VMAP0 and generalization procedures are being developed to bring the base to a scale appropriate for national mapping (generally for the National Atlas this would be 1:7,500,000). VMAP0 was chosen because it is an international global digital map base that is kept relatively current. The goal here is to see a consistent and widely used base for the National Atlas of Canada.

Data challenges

National scale data collection for mapping purposes poses challenges to any mapmaker: completeness, coverage, authoritativeness, year of collection, scale, state of preparedness are a few of the difficulties. Raw data sets need to be referenced to our frameworks or matched to our database. Metadata needs to be prepared. None of these are small tasks. Only after the datasets are properly referenced can the interpretation and representation occur.

Data mapped on the ecoregion framework works well, but when choropleth mapping is used for geostatistical areas, it can be misleading. Only 10% of Canada are inhabited with more than 1 person per square kilometer. By mapping these areas with colour, we inadvertently lead users to believe that there is an even distribution of population in the country. This is definitely not the case. We are now thinking of developing multi-scale maps or using different legends for different parts of the country (just as in the Fourth Edition).

Finding interesting and obvious trends at a national scale as well as portraying time-series data can be problematic. Some datasets are meaningless on a yearly basis but become extremely interesting when looked at over a 30-year period.

Convincing organizations to share their data and disseminate it is also quite challenging. There is fear of misinterpretation as well as little understanding of how much more explosive combining datasets can become. Many organizations have not realized that they can display their data spatially and they had never gone beyond displaying their data at a provincial scale. The learning curve for many of our partners is steep. Fortunately for the National Atlas, this curve is usually accompanied by excitement of discovering new analysis tools.

There is still a misperception about the time it takes to produce a National Atlas. Even though the technology speeds up the delivery of maps and its associated texts and graphics, the time needed to prepare the information is still as long, if not longer. In the non-digital world, maps can be fixed such that, aesthetically, the products appear perfect. In the digital world, things are not as simple. All data need to be attached to a database where there is no place for imperfections – the onus is on the geographer to prepare exportable, linkable and comparable data.

The last but not least of our challenges is to find ways of maintaining and updating our database efficiently and in a timely manner. We need to link directly to databases produced, held and maintained elsewhere. Resources are few. We need to exercise our value-adding skills on other organization’s datasets in order to enhance their analytical and dissemination capabilities while completing the subjects covered in the National Atlas.

Organisation de l’information

Nous avons organisé notre information de façon à pouvoir y accéder de trois façons: il y a d’abord l’approche thématique conventionnelle où les sujets sont ordonnés selon une table des matières; il y a ensuite l’approche intégrée où les sujets sont regroupés en fonction de questions d’intérêt national comme le changement climatique ou le vieillissement de la population. Nous offrons également la possibilité d’accéder à l’information de l’Atlas national par le biais d’un outil de recherche. Si un usager ne veut pas consulter la table des matières ou la section sur les questions d’intérêt national, il ou elle peut effectuer une recherche à partir de mots-clés.
Approche thématique

La classification des sujets selon l’approche thématique conventionnelle est certes celle que la majorité des usagers reconnaît et comprends. Il s’agit de notre approche «table des matières». Nous avons d’abord identifier trois grands champs de géographie dans lesquels la plupart des sujets sont inclus: la géographie humaine et sociale, la géographie économique ainsi que la géographie physique et environnementale. L’information est par la suite organisée par sous-thème, puis par carte et finalement, par chacune des couches qui composent les cartes. Ainsi, peu importe le sujet, l’organisation de l’information se résume à ceci :

- Thème (géographie humaine)
  - Sous-thème (démographie)
  - Carte (densité de la population)
  - Couches (division de recensement, littoral, hydrographie, frontières, etc.)

Une quatrième section porte sur les fonds de carte et données-cadre. Les usagers n’y trouvent que les fonds utilisés pour représenter les informations thématiques

- Thème (fonds de carte)
  - Carte (Canada)
  - Couche
    - (littoral, hydrographie, frontières politiques, circonscriptions électorales, écorégions, unités géostatistiques, lieux habités, noms de lieux, capitales, etc.)

Approche intégrée

Dans le but de démontrer l’importance relative de certaines questions d’intérêt national, nous avons développé une approche qui vise à mettre en valeur les liens qui existent entre les cartes et la connaissance qui y est associée. Les liens mis en lumière par une analyse statistique détaillée ou par la manipulation importante de données thématiques brutes sont décrits dans les textes qui accompagnent les cartes. L’exemple du module «ÉcoCarte» sur l’état des écosystèmes canadiens démontre l’approche intégrée. On y retrouve des cartes sur la biodiversité des espèces animales et végétales, les espaces protégés, les réseaux hydrographiques, l’exploitation de mines et la densité de population pour n’en nommer que quelques unes. Des textes, cartes et graphiques y démontrent entre autre, comment le développement urbain peut causer des préjudices à la survie de certains écosystèmes. L’approche intégrée (développement de modules) est celle que l’Atlas national du Canada préconise. Bien que plus exigeante pour les géographes en termes de qualité et quantité des données, cette approche éduque et renseigne mieux les usagers sur la géographie du Canada.

L’analyse et l’interprétation des données se fait toujours en collaboration avec les experts des divers sujets. L’interprétation est objective et basée sur des faits observables. Nous invitons les usagers à superposer des couches d’information et à tirer leurs propres conclusions quant aux liens qui unissent les cartes.
Choix des sujets

Bien que nous soyons gourmands, nos ressources nous obligent à prioriser le travail à accomplir. De façon générale, dans le cadre de l’approche intégrée, les sujets développés sont intimement liés aux priorités gouvernementales et ministérielles. Le Comité de direction, formé de partenaires et d’usagers, fournit également son opinion sur les grandes orientations de l’Atlas national, les stratégies de communication et de développement du contenu. Pour ce qui est de la «table des matières», nous tentons de la compléter avec des cartes que tout atlas devrait comprendre comme des cartes des sols, de la géologie, des précipitations, de la répartition de la population, etc.

Autres informations

En plus des cartes, graphiques et illustrations, l’Atlas fournit une série d’hyperliens à des sites comprenant de l’information gouvernementale et para-gouvernementale plus détaillée; des noms de personnes et d’organisations-resources pouvant être contactées pour recevoir plus d’informations sur des sujets compris dans l’Atlas national; des liens directs, transparents pour l’usager, à des catalogues de bibliothèque, des services de recherche de données à référence spatiale (CEONet) ainsi que des services de cartographie à plus grande échelle comme les profils communautaires de Statistique Canada et Strategis d’Industrie Canada.

Un autre aspect important du nouvel atlas touche aux contacts avec nos usagers qui ont la possibilité de nous faire parvenir leurs commentaires par le biais d’un lien direct. Les usagers reçoivent toujours réponse à leurs commentaires. D’ailleurs, les commentaires nous ont toujours aidé à améliorer le produit. Finalement, par le biais d’un forum en ligne géré par le personnel de l’Atlas, nos usagers peuvent faire valoir leurs opinions sur des sujets qui touchent les canadiens et en discuter avec d’autres qui ont les mêmes inquiétudes.

Il reste finalement la partie populaire et didactique de l’Atlas, c’est-à-dire celle destinée aux canadiens en général et aux enseignants. Cette section comprend l’Atlas des communautés canadiennes (un atlas régional, tout à fait subjectif, préparé par des élèves), un questionnaire interactif, un module d’enseignement sur la cartographie traditionnelle mais aussi sur le «Web», une liste détaillée d’informations sur le Canada vu sous toutes ses mesures (superlatifs) ainsi qu’un lien avec le site du Secrétariat permanent canadien des noms géographiques y effectuer des recherches ou trouver réponse aux questions qui touchent les toponymes canadiens.

L’avenir de l’Atlas national


L’Atlas national serait-il le «guichet unique» à partir duquel accéder aux informations géographiques sur le Canada?
The New and Improved Base Framework For National Atlas Data

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Abstract

Reliable framework data is essential for the practical use of geospatial data. It is one of the objectives of Geo-Connections (formerly the Canadian GeoSpatial Data Infrastructure or CGDI) to provide reliable framework datasets for Canada. The National Atlas of Canada is addressing this need by developing integrated and reliable framework datasets based on the Vector Map Level 0 (VMAP0) product.

The VMAP0 data product is a global digital dataset produced and maintained by the United States National Imagery and Mapping Agency (NIMA) at a nominal scale of 1:1,000,000. The National Atlas, in wanting to choose an international global digital map base, has adapted the VMAP0 for use as a base from which other, smaller map scales can be created and to which thematic layers can be added.

The 1:1M data had to be processed and quality controlled to allow it to be used. Since the National Atlas represents data at a national level, a variety of derived scales are being produced from the VMAP0 data. This is being done using automatic model generalisation techniques, as developed by Richardson [1996]. To prepare the data for these techniques, however, existing topology had to be corrected, and even more rigorous topology had to be defined.

Having overcome these shortcomings, the National Atlas of Canada VMAP0 data for Canada is of the highest quality. In addition, geostatistical atomic units of area such as Census Subdivisions have been fit to an enhanced VMAP0 base at the scale of 1:1,000,000, which should make the dataset even more useful. Throughout these processes, rigorous quality control has been applied to ensure the best possible result.

This paper discusses both the techniques used to achieve these results, and the quality control processes used to yield products of the highest quality.

Introduction

In order to better relate its datasets to global initiatives, and to better meet the needs of base data users at Atlas scales, the National Atlas of Canada is reconstructing all its bases at a nominal scale of 1:1,000,000. (The word nominal is used because the concept of scale has changed somewhat with the advent of digital maps.) To date, the hydrology and boundary layers have received the most work. These layers have been derived primarily from the VMAP (Vector Map) Level 0 revision 4 (hereafter, VMAP0) data. It is anticipated that other layers will come from a variety of sources.

The VMAP0 data was first released as the DCW (Digital Chart of the World) dataset. The DCW has been widely used and has proved to be very useful because it was the first global multitheme dataset at such a scale in the public domain. Despite its success, the DCW dataset is widely known to have had some deficiencies. The revision 4 data for North America was much better in quality, but still had to be improved before it would be suitable for use by the National Atlas of Canada.
Two kinds of improvements were performed on the dataset. First, improvements were performed where the data was occasionally in error, out of date, or incomplete. In particular, some parts of the James Bay power project and the Nunavut territory were not properly represented. International marine boundaries were not part of the dataset, and had to be added. Certain rivers which were connected in reality were not connected in the database. These types of improvements acted to update and correct the VMAP0 data, but did not appreciably change its specification. A second type of improvement was an improvement in structuring. The 1:1M base, when it is complete, will need to be generalised for use at smaller scales. The National Atlas of Canada has neither the time nor the personnel to do a manual generalisation of the entire country, so automated generalisation techniques will be used. These techniques require a highly topologically structured dataset, and considerable effort has been expended on topological structuring. These enhancements exceed the original specifications of the VMAP data.

The shift in bases is occurring simultaneously with a philosophical shift in purpose. Historically, the Atlas has produced cartographic products intended for viewing on paper, at a fixed scale, with the cartographer retaining ultimate control over the presentation of the data. This process is being supplanted by the production of datasets allowing interactive mapping. This new paradigm allows much more power for presentation, but at the same time places many more demands on the cartographer. It requires rethinking the concepts of scale, generalisation and quality control.

In no way should this new attitude be construed as meaning that cartography is no longer required. In fact, it is needed more than ever before. The Atlas is providing (and always has provided) information products rather than data products. The difference is that information products are expected to convey their meaning directly. An Atlas map should not have to be corrected or adjusted by its user, and should not have artifacts of the data in it. Since a user may – is expected to - combine the individual themes of data in unanticipated ways this places an obligation to have individual datasets be compatible to a high degree of accuracy. This requirement is further reinforced by the fact that many Atlas users are not geomatics professionals. In order to provide meaningful information to the user, the data must be of the highest quality.

Scale

The concept of scale has changed greatly with the advent of interactive mapping. In the past, paper maps would be designed for intense study. Therefore detail was held to be accurate to the limits of the medium, but errors smaller than what could be seen on the paper could be ignored. On a computer screen, two factors combine to produce a new way of interacting with a map. Firstly, the resolution is much lower, so it is physically impossible to pack as much information into the same space. Secondly, the computer user will tend to zoom in on areas of interest, rather than meticulously studying them at the original scale of presentation. Therefore, there is a change in the meaning of the scale parameter, and an increased and changed requirement for generalisation. Rather than building a series of separate, independent products at different scales, the National Atlas of Canada is now interested in building a single integrated geospatial database that supports representation at a variety of scales.

Multiscalar Datasets

A user will in general have more interest in some areas than in others. Canada is a country with a wide variation in the distribution of its people. Vast tracts of land are essentially unpopulated, while well over a third of the population is concentrated in or around the four largest cities. For any socially related theme, the feature density available and required in urban areas far exceeds that available for the remainder of the country. On a paper map, this sort of information would be handled by inset maps. On an online map representation, this
must be handled by zooming. In the paper case the inset map could be, and usually was, quite separate from the less detailed main map. In the online case, there is a requirement for very detailed information in urban areas, integrated seamlessly with the smaller scale remainder of the dataset.

The National Atlas of Canada is experimenting with a multiscalar approach where the base layers in these areas of great interest will have much greater detail. The effective scale in these areas will be 1:250,000 or larger but they will be seamlessly integrated with the surrounding data at 1:1,000,000. The areas of high detail will serve the function that inset maps served in a paper cartography world. They will be spatially compatible with the 1:1,000,000 data that surrounds them, and their feature density will be gradually tapered towards the edge of the area rather than abruptly changed. This seamless integration will allow them to be used in online mapping.

This approach has been used in the past. In fact, the census subdivision (CSD) boundary dataset, as distributed by Statistics Canada, has long exhibited this sort of structure. It was the challenge of creating a base consistent with these multiscalar datasets, that prompted the effort to develop a consistent set of multiscalar base data.

Generalisation:

The National Atlas of Canada is responsible for strategic mapping at a wide range of scales, and because of these wide variations in level of detail, generalisation is an essential capability. Generalisation is commonly broken down into two main types, model generalisation and cartographic generalisation. Both types are necessary to produce a good map representation [João, 1998].

Model generalisation involves the selection of the right features for display at a particular scale. This varies in difficulty depending on the type of data involved. For populated places, for instance, the population of a place is a good guide to whether or not it gets displayed at a particular scale. For a feature class with strong internal relationships between its features, such as hydrology, or geology, these issues become quite complex. For instance, river systems are generalised by removing the fingertip channels first, and working in towards a central main stream, which will be kept at all but the highest levels of generalisation [João, 1998].

Cartographic generalisation involves the adjustment of the presentation of the selected features to make the display intelligible at the desired scale. While this aspect of generalisation is subtler than the outright selection of features, it is also very important to the generation of meaningful maps. For paper products, linework must be kept to a certain degree of smoothness to avoid ink bleeds. For the screen, while the pixelation does automatically generalise features to a certain extent, because of the limited resolution, exaggeration and displacement become more important. Also, the size in bytes of the dataset is an important factor in the response time of an interactive online system [João, 1998].

The National Atlas of Canada does not intend to manually generalise a base dataset for the entire country. Automated generalisation will be used to produce base layers at smaller scales than 1:1,000,000. Richardson [1996] has developed automated generalisation routines for hydrology and transportation networks that can be used to perform the required model generalisation. Cartographic generalisation routines that preserve topological information have been developed (eg. Saalfeld, [1998]), but to date no specific procedure has been chosen to use on this data.

The automated model generalisation techniques work through feature selection based on importance computed by an analysis of the network topology. In effect, they explicitly model the relationships a human cartographer perceives intuitively. Clearly, for these to work correctly, it is vital to have accurate network topology. While the original VMAP was topologically structured, the accuracy of this structuring was not up to the exacting standards of accuracy required. Furthermore, the VMAP specifications did not include any requirement for accurate directionality of river systems. This is, however, needed for the generalisation algorithms to work. Therefore, a considerable amount of the processing of the data has involved detecting and correcting topological problems, and more will be done in the future.
Quality control

While the National Atlas of Canada has always taken a great deal of pride in the accuracy of its products, the new paradigm in online mapping has placed even greater requirements on quality control. As users now have the capability to use the data in unexpected ways, subtle errors or inconsistencies that could have been controlled in a paper environment can now become serious irritations. The construction of the base layers has been subjected to rigorous quality control procedures, and careful records have been kept. Each change to the dataset can be tracked and justified [Brooks et al., 1999].

Definitions of quality

At small scales, such as 1:1,000,000 and below, a user is less interested in positional precision than in accuracy of meaning. For instance, it is much more meaningful for a typical atlas user to know which islands belong to Canada, and which belong to the United States along the boundary between the two countries, than to know the boundary coordinates to sub-meter precision. On the other hand, it is the policy of the National Atlas of Canada to adhere to the highest available positional accuracy. When integrating new information not only must the immediate problems of data integration be dealt with, but also the indirect problems due to relationships affecting the updated features.

There are a number of relationships both in and between different geographic objects in the database which need to be correctly maintained. For instance, a river may also be an international boundary, which may also be the boundary of a census division, and of an ecological zone. It is no longer adequate to merely have a visual fit. Exact and explicit matching is needed if a dataset is to be suitable for analytical use.

This relationship is especially important because with the available software mapping tools, the user can view and query the data in far more sophisticated ways than ever before. Mistakes will subtly transmit their problems into these views and queries. They will either be detected, to the embarrassment of the author, or, worse still, they will mislead the user.

There are stronger relationships between certain types of geographic objects than between others. These stronger relationships allow identification of several families of datasets. Within a family, there are many strong relationships between the different object, while the relationships between objects in different families are loose. For instance, political boundaries, census subdivisions, and electoral districts form a strongly related family. Census subdivisions and electoral districts share many of their boundaries, and all provincial and national boundaries also form the boundary of some census subdivision, and some electoral district. Rather than treating each of these as a separate layer of information, they are all being integrated into one dataset, where the relationships between boundaries will be implicit.

Finally, when assessing the quality of a dataset, it is important to take its lineage into consideration. Wherever possible, the final product is based on data obtained as close as possible to its source. In cases of confusion, care was taken to verify the dataset against another with a different lineage. For instance, the VMAP0 data and the existing Atlas 1:2,000,000 hydrographic base were derived from the same source data. It was no surprise that a high degree of agreement was found between them. A stricter verification was to compare the VMAP0 data to the National Topographic Data Base (NTDB) map sheets which were separately compiled, sometimes from entirely different aerial photography. This type of verification was done for any change or displacement of a feature over a distance greater than two kilometres.
Data processing

The procedural and philosophical shifts discussed above required that we update, correct and enhance the VMAP0 datasets before using them as base data. To date, the hydrology and boundaries datasets have been significantly improved.

The hydrology data was chosen as the first layer to process for two reasons. The VMAP0 hydrology data makes up over half of the total VMAP0 data (almost half a million arc features) and by handling it first it was possible to better ascertain the quality of the data. It is also one of the most accurate layers in that dataset, for two reasons. Firstly, as the original purpose of the source dataset was for aeronautic navigation, rivers took on a high level of importance being used for visual reference by pilots. Secondly, hydrology is one of the slowest base layers to change, which meant that the late 1980’s vintage of the data did not present a problem.

The boundaries layer in the VMAP0 dataset also includes the coastline. In the National Atlas of Canada model of hydrology, however, the coastline is essential. For this reason, the boundary layer was processed concurrently with the hydrology layer. Duplicate copies of the coastline are preserved in both the new hydrology and boundary datasets. The new boundary dataset was based mainly on the boundary information from VMAP0. It was also adjusted by the addition of more accurate or more detailed information from other sources. In certain cases, more accurate information actually required the displacement of the VMAP hydrology in order to preserve the relationships between features.

Both layers of the data went through the following basic steps. First the format was converted from the Vector Product Format (VPF) in which they were distributed. Data conversion almost inevitably causes some data loss due to incompatibility in the data models. Great pains were taken to minimize this data loss; Even using the VPF to Arc/Info conversion tools which are available in Arc/Info, the program for making this conversion ran to well over 1000 lines of code [Brooks et al. 1999].

Following the import, the feature coding and other logical consistency checks were performed. In this phase, errors such as rivers running through the middle of lakes were detected and corrected. Tile boundaries were identified for later removal, and a duplicate coastline was placed in each of the boundary and hydrology datasets.

The two datasets then followed somewhat different processing paths. The hydrology data, because of its greater complexity, and because of the demanding requirements of the automated generalisation routines had to be checked meticulously for topological errors.

The main type of topological error checked for was the connectivity of river systems to the coastline. These errors were detected by making the assumptions that rivers generally drain to the ocean, and that river systems are generally acyclic graphs. Neither of these assumptions is entirely true in practice, but because they are true in the vast majority of cases the false alarms generated by these checking procedures were small. Also, these are the same assumptions used by the generalisation algorithms so deviations from them needed to be detected for special treatment in any case. Analytical tools were used to detect both the case where a small gap was keeping a river system from connecting as it should, and the much rarer case where two river systems were connected together that should not be.

As a support to these checks, the existence of large and medium scale water diversions in Canada was researched. These diversions tended to disrupt the acyclic topology of river systems in which they occurred. Therefore they were identified and integrated into the overall data model. Similarly, internal drainage systems, defined as river systems that do not drain to the ocean, have been identified and their sinks determined. In the beginning, almost 35% of the arcs in the dataset were not attached to any sink, after careful checking, that figure has been reduced to about 12%. This reduction was achieved by adding less than 3000 short connecting arcs. Bearing in mind that a certain proportion of the arcs in the dataset are intended to be isolated lakes and streams, that figure is considered good.
The boundary data needed less topological processing than the hydrology data. The data needed to be updated with the addition of the new Canadian territory, Nunavut. As well, the National Atlas of Canada had access to a very accurate international boundary and international marine boundary information, and this was used to enhance the dataset. In certain cases where the international boundary lay along a river, the addition of more accurate information also affected the hydrology layer. Care was taken to be certain that the information represented in both datasets is precisely identical.

The finest level of administrative subdivision which existed in the VMAP0 data set was the provincial boundaries. The National Atlas of Canada frequently uses census subdivision polygons for displaying social thematic information collected on these divisions. Census subdivisions are also considered part of the same data family as the provincial boundaries. Accordingly, these were integrated into the boundary dataset.

When processing the data, great care was taken to make sure that the data was genuinely enhanced, and not corrupted. When arcs were added to correct connectivity problems in all but the rarest of cases they were checked against another base map. Each such case was recorded, is traceable and the justification for its existence can be determined. At each stage of processing, the number of arcs was carefully tracked. Furthermore, automatic generalisation routines that could move or delete features were avoided in favor of manual checking. While tedious, this process has payed off by producing a dataset of the highest quality.

These datasets have been greatly enhanced, but further progress is still necessary. In order to prepare the hydrology for automatic generalisation, some further topological processing will be necessary. In particular, the directionality of each river in the dataset will have to be determined. More administrative and political divisions will be added to the boundary layer. Further datasets will have to be processed in order to create a set of minimal framework data layers. At a minimum, these datasets will include the recommended [Evangelatos, 1999] elevation, toponymy, transportation and imagery layers. The National Atlas of Canada is currently exploring a number of options, but at this point it appears unlikely that the data for these layers will come exclusively from VMAP0.

**Summary**

The National Atlas of Canada is building a set of bases at a nominal scale of 1:1M. These bases are intended to be both suitable and compatible with mapping of the nation or parts of it, but also suitable for integration with global mapping projects. To date, a hydrology and boundary dataset have been produced which are primarily based on VMAP0 data. This data has been updated, corrected and enhanced by the addition of new information, careful inspection, and analytical techniques.

Overall, the dataset proved to be of high quality from the outset. The original dataset contained on the order of half a million arcs; this number decreased a bit after processing. Of the various types of errors investigated, all could be said to occur for less than 1% of the features in the dataset. This starting error rate has been greatly reduced by the application of quality control procedures.

In the future, the National Atlas of Canada will continue to refine and construct base map layers at the 1:1M scale. These datasets will be constructed in such a way that the topological relationships between features, and the relationships between datasets will be explicitly maintained. This will be necessary if the datasets are to be automatically generalised in the future.
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Partnerships and the Evolution of The National Atlas of Canada

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Abstract

Building partnerships has been identified as one of the basic activities of the Canadian Geospatial Data Infrastructure (CGDI), a high-profile federal-provincial-territorial government, private and academic sector initiative to develop the Canada’s geographic information lane of the Internet.

CGDI is being developed through GeoConnection, a national partnership program. Developing effective partnerships has also been a key element of success in producing five editions of the National Atlas of Canada over the past century. As the Atlas moves into the 21st century, the GeoAccess Division will build on these partnerships, and has introduced new programs to establish the Atlas as one visualisation component of the CGDI. Among the more important are the Geomatics Development Program, GeoGratis and the Canadian Communities Atlas.

The Geomatics Development Program is an initiative of the GeoAccess Division. One of its goals is to assist Canadian geomatics companies in the development of new capabilities, products and services for the National Atlas. The program encourages partnerships with other government agencies and academic institutions, and its focus is adapted each year to the priorities of the GeoAccess Division.

GeoGratis is one of the operational components of GeoConnections providing access to geospatial data. It supports the distribution of free framework data sets that meet national and international standards. The National Atlas of Canada base maps form part of free data sets available through GeoGratis.

The Canadian Communities Atlas offers a unique national network of geographic information by providing schools the opportunity to create an Internet-based Atlas of their community. Supplemented by the National Atlas of Canada’s Internet mapping resources, students can see both local and national perspectives of many physical, economic, human, and historical geographic themes. The atlas project provides an on-going educational project and Canadian educational resource for students, teachers and the general public.

This presentation will describe several important partnership programs to accelerate the National Atlas development, namely in the context of the CGDI and CEONet, and provide examples of project contributions supported by the programs completed to date.

Keywords: partnerships, national atlases

Introduction

Since the early years of this century, the National Atlas Canada has served as a means to provide an overview of the many aspects of the country’s geography, including: the history, environment, climate, economy, transportation, demography and cultures. The five successive editions of the National Atlas of Canada have presented
A comprehensive geographic portrait of the nation in 1906, 1915, 1957, 1974 and 1994. In the final stages of preparing the 5th Edition, the program has evolved into the computer-based National Atlas Information System [Falconer et al., 1999]. Currently, the Internet-based mapping technology allows users to access the National Atlas data and information directly and rapidly, and to use it practically in a variety of applications.

The nature of the National Atlas activity depends on cooperation with data collection agencies, and requires data processing and presentation skills, expert knowledge of data interpretation, presentation and publication. In fact, existence of well organised statistical records extending over a reasonable length of time, established knowledge and skills in the fields of geo-sciences and cartography, financial backing, and editorial and advisory support are among the conditions for a publication of national atlases [Ormeling, 1979]. Partnerships are, therefore, essential in all stages of atlas information preparation and delivery. To use some recent examples, many National Atlas of Canada, 5th Edition maps resulted from a partnership agreement with the researchers from other government departments, academia or the private sector. Similarly, in publishing the National Atlas of Canada, 4th Edition, and the Canada Gazetteer Atlas, federal government departments formed a partnership with a publishing company, Macmillan of Canada Ltd.

Partnerships and alliances have become increasingly important also in the context of new public administration as part of a recent paradigm shift [Wright and Rodal, 1997]. As the National Atlas evolves in the world of digital geographic information and becomes part of the Canadian Geospatial Data Infrastructure (CGDI), partnerships are becoming more important than ever. This paper presents the National Atlas in the context of CGDI initiative, and describes new programs established recently to encourage and support the Atlas partnerships. Among the more important are the Geomatics Development Program, GeoGratis, Canadian Communities Atlas, supported by cooperation agreements and advisory groups. The paper also includes selected examples resulting from the existing partnership programs, and concludes with a summary of the National Atlas work throughout the 20th century and beyond.

**National Atlas in the Context of CGDI**

**Canadian Geospatial Data Infrastructure (CGDI)**

GeoConnections is a partnership initiative that brings together a host of projects and organisations to build the Canadian Geospatial Data Infrastructure. The Inter-Agency Committee on Geomatics (IACG) is working with the Canadian Council on Geomatics, the Geomatics Industry Association of Canada, and key Canadian universities to develop the CGDI.

The CGDI will provide easy, consistent and harmonised access to geographic information and services. It will make Canada’s geographic information accessible on the Internet through the following five thrusts [Labonté et al., 1998]:

- Access to geospatial data to help Canadians find what information is available using the Internet;
- National framework of data, a foundation of reliable geospatial data to allow for data integration;
- Geospatial standards will encourage harmonisation in collecting, describing and distributing geospatial data. These standards will also improve the quality of this information;
- Partnerships, the fourth element, in data acquisition will reduce the cost of government by fostering cooperation to collect, build, share and maintain geospatial data;
- Supportive policy environment that support the broadest possible use of the information. Such an environment will foster access, common licensing, lower costs and other activities that will make it easier to use geospatial data.
Among the key components of CGDI are:
- **CEONet** – data access, discovery and delivery component of CGDI
- **National Atlas** – one data visualisation and exploration component of CGDI
- **GeoGratis** – a tool for access, viewing and downloading of free geospatial data

Figure 1 illustrates how the GeoAccess Division activities fit into the CGDI.

**Canadian Geospatial Data Infrastructure**

![Diagram of Canadian Geospatial Data Infrastructure]

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**Figure 1.** The National Atlas of Canada and partnership instruments in the context of CGDI

**Canadian Earth Observation Network (CEONet)**

The CEONet is an initiative by the Canadian government to create a national infrastructure for providing access to geospatial data and related services. This initiative is being driven by the requirement of Canadian users for better access to geomatics and Earth observations data, and by opportunities for Canadian industry afforded by the rapid growth of the international market for geomatics and Earth observation data, services, and network systems.

CEONet system development focuses on features that make it easy for data suppliers to join CEONet and for system integrators to build value-added services on top of the CEONet infrastructure. This approach has a magnifying effect, as empowered data suppliers and system integrators will be able to provide a range of additional features that meet the needs of their own target users in the Earth observation and geomatics information communities.

CEONet makes use of relevant standards, technologies, and components wherever possible. Initiatives like Europe’s Centre for Earth Observation (CEO) INFEO may provide off-the-shelf solutions for selected parts of CEONet. The CEONet project team participates in the activities of standards organisations (e.g. Open GIS Consortium, ISO Technical Committee 211), and adopts technologies that are sufficiently mature for the intended application.
CEONet provides a comprehensive clearinghouse for suppliers and users of geospatial data and related services. CEONet is comprised of a series of discrete services including:

- **Advertising Service**: This service enables organisations to register themselves as suppliers and advertise their product collections and services.
- **Directory Service**: This service enables consumers to browse lists of organisations, product collections, and services, and to view their descriptions.
- **Distributed Search Service**: This service enables consumers to execute searches on product inventories maintained by the participating organisations and locate individual products of interest.

**The National Atlas of Canada**

The National Atlas of Canada is responsible for the development and maintenance of an authoritative synthesis of the geography of Canada. Products, in both digital and conventional form, include base maps, and thematic maps that reflect the social, economic, environmental and cultural fabric of Canada. Customised map services are also provided.

**Figure 2.** The National Atlas of Canada and its components.
The National Atlas objectives are:

- Work with other data suppliers/organizations to broaden the content and relevance of the Atlas data bases and associated interpretations;
- Prepare new representations of the information in the form of:
  - Global/continental views;
  - National views;
  - Local views;
  - Real-time and topical views;
- Integrate Atlas information with CEONet.

These objectives are achieved through the implementation of major atlas projects including: Resource Atlas, Schoolnet Atlas, and Canadian Communities Atlas, as well as the delivery of a variety of National Atlas products and services. Figure 2 illustrates major National Atlas projects in relation to the National Atlas database.

Geomatics Development Program

The Geomatics Development Program GDP is a partnership program initiated by the GeoAccess Division of the Canada Centre for Remote Sensing. The goal of GDP is to assist Canadian geomatics companies in the development and commercialization of new products and/or services of interest for the geomatics industry.

GDP projects are selected through a Request for Proposal (RFP) posted by Public Works and Government Services Canada. The type of projects sponsored depends on the priorities of the Geomatics Canada, coordinated with the activities of CCRS Advisory Groups. The 1998 priorities focused on:

- Connecting public and private suppliers of Canadian geospatial data to the CEONet infrastructure;
- Developing new capabilities for the National Atlas; and
- Developing innovative geomatics applications/products.

Each project is conducted in cooperation with a client/end-user, specified by the bidder, who will be the recipient of the project and who will ultimately benefit from the work conducted. The client must be a party to the proposal, agree to participate in and contribute to the project, and be in a position to use the technology. GDP contributes up to 50% of the total project cost, to a maximum of $65,000. A total number of projects (including their cost) supported by GDP each year since 1994 is provided in Table 1.

Table 1. Geomatics Development Program (GDP) projects supported since 1994 [Canada, CCRS, 1999]

<table>
<thead>
<tr>
<th>Fiscal year</th>
<th>no. of GDP projects</th>
<th>GDP contribution</th>
<th>total value of GDP projects</th>
</tr>
</thead>
<tbody>
<tr>
<td>1994 – 1995</td>
<td>3</td>
<td>$101,000</td>
<td>$269,600</td>
</tr>
<tr>
<td>1995 – 1996</td>
<td>8</td>
<td>$249,700</td>
<td>$661,745</td>
</tr>
<tr>
<td>1996 – 1997</td>
<td>8</td>
<td>$199,000</td>
<td>$541,500</td>
</tr>
<tr>
<td>1997 – 1998</td>
<td>13</td>
<td>$633,000</td>
<td>$1,300,000</td>
</tr>
<tr>
<td>1998 – 1999</td>
<td>13</td>
<td>$606,000</td>
<td>$1,250,000</td>
</tr>
<tr>
<td>TOTAL</td>
<td>45</td>
<td>$1,788,700</td>
<td>$4,022,845</td>
</tr>
</tbody>
</table>
**GeoGratis**

GeoGratis is one access method for digital geospatial data that is distributed free of charge. Its role as a partnership instrument is based on the philosophy that the widespread distribution of free data will stimulate the use of standard geospatial databases and promote the use of other Canadian data sets, and increase and the number of CGDI users and clients. This philosophy uses an alternative business model that expands upon the current Canadian federal policy of cost recovery, often criticised in the past [De Groot, 1998].

GeoGratis is a File Transfer Protocol (FTP) site, and part of the Canadian Geospatial Data Infrastructure. It houses a wide variety of raw geospatial data for locations in Canada. GeoGratis has five objectives [Wilson and O’Neil, 1999]:

- provide free, easily accessible, vector, raster, multispectral, hyperspectral and tabular data,
- distribute framework data sets,
- increase awareness and accessibility of data sets,
- extract and distribute legacy data, and,
- support an open geomatics environment, balanced by the needs of a set of proprietary solutions.

Data sets available through GeoGratis include National Atlas base map data, Canada Land Inventory data, satellite imagery mosaics, and other national or regional data [Wilson and O’Neil, 1999]. Among the important National Atlas data sets in preparation is Vector Map Level 0, revision 4, based on the Digital Chart of the World. The National Atlas of Canada is reconstructing principal base map layers at the scale of 1:1,000,000 [Brooks, 1999].

**Canadian Communities Atlas**

The Canadian Communities Atlas offers a unique national network of geographic information by providing schools the opportunity to create an Internet-based Atlas of their community. Supplemented by the National Atlas of Canada’s Internet mapping resources, students can see both local and national perspectives of many physical, economic, human, and historical geographic themes. The atlas project provides an on-going educational partnership opportunity with industry and Canadian educational resource for students, teachers and the general public.

This project is ideal for teachers looking for a practical and interesting opportunity that combines geography and a social studies curriculum with technology in an easy-to-use format. The project has been designed with guidance from an advisory group of kindergarten to grade 12 teachers representing every province and territory in Canada. The CC Atlas can be adapted to the curriculum of any school, anywhere in Canada. Students learn to develop their research, design and technology skills while working on their own Community Atlas site. As this is an ongoing project, teachers can develop their Atlas site as time and resources allow. A Community Atlas can grow to become a complete, geographical compendium of a community.

The CC Atlas project is a multi-disciplinary activity for accomplishing many learning objectives and outcomes. The benefits that students will gain from working on the CC Atlas are many and varied. The types of academic courses where the CC Atlas is an appropriate learning vehicle are also of great diversity. The CC Atlas also offers the opportunity for cross-curricular activity within a single project. The reality of today’s working world requires that students make connections and develop skills allowing them to cross subject boundaries and understand why that is important.
The CC Atlas project provides an excellent vehicle to establish corporate level partnerships. Many organisations have school based projects where research and analysis of geographical data is done using geographical information systems (GIS). The CC Atlas provides a medium and network for the results of this work to be shared with other schools all over Canada. The CC Atlas is a project that relies on partnerships of many kinds. These will allow it to grow and provide the information and data resources that will, in the end, prove it to be significant for schools and students and also a valuable part of the National Atlas of Canada.

Cooperation Agreements and Advisory Groups

Cooperation Agreements

Cooperation agreements between geomatics organisations are important partnership instruments in that they formalise and specify agreements concerning data exchange and cost sharing in developing new data and services. Two types of agreements used by the National Atlas are: a Memorandum of Understanding (MOU) and a Letter of Agreement (LOA). The two agreements are very similar; MOU is usually more general, while LOA is more specific. Current National Atlas agreements of co-operation include [Canada, CCRS, 1999]:

| 1. Emergency Preparedness Canada                  | • Ecological Monitoring and Assessment Network, Environment Canada |
| 2. Canadian Centre for Bio-diversity, Canadian Museum of Nature | • Resource Conservation Division, Parks Canada, Environment Canada |
| 3. Programmes Branch, Canadian Museum of Nature    | • Canadian Heritage |
| 4. Parks Canada, Environment Canada               | • The Canadian Wildlife Federation |
| 5. Endangered Species Conservation Division, Canadian Wildlife Service, Environment Canada | • Centre for Earth Observation, European Commission |
| 6. Habitat Conservation Division, Canadian Wildlife Service, Environment Canada | • Global Change Master Directory, NASA |
| 7. Bio-diversity Convention Office, Environment Canada | • FGDC Clearing House, USA |
| 8. State of the Environment Reporting, Environment Canada | • ESRI Canada |

National Remote Sensing Advisory Groups

Successful formulation and implementation of the CCRS mandate relies on the advice of the National Remote Sensing Groups established for key areas of CCRS responsibilities. Members of the advisory groups are drawn from industry, universities, and government (federal, provincial and territorial) user groups to represent the range of interest in the remote sensing and resource community. In partnership with CCRS, advisory groups review the plans and activities of CGDI, and formulate advice on priorities and requirements related to the National Atlas and applications of remote sensing technology development. The National Remote Sensing Advisory Groups include:

| 1. Geomatics Technology | 2. Geoscience |
| 3. Agriculture | 4. Hydrology |
| 5. Environment | 6. Mapping |
| 7. Forestry | 8. Disaster Management |
Geomatics Development Program Results: Selected Examples

The following summaries of GDP project are selected as examples of the National Atlas partnership results. Other examples can be viewed at the CCRS Web site under R&D support programs [Canada, CCRS, 1999].

Hydrometric and Climate Geospatial Catalogues

Ground Control GeoTechnologies Inc. and Environment Canada, Applications and Services, Pacific and Yukon Region designed and built a Hydrometric and Climate Geospatial database for disseminating hydrometric and climate data within Environment Canada Pacific/Yukon Region to clients. The resulting catalogue is be accessible via the CEONet system.

Health Records Geographic Information System

South Eastern Ontario Health Sciences Centre (SEOHSC), Kingston, Ontario, wants to use mapping/spatial analysis tools to assist their operational and strategic planning. Their interest is to visually demonstrate relationships between utilisation patterns and the distribution of health care services in order to provide a better continuum of care for the patient. Kanotech worked with SEOHSC and its subcontractor, the Queen’s University GIS Lab, and developed a central intranet/internet server to assemble, map, analyse and distribute spatial data for all groups within SEOHSC. The central server will be, in effect, a warehouse of layered spatial base map information within links to external databases containing in-patient, out-patient, clinic and community care records as well as socio-economic and demographic information for Statistics Canada’s census subdivisions. End users will use a free downloadable plug-in viewer that will allow them to build custom maps and reports by choosing map layers, querying the databases, creating buffer zones and overlays and printing to scale.

National Health Surveillance System

The proposed project is a collaboration effort between PCI Enterprises and the Health Protection Branch of the Canadian Ministry of Health in support of the National Health Surveillance Systems (NHSS). The NHSS is part of the Canadian Health Information Structure initiative to improve the Health surveillance with the capacity to anticipate, prevent and respond to health risks. At the core of this infrastructure is a distributed Spatial Data Warehouse providing access to local and remote geospatial and public health data sets. The infrastructure uses an Open Geospatial Datastore Interface (OGDI) to access the spatial data warehouse, supporting the retrieval of spatial data from many proprietary formats including PCI’s SPANS format. OGDI support within the PCI library GeoGateway was added so that all applications using GeoGateway can smoothly become OGDI enabled applications. This provides a wealth of desktop viewing and analysis applications with access to the full enterprise data of organisations (such as Health Canada) moving to an OGDI based architecture.

Geo-Targeting for Bio-diversity Conservation

The Canadian Bio-diversity Strategy advocates research to increase understanding of the status, genetic diversity and ecological relationships of species and populations. This project identifies locations across Canada which have the highest potential contributions to the conservation of wildlife species. The work provides a conceptual and spatial framework for decentralising resource management decision-making to more local levels, while maintaining the larger spatial perspectives necessary for sustainable resource use.
The Future

It can be argued that the establishment of the office of the Chief Geographer and the Geographical Branch in the Department of the Interior in 1899 [Mackay, 1982] created conditions for the publication of the National Atlas of Canada (1st Edition). This initiative evolved subsequently into the National Atlas program and launched a century of published atlases in Canada including:

- 1969 – Atlas and Gazetteer of Canada
- 1980 – Canada Gazetteer Atlas

A turning point in the National Atlas of Canada was the creation of the Atlas on the Web in 1994, launching the National Atlas program into the 21st century. By now, the Atlas is established as an integral component of CEONet and CGDI. It is supported by partnership program ensuring its continuity and relevance within the Canadian geomatics community from the national perspective to the community level. Launching of The National Atlas of Canada, 6th Edition, is scheduled for August 1999 [Frappier and Williams, 1999]. The current National Atlas development will continue for several foreseeable years of the 21st century. How the National Atlas of Canada will look like at the end of the next century, I do not dare predict.

Acknowledgements

I would like to acknowledge the input of my colleagues, Paul Harker, Eric Kramers, Jeff Labonté, and Doug O’Brien in completing this paper.

References


Session / Séance C2-D

Atlas of Québec and it’s regions: a multimedia cartography product on the tool Internet

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Abstract
All the universities of Quebec created a team of more than seventy researchers around this electronic atlas on Internet. This team has been working for the past two years on a project to create the Atlas du Québec et de ses régions. This project has a strategic significance, not only for the Quebec universities, but also for the whole society since no such Atlas of Quebec exists. Part of this Atlas is already available and can be seen on the Internet. The address is: http://www.unites.uqam.ca/atlasquebec/

The objectives of the Atlas go beyond creating maps for the inventory of land information. From a geo-referenced database, the Atlas is proposing maps of the province on a general level at a scale of 1: 8 Mo, a second level of informations analysing each of the 17 administrative regions on a national basis for the selection and discretisation of the data and, at a third level, on a local basis each of these 17 regions will work on a local atlas, produced by the local expertise. It is a good way to apply bi-directionality supported by the networking form of an electronic atlas. Data will decentralised towards all the regions. At least, data will be reachable in perephics regions not only for consulting but also for local treatment. After specialists of this portion of the territory will work on them, data supporting regional information will go back on the Atlas Network.

In brief, the Atlas du Québec et de ses régions is built on the Internet Network and it has a main object: support a analysis to bring out the major tendencies driving the evolution of the Quebec territory and give the tools to those involved in the local planning and developing.

The territory served by the Information autoroute

One of the factors building geographic space is information on the territory is. All should be able to get it, small localities to urban centres or metropole authoriries. For example, access to information is important for localising industries, specially those dealing with new economy. As a matter of fact, the capacity of cities or regions to attract those enterprises is making a lot of difference. Well, all regions do not have the same access to information. Some researchers used to believe that new technologies for commuting information would eliminate distances almost automatically and consequently differences between peripheric and cenral urban centres would disappear. Access on a real time basis communication should be accessible to everyone. We should admit experience showed the opposite was happening. Geographic distance still exist and urban centres are concentrating network and the information. We can also verify that large metropolitan area are getting into transnational network deconstructing the hinterland solidarity.

The new technologies and their bidirectionnality should be a guarantee for supporting the redeployement of activities on the territory. For those reasons there is a tremendous need to create a new approach for the appropiate way of supporting the diffusion of information with quality and speed: an electronic atlas on the Net is required. The Atlas du Québec et de ses régions is aiming to play this role.
The Quebec Universities Network Supporting the Project

The three levels of the Atlas including all the groups in region are submitted to the guide lines proposed by two Commissions: the Scientific Commission and the Cartographic Editing Commission.

The Scientific Commission regroups eleven members from ten universities and National Research Institute from all over Quebec. Orientations, objectives and quality controls guide lines are given by this Commission. All the work and results should be fully responding to scientific criteria defined by this Scientific Commission.

The Cartographic Editing Commission is also formed of eleven academic members from the same institutions and will look after the full respect of the geomatic standards and the cartographic rules. A technical guide has been produced and a common geobase has been structured and distributed to all participants in the universities network. In brief, this Commission will also be responsible for the multimedia editing of the content of the Atlas developed by the Scientific Commission and the researchers all over the Province.

A Rigorous Analytic Basis

For the Province of Quebec level, the County Regional Municipality (MRC) was adopted as the geographic reference basis. There are ninety-six MRC in Quebec to which we can add three Urban Communities. MRC should become the most important level for land management in the next decade as far as decentralisation context brings the administration closer to the terrain level.

At the intermediate level, the seventeen regions are subdivided by MRC, each of those subdivided again in municipalities (one thousand and six hundred).

Finally, at the local level, each region will use municipalities limits and also more refined subdivision (census territory or municipal districts).

We are building our data base with statistics from 1871 to 1996 mostly coming from Statistic Canada, Bureau des Statistiques of Quebec, governmental agencies and research groups in different fields.

A Dynamic and Interactive Tool

The decision of publishing an electronic atlas was taken in 1995. Although the feasibility of such a project was still on a prospective basis, the original team choose this way instead of producing a paper atlas that would be subsequently transported on a CD and then on a network. We already evaluated the potential of the diffusion, it’s decentralised way for consulting, the quickness of updating the information and reediting the maps. But this new technology has to be taken with its implications as far as changing the way to construct maps according to the way they are read. Consulting electronic atlases is dependent of the size of the screen, the resolution of the screen, the sequence of images required to cover a dense thematic on a large scale, etc. These atlases have great advantages too: dynamic, interactive, adapted to the needs and questions of the user and very accurate as far as actuality is concerned.

From these new configurations of an atlas come new concepts and paradigms of maps collections on one site. Atlas authors must be aware they are serving a large palette of users going from the anonymous surfer to the specialist researcher mining data to support his work.

Atlases are getting closer to actuality than ever before with the capacity of following political changes or, even more important, observing natural phenomena happening with it’s permanent reference to some landmarks known by all on the national map. Hurricane, ice storm or flooding are all good examples that people can follow on Internet to get more information on it’s geographic reference and the consequences for the regions touched by the phenomena.
Surfing through the Atlas

Because of the wide range of clienteles using the Atlas of Quebec on the Internet, it has to be totally user friendly and offer, beyond high technical quality, an easy way to travel in all the files and links implemented on such a site.

In the Atlas du Quebec, we come in on a three levels basis: the National level using three scales depending if it describes the whole territory, the large Northern part with a few settlements or the Southern part with large urban centres. At this National level a second difficulty concerns the different types of territorial subdivisions. With seventeen administratives divisions, ninety-six MRC and more than one thousand six hundred municipalities (mostly all of them in the south) the dimension of the screen and the capacity of the user to read so much details highlight the problems of apprehending the territory in its ensemble, and the zoom tool is not the proper solution. Maps collection creates another type of problem because when seen on a sequential basis, the global point of view is poor and, mostly, on a computer screen it is real hard to remember what was the image shown three or four or more steps ago...

To respond these queries, we tried to use metaphors, tables of contents, thematics research and year of data collecting plus screen request using hot spots on the maps or around the image (legend and buttons). Multimedia is opening new ways of doing things with the animation technology and the audio. We did use animation to show the evolution of the population density (dot represents 500 persons) over census data collected every ten years from 1871 to 1996. The example in the CD will give an idea of the effect that touches all the publics we tested up to now. Land appropriation over a one hundred and twenty-five years period is quite evident when you see dots appearing and also some disappearing in some peripheric areas. How many static printed images does it replace and mostly would they be more or even as much effective than our animation. The audio possibilities have just been tested with the narration of accompanying texts for maps. It is for sure a positive tool for some large publics but some of the most interesting perspectives we plan to work on are relied to educational applications. Interactivity would well supported from elementary classes to high school level.
National Atlas of the Federal Republic of Germany

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Abstract

In 1995 the Institute of Regional Geography in Leipzig started conceptualizing a national atlas of Germany. The idea was to develop a print edition as well as an electronic edition of the atlas, both based on a multimedia concept. In October 1997 the Institute of Regional Geography was able to present a pilot version with an electronic demonstration on CD. Now, nine years after reunification, the Federal Republic of Germany is about to publish the first volume of its national atlas.

Taking into account the 50-year-anniversary of the Federal Republic of Germany the first of twelve volumes deals with “Society and Nation”. The volume contains problem oriented contributions arranged in six main chapters: historical review, the German state today, its economic basis, spatial structures and planning, the country’s differentiated society, and its position in the world. There will be between 40 and 50 articles per volume, each restricted to two to four pages. By including a large number of authors, the national atlas of Germany aims at representing the most recent results of current geographic research in Germany.

The print edition uses complex maps of Germany on a scale of 1 : 2,75 Mio or more, combined with text and a broad variety of means of illustrations; these may include satellite and aerial-photography, pictures, graphics, tables and supplementary texts. The edition on CD-ROM offers two types of access to the electronic atlas, a view-only module, platform independent in html and java script and an interactive module running under Windows 3.x and higher. The view-only module includes all themes from the print edition in an encyclopedic type of program with many details, images, maps and text explanations which works on the basis of clickable images. The interactive module offers a large number of additional functionalities. It combines the data base of the atlas with a map constructing program and enables the user to visualize different sets of data on a map of Germany.

Introduction

More than one hundred nations in the world present their country, their national resources and the major social processes in a national atlas. Since the first Finnish national atlas, edited in 1898, when Finland struggled toward national independence, national atlases have always been a means to present national identity. With modern forms of multi-media representation, they have received the additional function of presenting spatially differentiated data in a popular and easily readable manner. As a consequence, target groups for national atlases have changed considerably. While traditional national atlases used to be aimed at a highly specialized group of planners and scholars, the new multi-media type visualizes complex statistical data and makes spatial relations comprehensible for a broad public.

Almost ten years after reunification, Germany finally decided to edit a national atlas in twelve volumes which will appear in the course of 6 years. Even though there is no governmental mandate, the Institute of Regional Geography in Leipzig has decided to raise funds on its own and gather forces of scientists and specialists from all over Germany in order to complete this ambitious objective. The German Association of Geography (DGfG),
the German Association of Cartography (DGfK), and the German Academy of Regional Science (DAL) have joined forces, in order to mobilize all possible input for the project.

**Organizational structure**

The project of the German National Atlas has been embedded into a network of the national scientific community. Several advisory councils guarantee that the interest of federal agencies and the know-how of scholars are well represented and can add their special knowledge to the project. The advisory council joins 9 federal agencies and institutions of national importance twice a year. In the program commission, representatives of the three scientific associations as well as from the Association of Geography Teachers accompany the general conceptualization of the project. A cartographic advisory board gives advice on the cartographic and perceptual aspects.

In the Institute of Regional Geography a permanent staff of 6 to 8 persons, including 3 or at times up to 5 cartographers, is charged with the entire project. Therefore, a cooperative type of organization is required. Among the established scholars of German Geography, a group of 30 has assumed the function of coordinators – between 2 and 4 per volume – who develop their own concept for each volume in agreement with the program commission and the institute as the general editor and coordinate the work of the respective authors. In several cases entire commission groups of the German Association of Geographers with their speakers have taken the responsibility for a volume, as e.g. for the volumes “Population” or “Education and Culture”.

**Editions and Target groups**

The atlas will be edited in two forms: a print edition and an electronic edition, which will be published for each volume with a time lag of a maximum of two months. Due to the complicated situation of rights regarding the use of official statistics collected by public agencies in Germany, there will be no online version, until further progress has been made in agreements about the use of official data, even though the main part of the electronic version is programmed in html-format. Naturally, the electronic version is the more adequate for coping with the problem of updating information. But although modern scientists underline the advantages of electronic atlases, various reasons point towards the traditional form of book publishing as the version, that will receive more attention and will have more users. For one, acceptance of electronic media in German households still is comparatively low. Secondly, even though data might be more recent and material might be more abundant, map quality and the possibility of a rapid overview in print editions still cannot be topped by electronic media. Thirdly, as a result of the budget limitations, the development of a spectacular electronic edition that presents additional information in a significantly different manner as compared to the print edition – as is being realized in the Swiss version, for example – is not feasible.

Different groups of users will be addressed by the two types of publication. In general the German national atlas is aimed at a larger public, that is families with higher education, schools and teachers, universities and students, all public libraries, politicians, institutions, and planners. While the representative appearance of the print edition presumably will be preferred by families and politicians, the additional functionalities offered by the electronic edition will appeal especially to teachers and planners.

The twelve volumes will be published at a rate of two per year and will be sold by a well established publisher of scientific books and encyclopedias. As the Swedish example has shown, a foreign language edition can never bring commercially satisfactory results. Therefore, an English language version will be realized if financial support can be found, only. We regret that it is not possible to introduce at least English captions and
legends to the maps, due to the limited size of the pages. It is being discussed, though, to realize a small booklet as an inlay, in which the most important text passages, captions and legends would be translated, if there proves to be demand on the international market.

Print edition

The concept for the print edition has taken up experiences from the “National Atlas of Sweden” and the Dutch “Atlas van Nederland“ which are considered the most advanced and most popular examples of modern national atlases. Due to the tight budget situation, the concept for the German national atlas sticks to author-bound individual articles. Twelve thematic volumes of about 150-180 pages each will comprise between 40 and 50 articles of two or four pages each. This concept does not aim at encyclopedic completeness, but rather at a problem inspired approach which takes up recent and current topics of national relevance. One of these major topics, for instance, will be the German reunification and its consequences on the spatial organization of the country; another one is the globalization and its impact on the living conditions of different groups of the German population. Twelve thematic volumes are planned:

- Society and Nation
- Relief, Soils and Water
- Climate, Flora and Fauna
- Population
- Cities and Villages
- Education and Culture
- Labor and Living Standards
- Enterprises and Markets
- Traffic and Communication
- Leisure Activities and Tourism
- Germany in the World
- Germany – an Overview

The volumes reflect today’s knowledge about spatial distribution and differentiation of the general theme and of themes of special interest. The accumulation of articles of individual authors guarantees a broad variety of approaches, different types of representation and different points of view. It also promises results of recent research, especially by young scholars from all over Germany. Doing so we want to initiate a process of discussion and focus attention on the variety of living conditions in different parts of Germany, and the processes that change the country.

Layout and cartography

The print edition follows a modified concept of the pilot version, published in 1997. With the distribution of 50% maps, 25% graphs and pictures, and 25% text on each spread of two pages, an attractive mix of media has been found. All contributions are limited to a length of 2 or 4 pages. Each spread of two pages should – as a general rule – include a major map of the whole Federal Republic of Germany on the maximum scale of 1:2,75 Mio or the next smaller scale of 1: 3,75 Mio. For themes of a limited spatial incidence, such as mining or harbors, as well as for articles dealing with the international integration of Germany, articles using regional maps only are allowed.

Parting from the topographic map (1:1 Mio) of the Federal Service of Cartography and Geodesy, a base map with more than sixty levels has been elaborated which vary the base elements: borders and administrative units, hydrologic network, traffic infrastructure, cities, woods and hypsometric tints. For each of these elements various levels of increasing intensity are available, most of them in the four scales which will be used for
the print edition (1:2,75 Mio, 1:3,75 Mio, 1:4,75 Mio, 1: 8,25 Mio). In most cases Germany will be shown as an isolated state, due to the lack of comparable information for the nine adjoining countries.

A major incentive for the atlas is the idea, to visualize complex and spatially differentiated information and to present it in an understandable manner, also for readers with relatively little experience in using thematic maps. For the cartographic part, special attention has to be paid to the legibility of the legends. This does not mean, that complex representation and the use of abstract symbols and indicators have to be avoided, but an effort will be made to explain such complexities in special boxes and by specially designed legends.

For the textual parts, the same principles are applied. A general aim for easy understanding and a good legibility does not prohibit articles which include complex analysis and the use of abstract concepts or models. The editorial board will have to modify the authors’ texts if necessary, and add special boxes for a glossary and for methodological explanations. The short texts should include an introduction to the general theme and its development, a description of the spatial patterns and an interpretation.

All references can be found in an appendix which contains information on the authors, about sources of data, maps, graphs and picture material, as well as a list of references and further readings for those interested in amplifying on the topic. An index of key words and terms explained in the glossary completes each volume. There will be no index of localities, though.

**First volume: Society and Nation**

With the official acts celebrating the fiftieth anniversary of the Federal Republic of Germany, in fall of 1999, the first volume of the German national atlas will be published. An introductory chapter by the known sociologists W. Glatzer and W. Zapf will deal with the future of the German society and will elaborate the sociologic point of view on the topic of “Society and Nation”, which in the further part of the volume will be treated in its geographic aspects.

The atlas is not a historical atlas, but a few articles at the beginning will delineate the German history of the last two centuries, putting emphasis on the ever changing boundaries which now will – hopefully – have reached their final shape. Two of eight historical articles will deal with the development of East and West Germany between the Second World War and reunification in 1989/90.

The second section is dedicated to the federal system and its institutions. Another section deals with themes which illustrate the spatial organization of the country, including the official administrative organization as well as institutional subdivisions and regionalizations realized by everyday actions.

The largest section is taken up by the presentation of the modern German society. Following an introductory article about population development, religious and ethnic groups are considered, special aspects of living conditions for children, women, and the elderly are put into maps. Further themes talk about poverty and welfare, education, and cultural institutions. Even though there will be an entire volume dealing with the economy, a small section outlines the economic basis of the country. At last, the situation of Germany in the center of Europe asks for positioning the country in European and in global networks.

This volume touches themes of other volumes in many articles. Hence, it can claim to give an overview and at the same time a preview on the volumes to come.

**Electronic edition**

The electronic edition of the German national atlas will combine the features of an electronic atlas and a multimedia book, even though not all components of a multimedia book – in the general understanding – come into use. As of now, video and acoustic elements as well as animation will not be integrated, for financial as well as for technical reasons. But the prerequisites for these elements are provided in order to facilitate a possible use at any later point in time.
Of all special features of the electronic medium, next to the possibility of including different media, the most outstanding one is its capacity to offer additional functionalities, among them search, active references, and – last not least – interactivity. Our project relies above all on these additional functionalities. The aims of the electronic edition can be summarized in three points:

- the representation of all themes of the print edition in their entirety
- a maximum of functionalities, making use of the possibilities given by the medium, and
- an adequate response to the perceptional necessities and modern demands of readers and users as regards the possibility of graphical representation on a screen.

Within this framework, a concept has been developed, that provides the options of a separate electronic edition per volume as well as a cumulative edition of all volumes edited as of yet. For each theme – the individual article of the print edition – a brief text, maps, graphs, tables and pictures will be included. This part will offer more illustrative elements than the print edition, but essentially will not differ from its printed counterpart. Additionally, the search of special terms and a glossary will facilitate the use. The most important element though will be the interactive module for generating maps, linked to from indicated key words. As a result, the electronic edition will dispose of two quite different types of maps – the unalterable static maps copied from the printed medium and the interactive maps from the map construction program.

The program of the electronic edition of the German national atlas can be subdivided into two parts: the editorial system for the production process, and the graphical user interface. These two parts of the program as well as the two types of maps will be described in the following.

**The editorial system**

For the representation of themes taken from the printed edition, the major part of material already exists. The textual parts have to be adjusted, though, to the necessities of the users. A screen page composed exclusively of text is tiring and unattractive. Therefore, texts have to be subdivided into separate units, and to each text unit a graphic or picture element has to be added. The whole material will be stored in an editorial database administered by an editorial system. This editorial system consists of two components: a supervisor module and a module for site design (see fig. 1).

![Figure 1. Modules of the editorial system](image-url)
With the module for site design, each element, such as text units, maps, or figures, can be located individually. It works according to the wysiwyg-principle with which the editor can decide the layout during formatting process. Through the supervisor module, the objects are equipped with the necessary meta-information: data about their position on the site, data on the type of object, the path where the object can be found, as well as information on links to other objects or to the glossary. From the data of the editorial database, the contents of the user interface will be generated. Data for the construction of maps are stored in a second independent database (see below).

The graphical user interface

The graphical user interface is subdivided into two separate fields: the field of thematic information and the navigation bar. Additional windows open for the functions of the interactive map generating program, the search for key words, and the glossary. These windows are fit into the field of thematic information (see fig. 2). The field of contents shows the pages, created by the editorial system. The individual objects can have different functionalities. When passing non-textual elements with the mouse, hints, titles or subtitles appear. They can function as internal or external links at the same time. Normally, a map element will have internal links (“clickable map”) which lead to a more detailed map, while a photograph will have an external link, i.e. a connection to the www.

![Graphical user interface](image)

**Figure 2.** Graphical user interface and additional windows

In the text units, specially marked single words can also have links. When passing the word, the shape of the cursor indicates the type of link, which again can be intern or extern. As intern links, they can either refer to another theme of the volume or to a definition of the glossary. If they refer to a set of data of the interactive map module, this will be opened by clicking.

The navigation bar serves as orientation and for moving within the atlas. It consists of seven buttons. The main button leads to the index and allows direct access to the search of key words, to the interactive map module, to the glossary, and gives the option for quitting the program. Two further buttons give information on related pages about the same theme on the same level or on the level below. The fourth button is for moving backwards, either to the immediately foregoing page, to the next level above, or to a history of movements. The latter shows the entire path up till now and allows to jump back over several levels. The next two buttons allow movements towards either the last or the next theme according to the index listing. The last button makes it possible to set bookmarks and shows the existing alternatives.
The maps

In atlases, maps always are of highest importance for the transfer of information, even though in modern atlases the complexity of information has been reduced in favor of an easier comprehension and interpretation. Despite this reduction, the printed map can support significantly more information than a map on a screen – at least if one takes the postulate of showing the entire map as a whole. And this postulate has to be kept up while it is considered necessary to give an overview about spatial phenomena. The zoom function provided by the electronic medium can not offer a solution to this problem. But interactivity and the possibilities provided by the functionalities of automatic map generating programs, can offer some new approaches towards map interpretation. Due to the limitations of these automatic map construction programs complex information or representations which vary the commonly used modes of illustration still have to be created as traditionally produced maps, that is with computer supported graphic programs. As of now it therefore is still necessary to integrate graphically produced static maps along with interactively generated maps.

Static Maps

Static maps are not being produced online and therefore cannot be modified. In an electronic atlas, they can be active or passive, though. A map can be considered an active map if by clicking, one or more actions can be activated, if not, the map is considered passive. The German national atlas will use both active and passive static maps. Depending on their size, the maps can be located together with text or other items in the field of representation of the interface. If they are small and therefore low in details, they will be treated as a normal object to integrate, if they are larger and more detailed, a generalized version will be integrated as a link-symbol, which by clicking, will show the whole map in a separate window. There will also be the possibility of various clicking points or clicking surfaces on a map which then lead to regional maps, to further information or to addresses in the internet.

An unaltered use of the maps created with the graphic program Freehand for the print edition is not possible, for reasons of absolute size (27 x 32cm) which would not fit on a screen, as well as for the amount of data which would surpass by far the capacity of a CD-ROM provided for each volume. The low resolution of the screen increases this problem. As a result, the maps have to be reduced in size and therefore generalized in detail, and other minimum dimensions also have to be applied.

As the graphic program Freehand functions by creating information levels, it serves at the same time for producing maps for screens. For each level of the printed map, a level is created which is based on the minimum dimensions for the screen [Müller and Dietrich, 1998] and including the generalization for the reduced map size.

Interactive maps

The module for interactive map generating is embedded into the general program as an external program system via an interface. It consists of two databases, of program routines for cartographic output based on the German map construction program PC-Map, and of a specific interface. When activating the module, it is opened as a window within the field of representation of the general program. When activated as a link, starting from a theme, the corresponding map is generated automatically. Once built up, this map can be altered interactively. When activated from the main menu of the navigation bar, a base map is produced.
Data
The two databases contain geometrical data and contextual data. The geometrical database provides base elements and references for statistical data. These can be locations linked to administrative units or the administrative units themselves. The locations go down to the NUTS-level 5 (community-level = Gemeinden). As administrative units NUTS-levels 2 (federal states = Länder) and 4 (townships = Landkreise) are available in addition to a special level of the “Regions of Spatial Organization” used by the “Federal Agency of Construction and Spatial Organization” (BBR). Representing the area of the NUTS-level 5 is impossible due to limitations of the minimum dimensions.

The contextual database contains all statistical data as well as meta-data about each set of data. This meta information defines the spatial level referred to, the time dimension, the source, as well as the way of operationalization, and the type of data which determines the type of representation for the map.

Functions
The interactive module offers various ways of manipulating data, its representation on the maps, and obtaining information. If the type of data allows it, it is possible to vary the number of classes and the way of classification. It is also possible to search in one or two sets of data simultaneously for maximal values, for minimal values, or for median-cluster.

For the map presentation, color sequences can be modified or changed, and the type of diagram can be varied. Since the type of representation on the map depends on the type of data, it is not possible to choose whether data shall be shown by symbols or by area filling. This is determined by an automatic user guidance. But it is possible to combine two sets of data by graphical supposition. If both types of data ask for an area representation, transparent patterns are put upon the colors. Alternatively, the two sets of data can be seen separately for an optical comparison. In this case, the window will be divided and two maps appear at the same time. Certain functions, such as zooming, will then take place in both windows simultaneously.

For exact information about the background data, an area or place can be activated by clicking and the statistical value appears, or the entire table can be activated. The function works in both directions: when clicking on the map, the value of the statistical table appears, when clicking on a value of the table, its location is identified on the map. Searching locations or districts is possible, as well.

The legend is a constant element of the interface as it is essential for interpretation. It varies with changes of scale and size. If, for example, by zooming into the map a symbol changes its size, the representation of the maximum symbol in the legend varies correspondingly. If it reaches a size that does not fit into the space provided, it disappears.

Topographic base elements
Last not least, after generating the map, topographic base elements can be activated in order to make it graphically more attractive and to allow orientation. There are various hierarchies among the following element groups:
• networks of border lines
• cities
• hydrologic networks
• traffic networks, and
• names.
The elements can be activated individually and are in most cases available on two intensity levels. While the first level can be activated at any time, the second one automatically appears or disappears, depending on the scale of zooming, even though the element might be activated. It is possible that an element only exists on the second level, if for reasons of minimum dimensions and the resulting problems of supposition of elements an activation makes no sense.

**Perspectives and updates**

In view of expected commercial results of the National Atlas of Germany, sales via internet do not seem feasible at present. Since commercial success in the world wide web depends on publicity, and publicity depends on the number of users, it is unlikely that the internet offers an economically reasonable solution. Still, about 75% of the electronic edition is apt to be put into the net. Only the interactive map program is limited to the use under *MS-Windows*. But it is planned to adjust this module within the next years, in order to reach an entirely platform independent version. Further developments are planned for the volumes dealing with physical geography, since only a small part of information is based on administrative units and statistical data. In order to provide interactivity for those volumes as well, other cartographic functions will have to be developed.

Any print edition of an atlas becomes obsolete once it is published. The electronic medium can cope with this problem in an easy and flexible manner. But while the update of a set of data is a relatively rapid task, it takes a lot of time and effort to update maps, graphs and tables. Therefore, it was decided to only update the data for the interactive map generating program. This means that for the cumulative version, each CD-ROM will appear with updated sets of data for all themes published as of yet. For those clients who bought the electronic edition of only one volume, it will be possible given to receive an update through the internet.

We hope to present an electronic edition that at the end of the project contains all twelve volumes on one carrier of data. This comprehensive product will also integrate references from one volume to another. At the same time, a school edition is being considered for both the print and the electronic edition.

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Development of a GIS Online for the Atlas of the “Sabana de Bogota”

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In the scope of the cooperation between the Instituto Geográfico Agustín Codazzi (IGAC) and the Presidencia de la República de Colombia, an extensive study was carried out to establish a spatial database and present the gathered information in the form of a printed atlas.

Advances in technologies over the past years have made it possible to create multimedia atlases in CD-ROM format and with the introduction of the DVD, having a capacity of around 16 Gigabytes, these possibilities will be expanded dramatically. The rapid growth of another media, the Internet, has incremented the sharing of expertise in many scientific fields and has made much geographical information available to a wider public through distributed geographical information (DGI). Many web sites offer the user the possibility to perform spatial analysis, compose his or her map and print or download the result.

In order to make the gathered spatial and attribute information available in a comprehensive way, it was decided to design a web site and incorporate online GIS functionality's, providing valuable information for the decision makers involved in the planning of the “Sabana de Bogotá”. The web site is divided in two main parts; an abstract of the printed atlas with explanatory graphics and a GIS part. The GIS data is presented at two levels of detail; those interested in the general situation of the Sabana can use the regional level and those in need of more accurate information for a specific municipality can choose to consult the local level. Additionally authorized users may download the GIS data in different exchange formats in order to carry out an analysis satisfying their specific needs.

Through the use of image-maps the user can navigate graphically through the site, but a text-only option has been provided for those with a slow Internet connection. Spatial data exploration has been enabled through the simulation of “brushing” techniques. The incorporated search engine allows the location of key words in the accompanying texts.

The site is compatible with the main browsers (Microsoft Internet Explorer and Netscape Navigator) and the fact that no plug-ins are necessary for its operation makes it potentially available to a large audience. The first phase of the project comprises the creation of the printed atlas and the web site based on normal browser capabilities without the use of special plug-ins. A second phase will be based on the usage of commercially available software evaluating the usage of remote map generators, proprietary-data map generators, GIS-data map generators, live GIS interfaces or Net-savvy GIS software.
Introduction

Internet is a network that connects millions of computers worldwide used by businesses, homes, schools and governments. The most popular service Internet provides is the World Wide Web, offering worldwide data access and communications through a user-friendly graphical interface, combining texts, sounds, graphics and animations.

The Internet originally started in 1969, when the Advances Research Project Agency (ARPA) designed a network, which would solve the incompatibility between the existing Local Area Networks (LAN) and Wide Area Networks (WAN). The network was designed in such a way that, regardless of the platform used, any computer could be connected to it, by using a standard protocol [5]. In the beginning the data exchange was limited to text-only, but during the past decade, the capacity of data exchange has increased tremendously, allowing for larger data quantities (needed for audio and graphics) to be transported. With the introduction of commercial Internet providers the Internet has become accessible to most households, and persuaded most self-respecting businesses to offer and promote their services on the web.

The web pages are programmed using a universal language known as hypertext markup language (HTML). It allows the usage of texts and graphics and offers the possibility to create links to other pages in menu form. More complex interactivity has been achieved by using CGI scripts (an independent program that processes data based on certain parameters) and image maps (graphics, in which areas have been defined as hyperlinks) [7]. Due to the static aspect of HTML and the demand to design highly interactive web sites, an enhanced HTML language (Dynamic HTML or DHTML [3]) is being developed by various commercial enterprises, closely monitored by the World Wide Web Consortium (W3C) in order to save guard the principal objective of the WWW, namely compatibility regardless of the platform used. DHTML offers the usage of script languages like JavaScript and VBScript and ActiveX applets to extend the interactivity and capabilities of a web site [2].

With the extended image use in web page design it didn’t take long before organizations involved in spatial analysis and map production began to make use of the WWW, by offering distributed geographical information (DGI) . Additionally, there is a growing need to analyze the spatial data using Geographical Information Systems (GIS), being able to consult attributes, (re-) classify data, overlay multiple maps and perform neighborhood and connectivity operations [1]. Although many people have access to the Internet, only a small number of them have access to GIS software. Therefore, several software packages have been developed allowing the online analysis of spatial data, without the need of having a GIS installed locally. These software package and spatial databases are called online GIS’s. [6]

Objectives of the project

The main objective of the study was to recollect existing data for the altiplane area of the “Sabana de Bogotá” on earth sciences (soils, land use, land cover, geology, geomorphology, socio-economics, etc) in order to present them in a printed Atlas. Additionally, the idea arised to promote the atlas through the use of digital media, and give limited online access to the information gathered for the publication of the atlas. Thereby contributing in the planning process of each municipality which makes part of the altiplane of Bogotá.

The DHTML files of the web site can be used as promotion by distributing them on CD-ROM for off-line consulting. This article describes the development of the web site of the “Atlas de la Sabana de Bogotá”. Due to the low budget of the project, no online GIS software has been acquired, but an evaluation of the different DGI types of software packages has been carried out for the second phase of the project.
Web cartography

The WWW is a popular medium to publish cartographic products, however, it requires a different approach to generate cartography. As printed cartographic products become more advanced every day, by using three-dimensional models, integration of satellite imagery, and high quality output, web cartography has quite some restrictions, due to screen resolutions, software requirements and download times.

The screen resolution limits the size of the graphic and the colors used for its presentation. Nowadays, most household computer have configurations of 600x800 or 768x1024 pixels and most are able to handle 16 bit or 24 bit graphics. When a graphic (map) is larger than the screen resolution, simple scroll bars can be used to scroll through the cartographic product. The biggest restrictions are software requirements, and the download times. In order to attract the visitor, download time should be minimized where possible and no additional software should be required, since this yield higher costs and increments time.

Instead of static maps, dynamic maps can be used, which can either be generated at client side or server side. This increments the attractiveness of the web site, but increases development costs and client and/or server requirements.

The user should have access to basic display interfaces, such as being able to pan and zoom the image. In order to know where the displayed map fraction is located, a small map should indicate this and a legend should explain all symbols used in the map. To increment functionality of the displayed image, the user should have access to attribute data and being able to query it [URL 2]. In order to establish the optimum solution, detailed information about the target group is a necessity. Combining those with the objectives of the site should define the type of web site.

Designing the web site

In order to offer information to the different planning organization (local or regional) involved in managing the altiplane, we decided to have two working scales; local level, to be used for municipalities and regional level to be used by regional organizations. When entering the web site, the following possibilities are available; access to some limited information of the printed atlas, consult the information at local level (select a municipality), consult information at regional level (select a thematic map), perform a key word search, link and info pages and a download page.

At local level the user can select the municipality to consult by using a graphical interface. This level provides a full description of socio-economical aspects. At the regional level, legends give a brief explanation of the units displayed in each map. In case extended explanation is desirable this can be obtained through hyperlinks defined in each unit of the legend which directs to a related page with a more elaborated description.

Through a graphical interface the user can download (depending on its authorization) the GIS data collected for the project. The most common GIS data formats for Colombia are supported. The site has been developed by using Microsoft FrontPage software, since it is easy to use and has low cost, using mainly static HTML and some DHTML features. Regular updates of the web site should be performed, since static web site cause visitors to be de-motivated to return to the site.
Evaluation of alternatives

The used methodology is only one simple and low cost method to reach the objective. The following is an evaluation of the current alternatives.

Raw data download

Web sites that provide this type of DGI service normally have huge databases that can be completely or partly downloaded for no or low cost. The data is normally offered in standard exchange formats such as Arc/Info’s E00 or SDTS. One of the first GIS data providers was the U.S. Geological Survey Geodata Online web site [URL 4]. Another good example of a web site that provides raw data download is the USGS node of the NSDI [URL 11]. Additionally it provides search tools to enable users to find appropriate data sets [6]. Many web sites offer this type of DGI service apart from other main DGI services they may provide.

Static map display

This DGI service consists in displaying pre-designed map images in raster or vector format. No analysis can be performed at these type of web sites. Although it is technically simplistic, this approach will likely have the widest audience because it requires the least amount of browser and user capability. [6]

Dynamic HTML

Many functionality’s comprised be online GIS’s can be simulated by using DHTML and some simple JavaScript or VBScript applets [3]. One can think of “brushing techniques” that would normally require specialized software. Brushing is a technique where, selecting an element in a map, automatically highlights the corresponding elements in other graphics (being related spatially or being attributes)[4]. The DHTML option is low cost, when access to a web programmer is available. No special software is required at the user-end. A pilot project that demonstrates the usefulness of JavaScript is the GeoShop Pilot. In this project the user can combine information from three different sources; information from Cadastre stored in Ingres, topographical data stored in Illustra and flat DXF files for tv cable information [8].

Remote map generators

Remote map generators are used by those with no access to GIS software nor data. Some software developers offer the possibility to use their software and data to generate maps to be published on a clients web site. Based on parameters send in the URL definition the resulting map is generated. The restriction of this type of DGI service is that only data available at server side can be used. In case the user has his or her own data, this cannot be integrated in the resulting map. [6] Most service provide street maps for the US. For instance the web site of Mapquest Connect/InterConnect [URL 6] is a good example. Another example and one of the first DGI services on the Internet is the TIGER Mapping Service. [URL 3].

Proprietary-data map generators

These programs are essentially self-contained GIS software connected to the Web server. When parameters from a browser are passed to this type of generator, a self-contained database is used to generate a map or perform a simple analysis. The resulting map image and any text are passed back to the server, which forwards it to the browser [6]. MapGuide developed by AutoDesk is an example of this type of generator [URL 7].
GIS-data map generators

The GIS-data map generators work the same way the proprietary-data map generators do, with one critical difference; the GIS-data map generators are able to read native GIS data. This gives the advantage of being always up-to-date, since it is reading directly from information stored on the server, which can also be used for local analysis if the server is used in a Local Area Network [6]. MapObjects Internet Map Server developed by ESRI is a software package that belongs to this type of DGI software [URL 8].

Live GIS interfaces

One of the most powerful and flexible types of DGI programs are the live GIS interfaces, however they do perform slowly. The DGI program acts as a gateway between the Web server software and a running GIS program. The gateway reformats the request into a set of commands which are processed by the GIS software [6]. The first true online GIS is GRASSLinks developed by the University of California at Berkeley [URL 5]. Another example of this type of DGI software is the MapInfo ProServer developed by MapInfo [URL 9].

Net-savvy GIS software

This type of DGI software differs from the rest of the software described previously, since it is a client-side application. The difference with normal GIS software is that net-savvy software has the capability to use local data sets as easy as data located on local area networks or the Internet. It natively reads a variety of GIS data formats, and is capable of changing projection and coordinate systems on-the-fly. Net-savvy GIS software is one of the primary goals of the Open GIS Consortium, which is a collective of GIS vendors, developers and other parties whose mission is to increase the ability of disparate GIS platforms to operate together. The consortium’s vision GIS in a distributed computing environment (DCE) includes GIS clients, scattered across the Internet, that communicate with one another and share data. Net-savvy GIS software must have at least three primary capabilities; remote file access (access data stored on the Internet), natively read various data formats (reading GIS data formats without the need of converting them) and real-time projection and positional matching (changing projections in order to be able to combine data sets from different sources using different coordinate systems) [6] [URL 1]. GRASSLAND developed by LAS [URL 10] is a highly capable net-savvy software.

Conclusions

Development of a DGI web site depends on the objectives, target group and budget.

The following lists the conclusions of we reached after evaluating the previously mentioned methods for the creation of an online atlas with analysis functions.

Raw data download web sites are not suitable for the presentation of an atlas, yet the option to provide raw GIS data can make the web site more attractive. In case the information is the result of large scale investigations and the information represents a high commercial value, the data download capabilities should be limited to the meta-data and some “teasers” which show the type of information available but do not allow the client to download the actual gathered data.

Static map display is the easiest way to present the information in atlas form and for its low costs aspect has been the method applied for the construction of the web site of the atlas of the altiplane of Bogotá. Due to limitations of the static aspect, this may result in de-motivating visitors to return.

Dynamic HTML has the capability to simulate various GIS functions, however requires some programming time. For instance, with DHTML the regional map with municipality borders can be displayed, another window
may display attribute information (such as socio-economic data) for the municipality indicated by the cursor position. Large data bases can be read and sorted or queried without the need to re-read them. All of which is not possible with static HTML. Additional functionality can be included by using Java or VB Scripts. This is a good possibility for presenting a highly interactive atlas.

Remote map generators are used for developing DGI web sites by those who do not have access to GIS software or data, and for this reason are not functional of presenting the atlas since only remote data available at commercial servers can be displayed and no user defined data can be integrated.

Proprietary data map generators are generally cumbersome for organizations wishing to distribute their existing GIS data because of its proprietary nature. Since distributing GIS data gathered during the project is one of the objective of the atlas of the altiplane of Bogotá, this type of DGI software is not suitable for this or similar projects.

GIS data map generators are more suitable than proprietary data map generators, since they has the ability to read native GIS data. However, they are normally designed for simple analysis and basic queries. In case some more specific analysis is desired this DGI software type will not be suitable.

Live GIS interfaces are capable of performing most types of GIS analysis. However, they would require the user to have knowledge on how to operate a GIS and perform GIS analysis. The relative high costs of the software in comparison to using DHTML, make this option less attractive.

The net-savvy software are very capable, but are a client side solution. Since the design of the web site of the atlas has as objective the accessibility of a large public, this option is not suitable, because it would require that a large public would own a net-savvy GIS.

When a second phase of the atlas will be executed, DHTML and live GIS interfaces are possibilities of offering high interactivity to the web site. DHTML will require that most common analysis is performed before publishing the static data on the web site. An example of a very simple analysis is the overlay of a land use map with a land use suitability map in order to establish conflicts. In case live GIS interfaces are to be used extensive help pages should be generated in order to assist unexperienced users to obtain their desired results. Both options will need extensive programming.

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Electronic Atlases in Poland: Concepts, Development and the Present Status

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Abstract
The paper presents an overview of the accomplishments of Polish cartography in the field of electronic atlases. After a brief presentation of the initial stage of electronic atlas development, it then characterizes the concepts and presents content of the most valuable atlases of that kind, taking into account their concept, the map contents as well as their interactivity. The paper also contains a complete list of electronic atlases published in Poland.

1. Introduction

The term “electronic atlas” was introduced by Eva Siekierska (1984). It was then adopted by the ICA National and Regional Atlas Commission [Rystedt (1995)]. Starting from the late 1980s, electronic atlases form a group of most dynamically developing general reference cartographic publications.

In Poland, first electronic atlases appeared as late as in 1993. Prior to that time, the use of computer assisted cartography had been limited to the strictly professional applications [Baranowski (1990 (1991)]. Currently published atlases are designed to be used almost exclusively on a PC platform. As to their topics, the majority of atlases is comprised of general reference items, route planner and city maps.

2. Definition of an electronic atlas

The analysis of already existing electronic atlases, both the map themes and levels of detail of the cartographic representation included therein leads us into conclusion, that there exist a number of features different than in paper ones. While there are commonly accepted definitions of paper atlases [Salischev (1959; Horodyski (1979)], the proposed definitions of electronic atlases [Bos (1991; Van Elzakker (1993)] seem much less precise. In particular, they do not state precisely the relation between the particular cartographic representation
which form the atlas, and do not make a distinct division between the electronic atlases and typical GIS software. Numerous attempts at the systematization of these issues have been made so far [Artimo (1994; Ormeling (1995)], however they have not been commonly accepted [Okonek (1998b)]. In order to make the further contents of this paper clear, it is necessary to make the following settlement: if all cartographic publications containing a number of maps linked with a common idea and cartographic realization are to meet the definition of an atlas, also such publication in a digital form should be considered as atlases, even if the word ‘atlas’ did not appear in their title. The described situation happens fairly often in Poland, as a lot of such publications are entitled ‘map’. The Mapa Polski 98 z Ksiazka Telefoniczna [A 19, A 20] (Map of Poland with the Phone Directory) being a detailed route planner with a set of almost 400 city maps can serve as a good example.

3. Criteria for the atlas classification

In the cartographic literature electronic atlases are most often classified by their thematic structure [Ormeling (1995; Perkins (1995; Okonek (1997a], number of separate levels of detail [Okonek (1997a], as well as their interactivity [Siekierska, Taylor (1991; Siekierska (1993; Ormeling 1995; Baranowski (1996].

In this paper, atlases have been classed primarily by their thematic structure, and within the particular themes they have been put in a regional and chronological order. Such a grouping allows an easy distinction of major thematic groups, and within the groups it also allows to follow their evolution. Electronic atlases published so far in Poland on basis of their thematic structure can be divided into general reference and thematic ones. Majority of the latter group is formed by route planners and city maps.

3.1. General reference atlases

3.1.1. Atlases of the World

General reference atlases of the World have been published in Poland since 1994. Mapa Swiata, wersja 1.2 [A27] (Map of the World) and Mapa Swiata dla Windows, wersja 1.2 [A28] (Map of the World for Windows), both published by Cartall are first such publications. The basic difference between them is the operating system (MS DOS and MS Windows). The map contents remain almost unchanged, however their graphic design was modified. The content is composed of continents with major hydrographic features (rivers and principal lakes), selected summits, international boundaries, populated places presented with nominal points, a principal road and railroad network as well as physical regions. The atlases do not have any graticule. The particular thematic layers can be also viewed separately. However the cartographic correctness of these atlases is far from the commonly acceptable standards. This is mostly caused by huge distortions of the presentation of continents, international boundaries, improper location of certain objects, as well as by the violation of most of the rules about positioning lettering with respect to linear and areal features.

Three editions of the Atlas Swiata [A3, A5, A6] (Atlas of the World) published by the same company, are the next step in the Polish general reference atlas publishing. They contain a main map and a set of 109 thematic maps. The set of statistical data, text descriptions of countries and major cities as well as photographs form the additional content. The main map is composed of nine thematic layers. The software also provides the possibility of enlarging the selected area. Nevertheless, also this atlas cannot be considered to meet any principles of map elaboration. The fact, that lands and oceans are presented in a completely different projection serves as a prefect example. The particular map layers most often include only a very poor selection of features. For example, 96 rivers and 82 lakes [Okonek (1996a] form the whole hydrographic layer of this atlas. The atlas also contains a set of 109 thematic maps divided into two separate groups: 7 isarythmic maps (mostly climatic), and 102 choropleth maps (mostly economic and demographic).
The next electronic world atlas was published in 1998. This is the *Wielki Multimedialny Atlas Świata* [A36] (Great Multimedia World Atlas) published by the PPWK A. on 2 CD-ROMs. It contains raster maps adapted from the printed atlas published by the same company. The content of the atlas includes general reference maps of the world, particular continents and major regions. It is also enriched by a rich set of thematic maps of the whole world and continents both of physical and socio-economic content. The whole atlas contains 470 maps and an index of 4 thousand geographic names. When compared to the previously described Cartall atlases, the cartographic level of the PPWK atlas is much closer to the level that can be acceptable, however its major drawback is a very low level of interactivity.

### 3.1.2. Atlases of Poland

The first electronic atlas devoted to Poland was the *Szkolny Atlas Polski* [A33] (School Atlas of Poland). The atlas was designed mostly to assist schoolchildren in their geographic education [Tarasiewicz, Krzywda-Pogorzelski (1995)]. A general reference map of the whole country with nine thematic layers serves as a basic map. It is possible to display any combination of the layers. The atlas also contains a set of 62 thematic maps, in two separate groups; 33 maps in the ‘Thematic Maps’ group and the remaining 29 in the ‘Statistical Maps’ category. The former is composed mostly of physical maps, the latter being devoted to the socio-economic issues. Another part is formed by 49 maps of 1st level administrative areas, containing populated places and basic hydrography (streams and water bodies). The *Szkolny Atlas Polski* also contains a statistical dataset (.pdf format), serving a base to display various choropleth and graduated symbol maps. The software also offers a feature of elaborating custom statistical maps by the user. All maps are raster.

*Atlas Polski* [A2] (Atlas of Poland) published by Cartall is a next atlas of this kind. The cartographic part of this atlas consists of four elements. The general reference map in a vector format with 5 levels of detail serves as a basic map. A set of 27 thematic maps of both physical and socio-economic contents is the second element. Each of these maps is available in two levels of detail. The maps are stored in raster format. *Atlas Polski* also contains a set of 7 city structure maps of the Poland’s largest cities and metro areas. Finally, it also incorporates 114 statistical maps - choropleth and graduated symbols. [Okonek, 1998a].

The third atlas of Poland *Krajoznawczy Atlas Polski* [A10], (Landscape Atlas of Poland) was published in 1998 by the Gdansk Multimedia Group. Its cartographic content is comprised of 24 maps accessible through two separate menu options (Maps and City Maps). A set of maps of the whole country incorporates the following themes: topography, forests, physical regions, environment protection, tourist areas, transportation, industrial areas, administrative division, as well as 6 statistical maps. It also contains 6 city maps: Gdansk, Katowice, Krakow, Lodz, Poznan, Szczecin, Warszawa and Wroclaw. The particular maps have from 1 to 4 levels of detail.

The latest, multimedia *Szkolny Atlas Polski* [A_34] (School Atlas of Poland) was published by Wydawnictwa Szkolne i Pedagogiczne in May (1999). It is a joint effort of the co-operation of the WSiP, the Ambient software company and the GRID-Warsaw, where all atlas maps have been designed and elaborated. The atlas is divided into a number of elements, which enable to access geographic data with the use of different media. It contains over 180 cartographic representations divided into 6 thematic groups associated with the area presented: World, Europe, Baltic Sea, Poland (general reference map in 2 levels of detail map and thematic maps), city maps as well as statistical maps. High interactivity is a distinctive feature of this atlas. The user can create customized maps by displaying selected thematic layers. The software also offers the possibility of saving such information as a separate file and/or of printing it. All maps are raster. Moreover, the user receives the access to a vast database, that can be visualized with choropleth and graduated symbol maps. It is also possible to keep the data up-to-date through the Internet. A separate group is made of the landmark maps, which provide information on spatial distribution of over 600 objects of cultural, environmental or economic importance (also presented on a photographs). *Szkolny Atlas Polski* certainly is top class software (both cartographically and technically), presenting the geography of Poland.

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It should also be noted, that it is planned to publish the *Atlas of the Republic of Poland* also as an electronic atlas [Andrzejewska, Baranowski 1996]. The traditional paper edition was completed in 1997. The publisher plans to start the elaboration of its digital form in 1999. The content will reflect the original paper product thematic structure, however it will also incorporate certain multimedia features.

3.2. Thematic atlases

3.2.1 Route planners

The route planners form the largest group of electronic atlases published in Poland. They are also worth noting, as they usually provide a high level of interactivity. The trip planners published so far, devote to Poland, Germany and Europe. The first route planner of Poland was published by Sophonias Cartesco. This was the *Mapa Polski, wersja 2.0.* [A24] (Map of Poland, version 2.0). It contained a transportation network at a base of a raster presentation of hypsometry, hydrography and a few thousand of populated places. A set of 21 city maps was also added. The major changes in next editions (*Mapa Polski, wersja 3.0 i 3.1*) [A25, A26] consisted in increasing of the number of populated places and adding new city maps [Z. Taylor 1994, 1995]. At the same time, the Sophonias company published a similar route planner entitled Geo Graph v.3.1 dla Windows [A8]. More visible changes appeared in two next versions of the *Mapa Polski* [A21, A22] [M. Okonek 1995]. The change of the operating system (MS Windows) resulted in major improvement of the map’s graphic design. The raster hypsometry was converted to vector format. Also, the number of city maps grew to 48 and 144 respectively. The number of details of the main map was increased, and the route planning functions being greatly improved. Other publications include the *Komputerowa Mapa Polski Auto Plan 1.12* [A23], published by Next. It contained five categories of roads [Okonek, 1997b].

However, the turning point of both the map content and the number of route planning features was in 1998, when two editions of the *Mapa Polski 98 z Książka Telefoniczna* [A19, A 20] (Map of Poland with the Phone Directory) were launched. The atlas combines a cartographic database and a business phone directory. The cartographic content is composed of a 1:200,000 scale base map (52 thousand populated places) and almost 400 city and town maps: some of them include the street numbering. The software offers a wide selection of trip planning functions.

The group of atlases of Europe is formed by 3 publications: *Mapa Europy. Wersja 1.2.* [A15], *Mapa Europy dla Windows. Wersja 2.0.* [A13], and *Wersja 6.0.* [A14]. Also, two atlases of Germany have been published: *Mapa Niemiec dla Windows Wersja 1.0* [A16], and *Wersja 6.0* [A17]. Both the atlases of Europe and of Germany incorporate similar function as the early route planners of Poland [A21, A22].

3.2.2 Tourist atlases of cities

Electronic atlases of particular cities can be divided into two distinct classes. The first of them is composed of publication containing a raster city map, enriched with a set of thematic maps covering the surrounding areas. As to they interactive function, they usually provide a possibility of searching the street names. Often, such atlases also include rich multimedia features. Four of such atlases have been published by Polsoft. These are: *Lodz. Multimedialny Plan Miasta* [A12] (Multimedia City Map), *Warszawa. Multimedialny Plan Miasta. Wersja 1.0* [A35], *Gdansk. Multimedialny Plan Miasta. Wersja 1.0* [A7], and *Krakow. Multimedialny Plan Miasta. Wersja 1.0.* [A11].

The other group is formed of publications with maps stored in a vector format. These atlases provide the possibility of visualizing the selected thematic layers. So far, three such atlases appeared *Komputerowy Plan Warszawy. Wersja 1.0,* [A9], (Digital Map of Warsaw) published Attec & softKart, *Wroclaw. PLAN miasta* [A36], as well as the *Plan Warszawy w skali 1:10000* [A30] (Map of Warsaw at a scale of 1:10,000).
3.2.3 Environmental atlases

Atlases presenting the state of environment require, in a greater degree than the others do, to be enriched with non-cartographic illustrations. The presentation of spatial objects in a form of photographs or video files can also be completed by animation showing the progress of processes with demonstrative drawings or schemes. The dynamics of environmental features is more often presented with the use of animated maps.

In 1994 the UNEP/GRID-Warszawa elaborated the Electronic Atlas of agenDA 21 - ELADA21, which was designed to present the contents of the documents of the 1992 Rio de Janeiro Conference. This was a program of activities for the 21st century, a joint outcome of the agreement of almost all countries, leading to the achievement of uniform development aiming at the preservation of natural environment, without affecting the civilization progress. Its first chapter, transformed into a demonstration program referred to the issues of biodiversity. Such national scenarios were prepared separately for nine countries, with a uniform structure. The Polish scenario can be distinguished by the comparatively large share of maps showing the spatial aspect of biodiversity in the total number of illustrations. The program contained 25 maps for the total of 300 screens forming its contents. Most of these maps were static illustrations of environmental issues, only a few were interactive. The Polish scenario of ELADA21 is in the English language, however the up-to-dated Polish version will be elaborated in 1999.

Since the national atlas of Poland in its electronic form had not been initiated, the preliminary stage of elaboration of the Elektroniczny Atlas Srodowiska (Electronic Environmental Atlas) was recently set out. It is planned to publish this atlas within the next two years. Its main purpose is to present the state of Poland’s environment, its degradation and the activities to protect it in a modern cartographic form. The software will incorporate advanced multimedia functions in addition to the possibilities of cartographic presentation of the environmental data. Also, it is projected to include the Internet data exchange functions. This atlas will be published in Polish, but a selection of maps in the English version will also be accessible through the WWW site. Apart from the analytical maps presenting the state of mapped phenomena, also synthetic maps presenting interaction between the particular phenomena will be included. A number of indices adopted by the EU and UNEP, both simple and complex, will be incorporated in this atlas in order to achieve a comparable view on the environment of the country.

4. Concluding remarks

Electronic atlases form a very dynamically developing category of cartographic publications in Poland. However, when compared to the leading countries, the share of electronic atlases in the total number of atlases published is much smaller. As to their thematic structure, so far, no national and regional atlases have been published. It should also be noticed, that few typical cartographic firms produce electronic atlases. Most of them are published by the software firms.
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Atlases


[A8] GeoGraph v.3.1 dla Windows, Lodz [1994], SophoniaS Sp. z o.o., 2 FD 3.5


[A23] Mapa Polski. AutoPlan 1.1, Next


[A29] Mapy Polski v. 1.3 samochodowa i hipsometryczna (Amiga), Lodz 1993, Sophonias Cartesco, 1 FD 3.5, instrukcja 4ss.

Creation of the electronic version of the National atlas of Russia

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The National atlas of Russia will be made in traditional printed as well as electronic versions. Usage of the same initial information allows to co-ordinate creating processes for both versions in technological way. Work for electronic and paper versions of the first volume of the National atlas of Russia is carried out in parallel way. Electronic version plans to be ready in 2000.

The electronic version is the representation of the National atlas of Russia in the digital form in vector and raster formats. It could be reproduced on the screen of display and let to make such operations as scaling of image, moving across the map, measuring of distances and areas, the automatic determination of geographic co-ordinates, search of objects according their names in the data base, screening of the object reference data from the data base.

The electronic version of the first volume of the National atlas of Russia will be:

- to work in the system of IBM-compatible PC, which are 95% of all the computers in Russia;
- to ensure the space attachment of the objects (in geographic co-ordinates) with the exactness not less then in the printed version;
- to circulate and to handle to users on CD-ROM’s.

The electronic version will be in future updated and added with new materials by the issue of the additional CD-ROM’s.

The information from the electronic version will be represented as the images of Atlas page, map or other element of content, fragment of map or single layer of map.

The user’s manual and the brief description of content, published by printed way as booklets, would be added to the electronic version.

The design and manufacturing of the soft- and hardware protection facilities against the unauthorized circulation of the Atlas are developed in the process of creation of the electronic version. The limits of the installation numbers (the total and for single user) would be established.

The electronic version of the National atlas of Russia would be consisted of: the vector files (maps), the raster files (space and ground photos, drawings), the text files, fitted data base, the software system, the user’s shell.

The electronic version of the National atlas of Russia would be completely identical, as its content, to the printed one.
The electronic version is differed from the printed one by:

1) the possibility of realization of operations (scaling of images, moving across the map, measuring of distances and areas, the automatic determination of geographic co-ordinates, search of objects according their names in the data base, screening of the object reference data from the data base),

2) the arranging (texts, tables, diagrams, drawings and so on are not lodged in one sheet with the map, but displayed from the data base separately; there are the diminished variant of each sheet, it is permitted to see the map as a whole on the 14-17” display and the basic variant in the scale of the printed version of map, it is permitted to inspect the map partly),

3) the possibility to output and to search of single subject layers of the maps,

4) the existence of the data base, which is included the more reference data in comparing with the printed version, for example, the data about geographical objects from the statistical hand-books and encyclopedia),

5) the possibility of including of multimedia effects (animation, sound).

The compatibility of the electronic and printed versions is guaranteed by the using of common initial materials, by the unified technology and the unity of the version content, by the transfer of the files of the printed version for creation of the electronic version.

The electronic version of the National atlas of Russia would be the base for the creation of the geographic-information version of Atlas and the forming of national information and cartographic system. The geographic information version would in comparing with the electronic one have the spacious data base, updated regularly, the extended software shell, working in the certain operating environment and permitting to conduct the different operations with the cartographic and other information (simulation of the processes and situations and so on).

The electronic version of the National atlas of Russia would be functioned in the next modes of operation:
- the reading from the screen of display,
- the executing of above mentioned operations,
- the output on printer.

The design of electronic version is based on the following principles:

a) the accordance to the international and national standards for the geoinformation,
b) the accordance to the automatic information systems,
c) the securing of the hardware, software and legal protection of the electronic version information,
d) the creation of the software shell in Russian and English,
e) the including the effective reference and searching system into the electronic versions.

The software facilities are ensured the transfer of the vector files from Macintosh to the PC-system (FreeHand 7.0), the analogous conversion of the files with the captions of names, the editing of the vector images, the assembling of the pages of Atlas from the vector, raster and text images, the division of layers, the colour correction, the forming of Atlas shell. They includes:
- the Windows 95, 98 software,
- the special software FreeHand, Photoshop, CorelDraw, Adobe Illustrator,
- the software for vectorization,
- the software for editing of vector image ARC/INFO, AutoCAD,
- the user’s shell.

The user should have for the working with the electronic version PC not less PC 486 or Pentium with the memory not less 16-32 Mb, CD-drive 8-12”, 14-17” display. The computer should work in the software environment Windows 95, 98 or Windows NT. The user should not buy at this condition any additional software products.
Creating of the Atlas electronic version begins with user’s shell supplying contact of the user and the Atlas electronic version: entering, storing, synthesizing of graphic data and making hard copies.

The user’s shell – the software product for visualization of the electronic maps, the scanned space photos and for the access to the database. It should be worked under the software environment MS Windows 95/98/NT, localized (Russian) or having any program of russification. The vector, raster and text layers would be used in the system.

The user’s shell is guaranteed the standard set of operations for the Windows software:
- the scaling of image,
- the increasing and decreasing of the image by the window (Zoom),
- the measuring of the distances and areas,
- the measuring of the geographic co-ordinates,
- the receiving of the cartographic information about the object, selected by the user (from the fitted data bases), and the existence of the information and reference system.

The information and reference system is guaranteed the search:
- maps (according to names, schemes of disposition, the most important geographic objects),
- space photos (according to names, to the attaching to objects), parts, for which there are the space photos, should be marked by a special sign,
- the text information (according to titles, themes, attaching to objects and sheets of maps).

The helping system is provided in the information and reference system. The user’s shell would be included tables of conventional signs. The user’s shell could be modified for the using of multimedia facilities and for the distinguishing of the subject layers according to the subject volumes of the National Atlas of Russia.

The following initial materials are used at the creation of the electronic version:

1) The sets of files for each sheet of atlas (pages of volume with maps, the conventional indications, page numbers, map names, tables, diagrams, texts, frames and out-framing get-up), prepared in the result of treatment of the materials for the printed version on the Macintosh computer-edit system in FreeHand 7.0 program product. The files with the cartographic and other images could be used at this condition after the graphic editing. The files with the captions of names are converted from Macintosh to IBM-system.

2) The raster images (the space photos, the ground photos, drawings, the reproductions of the old maps and so on) in the TIFF-format with the resolution not less 300 dpi. The space photos are scanned for the using as in printed version and in electronic one. The colour correction and colour separation are used for these scanned photos. The files with the photos, processing by this way, are transmitted for the creation of the electronic version.

3) The text materials (the text issues, the geographic references, the annotations to the space photos, indexes, the statistical information, the output data and so on), composed and edited on the IBM-compatible PC in the ASCII-format in the Word 7.0/97 under Windows 95/98/NT. The common for the electronic and printed version phase is included according to developed technology the editorial and preparatory works, the scanning of the initial cartographic materials and their vectorization in Macintosh computer-edit system in FreeHand 7.0 program product, the symbolizing of the map objects according to the accepted arranging.

The format of the FreeHand program product is the internal format, closed for programming. That’s why it is impossible to create a converter for the direct transformation from this one to the universal vector DXF-format. Files of graphic information cannot be directly loaded into user’s shell of the Atlas, so files stage by stage are converted to universal graphic format DXF.

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The conversion is executed by the applied CorelDraw product, where the vector DXF-file is created.

Then linear and square objects are edited by ARC/INFO and AutoCAD programs. After that inscriptions of geographic names and other word elements, symbols of which were before set as their codes, are converted into inscriptions curves.

Edited vector layers are converted from DXF format into inner format of the Atlas program system, that will be closed for using in other programs. In this program system each cartographic object is edited: colour, type and width of line are set, square objects are coloured according classificator.

Attributive data base are made in user's shell.

Space images, general photographs, pictures are scanned and transfered into raster format. For proper inflorescence (close to natural) colourcorrection takes place. This work must be made by experienced specialist, who knows real image of the place. After colour correction the Atlas page is installed, there are raster images, its cartography attachment and text.

Vector and raster images, texts, reference data bases are loaded into user's shell of the Atlas electronic version.

The fitted data base, which is included necessary information about the objects, imaged on the maps, is linked up to the objects.

Prepared files for all elements of the Atlas electronic version are recorded on compact disks and duplicated.

Work for electronic and paper versions of the first volume of the National atlas of Russia is carried out in parallel way. Electronic version plans to be ready in 2000.
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Status of Atlas Cartography in Tanzania — ‘Meeting specific group demand of maps and creation of large scale Digital dB.’

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Abstract

The review period of an atlas maps in Tanzania is recorded to be at an average of ten years. Fortunately, since 1976 when last edition of atlas was made, there has been no any new or revised atlas edition either as special publication or under atlas map publication series by the Surveys and Mapping Division. There are so many reasons for this stagnation but, lack of financial support together with less attention to atlas map production by the national mapping authority are considered in many cases as major factors. Many researchers and in particular private business information explorers have been looking for a revised atlas map of Tanzania unsuccessfully. An atlas map is a basic source of information to many researchers where it provides primary reconnaissance or pilot data. As a teaching facility and historical archive tool, atlas maps are highly demanded right from primary to secondary schools and higher learning Institutions. There are hardly atlases made today by private or government organizations that depict current Tanzania’s culture. For over 20 years past, none of the collected information for atlas revision could be published using the national atlas series. The available small size atlas map (A4) are purely made for general reference and are of very low quality while prices are high. These atlases don’t meet majority demand. Few available atlases made from abroad are too expensive for majority to afford. For example, average price of A4 size atlas which including about 18 pages was $5 in 1998. Considering majority’s minimum wage in Tanzanian, civil servants wage is $50 p.m. Thus, the price of a single atlas covers about 9.9% of the civil servant wage at average.

Today, the world is fast moving to digital atlas technology. Tanzania is one of the recipient and implementers of this technology. Atlases are digitally available in different format and thus, forming an affordable atlas accessibility environment to majority. Tanzania is not yet at position to do this although well equipped with digital data capture tools. Future position of Tanzania’s atlas mapping progress is not yet known till this moment. Since Cartographers of Tanzania are aware of the situation, it therefore presents a challenge to us on what to do further. Understanding truth about status of atlas map in Tanzania, is one of the reconnaissance or pilot base point for investor who wishes to invest in this country for production of atlas to catch the immediate map user market.

This paper gives in summary the status of atlas mapping in Tanzania. The history, present situation and internal efforts as experienced or researched by myself and from other scholars. Future outlook of atlas mapping in Tanzania is given weight together with focus to Cartographers role, also challenges to Surveys and Mapping Division (SMD) authority. An advise to establish digital atlas mapping unit which is not yet there in Tanzania is being set forward. The greater effort which were given by Mike Shand and Eugene Silayo in their 1996 paper at Addis Ababa Ethiopia, are also supported here as with emphasis on the need to have a rated atlas map in Tanzania. Proper choice in the atlas production methodology and technology and technology will save time and as well as economic growth. It requires however, competent designers, reasonable cartographic skills and capable digital equipment which I would say both are present at SMD. Comments of this paper suggest on the establishment of digital atlas map unit at SMD in Tanzania now because, the Surveys and Mapping division is already well equipped.
Introduction

General overviews to the atlas Cartography in Tanzania

A copy of printed atlas map or its page is becoming difficult to get or access to it wherever may be found in Tanzania because, there are no atlas map made for sale at the SMD’s map shop today. Only three editions of the past atlas map from all the range of pre and after independence atlases can be found in some places in Tanzania. One of the reasons for the difficulties in getting past atlas maps is lack of reliable storage facilities and uncontrolled accessibility to original atlas map manuscripts. Many of the original materials are either not available or not in printable due to their condition. This kind of situation which one may rather call it as “the beyond serious problems in the historical atlas map tool or facility of analysis for the use by future generation” in Tanzania, is no longer reversible. The existing atlas map pages of 18th up to early 19th century are very difficult to handle, as they have almost turned into paper powder form. Good example of this is found from the 1957 Tanganyika atlas map pages available at SMD. They can hardly be handled from the place they are being kept before independence. There is still a big room for discussion about the history and development of atlas map in Tanzania because, neither of the map production sectors in this country has being well researched. However, most of atlases and maps were considered as confidential document in the past. Atlases produced in Tanzania by SMD used to be as government official documentary series. That, no one could purchase it unless by permission or by giving an acceptable reason which is directly related to use. The SMD in most cases use to distribute new edition of atlas to some Ministries whom in particular had their information included in the publication. For the rest of the time since colonial period to independence, the D.O.S (Directorate of Overseas Surveys) was the map or atlas data collector and production advisor in Tanzania. Today, atlases are commodity like others goods and can universally be produced. Difficulties are in the publication of atlases by the private atlas producer using SMD’s current digital dB. This is due to the presence of low degree in the information liberalisation. This situation is still a problem in many sectors in Tanzania, and in particular mapping. No even a single copy of atlas is available at SMD’s map shop for sale today.

Historical overview of Atlas map in Tanzania,

History of Atlas map in Tanzania is somewhat veiled in obscurity before the arrival of the Islamic Asiatic. Though atlas maps illustrating the information about Tanganyika as part of Africa’s continent were prepared for travellers and historians, yet majority of the land of this country remained clothed in mystery pierced only by legend and hearsay. Ancient geographers could only show much information about the interior part of this country. Slave trade centres and ivory trade routes were areas of interest in these early atlas maps. Cartographers who came after the ancient geographers expunged much of details and thus promoted atlas making and its skills. To the time of A.D 150, Ptolemy the traveller and discoverer knew about Great Lakes in East Africa-Tanganyika. These water bodies included lake Victoria or so called lake Nyanza today and which is a source of the Nile rivers head. Smith’s new kind of atlas map page of Africa which comprised Azania region to specify the approximate geographical position of Tanganyika territory was drawn in the year 1815 (see map 1). In Tanzania, the history of atlas cartography is said to commence about A.D 750 when political and Religious dissension’s broke up the unity of Islamic Asiantics. Pedro da Covelho, the Portuguese man who in 1490 is said to have come from Goa as 1st European, visited coast of Tanganyika and in particular Sofala build up this history. Vasco da Gama who rounded though up to Cape of Good Hope in 1497 and later reaching Mombasa via Malindi through Tanga region coast Tanganyika, contributed a lot on the understanding and drawing of the route-atlas map of the Tanzania-East Africa.

One of the oldest Tanganyika atlas map page was drawn during the discovery period. It was showing Kilwa area with the tittle ‘Quiloa’ in 1506 (see map 2). However, Islands of Zanzibar (Pemba and Unguja), which are
parts of Tanzania Union today, are not well known of its atlas map history (see current status on map 3 of the Islands). A atlas map page from ‘Braun and Hagensburg in 1591 and another one from Munster after Ptolemy Basle 1544’, partially includes the Zanzibar Islands. (see map 4). The beautiful Islands of Zanzibar were under Arabs Colonies most. Historical experience on atlas map making interests does in fact suggest that, Arabs were not very much interested to Cartography but rather, in Ivory and slave trade. It is essential to realise that, there is no way one can talk of Tanzania country without its Islands, which has being long time mistakes. Although some of the researchers and writers have developed tendency to consider independently Zanzibar and Tanzania Mainland while under one map subject ‘Tanzania’, it does in fact makes no sense. Around the year 1850 still very little was known about atlas Cartography of Tanganyika but through the European explorers and specifically Missionaries Krapf and Rebmann, Von der Decken, Burton Stanley, Livingstone and many others, atlas maps became necessary geo-referencing elemen. This is what resulted in the production of large scale maps of Dar Es Salaam which were in 1891 and another in 1941 (see map 5 and 6). Today, there are more digital data than it was in the past. Atlas pages could simply be derived from already made district maps like the one on map7 & 8, Kinondoni district in Dar es Salaam region and Kisarawe districts in cost region.

Discussion

National atlases of Tanzania

The atlas publication era in Tanzania is somehow in two periods. Time before and after Union of Tanganyika and Zanzibar. Atlases produced before the Union could be termed as Tanganyika editions while those published after to be of Tanzania editions. Atlases published during Tanganyika era were purely based on exposition of national natural resources. They were of much political objectives towards independence than for society multi-disciplinary purposes. However, atlases by its nature it was an education facility. It was spreading the information about town and territory trade growth of the ruling emperors. It was governments right to publish and own atlas and not any one else. The degree of confidentiality to atlas data sources (topographical maps), was very high. Atlases published were of big sizes almost three by two feet in dimension, heavy but of high quality and durable. Summary on fig 1 gives in detail three atlas edition which falls under Tanganyika era and which cover the period from 1906 to 1964.

After independence of Tanganyika 1961, and in particular five years later in 1966, 1st edition of Tanzania era atlas was published. This atlas was designed as an essential document of furthering of education, public information and development. The late Prof. A. Babu who by then was a minister for lands, settlement and water development said the atlas publication at that time, “will be of value in the international field to all those people with an interest in Tanzania.” Meaning that, whether in trade, tourism or education sectors, atlas was so important for development planing. Its most important function is still to provide a basic and easily referenced volume of Tanzania’s human and natural resources for use in the planning process. These were Babu’s comments and vision some 30 years ago about validity of atlas map in this country. At that time, atlases were compiled and printed by ministry of land. Data from other ministries, parastatal organization and some private bodies including the University of Dar es Salaam were also incorporated. As an historical document, the 1st edition of atlas after independence of Tanzania was completely financed by the government to give a symbol of respond to policy of self-reliance as was marked under Arusha declaration 1967 by Mwalimu J.K Nyerere (1st President of Tanzania).

Publication of he second edition of atlas of Tanzania was in 1976. It was meant for the same objectives as previous 1st edition. However, point was made upon the usefulness of this atlas in explaining the way in which the forces of the weather play upon human and natural resources. It was made also to enable all the citizens of Tanzania to obtain in totality clearly the picture of their country. This atlas was in many respects explaining...
how the state functions in the economy field. This atlas contained lots of illustrations and pictures were accompany with atlas page map theme. For example, agricultural distribution at national level was accompany with pictures of clove harvesting from Pemba island in Zanzibar. The same case applied to maize in Iringa region, coffee in Kilimanjaro, and Bukoba, sisal in Tanga, Fishing, sugar cane, wildlife, etc. One could get immediately the impression of what is where and how it looks by using his/her minimum knowledge or the understanding. The minister for lands, housing nad urban development at that time, T.Siwale (M.P), said that this atlas was a sort of bench-mark recording for posterity where the national stood at a given point in time. Fortunately as I would say, Tanzania was at that time moving towards socialism or Ujamaa policy which was based upon 1st President ideology. Although status of this policy can’t be explained easily of its success or failure, it is considered positively as use of atlas tool to educate and change peoples mentality to better collective kind of life in Tanzania. In deed, this atlas was used as one of the spreading tool of the Ujamaa policy through education and by using illustration which were accompanied with many phrases like “Uhuru ni Kazi” meaning Freedom mean hard working, “Ujamaa ni imani” meaning that socialism is a believe, etc. T.Siwale (M.P), stated further that, an economic structure or a set of data recorded and expressed in a work of atlas will portrait a false picture unless updated, amended, and changed systematically. Essentially, then, this atlas work recorded the position of an independent nation, only sixteen years removed from colonial status and already well on its way to development.

As I would say, the year 1976, was a peak to reach in the national atlas publication series. Atlas publication work was so deterministic and was considered as future mirror upon society demand of large and small scale maps for general reference.

**Professional/academic atlases of Tanzania**

*Tanzania in maps (academic atlas)*

Researchers from the University of Dar es Salaam are among people who contributed much to atlas progress in Tanzania. Prof. Mascarehnas who was and still a member of nation atlas publication team had done a lot to bring back the life of national atlas but fortunately no new or up to date atlas edition since the 2nd edition was published in 1976. “Tanzania in map” the atlas of year 1975, is one of the oldest atlases placed at the general reference part of the University of Dar es Salaam main library. It is unusual that no any up to date national atlas at the library for the use to meet current University’s demand. It is still very difficult to get atlas map in digital form using the CD-ROM or any other modern technology as part of the University library because, no atlas material made (digitized) for this purpose.

**Soil Atlas map of Tanzania (professional atlas).**

One of the few large size atlases published outside the national mapping agency the SMD, was the soil atlas map of Tanzania 1983. The author of this atlas was S.A.Hathout senior lecturer, geography department, University of Dar es Salaam. The atlas made was focusing to the land and its major components; soils, minerals, vegetation and water, which until today have vital role in the process of economic development of Tanzania where agriculture is the mainstay of the economy. Fortunately, this was the 2nd edition of large soil atlas made although the author stated that, it was not a detailed atlas for regional analysis of Tanzania. It had 49 maps that were dealing with particular parametric component of land where, each single page of this atlas was designed based on reliable classification covering national variations. Also, it was designed to strongly adhere to cartographic representations. Unlike national atlases made by the SMD, the soil atlas was purely designed and made as research furthering document. The agronomic potential including soil genesis, vegetation, water availability, soil fertility, lithology of the parent material and soil erosion were presented first. Complimentary material for this atlas was, and still are available from forth book “resource of Tanzania” at the Institute of Resource assessment, University of Dar es Salaam.

Fig 1: Atlas maps series as were published in Tanzania since 1906 to time.

Key.
- Atlas 1906-1942 (35 years old)
- Atlas 1942-1948 (5 years old)
- Atlas 1948-1956 (7 years old)
- Atlas 1956-1966 (10 years old)
- Atlas 1966-1976 (10 years old)
- Atlas 1976-1986 (10 years)
- Atlas 1986-1996 (10 years No publication)

Prepared by L.V. Mtaroni Nov. 1998
These kind of information which are acquired at large scale and summarized to enable user get proper impression, can not be found from the regional or other topographical maps which are made as single sheets. That is why atlas became an important source as provider of variety of analysis information to different sectors. Basically, an atlas as on one book (a book of maps), and not as single topographical map sheets. However, it is very expensive to collect data, organize them and present as atlas page or book because it involves long cartographic procedures. For example, the 1983 soil atlas has its original information compiled at scale of 1:2mill using aerial photographs. Later, the compilation was reduced photographically into scale of 1:4mill. This is a typical type traditional cartography work.

In the digital atlas system this wouldn’t happen. Instead, digitization could follow right after the interpretation of aerial photographs. Which will immediately mean no manual compilation, few labor time, few materials, less error compared to photographic reduction, creation of permanent data which is accessible, reliable and flexible in digital format.

**Future outlook of atlas map in Tanzania**

Mike Shand had pointed out about a certain digital atlas program under supervision by Glasgow University since 1996. But until today nothing can properly be said although there might be some progress that are not yet in the world network. One the great problem that is assisting in delaying atlas progress in Tanzania is the lack of transparency during the planing of atlas work together with its publication. That, SMD keeps data and atlas map progress in secret while academicians are in need of transparency to be sure of what is to assist where and understand the extent of atlas problem. People although don’t have authority to publish atlas, would like to see SMD reluctance to data and ready to incorporate other atlas professional closer than now. During my research at digital mapping unit I could realize that, there is a program called “Atlas 2000”! To be sincere this came to my mind accidentally because if this was considered true as I may say then, it is not clearly known even by those who are expected to work in the digital atlas unit to be. It is important for the government to retain confidentiality for matters of national security, but I don’t buy the idea that confidentiality in professional progress will assist. Perhaps I would say this, improper administrative conducts and management bottlenecks which are resulting from the superstructure (status quo nature), and personalization in the working places are core factors to the atlas progress in mapping sector in Tanzania.

**What can we say about this situation:**

The validity of atlas map comes where time to time revision is done as suggested by T.Siwale (M.P)1976. If the revision process of the atlas map is not active or either, is taking too long, atlases value become less almost to the extent of no longer important to the society. Simple and affordable small and large size atlases with up to date information is a vital to growing sectors of economy in Tanzania which includes tourism, transport and communications. Digitally produced atlases in Tanzania will be a primary material for researchers who are outside this country for they can access this type of map with maximum freedom via world wide web and other communication networks.

Atlases published inside and outside Tanzania by different organizations today, are much more up to date than the editions available at National Mapping Agency or Surveys and Mapping Division (SMD). These kind of atlases suits broad demand of small scale atlas map users. However, the amount of information available at these atlases is limited and some how unreliable because they are rich in overgeneralization. If there has to be a stage by stage development of atlas mapping in Tanzania which is based on the historical development, culture and mapping environment of Tanzania then, a confined digital atlas mapping unit is of necessity in Tanzania now.
Map 1. National level atlas map information which is very helpful for Tourist planning.

Digital data that can provide base information for investors and researchers in the area of interest like tourism in Zanzibar Islands.

Digital Cartography design and production by L.V.Mtaroni 1998.

Figure 2. Summary of the Status of National and School Atlas map in Tanzania since 1906 to 1988.

<table>
<thead>
<tr>
<th>Atlas Title</th>
<th>Year of Publication</th>
<th>Publisher</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deustch-Ost-Africa Atlas</td>
<td>1906</td>
<td>Fuller, F. Dietrich</td>
</tr>
<tr>
<td>Atlas of Tanganyika teritory (1st Edtn)</td>
<td>1942</td>
<td>SMD</td>
</tr>
<tr>
<td>Atlas of Tanganyika teritory (2nd Edtn)</td>
<td>1948</td>
<td>SMD</td>
</tr>
<tr>
<td>Atlas of Tanganyika (3rd Edtn)</td>
<td>1956</td>
<td>SMD</td>
</tr>
<tr>
<td>Atlas of Tanzania (2nd Edtn)</td>
<td>1976</td>
<td>SMD</td>
</tr>
<tr>
<td>Tanzania in Maps</td>
<td>1971, 1972, 1975</td>
<td>SMD</td>
</tr>
<tr>
<td>Regional economic atlas of Mainland Tanzania</td>
<td>1968</td>
<td>Jensen S.B.A (BRALUP)</td>
</tr>
<tr>
<td>Population and health facility in Tanzania 1978</td>
<td>1983-84</td>
<td>University of East Anglia</td>
</tr>
<tr>
<td>Maps for primary schools. (Ramani kwa shule za msingi)</td>
<td>1963</td>
<td>McBain, F.C.A</td>
</tr>
</tbody>
</table>

Map 2. District level type of large scale map information available in digital format at SMD.

Map 2 presents kind of large scale atlas information map, which when accessible by public can highlight source of investment in Tanzania.

Map 3. Digital information suitable for large scale atlas map as available at SMD ready for digital atlas.

This kind of information (Map 3), requires only the redesigning of base digital map data to produce detailed atlas guides for different purpose and mult-users. This information was created between 1992 and 1995 but not yet well utilized. It has remained as official protected data within SMD while becoming outdated. Atlas map consume data at secondary level most, therefore, no more reason to the delay of its publication because base maps are somehow being produced with revision.
Conclusion

Since the financial constraint has remain as an immune decease in many countries due to continuous economic crisis and thus development instability, the solution to break through to atlas production in Tanzania should be within Tanzanian. However, the already available resources at Surveys and mapping (SMD) center Dar Es Salaam gives a better beginning to reach this solution. Sharing the little resources we have and putting forward new plans towards proper utilization of technology and Mapping skills available at SMD, atlas production might be not as difficult as is now. An importance of atlas map in Tanzania may have not received its proper outlook by general public till this moment because, are not as directly in application as may be the case of the topographical maps when on the hands of the decision makers. Some people thinks atlas are for educated group as they contain lots of information while some thinks atlas are for illiterates as they look so wordy and diagrammatic or pictured when compared to a single detailed contour topographical base map. The truth is that, over hundred thousands of the primary and secondary school learners in Tanzania shares very few atlas map or map book during their studies and thus, marginalizing their chance to further up with geography specialization. This problem is critical even at the University of Dar Es Salaam where over 3000 students shares only about six old or un-revised Tanzania atlases. Costs involved in atlas production stands as core obstacle in its production. Also lack of physical and mental efforts to establish an effective digital atlas unit by mother mapping organizations in Tanzania has given an impression to less sensitivity. Atlas scarcity problem in Tanzania is an issue of long ago which require permanent solution now. However, in the first instant Tanzanian and digital mapping specialists in particular should carry the burden to sort out atlas problems before anyone else as could be expected by many.

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The conception of atlas for students and applicants

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Abstract
This poster paper presents the results of our second scientific project - the atlas for students and applicants - within the framework of cooperation between the Institute of Cartography, Dresden University of Technology and the Geographical Faculty of Altai State University.
The projecting and compiling of a set of Barnaul’s thematical atlases are carried out with the participation of German and Russian students.

As a rule, in an elaborations of cities atlases the tourist and scientific themes are predominated. Our first project also included the elaboration of complex atlas of Barnaul which consisted of tourist and scientific information [Wolodtschenko et al., 1997].

Barnaul is centre of the region Altai, a big industrial and cultural city of Western Siberia. It is a polyfunctional city with developed industry, transport and modern communication. The population of the city is over 600 thousand people where there are 25 % of young people under 25 years. Barnaul is a student city. Here there are 6 universities, several research institutes. For this reason we decided to carry out our second project together with students and for students and to title it “Barnaul - Atlas for Students and Applicants.”
The atlas-model is maked in two languages (German and Russian) and in two versions: traditional paper version and CD-version for Page-Marker 6.5.
The program of the atlas includes six basic parts:
- introduction
- general information
- universities
- libraries
- recreation
- transport and communication.
The main scale of maps of Barnaul’s central part is 1 : 30,000. 58 coloured photographs are included in the atlas. The explanatory text of the atlas makes up about 35% of all pages. The format of paper version atlas is A5. It contains a total of 96 pages.

A cartosemiotic analysis of the atlas paper version is shown in Table 1 where the information-semantic structure (3 kinds of graphical information) and the load (in percent) are statistically demonstrated by the kinds of information.

Table 1. Information load of the atlas

<table>
<thead>
<tr>
<th>Types of information</th>
<th>%</th>
<th>page</th>
<th>number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maps</td>
<td>20,9</td>
<td>20</td>
<td>16</td>
</tr>
<tr>
<td>Explanatory text</td>
<td>35,4</td>
<td>34</td>
<td>-</td>
</tr>
<tr>
<td>Photographs</td>
<td>43,7</td>
<td>42</td>
<td>58</td>
</tr>
<tr>
<td>Total</td>
<td>100,0</td>
<td>96</td>
<td>74</td>
</tr>
</tbody>
</table>

Table 1 clearly shows that the atlas has an illustrative-textual informative direction. The illustrative-textual part (79.1%) is an important portion of the atlas. In our opinion such combination of information is more attractive for young people.

Conclusion

Our cooperation in the atlas cartography has begun in 1994 during the stay of V.V. Rudsky in Dresden. Top-priority subject directions and optimal variants with the creation of various subject reagional atlases for the region of Altai have been discussed. In 1995, the approval of a number of atlas topics has begun in a diploma thesis and in two advanced student’s seminar theses. The “Barnaul - Atlas for Students and Applicants” continues Barnaul’s atlas topic.

Today there is good reason to consider [Wolodtschenko, Rudskij 1998] that a new research direction - atlas cartography - is being formed conceptually and technologically at the Geographical Faculty of the Altai State University.

References


Abstract

This study consisted of the elaboration of school atlases for three municipalities in the state of São Paulo, Brazil, destined for nine-to-twelve year-old students. For the research team, which consisted of a university professor and elementary public school teachers, this required the development of both products and methodologies. It was necessary to create procedures for the production of the material as well as for its validation. This task made it possible to join technical concerns of cartographic representation with dilemmas of the classroom, opening a space for the establishment of methodologies in cartographic education.

Introduction

This study, conducted during 1997 and 1998, consisted of producing municipal atlases that were pedagogically appropriate for users at the elementary school level. This involved both the development of products as well as methodologies. This was not an easy task since there are few Brazilian studies about the use of municipal maps by nine-to-twelve year old students which could assist in the delineation of the cartographic profile wanted for this type of didactic material (we cite the research of Dr. Janine G. Le Sann, who published school atlases for cities in the state of Minas Gerais in the Cartography Laboratory of the Federal University of Minas Gerais.)

Atlases were produced for three inland municipalities in the state of São Paulo: Rio Claro, Limeira, and Ipeúna. All are situated in the region of Campinas, the second most populous and industrialized city in the state.

The municipal atlases resulting from this research are founded on the psychology of representation of space and on modern cartographic technology. Through these, we sought to guide the students toward the study of their immediate environment, contributing to their increased consciousness about the importance of the preservation of natural resources and the recuperation of local historical origins and memories.

The participants in the study were public school teachers who requested guidance from specialists from the university. Through a special program that funded research in the schools (FAPESP, a funding agency of the government of the state of São Paulo), it was possible to guide a group of ten teachers in the collection of information about various themes dealt with in the atlases, creating a sizeable accumulation of theses, articles, maps, timelines, and photographic sequences to compose the thematic pages of the atlases.

Attempting to take into account current curricular guidelines, teaching activities were developed that were applied in the schools with the objective of verifying the appropriateness of the material for the users.

The atlases include themes such as: location of the municipality in the country and in the world; political/administrative divisions; transportation network; neighborhoods and sectors of the urban area; rural neighborhoods and centers; arqueological sites; land occupation and population trends; the sugar cane and coffee economies; urban expansion; hydrographical basins; management of water resources and basic sanitation.
The production of the atlases was not the only result of this research. From the interventions in the schools, it was possible to establish some methodological guidelines with respect to the language most appropriate for the understanding of the students, as well as more interesting activities that can be carried out with municipal maps.

**Development of the School Atlases**

Teachers are accustomed to using atlases in their classrooms for studies that are generally restricted to the localization of various types of information or comparisons between maps; always using small-scale maps, since conventional school atlases usually consist of regional and world maps. Thus, the study of localities encounters the problem of the almost complete lack of large-scale maps in Brazil, appropriate for use in schools. Topographical maps can be found in municipal offices, but they are inappropriate for use in schools because they are technical maps, too complex for students, and even teachers, to understand.

Before beginning the production of maps to fulfill this need, it was necessary to put the problem in the proper context, by specifying: What is significant for an elementary school student to know about the place where he or she lives?, and also, What type of materials and procedures help the student to acquire this knowledge? These two concerns shift the question of the production of maps from the area of cartography, moving it closer to the area of education, and creating conditions to obtain a better product, for the student as well as the teacher.

Taking the first concern into account, a survey was conducted among public school teachers in the municipalities included in the study to verify what information should be contained in the atlases. It was found that, for a large part of the teachers, the use of atlases was restricted to localization and copying of maps. They did include an extremely long list of themes that should be represented in an atlas, which included various subjects related to history, geography, and the environment, but without establishing a serious justification for studying so many things about a city.

Given such an unenlightening response, it was left to the group of researchers to search for another answer; through analysis of curricular guidelines (National Curricular Parameters and Proposals of the State of São Paulo) and the study of texts written by some educators, they established as a criterion for determining the contents to be included in the atlases, to privilege the understanding of the locality in its historical and environmental context. The goals were defined as follows:

- explain the current socio-geographic situation of the municipality;
- establish a parallel between the formation of the Paulista territory, in the context of national history, and the process of population of the region in which the municipality is located;
- analyze urban environmental problems and sensible solutions.

The second concern of the group of researchers also included the careful design of the profile of material to be elaborated, since it was destined for all the public schools in the municipality and needed to have a low cost of production; it was to be distributed free or reproduced through photocopying. It was decided to print the atlases on A4 paper, with black and white maps. The themes were represented on two pages, with the maps on the right and the text or other iconographic resources on the left. Graphic software was used (Adobe Photoshop, Page Maker, and Corel Draw), since it was not possible to acquire cartographic software. With the assistance of computer technicians, the following procedures were established:

- creation of vectorized bases for:
  a) the area of the municipality (scale 1: 200,000) with contour lines (100 m equidistance) and the main drainage network;
  b) the urban area (scale 1: 50,000), with neighborhood divisions and administrative sectors;
- creation of layers for each element plotted, which could be over-layered, creating poly-thematic maps;
• links between files to facilitate adjustments and alterations without losing information;
• creation and alteration of images, photos, and drawings;
• a limit of 1000 characters for the texts;
• creation of a timeline for historical themes.

The principles of graphic semiology (Bertin; Bonin) were taken into account by the researchers when delineating the pages of the maps. Thus, the idea that the figures should be based on what can be read and understood by the teachers and the students was always present in discussions during the elaboration of the material.

The most arduous task for the group of researchers was to construct a work methodology that took into account the guiding concerns of the study; on one hand, to select contents with the student and his/her meaningful learning in mind, and on the other hand, to articulate the contents with the most appropriate form of teaching (articulation of content and form). At the end of the first year, the researchers decided that an efficient way to systematize information about a theme obtained from various types of publications would be to write a text unlimited in size, in more academic language, with the intention of being able to share it with the school teachers. From this text, a shorter, more concise text would be extracted, intended for the students’ use, containing explanations or interpreting the additional elements depicted on the thematic page. For example, with respect to the theme, “the occupation of the Paulista territory in the Sixteenth Century,” the point was to demonstrate the importance of the settlements of São Vicente and São Paulo as points of support for the exploration of the interior of the colony which persisted for more than a century. The text provides this interpretation, which was impossible to transmit only with the maps and timeline. In this way, a methodology for research and production of thematic pages was delineated.

School atlases in the classroom

With the objective of evaluating the material produced, interventions were conducted in third, fourth, fifth, and sixth grade classes in one school in each of the cities of Rio Claro, Limeira, and Ipeúna.

Recent studies about teachers and their practices are concerned with the transformation of the school, conceiving of the teachers as “managers of dilemmas”, subjects of pedagogical knowledge and practice. The present study was structured within the ambit of a continuing education project in which primary education teachers and university professors acted in collaboration. Bueno (1998, p.7) justifies this procedure as a new way of understanding educational research: “more recent attempts are being made to break the lack of dialogue between researchers and teachers and dissipate the dissatisfaction expressed by some.” In the same way, Erickson (cited in André, 1986, p.54) defends the cooperative posture “of open dialogue” where the partnership between the researcher and people from the schools is necessary if one intends to change the school in an emancipatory sense.

This study was carried out by elementary school teachers collaborating with a university professor. While the initial project was conceptualized by the coordinator from the university, all the activities were developed jointly and involved the following actions in the schools: accompaniment and application of the activities in the classroom; observations of the classes with detailed note-taking; evaluation of the procedures and activities carried out; discussions about the results.

In each city, a school was chosen for the development of the research in the following stages:
• characterization of the school, starting with the information in the school plan;
• selection of the classes that would be subjected to the research;
• evaluation of students’ previous knowledge about spatial representation;
• reading activities and interpretation of the themes in the atlas.
The schools chosen were among the better schools in the cities, and there were no significant socio-cultural differences among the students’ families. With respect to the relationship between age and grade, no significant difference was noted between the classes.

The students’ previous knowledge about spatial representation evolved from the third to the sixth grades. In third grade, students already had a good grasp of localization; difficulties with point of view (perspective) and proportion were noted which diminished with increasing grade level.

The thematic pages of the atlases were introduced in the classes (directed intervention) with activities for the students to carry out based on the contents of the pages. As evaluation procedures, open-ended questionnaires were used that evaluated the students’ ability to read the page; in addition, notes were made in a field notebook by a teacher-researcher who acted as adviser in the elaboration of the intervention plans and as observer during the intervention. Responses obtained in the open-ended questionnaires were compared with the notes made by the observer, and the results were weighed so as to situate the material produced within classroom practices.

With respect to the cartographic representations, greater difficulties were noted in the reading and interpretation of the maps. Students did not fully understand the procedures for reading a thematic page, such as: begin with the title and observe the figures and photographs; then, read the map; and finally, read the text. For the majority of the students, the profile of the map of the city was unfamiliar; the resources of representation of the Earth most familiar to them are the Earth’s globe and the planisphere. Among the maps used, the only ones they did not find strange were the political map of Brazil and the map of the state of São Paulo.

Another difficulty reported was the establishment of a relationship of scale (proportional sizes) between maps that cover different areas but occupy spaces on paper that look the same, such as Brazil, São Paulo, and Rio Claro. This interfered with the proper localization of the city in the world using maps that range from the planisphere to the municipal map; that is, students do not relate the variation in size of the maps with the area covered.

Regarding the use of the atlases as a teaching resource, it was perceived that the main problems reside in the organization of the teaching activities, which go against traditions rooted in the use of maps, such as: identify names of localities, color them in agreement with an established legend, list the principal elements, etc., that lead to learning that is repetitive and not very meaningful. This is the main issue that must be faced if students are to be lead to appropriate meaningful knowledge using school atlases.

It can be said that the production of school atlases, considering them as didactic material, should be a collaborative effort between specialists in cartography, educators, and teachers. If not, there is a risk of creating atlases that are visually pleasing and technically correct but strange in the classroom and inappropriate for use in the schools. In fact, the production of school atlases, although supported by cartographic methods and techniques, actually becomes a problem of education (cartographic education) since the central issues of thematic cartographic representation have already been resolved.

References


Découvrir la géographie au moyen d’un atlas scolaire de sa commune

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Résumé: Au Brésil, actuellement, les programmes officiels pour l’enseignement de la géographie, dans les classes primaires, recommandent l’étude de l’espace local, dant le but de “développer la capacité d’apprendre (...), de faciliter la compréhension de l’environnement naturel et social, du système politique (...).” Étant donné que les enseignants de ces classes ne reçoivent aucune formation spécifique en géographie et qu’il n’existe pas de matériel didactique qui traite de l’espace communal, ce projet développe une méthode d’approche géographique de la réalité spatiale de la commune, adaptée aussi bien aux élèves qu’aux enseignants.


Les principaux objectifs du projet sont d’amener l’enfant à former des opinions personnelles et à prendre conscience de la responsabilité de ses actes, et attitudes comme futur citoyen, à partir de la connaissance et de la compréhension du milieu dans lequel il vit. Pour cela, il devra apprendre à percevoir, représenter et connaître son environnement; analyser, traiter et interpréter les données issues de ses observations, de statistiques, ou de n’importe quelle autre source d’information; exercer un raisonnement logique, tout en respectant les divers points de vue de ses collègues.

La méthode de travail est basée sur les principes suivants: partir de la connaissance des enfants; des concepts de base de la géographie pour construire la notion d’espace, pas à pas, du simple au complexe; accroître l’échelle de compréhension de celui-ci; fournir des données actualisées comme support pour la construction de son savoir; proposer des techniques de représentation, analyse et communication des informations adaptées au niveau des enfants; et, diversifier les moyens pédagogiques pour induire la participation active de l’enfant au cours du processus d’acquisition des connaissances.

L’Atlas se compose de trois parties: la première présente des planches inachevées avec les plans des quartiers du noyau urbain. L’élève doit vérifier l’exactitude des informations présentées, compléter les textes, les tableaux de données, les diagrammes et les cartes avec les informations qu’il recherche, en allant sur place. Les planches de la deuxième partie présentent des informations relatives à la commune, variées et actualisées. Des travaux parallèles sont suggérés, dans le but de laisser une certaine liberté de choix aux professeurs afin de varier les activités au maximum. La troisième partie de l’Atlas est formée de textes courts, destinés aux professeurs, à titre d’orientations pédagogiques.

A la fin de la première étape de la recherche sur un matériel alternatif, qui a abouti sur l’élaboration d’un ensemble de 178 fiches d’exercices pour l’enseignement des concepts de base de la géographie, dans les classes primaires, au Brésil (but de la thèse de doctorat), la recherche a continué avec, comme laboratoire, deux classes d’une école de Contagem, ville de la région métropolitaine de Belo Horizonte (Minas Gerais, Brésil).
Ce matériel a été testé dans les deux classes, pendant trois ans. Au cours de la quatrième année, il s’est trouvé indispensable d’organiser un autre matériel, au contenu géographique, relatif à l’espace vécu de ces enfants, de la commune de Contagem. Ce premier atlas municipal a donc été publié en 1996, après plusieurs années de recherche. Ensuite, un nouveau projet a été développé pour les communes de la Haute Vallée du Jequitinhonha. Une partie de ce projet, financé par la FAPEMIG, organisme qui patrochine la recherche dans l’état de Minas Gerais, devra être terminée en juillet 1999. La FINEP patrocline une autre partie de cette recherche. Au cours du deuxième semestre de 1999, d’autres communes intéressées par le projet devront faire l’objet de nouveaux travaux.

Etant donné qu’il est impossible d’élaborer un atlas pour chaque commune, la nouvelle phase de ce projet prévoit une étude méthodologique afin d’orienter les professeurs de l’école primaire dans le sens de construire leur matériel pédagogique à partir des informations disponibles dans les communes. Le produit de cette recherche devra être publié comme une proposition de méthode pour travailler la géographie des communes, avec des orientations précises sur les sources d’informations disponibles et des suggestions d’exercices qui permettent une construction du savoir, ayant pour objet l’étude de l’espace communal.

La présentation matérielle des atlas

L’Atlas de Contagem a un format A3 parce que la manche urbaine est très grande et a dû être découpée en 18 morceaux. Le format des autres atlas est celui d’un double A4, en position couchée, puisque leurs zones urbaines sont beaucoup plus réduites. Ce format est, aussi, plus pratique pour l’usage des enfants. Le type de reliure est choisi par les responsables de chaque commune, pouvant varier entre une reliure avec la couverture agrafée et collée ou une reliure en spirale. La commune est présentée sur la couverture de l’Atlas au moyen d’une image de satellite. Généralement, cette représentation de la commune est encore inconnue de la plupart de sa population.

Le noyau des Atlas est imprimé en noir et blanc pour une raison économique, le coût d’impression, mais surtout, pour une raison pédagogique: l’enfant doit colorier son atlas et apprendre à utiliser les couleurs selon les règles de la perception visuelle, présentées par la sémiologie graphique.

L’organisation des planches

Les Atlas ont environ 34 planches. Ce numéro varie en fonction des particularités de chaque commune. L’atlas de Contagem, deuxième commune du Minas Gerais, de part sa population, est composé de 43 planches. Dans la plupart des cas, les planches sont organisées en deux parties: l’une contient les informations et les concepts introductifs ainsi que les tableaux de données; l’autre, les cartes et/ou les diagrammes. Le plus souvent, ces documents sont incomplets pour amener l’enfant à chercher des données complémentaires et actualisées, et à compléter les cartes et les diagrammes.

Les thèmes et les principaux concepts

Les thèmes couvrent l’ensemble de la géographie de la commune. Pour que l’enfant puisse comprendre la structure de l’espace local au cours de cette première approche, des concepts fondamentaux, mais simples, sont travaillés par le biais de ces thèmes.
La première partie: connaître sa commune.


L’échelle locale est travaillée avec les plans de la zone urbaine de la commune. Ces planches doivent être complétées, par l’élève, par des informations retirées de l’espace réel, au cours d’un travail de terrain. Ces nouvelles informations sont localisées sur les plans, par l’élève, au moyen de couleurs différentes pour représenter des objets différents. La Rose des vents sert de référence pour localiser les objets dans l’espace réel et sur sa représentation. Un exercice prévoit une approche de l’échelle perceptive au moyen de la perception d’une mesure d’une distance réelle (un côté d’une place, par exemple) et de sa représentation sur le plan. Tous les enfants doivent avoir la chance de se localiser dans l’espace de la commune, c’est pourquoi une ou deux planches présentent les photographies des écoles de la zone rurale.


Le réseau hydrographique est traité sous la perspective du bassin et de la hiérarchie de ses cours d’eau.

La construction de la notion de climat est prévue à long cours. Les observations de l’aspect du ciel, chaque jour, à la même heure, ainsi que de la température, à ce moment là, sont enregistrés sur un calendrier. A la fin de chaque mois, les observations sont sommées pour chaque type de temps (soleil, soleil avec nuages, nuages, pluie) et chaque type de sensation de la température (très chaud, chaud, agréable, froid, très froid). Des diagrammes sont construits chaque mois. A la fin de l’année, les diagrammes sont analysés dans le but de reconnaître les principales caractéristiques de chaque saison et de faire la synthèse entre la température et l’aspect du ciel, au long de l’année, définissant ainsi, le climat de la commune, cette année là. Ce travail évolue au cours des années, entre la première et la quatrième année de l’enseignement primaire. L’enfant plus âgé peut lire les graduations d’un thermomètre, par exemple. Ou encore, le climat de lieux différents peut être observé au moyen des registres publiés quotidiennement dans les journaux.

La végétation est traitée à partir de photographies sur lesquelles sont identifiés les principaux types présents sur la commune, tels que la savane arborée, la forêt, la forêt galerie ou les champs d’altitude.

Les types d’activités économiques développés sur le territoire de la commune sont localisés sur une carte. L’enfant doit compléter la carte par les informations de sa connaissance. Un tableau montre la proportion entre les surfaces dédiées à chaque type d’activités tels que les pâturages, les forêts, les cultures, la savane arborée exploitée, ou non, les cultures de fond de vallée, entre autres. Un diagramme accompagne le tableau de données. Des questions incitent l’enfant à lire et à comprendre la signification des données du tableau et du diagramme.

Les problèmes de l’environnement de chaque commune sont présentés de manière à faire réfléchir sur les effets de l’action de l’Homme et sur ce qui peut être fait pour les amoindrir. Les concepts de collecte sélective et de recyclage des ordures sont discutés.
La deuxième partie: connaître les besoins et les activités de la communauté.

Des thèmes géographiques relatifs à l’espace local et à sa structure sous l’angle de la réponse à des besoins essentiels de la population sont présentés dans la deuxième partie des Atlas. Ainsi, sont considérées comme essentielles les actions de s’alimenter, s’habiller, travailler, étudier, avoir accès à une habitation, à la santé, aux loisirs et à une religion. Au cours du travail, les enfants ont reconnu, comme également essentiels, l’accès aux transports et la sécurité.

L’étude de la population passe par l’analyse d’un tableau de données et de diagrammes sur l’évolution des quantités absolues des populations comparées de la commune, de l’État et du Brésil. Des questions amènent l’enfant à lire le tableau de données et à comparer les diagrammes. La notion de croissance de la population est associée à celles d’accroissement végétatif et de migration. L’élève est invité à faire une recherche pour découvrir les lieux de naissance de quelques migrants et à les localiser sur une carte. Un autre type de migration est fréquent dans ces communes. Une grande partie de la population de la zone urbaine vient de la zone rurale. Une recherche semblable à la précédente permet à l’enfant de comprendre la signification de ces concepts et, par conséquent, celle des tableaux de données présents dans les manuels de géographie. La structure de la population, par âge et par sexe, normalement représentée par une pyramide des âges, est introduite par un exercice décrit par Passini. [Passini, 1994]. Au tableau, le professeur dessine deux grilles, côte à côte, l’une pour les garçons et l’autre pour les filles. Au milieu, sur l’axe des y, il marque la référence des âges des enfants et, sur l’axe des x, la quantité absolue des enfants, pour chaque sexe, comme pour une pyramide traditionnelle. Chaque enfant doit marquer sa position dans le tableau en fonction de son sexe et de son âge. Lorsque tous les enfants de la classe ont marqué leurs positions, ont a obtenu la pyramide des âges du groupe. Le passage à l’analyse de la pyramide de la commune s’en trouve grandement facilité. Chaque enfant peut également reconnaître sa position sur cette pyramide.

Des définitions présentent les activités de la population, par secteurs de l’économie. Un exercice de recherche permet la compréhension de ces définitions à partir de l’observation de la réalité de la famille de l’enfant. La lecture d’un tableau de données qui décrit les proportions de la distribution de la population entre les divers secteurs d’activités et sa traduction visuelle, au moyen d’un diagramme de barres, complètent l’étude de la population de la commune.

Les notions d’agriculture et d’élevage sont travaillées à partir de données sur les surfaces cultivées, les principaux produits de la commune et les effectifs des troupeaux. Des questions amènent l’élève à percevoir les problèmes locaux relatifs à ces thèmes. Il est important de remarquer que l’auteur ne fournit aucune réponse. Chaque enfant, et chaque classe, doivent tirer leurs propres conclusions, tout en respectant l’avis des autres et leurs différents points de vue. Seulement ainsi, l’élève découvrira qu’il a des opinions personnelles et qu’il peut agir dans sa communauté, individuellement ou en groupe, formant, ainsi, sa conscience de citoyen.

Selon le cas, l’Atlas peut présenter une planche sur son activité minière. Une carte géologique, très simplifiée, montre les divers types de roches présents sur le territoire de la commune, et leur mode d’exploitation. La Haute Vallée du Joquintinonha est localisée dans une région productrice d’or, de diamants et de gemmes semiprecieuses, sans oublier les matières premières pour la construction civile.

Le thème des industries est travaillé à partir de l’observation de la présence et du registre de celles-ci, dans un tableau de données. Leur classification est faite par l’enfant en fonction du besoin auquel l’industrie répond, tout en définissant le niveau de ce besoin (essentiel ou secondaire). L’élève doit choisir une couleur pour chaque besoin et colorier le point qui localise l’industrie, avec la couleur choisie. De nouveau, chaque classe est autonome dans ses choix, dès qu’ils soient correctement justifiés. L’exercice oblige à classer et à représenter sur une carte, au moyen d’une légende, les relations observées.

Les thèmes commerce, service, infrastructure de base, transport, santé, enseignement, loisir et culture sont traités de manière semblable, au cours de planches spécifiques.
Une planche spéciale explique la structure administrative de la commune et le rôle des administrateurs élus par leurs concitoyens. Tout au long de l’Atlas, l’élève est incité à réfléchir, prendre position, reconnaître ses droits et ses devoirs. Il est donc nécessaire qu’il connaisse cette structure afin de savoir où se diriger en cas de besoin.


Au cours d’une conversation de l’auteur avec le maire de la commune, le futur de celle-ci est idéalisé. Le programme de gouvernement est transcrit dans une planche spéciale. Au moyen des exercices de cette planche, l’enfant doit reconnaître les besoins de la population et les priorités données par les élus de cette administration. L’objectif principal est, ici encore, de former une conscience de ce citoyen qui aura, un jour, le droit de vote.

La dernière planche de cette partie inscrit la commune dans le contexte global. Une réflexion est induite sur l’importance de la commune dans son contexte spatial, aux diverses échelles. A l’inverse, l’enfant est invité à réfléchir sur le rôle des “autres lieux” dans la vie de la commune, percevant ainsi, les relations de tous types existantes entre les diverses communautés, au Brésil et dans le reste du Monde.

**La troisième partie: comment travailler avec l’Atlas**

Elle s’adresse aux professeurs et y sont décrites des méthodes de travail qui sont suggérées au cours du texte de l’Atlas. L’élève est induit à faire des recherches, compléter des tableaux de données, construire des diagrammes, élaborer des légendes et dessiner des cartes. Ces activités sont souvent nouvelles pour les professeurs qui reçoivent, au Brésil, une formation précaire pour l’enseignement primaire. Les planches de cette partie ont donc pour objectif d’orienter les professeurs pour construire des diagrammes, organiser une recherche avec des enfants de ce niveau d’étude, ou encore, élaborer un questionnaire et organiser un travail de terrain.

**Les savoir-faire**

Bien au delà de l’apport d’informations actualisées et de notions pour la formation de concepts, ce matériel propose la construction du savoir à partir de l’acquisition de savoir-faire. “Donner le poisson ou enseigner à pêcher?” [Le Sann, 1997]. En effet, considérant que l’apprentissage se fait par l’action du sujet, l’appréhension, ou action de prendre pour soi, est facilitée par la participation active de ce sujet dans le processus de construction du savoir. Le professeur ne donne plus son cours, mais l’élève acquiert ses connaissances sous l’orientation du professeur. Il s’agit d’un changement de posture fondamental vis-à-vis de l’enseignement.

L’Atlas de la commune possibilite l’acquisition de savoir-faire de natures différentes. Ils peuvent être classés en plusieurs catégories, comme montre le tableau 1, à suivre:
**Tableau 1.** Catégories des savoir-faire travaillés dans les Atlas

<table>
<thead>
<tr>
<th>Catégories</th>
<th>Savoir-faire</th>
</tr>
</thead>
</table>
| Préparation de l’acquisition de données | Faire une “tempête cérébrale” *  
| | Préparer un questionnaire  
| | Préparer une entrevue |
| Acquisition de données | Lire des textes  
| | Observer et enregistrer les observations  
| | Lire des tableaux de données statistiques  
| | Lire des documents photographiques  
| | Lire des croquis  
| | Lire des diagrammes  
| | Lire des cartes |
| Traitement de données | Elaborer des tableaux de données  
| | Ordonner des données  
| | Organiser des données par catégories  
| | Comparer des données et des informations  
| | Choisir des classes |
| Représentation des informations | Elaborer des diagrammes  
| | Elaborer des légendes  
| | Elaborer des cartes  
| | Elaborer des textes analytiques  
| | Elaborer des textes synthétiques  
| | Construire des images mentales, des concepts |
| Acquisition de savoir-faire liés aux concepts de base de la géographie | Reconnaître et utiliser une échelle  
| | Orienter une carte  
| | Se localiser à diverses échelles  
| | Dominer la notion d’espace  
| | Analyser des tableaux de données  
| | Analyser des diagrammes  
| | Analyser des cartes  
| | Analyser des textes  
| | Monter des schémas  
| | Réfléchir  
| | Synthétiser  
| | Tirer des conclusions  
| | Former des opinions  
| | Formuler et défendre ses opinions  
| | Prendre des décisions  
| | Discuter et argumenter  
| | Respecter les opinions des autres  
| | Être créatif  
| | Comprendre les notions relatives à la population  
| | Interpréter des informations  
| | Reconnaître les principaux éléments de la géographie de la commune |

* Il s’agit de réfléchir pour vérifier ce qui est connu par l’élève, et/ou par le groupe, sur un thème particulier, de définir les doutes et de décider ce qui devra être rechercher pour augmenter ses connaissances sur le thème en question.

Ce tableau n’est pas exaustif. Comme l’Atlas est une “oeuvre ouverte” dans laquelle chacun met un peu de soi, de son expérience, de sa vie, il est certain que d’autres savoir-faire vont apparaître, selon ses usagers.
Quelques exemples d’exercices


1. Observe la localisation des communes voisines en fonction de la Rose des vents et écris leurs noms sur la carte de la page à côté. Diamantina, au Nord; Datas à l’Est; Santana do Pirapama et Conceição do Mato Dentro, au Sud; Monjolos et Presidente Juscelino, à l’Ouest. (Planche 2)

2. Observe, sur une carte routière, quelles sont les routes qui prolongent celles qui passent dans Gouveia. (Planche 3)

3. Colorie, sur la carte, les cercles avec les couleurs indiquées: noir, pour les rues commerçantes; rouge, pour les écoles; gris, pour les industries; vert clair, pour les centres de santé; bleu, pour les banques; rose, pour les places... (Planche 4)

4. Observe sur la photographie une colline, forme de relief arrondie et peu élevée. La “serra” est plus haute et présente une forme allongée. Renforce, sur le croquis, le dessin d’une colline, en vert, et de la “serra”, en marron. Dessine la vallée en bleu.
Observe la photographie, dessine les détails observés sur le croquis en utilisant des symboles de couleurs différentes. Enregistre, ensuite, les symboles et leurs significations. (Planche 8)

5. Avec un crayon rouge, relie les sources de cours d’eau qui se jettent dans la même rivière. Tu as dessiné le bassin de cette rivière. (Planche 9)

6. À la fin de l’année, tu vas décrire et enregistrer les principales caractéristiques du climat de Gouveia, mois par mois, en fonction de la température et des types de temps, en complétant le tableau suivant:

<table>
<thead>
<tr>
<th>Températures</th>
<th>Mois</th>
<th>Types de temps</th>
<th>Mois</th>
</tr>
</thead>
<tbody>
<tr>
<td>Les plus chauds</td>
<td></td>
<td>Avec le plus de soleil</td>
<td></td>
</tr>
<tr>
<td>Les plus agréables</td>
<td></td>
<td>Avec le plus de pluie</td>
<td></td>
</tr>
<tr>
<td>Les plus froids</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Maintenant, tu peux caractériser les saisons à Gouveia, donc, en définir le climat. (Planche 11)

7. Observe le tableau et réponds aux questions:
Quelle est l’utilisation du sol qui prédomine à Gouveia? Pourquoi penses-tu qu’il y a tant de terres improductives dans la commune? A quoi servent les paturages? (Planche 13)

8. Savais-tu qu’une partie des ordures peut être réutilisée? Recherche quelles sont les utilisations possibles pour les ordures de la liste suivante: papier usé, propre; emballage de soda en aluminium; vieux fourneau; bouteille en plastique; épluchures de fruits; verre cassé; vieux vêtement; papier journal; restes d’aliments; jouet en plastique.
Qu’est-ce que vous pourriez faire, toi et tes copains, pour recycler les ordures de ton école? (Planche 14)

9. Sais-tu d’où viennent les personnes qui ne sont pas nées à Gouveia? Recherche trois de ces personnes et demande-leur quelle est leur commune d’origine. Enregistre les données de ta recherche dans le tableau suivant:

<table>
<thead>
<tr>
<th>Pessoa</th>
<th>Commune d’origine</th>
<th>Année d’arrivée à Gouveia</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Compare tes données avec celles de tes collègues. Localise, sur une carte du Brésil, l’origine des personnes interviewées.

10. Complète le diagramme, en dessinant et en coloriant ses barres, avec les données, pour cent personnes, du tableau “Population occupée, par secteur de l’économie”. (Planche 19)

11. Visite un commerce de matériel de construction et demande au propriétaire de t’expliquer d’où viennent le sable et les graviers qu’il vend, et à quoi servent ces matériaux. (Planche 21)

12. Le tableau suivant contient la liste des industries de Gouveia. Classe-les selon le type de besoin, essentiel ou secondaire, auxquels elles répondent. Choisis une couleur et représente les industries, sur la carte, en fonction de ta classification. (Planche 22)

13. Observe la légende proposée pour la carte à côté. Les points correspondent au nombre de voyages des cars qui relient Gouveia aux autres communes, selon le tableau “Lignes de cars entre Gouveia et les autres communes”. Complète la carte avec les points qui correspondent aux communes servies. (Planche 26)


15. Observe le tableau qui montre la quantité d’élèves présents dans chaque école de la commune. (Les écoles sont regroupées en fonction de leurs effectifs puis classées entre très grande, grande, moyenne, petite et très petite.)

Choisis cinq points de tailles différentes pour représenter chaque classe d’écoles, sur la carte. N’oublies pas de dessiner la légende auprès de la carte. (Planche 28)

16. Recherche quelles sont les attributions de l’administration communale. Vérifie quelles sont les besoins essentiels de la population qui sont de la seule responsabilité de la Mairie. Recherche quelles sont les fonctions des conseillers municipaux et quand, et comment, ils sont choisis. (Planche 30)

17. Dans le texte ci-dessus, souligne les principaux objectifs prévus pour le futur de Gouveia. Liste-les dans le tableau à suivre, et vérifie quels sont les besoins essentiels qui devront être satisfaits.

<table>
<thead>
<tr>
<th>Objectif</th>
<th>Besoin essentiel</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td></td>
</tr>
<tr>
<td>2....</td>
<td></td>
</tr>
</tbody>
</table>

(Planche 32)

18. Recherche des informations sur les conflits qui ont pour cause l’appropriation de richesses, au Brésil et dans le Monde. Organise une exposition pour montrer les richesses convoitées et les lieux des conflits.

Réfléchis sur ce que Gouveia peut offrir aux communes voisines, à l’état de Minas Gerais, au Brésil et au reste du Monde.

Réfléchis sur ce en quoi Gouveia dépend de ses voisins, de l’état de Minas Gerais, du Brésil et du reste du Monde. (Planche 33)

**Considérations finales**

Actuellement, cette recherche évolue vers l’élaboration d’une méthode de travail qui puisse être utilisée dans n’importe quelle commune, par n’importe quel professeur qui y trouverait intérêt.

Les résultats de l’utilisation des Atlas dans les classes sont très intéressants, surtout en ce qui concerne la nouvelle posture pour l’enseignement de la géographie, assumée par le corps enseignant. La géographie passe d’une matière de second plan, empoissée, pour laquelle il ne restait que très peu de temps dans le cursus, au quotidien, en une matière vivante, intrigante et même passionnante, tant pour les élèves, comme pour leurs professeurs.

Ces principaux intéressés nous ont laissé quelques témoignages. Ce sont eux qui auront la parole, en guise de conclusion:

- “Le changement dans les cours de géographie a été très bon. Et les élèves pensent aussi ainsi, ce qu’ils démontrent par leur intérêt pour les cours de géographie. Avant, on se préoccupait seulement d’étudier l’espace géographique avec les enfants, aujourd’hui ce sont eux qui collectent les données et ainsi, comprennent leur espace.”

- “La manière de voir et d’étudier la géographie ont changé. Je voyais la géographie comme une matière complète et prête, dans les manuels. Aujourd’hui, je sais que la géographie se trouve dans tout ce qui nous entoure et que pour la comprendre je dois observer, chercher, analyser.”

- “Avant, tout me paraissait vague. Cette année, nous avons où nous appuyer, nous avons un point d’ancrage. L’Atlas nous a donné une bonne référence, a introduit les concepts nécessaires, basés sur notre réalité et lève, les professeurs et leurs élèves à construire leur savoir et à comprendre l’espace proche et, ensuite, les plus lointains. Rien n’est prêt ni fini, il faut beaucoup de recherche...”

**Bibliographie**


Abstract

Geography has come back to the curriculum for students 16-18 years old in Sweden. So the need was great for a more advanced school atlas than the ones published for younger students.

With the modern electronic technique the map production has changed the work for the cartographers. But more than ever it is necessary to have experienced cartographers. The electronic technique also makes it possible to use the data to make different kinds of supporting material for the education, like tables, CDs, transparencies, on-line services. By giving the information from which source the data are caught the student can try to make new updated maps themselves to compare with the map in the atlas.

The work with getting data for manuscripts has changed due to Internet and e-mail. Some data (but far from all) are there for you to get and time consuming visits to libraries and statistical agencies have been less. It has also become much more comfortable to communicate with international friends and offices to get information.

The first very difficult question is to decide what to include in the atlas, as the volume cannot be too large. As this has been a joint Nordic production compromises have been common. Compared to older atlases in Sweden this atlas includes a lot of thematic maps, and especially those concerning the environment. There are a few gender aspects in the maps, but as most of the map makers and cartographers have been women, they have had the opportunity to influence the cartographic design. Another important news is that all countries (with a small exception in NE Russia) can be seen in the scale 1:15 M, so the student can see the real difference between areas, for example Canada and Sweden.

A special file with transparencies of about 50 maps support the teacher’s work. Beside the transparencies there is a text book with questions around the maps and also advice about which topics the teacher can introduce to a map and where to find other sources for the topic. The atlas was published in spring 1999 by Liber AB.

Why a new school atlas?

The answer is quite simple. There was a growing need of a more advanced atlas as geography has come back to the curriculum for students aged 16-18. And with the subject back, the schools got geography teachers who were familiar with the atlas as an educational tool. Thematic maps have also been more common in different medias as papers and television with the effect that other teachers also wanted an atlas. Until then they had to settle with foreign atlases if they wanted a more advanced atlas.

An interview among geography teachers told me that most of all they wanted more thematic maps than was available in the old atlases. There was also a strong opinion that the atlas book never could be substituted by electronic atlases or using the maps on Internet, though they thought them to be good and useful complements to the book. Cross-references to Internet were wanted so that the students could update and compare maps – but this was not as easy task as it seemed.
**Cartographic work**

With the modern electronic technique the map production has changed the work for the cartographers and also the editors. Data are plentiful and it seems to me that data are more easily accepted when they are digital, and you are tempted to use them less critically than if they were analogue. Wrong data may pass through into the production phase. Sometimes it can be hard to evaluate the quality of the data. To illustrate this you can for example look at data for births, deaths and life expectancy in different sources and you will find unbelievably large differences among the sources. It illustrates well the problem of choosing the right statistics for the maps.

I have had the opportunity to compare operators with experience of traditional cartographic production and young operators with very little experience of traditional work. It is quite clear that the experienced and cartographically educated operators more easily can visualize what the printed map would look like after having chosen colours, widths of lines, symbol sizes, lettering etc. than what the unexperienced can do. What looks nice on the display does not always look nice in an outprint. Scale is not a problem for the experienced ones but a much more delicate problem to handle for the unexperienced. Remaking maps are time consuming and costly so this includes the question of efficiency. On the other hand unexperienced and involved operators may be more keen on trying new and unconventional ways of presenting themes like new kinds of symbols or patterns.

What also has changed is the scrutinious work of proof reading. Due to the quality of the prints you do have the problems of seeing how lines will look or how close to reality colours are. This has been a big frustration to me as an editor and also to the experienced cartographers.

Another problem has been that you can never trust a new corrected proof not to have new mistakes that were not there in the first proof. In that way the proof reading phase with reading all the proof every time is extended until you have a correct chromalin in your hands.

**Data problem**

As the editor the biggest problem has been to know the quality of the data. This phase of the production was more time consuming than I expected due to some problems:

1. Problems of searching the net
2. Lack of available new reference statistics
3. Contradicting sources and statistics
4. Weaknesses in statistics and lack of global data
5. Problems to convince myself and then convince other people when data told you something else than you expected
6. Problem of organizing all sources so that you easily could go back on the net, especially as sites are changed, links get old and cannot be used etc. On the other hand data on Internet saved me some time consuming visits to libraries and the like.

As our ambition was to make a quite new atlas considering layout, manner, contents and only use available data for more or less unchangeable themes I tried not to look too much at other atlases or encyclopedias. I have myself been working as an editor both with an encyclopedia and with the Swedish National Atlas and during the work you can see that a lot of fundamental facts are taken and given from each other. And so mistakes can live for ever. But it is unavoidable that you also get inspiration from other atlases and the teachers had pointed out maps they would like to see in the new Swedish atlas. For the publisher it is more important that teachers get what they think is the best instead of trying new ideas. So it was sometimes hard to introduce untested maps.
A joint project

The atlas production was a joint project with Sweden and Denmark and to some extent with Finland. We agreed on which maps should be in the atlas so a lot of compromises were done. That was, however, not the biggest problem. The biggest problem was the distance between Stockholm and Copenhagen (about 700 kms). Discussions, decisions and proof readings of about 200 thematic maps was not an easy task. Time did not allow too many meetings between the editors or between editors and cartographers to discuss the maps. On the other hand, with the cooperation a lot of good ideas appeared and mistakes could be avoided. Unfortunately for the time schedule some maps had to be exchanged rather late when data seemed to have too many weaknesses.

What is new?

Swedish is a small language and to make a new school atlas is a costly project considering how many books can be sold. Another new atlas from the same publisher will probably not be made during my life-time. Some up-datings will be expected in the future instead. The amount of thematic maps (more than 200) is news. New themes you can find is for example maps concerning global and local environmental problems. Town plans for some capitals have been introduced. “Case studies” of for example water problems in the Middle East or the organisation of a farm in the Nile delta are introduced. My intention was also that the atlas should include maps with gender aspects to a greater extent than what now is the case. Most of the cartographers are like the editor women, and it may be interesting to examine if this has had an influence of the cartographic design.

The most important introduction is that you can find all nations on physical maps, with a minor exception of NE Russia and some oceanic nations, at the scale of 1:15 million. For the first time in a Swedish school atlas you can compare areas in the same scale all over the world although the projection may differ. My opinion is that it is very important to create good mental maps of the world by the students. When I was at school I was rather convinced that Spain and Australia was about the same size.

As far as possible the data sources are given close to the maps. This will help teachers and students to make further studies and perhaps make their own up-dated maps to compare with the atlas map. We have also thought that it is important to tell which year the data are valid for. The publisher was afraid that the teachers would easily get the opinion that the atlas data were old and buy less books. Our opinion is that geography teachers (the buyers) know that geographical patterns for the most part do not change quickly. The fact that the year is given on the map may also inspire the student to go for new datas and evaluate the development between the years. Maps that change the pattern easily will of course be the first ones to be revised before a new print.

Support

The publisher is also editing a geography text book and the atlas maps will be complements to the maps in the text book. From the beginning of the project we planned different kinds of support like tables, CD-ROMs, transparencies and on-line-services. Due to lack of time and due to costs only transparencies are available now. About 50 maps are included in a file and to every map there are suggestions to the teacher how he/she could use the maps for lessons. There are also questions and problems to solve for the students. This text part of the file also include chapters on cartography and especially how to read and work with thematic maps and statistic cartography.
Conclusion

Is this atlas better and more beautiful thanks to the electronic technique than other atlases are? My answer will undoubtedly be no. The cartography misses the personal touch of a manual cartographer – what I would like to call feeling. The biggest problem is generalisation questions. Bad generalisation of for example coast lines will be copied to many maps instead of just one. Lines and symbols are too perfect and lettering is difficult. I will not say that these problems not can be solved but up to now these solutions are not efficient enough to use for such a big project. There is not enough experience with the new technique.

The real great advantage is the possibility to revise the maps quite easily and to produce support material. But from my own experience with the national atlas I would say that even to revise a map does not cost much less than to make a new map. Maybe this will change in the future. I will not say that we have made the most perfect school atlas but it is a good start and the atlas will definitely fill a gap in Sweden.
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Geography Education with Books and Atlas Information System — What Nils Holgersson Can Teach Us

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Abstract
In 1906 Selma Lagerlöf wrote a geography book for the basic geography education in Sweden. Is today’s educational material any better? Have we actually improved on Selma’s masterpiece? In this paper we will suggest that we haven’t learned enough from Selma, but that by incorporating some of her techniques we can quite easily improve a current atlas information system.

Literature versus Atlas Information Systems

Can an electronic atlas information system compete with a masterpiece of literature? Primary schools used the book about Nils Holgersson during half a century. Today few electronic publications are seen as having a lifetime of more than a few years. Can we learn something from an old book?

Literature
Between 1906 and 1907 Selma Lagerlöf wrote “Nils Holgerssons underbara resa genom Sverige [The Wonderful Adventures of Nils]” – a geography book for elementary schools that has been translated into more than 30 languages. A few years later she received the 1909 Nobel Prize in Literature “in appreciation of the lofty idealism, vivid imagination and spiritual perception that characterize her writings”. Selma Lagerlöf tells us about Nils Holgersson who from the back of a goose watches different landscapes similar to the imagery later produced through aerial photography. Through stories, myths, and folk-tales the reader learn many basic facts about Sweden, its culture and nature in different regions. Changing seasons, as well as more long-term changes to landscape, spatial distribution of different types of building styles is also discussed in the same manner.
Atlas Information Systems (AIS)

The key in Atlas Information Systems is the strong focus on integration of text and images (maps, pictures, graphs, charts, and tables). This integration is also one of the key ingredients in the National Atlas of Sweden, both books and electronic versions. Currently, we are working together with educators to aid teachers using the National Atlas of Sweden in their teaching. Many educational institutions, primarily high schools, are currently using our atlas information system, PC-atlasen GIS.

Parts of an AIS

An atlas information system can be divided into three parts: data content, programming, and method of presentation. The data content can quite easily be kept up-to-date using the information highway (we are already doing this). Today we take for granted constant changes in operating system, new versions of programming languages and users expectations of standard graphical interfaces. Technological change is constantly effecting the programming. By separating out the method of presentation, we can focus on something important and hopefully more sustainable over time. Using data, metadata, and templates the programming becomes a part where queries of data is presented in templates based on, among other things, the metadata.

A brief comparison

Can an electronic atlas information system compete with a masterpiece of literature? Primary schools used the book about Nils Holgersson during half a century. Today few electronic publications are seen as having a lifetime of more than a few years. Can we learn something from an old book?

Other Approaches

Without throwing away the old for the sake of age, we try to re-use and re-think traditional approaches. Many people have proposed and implemented games or game situations as a teaching method. The National Atlas of Sweden are investigating the strong framework used in both games and Nils Holgersson in order to visualize a future with a successful atlas information system being used in education.

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Abstract
The land and population base of the American Indian has changed dramatically since the first landfall of Columbus in 1492. Land transfers from Indians to Whites were sometimes piecemeal and sporadic, at other times organized and intense. Actions such as treaties, purchases, de facto seizures, and other forms of acquisitions diminished American Indian land holdings to less than five percent of total U.S. land territory. This project contains three components with the end result illustrating and cartographically analyzing the historic configuration of American Indian lands and their associated peoples. The first component reproduces and adds value to C.C. Royce's book, Indian Land Cessions in the United States [1899], in digital form. At this stage, the tables from the book are being recast to become part of the database connected to the scanned maps. And the original maps, while excellent given the knowledge of the late 19th century, are being adjusted to current map accuracy standards. The second and third components of the project extend the work backward into the colonial era and forward through the 20th century, respectively. Included with these portrayals of American Indian land tenure are population, economic, topographic and vegetation overlays to provide a more realistic and complete perspective. Concurrently, the relational databases allow multifaceted queries of the information presented. The culmination of this project is to publish an atlas of American Indians in the United States.

Introduction
The amount of information on American Indians is voluminous. But given the vast array of books, studies, reports, and maps, the data seem almost too overwhelming to grasp. Consequently, the American Indian Atlas: Centuries of Change, is being designed to place the most significant aspects of American Indian lands into context. To accomplish this task, this atlas will concentrate on land issues and their importance to the historic and current status of American Indian lands and the distributions of their peoples.

The format of the atlas will be a combination of historic maps, computer-assisted cartography, and digital images. Maps will be produced that best illustrate the historic development of the reservation system and the modifications that have taken place over time. The atlas will be divided chronologically and subdivided into sections on tribal distributions and populations, economic activities, non-Indian contacts and settlements, and land transfers. Brief discussions will open each section with short, interpretive narratives analyzing the maps, graphs or illustrations. Relevant passages from books, articles, journals, diaries, and speeches will be integrated into the atlas to emphasize that aspect of information. The atlas perspective will be on the United States,
however, isolated instances and examples from specific tribal groups, reservations, or regions are to be highlighted. This arrangement will allow the reader to observe the national context of information, as well as the specific instances and circumstances of actions or situations. This so-called ‘zooming in and out’ affords the opportunity to highlight specific and relevant events without losing the thrust of the atlas, a national perspective.

Project Description

This project is divided into three time periods: the colonial era, the federal period to the end of the 19th century, and the 20th century. The first time period being addressed is that covered by Charles C. Royce of the Bureau of American Ethnology in Indian Land Cessions in the United States [1899]. This project is designed not only to reproduce his work, but to integrate modern techniques of computer mapping with relational databasing. The project will create a new visualization of American Indian lands, not just as cartographic portrayals, but as a realization of the landscape and area of American Indian lands. Not only will the boundaries of the tribal lands as illustrated by Royce be included, but the environmental context of the lands will be overlaid as well. On a two-dimensional map, the lands look large and promising, but this project will add the other dimension of terrain as well as a layer of vegetation put them in their proper geographic perspectives. These overlays are extracted from the USGS digital National Atlas of the United States.

Royce’s maps are being scanned and adjusted to 1999 cartographic standards. The concept is to portray the spatial information as accurately as possible using current technology and cartographic knowledge. His maps are one of the three basic elements in the legal struggle of the different tribal entities trying to mitigate land based conflicts between themselves and the United States government. So the results of this revision of his work will have an impact on the legal status of over 49 million acres and the livelihoods of almost two million American Indians. In most instances, the lands reserved for American Indians were not their tribal homelands, thus forcing them to adapt to different environments and lifestyles. Overlaying topography and vegetation on the land transfer boundaries will provide a more realistic illustration of the environmental conditions imposed on the American Indian. Next is the creation of a relational database that integrates the maps with an edited version of Royce’s tabular data. In the historic manuscript mode of inquiry, a search of each element separately is all that is possible. By using a digital database of the year of transaction, form of transaction or legal action, Royce’s land cession numbers, tribal group, and geographic base files, accurate and efficient multifaceted queries can be made. For example, at the simplest level, creating ‘hot keys’ and merely clicking on land cession number 268 in the table would automatically connect the reader to a map of Minnesota (figure 1). As another example, a map and table could be produced of all Arapaho land cessions during the period of 1855 through 1878. Or a query could be made of all land transfers completed through executive order in selected states or within given latitude and longitude coordinate boundaries.

The end results of this portion of the project will be three fold. The first is the computerization of Royce’s original maps along with the database query potential. This project proposes to methodically distribute the results of his previously published scientific research. First, all of this work will be reproduced as a CD-ROM with a relational database interface containing the full text, tables, maps and indexes. Second, a link to the Smithsonian Institution website will be created with scanned images of the maps and tables. And third will be the adjustment and correction of Royce’s maps to present-day standards. This project is an extension of his work using modern computer database techniques and cartographic accuracy. These actions will enhance the abilities of researchers to cross-reference tribes, treaties, dates and locations; investigate similar treaties and visualize the impacts; or examine a specific tribal group and their multitude of treaty negotiations. Currently, this type of research is only available in the more tedious methods of surveying through the index, the individual maps, or the tables. Further, this project will portray this work not merely as lines or polygons on maps, but in its geographic context, as elements that enhance the significance of American Indian lands.
Figure 1. Example of matching a table number and data description with that of a corresponding partial map from Royce [1899].

**Historical Background**

Since European contact, the land base of the American Indian has changed radically. Land transfers from Indians to Whites have reduced their holdings to less than five percent of the total lands in the United States. During the colonial periods of settlement, lands transferred included: those formally ceded by treaty or purchase; those seized privately or in the name of the crown; and those that after a time, became de facto seizures. After the United States achieved independence, lands transferred from Indians to Whites included: those formally ceded by ratified treaty or agreement; those obtained by purchase; those taken by unratified treaty or agreement; and those expropriated without any Indian consultation, by executive order, act of Congress, order of the Secretary of the Interior, or private seizure. Many transfers recurred in both the colonial and federal periods due to successive White administrations, or to overlapping tribal claims, or to Indian tribes that had relocated on already ceded land later ceding portions so that still other Indian tribes could locate there also (especially in Oklahoma). Lands returned to Indians include those retroceded as reservations by one of the following: ratified or unratified treaty or agreement; executive order; act of Congress; or order of the Secretary of the Interior. In addition, reservations were diminished or enlarged by court action.

Royce’s work stands alone in its compilation of the processes by which all American Indian land transfers have proceeded. His efforts tabulated and mapped 720 different land exchanges registered from 22 October 1784 through 15 August 1894. The book is well known for its contribution to our knowledge of the American Indian land base transfers. His cartographic portrayal of the treaties, laws, and executive orders, produced a clear, visual interpretation of Indian lands. Before his publication, no one person knew exactly the areas set aside for all the tribal groups. So the negotiations during many of the treaties were a blind allotment of lands, known in the individual states or territories, but not in a comprehensive or strategic manner. No other published document exists that combines the cartographic record of the land transfers with the tabular listing of the treaties, legislative actions, executive orders, and so on. Single sheet maps exist at a very small scale (1:5,000,000), illustrating the treaty boundaries, but these are basically reproductions of Royce’s work. Several books are available regarding the different Indian treaties, but they do not have the cartographic record that provides the locational information as produced in his report.
Colonial Periods

For the era prior to Royce’s coverage, this project will draw on previously published research as well as original research from the historic cartographic and textual records. The various European powers felt that the right to land depended on discovery without consideration for the native population inhabiting and possessing the land [Thomas, 1899]. Over the years, this policy evolved into the right of eminent domain to accommodate settlers as well as colonial, and later federal, expansionist policies. Nonetheless, even though kings substantiated free and complete title to land grants, patents, and charters, grantees had the option of how to deal with Indians, i.e., simply move in, or, to keep the peace, purchase land or treat with them to get land [Deloria and Lytle, 1983]. Many land purchases from Indians were purposefully vague and tended to have no limits in one or more cardinal directions [Snyder, 1969]. Indeed, some colonial land grant charters extended from ‘sea to sea’ (Atlantic to Pacific). Mapping these ambiguities creates a challenge when documenting land expropriations.

The smaller colonies in the future United States, such as New Sweden and New Netherlands, are being examined, along with the larger colonies established by France, Spain, and England. Competing interests amongst the European powers on the broader scale and the frequent lack of surveying on the local scale often resulted in overlapping and conflicting land grants and claims. Copies of historical maps are being gathered and sketch maps are being compiled, and prepared for analysis, before editing them to current map standards, followed by inclusion in the final version of the atlas.

Federal Period

Literally hundreds of treaties and agreements were made between the United States and Indians from the treaties with the Cherokee at Dewitt’s Corner and Long Island in 1777 to the last major agreement with the Ute Mountain Ute in 1914. There was a gradual recession of Indian land possession from east to west across the 48 contiguous states. In the mid-19th century, White acquisition of land jumped from the center of the country to the west coast resulting in the final lands being acquired in the Rockies and Great Basin. The compression of western Indian lands continued throughout the rest of the 1800s confining the Indians to smaller and smaller tribal areas culminating in the present-day reservation system. Like these aggregated maps, within the final atlas, the user can compile land transfers by range of dates, or may select a single date to view the events of a particular year.

Throughout the 19th century, not all lands were expropriated by treaty. And some of those lands taken by treaty were not ceded, e.g., in the treaty with the Caddo, they only extinguished their right of occupancy, not their title to the land [Downs, 1978]. Actions by the President, Congress, Secretary of the Interior, or even private individuals on a smaller basis amounted to numerous land exchanges. In addition, while treating with other countries (France, Great Britain, Russia and Spain), the United States recognized these countries’ land title based on discovery or conquest, sometimes with little or no regard for Indian title. Not all treaties and agreements were ratified so large areas of the country were never transferred by ratified treaty. Note that this tentative map does not take into account any reservations established within these areas, nor does it attempt to reconcile these areas with any land settlements made with the Indian Claims Commission or the Court of Claims.

Other threats and gains to Indian lands have included: the alienation of lands through the General Allotment Act of 1887; the Indian Reorganization Act of 1934 which ended the prior act and restored some of the lands; the House Concurrent Resolution 108 in 1953 terminating the status of a some tribes and reservations followed by several subsequent restorations since 1973; and governmental land seizures for public projects to lands recovered through the Indian Claims Commission [Gibson, 1988].
Present-Day Indian Lands

In 1999, 289 federal and 12 state reservations exist, along with extensive land holdings by the Alaskan Native Regional Corporations. The problem that arises when considering present-day Indian lands is the misconception in equating reservations with Indian land. As Sutton [1976] noted, “...the rubric ‘Indian reservation,’ unless more clearly defined in its various uses, wrongly connotes a universality of legal status, political organization, and perhaps even economic poverty” (p. 281). This statement still holds true.

One major exception to the ‘reservation as Indian land’ disparity is the Alaskan Native Regional Corporation lands. In fact, only one small reservation exists in all of Alaska: Annette Island. Elsewhere in the United States, reservations are seldom the solid blocks of land that one sees on a map. Because of the allotment and termination policies, as well as occasional government actions of eminent domain, many reservations contain large sections of non-Indian owned land including White towns; and other reservations share jurisdiction with the federal government, e.g., Wind River Reservation and the Bureau of Land Management. These White towns that lie within reservations consider themselves separate; in turn, the reservations that lie within counties and states consider themselves separate. That is, while the reservations are not independent or autonomous of the United States, they are independent of the states making each reservation “a semi-autonomous enclave” [Sutton, 1976: 292]. In simple, non-legal, land based terms, a reservation is a geographic area established by treaty, statute, or executive order, as defined by the courts, over which a tribal entity exercises some degree of civil jurisdiction [Piepenbrink, 1988].

Indian lands, whether on reservation or off, may be grouped into two classes: tribally or communally owned, and individually owned. They are further subdivided into the seven subclasses [Cole, 1993; Piepenbrink, 1988; Reeves, 1950]: fee simple, restricted fee, fee or title held in trust by the U.S. government, allotted restricted fee or trust, fee held by a third party, converted restricted fee, and alienated land. There are still other types of Indian land classification. In Oklahoma, the Osage have retained total subsurface reservation rights but have only scattered surface holdings in Osage County. And a new category of lands is included in the recent agreement between the federal government and the Navajo tribe. A broad swath of land in northwestern New Mexico was set aside for Navajo use on lands held by the government [Piepenbrink, 1992]. The key word at this point is ‘use’, not ownership. Whether or not that will change in the future is unknown. The database for the maps encompassing the 20th century will incorporate all of these different classes of Indian lands thereby enabling comparisons between tribes, locations, and time periods.

Conclusion

All of what has been discussed presents complex historical scenarios of Indian-White land transfers and population patterns. Whether non-Indians obtained the lands by purchase, fraud, cession, seizure, homesteading, trade or conversion, the results are the following: (1) many tribes lost all or most of their lands held at contact; (2) those lands that have been retained are often different from the areas inhabited at contact; and (3) Indian lands today display a complex and unique land tenure pattern within the United States. And whether multiple distinct tribes were molded into one another in single reservations, or individual tribes were broken up into multiple reservations, the Indian population has been decimated and segregated while surprisingly maintaining a significant degree of integrity. This atlas aims to visualize both of these scenarios during the next few years.
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Compilation of the Electronic Atlas “Space Methods in Geoecology”. Demo-version

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Abstract
In 1998 Faculty of Geography, Moscow State University, has published a new atlas of satellite images and ecological maps, compiled on their basis, titled “Space Methods in Geoecology”. Now an electronic version of this atlas is being created. The electronic version will provide for not only review of the Atlas materials, but for profound work with them. Main principles in its solution are:
- Completeness and systematic approach. All materials of the Atlas are included into the electronic version; it is complemented by a catalogue of space images and maps, and related reference tables. Special software will allow to access them from any part of the Atlas.
- “Easy” and “deep” reading levels. The possibility of work with the Atlas for readers of different level is provided.
- “Zooming of meaning”. Zooming from general to detailed levels, and from preview to deep investigation is provided.
- Cross-reference system of links: links from the text to satellite images and maps, from images and maps to their catalogues, from space to terrestrial images, from maps to their legends.
- Preservation of attributes. All attributes of maps - scale, legend and others, all attributes of space images - scale, data of survey, spacecraft - are preserved or changed accordingly in process of zooming.
These principles are realised in the demonstration version of Atlas, which presents one of its 50 subjects - “Impact of mining and mineral processing. Nonferrous metal ore processing. Monchegorsk area”.

Introduction
In 1998 Faculty of Geography, Moscow State University, has published a new atlas of satellite images and ecological maps titled “Space Methods in Geoecology”, connected with application of space investigations for ecological purposes. The Atlas shows the ways of satellite images use in geoecological monitoring and for solution of ecological problems. The Atlas characterises the possibilities of space methods for investigation of global ecological problems, such as global climate warming, loss of plant biomass, depletion of ozone layer. More details are given for Russia and neighbouring territories: regional ecological problems, related to sea level fluctuations, air pollution and water contamination, anthropogenic impact in different natural conditions - in tundra, forest, steppe, desert zones. Problems of deforestation, erosion, desertification, technogenic impact in mining and industrial regions, problems caused by urbanisation and nature management, as well as problems of natural disasters and nature conservation are examined in Atlas.
The Atlas exists in traditional paper format, but thanks to computer aided publishing all the materials were transformed to digital format, reserved for printing process, but not suitable for readers’ work with Atlas.
In the recent period of common informatisation, telecommunication, and digitalisation, the tendency to present in electronic form such vast sources of information as atlases of maps and images has been seen very clearly. That provides inexpensive multiplying and for possibilities of computer work with materials. The 18th International Cartographic Conference in Stockholm has clearly shown the tendency to creation of electronic versions of large map collections, like national atlases [Kravtsova, 1998]. Projects and results of creation of electronic atlases for Switzerland [Bar and Sieber, 1997], Sweden [Wastenson and Arnberg, 1997], USA [Gubtill, 1997] were presented at that conference. In Russia, the Institute of Geography, Academy of Science, in cooperation with “Data+” have created electronic atlas “Our Earth” as a brief versy of atlas “World Environment and Natural Resources” [Liouty et al., 1997]. A new Russian atlas “Ecological Atlas of Russia”, before being published in paper format, is being worked out in electronic form [Kotova et. al.,1998].

By initiative of prof. Yuri F.Knizhnikov, the suppervisor of atlas “Space methods in Geoecology” compilation, it was decided to begin elaboration of an electronic version also for this atlas, which is in fact a collection of extraordinary type, including satellite images, maps compiled on their basis, text materials on methods of images use for ecological tasks solution.

Main principles of creating an electronic version

The electronic version will provide for not only review of the Atlas materials, but for profound work with them. Five main principles in its solution may be distinguished.

Completeness and systematic approach

All materials of the Atlas are included into the electronic version; it is complemented with a catalogue of space images and maps, and related reference tables. Special software will allow to access them from any part of the Atlas.

“Easy” and “deep” reading levels

The possibility of work with the Atlas for readers of different level is foreseen. A choice is provided between a short descriptive text to illustrative materials for easy reading and complete profound and full text with detailed characteristic of remote sensing materials and methods of their ecological interpretation.

“Zooming of meaning”

Zooming from general to detailed levels, and from preview to deep investigation is provided for the contents page (from main chapters to details), illustrations (from their collection by theme to their detailed characteristics, from small to large scales), text (from brief to complete text).

Cross-reference system of links

It is planned to provide links from the text to satellite images and maps, from images and maps to their catalogues, from space to terrestrial images, from maps to their legends.

Preservation of attributes

All attributes of maps - scale, legend and others, all attributes of space images - scale, date of survey, spacecraft - are preserved or changed accordingly in process of zooming.
Demo-version of the Atlas

The above principles are realised in the demonstration version of Atlas, which presents one of its 50 subjects - “Impact of mining and mineral processing. Nonferrous metal ore processing. Monchegorsk area”. This part of Atlas deals with the influence of industry on the nature in one of the northern regions of Russia - Monchegorsk in Kola Peninsula, where SO2 emissions from copper-nickel factory caused damage to vegetation and resulted in formation of technogienous barrens around the factory. Space images are used here for interpretation of the degree of industrial damage to tundra and forest vegetation, monitoring of its dynamics and for compiling the maps of vegetation state by visual and computer methods. This part of the paper version of the Atlas consists of 4 sheets (in total there are 108), their authors are Yu.F.Knizhnikov, V.I.Kravtsova, I.K.Lourie, A.I.Ressle, O.V.Toutoubalina.

The electronic version is prepared by V.V.Goryachko, a student of Cartography and Geoinformatic Department, Faculty of Geography, MSU, and based on the software created in Laboratory of Automation in Cartography, the same Department, by V.N.Semin. The electronic demo-version is about 100 Mb. The working out and the creation of the atlas was made in the Media View 1.4.1 (Microsoft company) program, in which the author’s method “Scenarios’ language” lies as a basis. This method is very close in it’s form to the traditional programming. It is presented by powerful, object-oriented programming language, determining (with the help of special operators) interaction of multimedia’s elements, location of active zones, button setting, synchronization etc. The programming language is the central part of such system; the editing of the elements inside the program (graphic images, video, audio etc.) is presented by minimum or are absent at all.

The system’s choice was determined by experience from previous works. this Thus this DEMO-version isn’t the first multimedia supplement, created in the laboratory. For example, in 1998 a CD-ROM dedicated to the 60 anniversary of the Geographical department was made. Mostly it was intended for the department’s and university’s staff, but it is also supposed to be interesting to other people who are interested in the information of such kind (for example, for university entrants, other universities staff, etc.). On the base of the CD-ROM’s materials a demonstration computer clip about the Geographical department was produced.

The demonstration version starts from information about the newly published atlas “Space Methods in Geocology” and its title sheet (Fig.1). The reader has possibility to get acquainted with its contents - either in general, where 14 chapters of the Atlas are presented, or in details, moving to widening of every chapter, where all 108 sheets of the Atlas may be found. It is also possible to move from the page with contents to common materials of the Atlas, such as abstract, information about authors, brief and full text for every chapter and sheet.

Example: One chapter of the Atlas. “Easy” and “deep” reading levels

The presentation of a chapter titled “Impact of mining and mineral processing” begins from short characteristics of the place taken by this chapter in the Atlas. The reader is being informed, that along with characteristics of influence on nature of such kinds of mining processing as gold, coal, apatite mining, peateries, oil exploration, Atlas includes materials about damage to nature caused by nonferrous metal ore processing. There are examples of satellite images application for investigation and mapping of industrial damage to northern vegetation by copper-nickel factories in Monchegorsk and Norilsk. This processing is characterised by emissions of SO2 and heavy metals which lead to depression and death of woundable northern ecosystems. Destruction of vegetation is seen at space images and results of their visual and computer interpretation and maps compiling are represented in the Atlas.
Figure 1. The title sheets of electronic (upper picture) and paper (lower picture) versions of Atlas “Space Methods in Geocology”
Further main themes of subchapter “Nonferrous ore processing. Monchegorsk area” are presented; it is just they that form the contents of the demonstration version. The material is divided into 8 themes. The list of these themes is shown together with “pictogrammes” - miniature rendering of main images and maps in every theme. Such brief collection of illustrative materials allows to represent the subchapter of the Atlas at whole, and the widening software enables going any theme. The reader can call any image or map to the screen, further observe them in enlarged form by portions, moving the image. All maps and satellite images are provided with line scale, that allow to know the scale during any enlargement of image. The images are rigged with “active indices”, that allow to obtain the characteristic of marked objects. For example, zones with different degree of technogenious impact around Monchegorsk have indices at satellite image; by these indices it is possible to call quantitative characteristics of pollution in smoke emission of the factory or to look at terrestrial photo pictures of technogenious landscapes in these zones (Fig.2).

Such is the “easy” variant of the electronic atlas for a wide reader. For deeper investigation of the material, the reader uses “entrance” into the main text and obtains the possibility of full materials reading; in the main text, in turn, there are “active dispatches” to images, maps, illustrations, that allow to pass to these images, also provided with widening text explanations. So the full variant of the Atlas is also constructed multifoldly, with opportunity of step-by-step widening and cross reverting to materials.

**Eight topics of demo-version**

Further, we will characterise main materials, included in demo-version of the Atlas and concerning eight themes. The theme “Characteristics of problems of rational land use in Kola Peninsula, caused by concentration of large mining and nonferrous metal processing centres” includes the observing winter image of Kola Peninsula taken from “Resource-O” satellite, where industrial centres and zones of polluted snow cover around them are seen. Geochemical maps of Cu and Ni air pollution, represented here, show that air pollution is concentrated near main centres of copper-nickel processing in Nickel-Zapolyarny and Monchegorsk.

The theme “The characteristic of zones with different degree of ecosystems destruction in Monchegorsk copper-nickel factory pollution area” includes space image from “Landsat” satellite, where zones of dead vegetation and of different destruction degree around Monchegorsk copper-nickel factory are seen. For these zones characteristics of the landscapes profile are represented, where for five zones of different damage degree quantitative characteristic of factory polluted emissions are given, accompanied by characteristics of ecosystems destruction [Kryuchkov and Syroid, 1984]. The state of nature environment in zones of full, strong and partial destruction of ecosystems is illustrated by terrestrial photo pictures.

In the theme “Space photo images of Monchegorsk area and interpretation signs of damaged vegetation” two fragments of photo pictures from “Resource-F” satellites are represented - for western and eastern parts of Monchegorsk area; interpretation signs of vegetation with different degree of damage are characterised here.

In the theme “Results of damaged vegetation visual interpretation by space photo images and their comparison with data of forest-pathological investigations and field observations” the scheme of vegetation injure, compiled by photo images interpretation results, is represented; it shows the share of dead trees in forest (in percentage). It is shown that forest-pathological investigation data confirms the correctness of space pictures interpretation. It is illustrated also that boundaries of damaged vegetation zones, drawn without satellite pictures use, are more schematic than those determined by space images.

The theme “Scanner images from “Landsat” satellite” acquaints the reader with the main material of space survey, used for mapping of technogenious damage to vegetation, - the colour composite image taken from “Landsat” satellite, scoped mountain massives of Khibiny and Lovozero tundras, Chuna-tundra and Moncheg-tundra ridges. The interpretation signs of industrial damage to vegetation are characterised for scanner image.
Figure 2. An example of characteristics for zones with different degree of technogenous damage around Monchegorsk
The theme “Methods and results of scanner images interpretation with field and aerovisual control. The map of industrial damage to vegetation, compiled by results of visual interpretation “Landsat” image” includes the map of industrial damage to vegetation, compiled by visual interpretation of satellite image [Kravtsova, Lourie, and Ressle, 1995], accomodated by field interpretation of airphoto pictures for test sites and with aerovisual control. The map shows technogenious barrens; forests are divided into 4 categories by degree of destruction; swamps and mountain tundras - into 2 categories. At whole 27 classes of objects are shown. For the first time the map shows the distribution of vegetation destruction caused by emissions of copper-nickel industry in so much detailed form.

In the theme “Methods and results of automated classification of damaged vegetation by digital information from “Landsat” satellite. Use of investigating objects spectral signatures and creation of algorithms on that basis” it is shown that tundra and forest spectral signature curves taken by multiband information from “Landsat” satellite allow to divide vegetation by the degree of industrial damage. It makes it possible to create a computer classification algorithm on the basis of threshold meanings of spectral brightness ratio and vegetation indecis [Kravtsova et al., 1996]. Represented results of such classification show that this method allows to divide forest by degree of its damage, but for tundra such division is not achievable.

The theme “Classification on the basis of principal components composite and of vegetation index: derivative images and classification results” shows that further perfectioning of computer classification method requires applying of spectral signature meanings in more than two bands. For this purpose, image transformation by principal components method and colour composite of the first three components was made. This method allows to divide tundra by damage degree into undamaged, damaged tundra and technogenious barrens at former tundra place. For forest division by damage degree calculation of normalised vegetation index NDVI is made. Interactive threshold classification by brightness quanting of the both derivation images - principal components composition and vegetation index - gives the result in the form of map of damaged vegetation classification. The both derivation images and the resulting classification map are represented.

Conclusion

Thus, the “kitchen” of the creation of original classification method is open in the full material of one chapter of our scientific-methodologic atlas. The method was necessary for solution of a difficult task - the division of tundra and forest vegetation with different degree of industrial damage by space images. The reader of the Atlas electronic version has the possibility to estimate the correctness of the solution, and if necessary - to use this new method. At the same time wide circles of readers have possibility to avoid deepening into methodic details and to pay attention to final results of images processing, as well as to capabilities of space images use for solution of ecological problems.

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The inevitable transition to the model of sustainable development of the mankind is discussed. The necessity of adapting the Index of Human Development to the realities of Russia is pointed out. The scope of themes and indicators characterizing the possibilities and the ways of reaching the sustainable development of Russia is identified. The importance of historical aspects for the elaboration of the models of sustainable development of various territories is emphasized. The structure of the Atlas of the Sustainable Development of Russia is described.

Future of mankind and world economy depends directly upon the global ecological situation. Destruction of natural ecosystems was given start 10 thousand years ago and it is still in progress on the global scale. By the end of the XX century, man has destroy about 40% of all ecosystems resulting in ecological crisis owing to the fact than human economic activities have exceeded what economic capacity of the biosphere can afford. Following the theory of biotic regulation of environment, mankind has to work out a principally conception of using natural resources, developing economic and social relations. Stability of economic development should be based on balanced solution of socio-economic problems on the background of preserving natural environment to satisfy the needs of both present and future generations.

The UN World Commission on Environment and Development (1987) and the United Nations Conference of Environment and Development (1992) pioneered the concept of sustainable development of the modern civilization as a strategy equally ensuring the balanced social development and the environment conservation both for the present and future generations. The Russian scientist V.G.Gorshkov supposes that human activities have destabilized the global ecosystem and its compensation mechanisms, thus causing the environmental crisis at global, regional and local levels. Under the sustainable development of social and economic activities the allowable level of the biosphere degradation would not be exceeded and, therefore, the extent and the quality of the environment required for its stability could be preserved.

The complexity of the sustainable development issues is influenced, among other things, by the conflicting approaches of the nature, population and economy. This is particularly tangible in the developing countries, where the population overgrowth, or the demographic explosion, often results in the reduced well-being and the growing anthropogenic pressure on the environment. Even in Russia with much less acuteness of these conflicts one should correlate the lines of social development with the sustainable development of the environment. There are critical demoenvironmental situations, both in the densely populated industrial and transportation centers and agglomerations, and in the relatively less populated areas due to the local impacts of mining, the overexploitation of pastures and forests, etc.

The assessment of the demographic state of Russia without regard for the environmental aspects leads to the misconception of the need of the considerable population increase, the growth of new large cities, etc. The pure
environmental approach, for its part, often suggests the radical population decrease down to less than 10 persons per 1 square kilometer. The balanced approach to the sustainable development of population, economy and the environment of Russia would favor the models of the stable population reproduction, which prevents its considerable increase, but provides the attainment and the maintenance of the balanced relations between the principal age groups, i.e. pre-working age, working age and post-working age population. All the above requires the adequate economic and social development, which is the third element of the sustainable development, providing for the realization of both the demographic and the environmental components of this concept.

Thus, the concept of sustainable development embraces the environmental aspect in close connection with the economic and social ones, including the stability, or the attainment, of the population well-being. According to the conclusions of the United Nations Conference (1992), the governments of the world should adopt the national strategies of sustainable development, which allow each country to shift to the relevant model, no matter how far it is from it now. As a response, the 1994 Decree of the President of Russia has ordered the elaboration of the sustainable development strategy for Russia. The general lines of this concept have been suggested by 1995. The frame of the concept embraces the wide spectrum of the environmental, economic and social aspects of the national development. It has been accepted that the sustainable development of Russia should be aimed at the support of the reproduction of healthy generations and the conservation of the natural and cultural potential of the country.

The United Nations Program suggests the common criterion of the social development, i.e. the Human Potential Development Index. It is based on three integrated indicators. They are the life expectancy, as a general indicator of the national health status, the educational level based on the index of literacy and the standards of living and welfare calculated as a value of per capita GNP. These parameters result from the interactions between many social, environmental and economic factors. For example, the population health in Russia depends on various social factors, such as the proliferation of alcoholism, tuberculosis and traumatism, low security of the majority of the population, etc. The value of per capita GNP is controlled by the economy development, the effective utilization of natural and labor resources, etc.

The diagram 1 represents the themes and indicators to be investigated in order to identify the factors which control the possibility and the ways of sustainable development of Russia. The core block includes the environmental indicators. To assess the environmental situation in Russia it is necessary to evaluate the distribution and the degree of environmental impact of particular branches of economy, such as industry, agriculture, forestry and transport, correlate the environmental changes with the initial natural potential, for example, by the degree of environment deterioration, reduced fertility and pollution of soils, degradation of plant and animal cenoses, etc. The environmental standards make it possible to evaluate the state of geosystems and their components in terms of their stability, as catastrophic, critical, satisfactory, etc. The catastrophic state means the total destruction of geosystems, the critical one suggests that the natural ecosystems could become stable again after the anthropogenic overburden is removed.

The socio-demographic block includes the following factors which are of particular importance for the sustainable development of the country: average value of per capita income, income differences, income - minimum of subsistence ratio, educational level, etc. Of particular importance in this block is the general morbidity of population, as well as the diseases controlled by the environmental (respiratory, congestion and other ones) and the social factors (tuberculosis, alcoholism, narcotism, etc.). The demographic potential should be described in the historical aspect, by the main stages of the social development.
Diagram 1
The economic block is aimed at the identification of the parameters of economic stability and includes the characteristics of the present-day national economic potential, as well as the assessment of its utilization, through the power and the labor consumption of production processes, pollution and waste amounts per unit product, etc.

The integrated assessment of environmental, economic and social stability makes it possible to classify the subjects of the Russian Federation according to how they comply with the national model of sustainable development.

A principal aspect of study is the historical one. To analyze the stability of development it is necessary to reveal the dynamics of environmental changes and the development of socio-demographic and economic potentials of the country. This allows to identify the temporal limits of the ecosystem transition to the unstable state in correlation with the certain stages of socioeconomic development.

The integrated assessment of the environmental and social stability requires to identify the causes and factors, affecting the environmental, demographic, social and economic situation, in order to propose the system of measures aimed at the sustainable development in all these spheres. The following tasks should be solved in this connection:

1. The survey of the state of the environment and the socioeconomic situation in the regions of the Russian Federation.
2. The spatial modeling of the environmental, demographical, social and economic situations in order to forecast the possibility of their sustainable development.
3. The integration of the system of indicators to assess how close is the state of the regions to the model of sustainable development.

Among the most important means of accomplishing these tasks is the system of spatial cartographic models in the form of the Atlas of the Sustainable Development of Russia. There are all grounds to believe that it is possible for any region, whatever critical, to immediately apply a model of sustainable development. That is why, despite the crisis underway in Russia, we find it urgent and topical to make a special Atlas of Sustainable Development of Russia.

The complexity of the factors of sustainable development leads to the complicated structure and the thematic diversity of the atlas. At the same time it is necessary to conjugate the spatial and temporal elements of its content.

With the above tasks in mind, the structure of the atlas could be as follows:

1. The basic inventory maps of the initial environmental potential and natural resources, the demographic potential and the social and economic potentials.
2. The evaluation maps of the state of the environmental components and the whole geosystems, the demographic situation and the state of the social sphere and the economy.
3. The integrated assessment of how close are the regions to the model of sustainable development.

In this context, intellectual geographic information systems to support decision making gain special importance in choosing strategy of transition to one or another model of sustainable development.
The Design and Compilation of Marine Policy Atlas of China

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Abstract
The Agenda 21 adopted by the United Nations Conference on Environment and Development held in 1992 makes the ocean one of its integral parts. UNCED Agenda 21 points out that the marine environment—including the oceans and all seas and adjacent coastal areas—forms an integrated whole that is an essential component of the global life-support system and a positive asset that presents opportunities for sustainable development. Modern ocean development has brought a series of issues in resource and environment in the course of its rapid production of huge economic benefits. Every country is strengthening its research, development and application of marine science and technology in order to strengthen its competition in the marine field in the world. China is confronted with great challenges and opportunities in its ocean affairs. In order to implement better in the mariner fields the China’s Agenda 21 and promote the sustainable development and utilization of the oceans, the design and compilation of Atlas for Marine policy is under way.

1. Purpose of Design of MPAC

The first purpose of atlas is to make it possible for the users to get acquainted with seas and oceans, that is, to transfer spatial information of seas and oceans to the users. Much information is not passed to the users through direct chart symbols, but through careful and detailed analysis and understanding. A successful atlas can provide, together with the direct information, much more indirect information, which sometime is more valuable. MPAC is a middle-sized general-purposed atlas, the design of MPAC focused on how to collect and then transfer as much indirect information of the seas and oceans as possible.

One of the most important work for China in the next era is the continuable utilization and protection of marine resources. That is, to complete the laws on ocean affairs, to maintenance the nation’s ocean rights and interests, to develop the ocean science and technology and to propel the international cooperation, etc. so the most prior target for MPAC is set to show and explain the kernel of the nation’s ocean policies.
2. Usage and Contents

2.1. Readings

As a general-purposed atlas, MPAC collected a large variety of chart types and contents, including:
- Marine geographical and social environment;
- Marine resources;
- Environment protection in marine area;
- Integrated Marine Management;
- Marine investigations, Antarctic exploration;
- and so on.

The sheets selected together can give relatively full sense of the marine affairs and Chinese marine policies. The atlas is greatly readable with its content charts covering domains of marine surveying, investigating and engineering and closely related to the marine policies of China.

2.2. Analysis

Users can perform analyses on the changes of marine information for the same area, or the differences among several areas by MPAC. The arrangement of charts, the alternation of contents and utilization of historical and statistical data are carefully concerned to make the atlas a convenient and reliable tool for analysis.

2.3. Decision-making

The data in MPAC is absolutely measurable. Users can get information from the heights, areas, volumes, distances as well as the spatial relationship between them, so as to support their decision-making procedures.

3. Form and Characteristics

MPAC is B3 in size, printed in six colors, and consists of mainly three parts: introduction, main sheet and appendix. Besides of essential charts, MPAC uses large amount of images, figures and statistical charts derived from observation data.

Each chart is preceded by an introduction text, from the main idea of Chinese marine policy to marine resources, disaster, environmental protection, scientific research, rights and interests, management, etc., to give the user a general sense and knowledge of the chart. The selection of introduction helped to enhance the logical and systematical structure of MPAC.

Reference