8 MAP DESIGN AND VISUALIZATION

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8.1 VISUALIZATION CONCEPTS FOR GEODATA IN ATLASES

Printed atlases have always been a common and ideal medium for the visual presentation of large amounts of geospatial data. The map editor, having in mind a specific segment of map users, selects a series of topics from the abundance of available georeferenced base materials. Within each topic he chooses and combines the appropriate map features, analyses and synthesises their logic thematic structures and translates them into a map symbol structure that corresponds to that logic. As a result the map user is presented for each topic with a map that shows a static view. Whether in bound book form or prepared for the display on the monitor, a whole collection of such maps, developed from the selected source data, may be called therefore «a view-only atlas» (see position A in Figure 8-1).

The advent of electronic atlases has opened for the map user entirely new perspectives. The notion of interaction enlarges their potential. It enables a whole range of new functionalities. It has added to the map use a third dimension. This concept has been illustrated first by Mac-Eachren in the form of the «map use cube» (Figure 8-1). It can help the map atlas editor to position his atlas project by considering the amount of interaction he might allow his users, the degree of synthesis and fixed or open map symbolization he intends to provide.

Position B in this figure stands e.g. for a web-atlas that leaves the user with rather restricted means of interaction, like switching on and off different image levels, zooming, panning etc. Such a concept may be useful for an inexperienced user group.

Position C on the other hand represents an interactive electronic atlas with maps that are conceptually structured and designed. But in addition the user has means for further analysis based on original or map data, and a wide range of functionalities for map image manipulations as e.g. change of contrast or transparency, of map symbolization like colour and form for the presentation of the data. This atlas type is positioned very near to a geographic information system. It has however the advantage that the data have passed already through a profound analysis, symbolization and design process.

The position of atlas type D in contrast indicates a collection of maps for which the data sets have been more or less provisionally visualised cartographically for further analysis purposes.

FIGURE 8-1:

MAP USE CUBE AND INTERACTIVE ATLASES
(AFTER MACEACHREN AND KRAAK, MODIFIED)

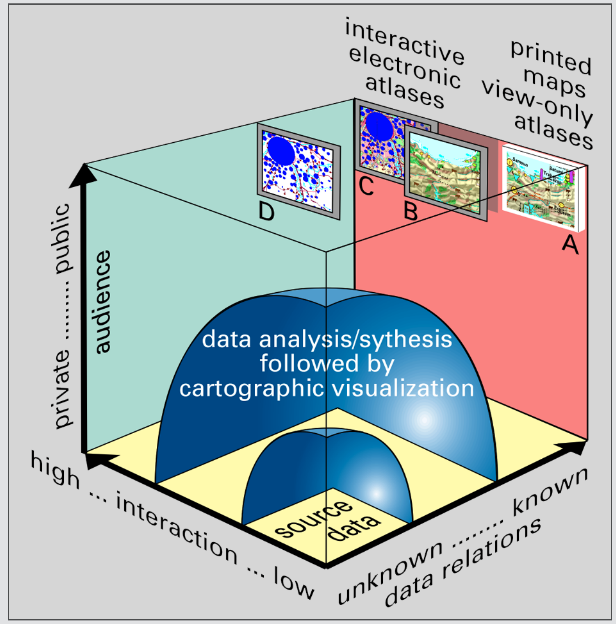


FIGURE 8-2:

AN INTERACTIVE ONLINE-MAP WITH CLICKABLE LAYERS, ZOOMING AND PANNING FOR THE PRESENTATION OF INVENTORIES OF RENEWABLE ENERGY (US ATLAS OF RENEWABLE RESOURCES)

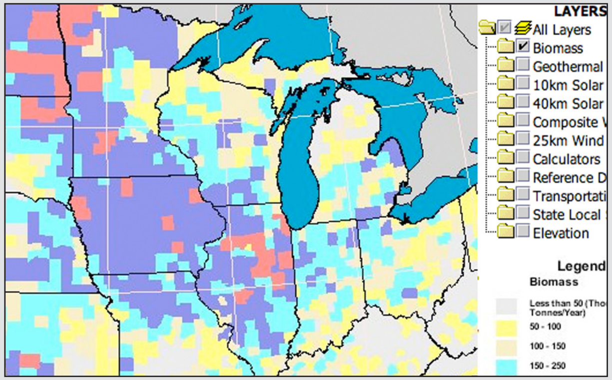
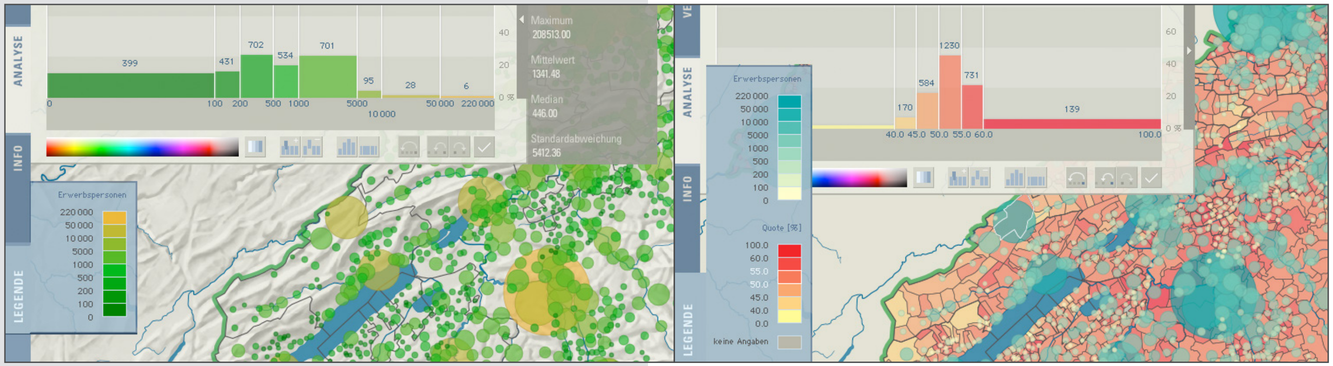


FIGURE 8-3:

TWO VERSIONS OF AN INTERACTIVE ONLINE-MAP USING DIFFERENT TOOLS FOR FURTHER ANALYSIS AND MODIFICATION OF THE SYMBOLIZATION OF STATISTICAL DATA ABOUT THE ACTIVE POPULATION (ATLAS OF SWITZERLAND)



Possible correlations or interdependencies are known only partly and left openended. The profound analysis and interpretation is left to the individual user. The symbolization for such an atlas must remain therefore very flexible.

Optimal or multipurpose visualization

Depending of the user group the atlas editor has in mind, he will therefore have to decide, if he strives for a meticulously elaborated cartographic design, which will be functionally and effiently work in almost all cases of user requirements. The main purpose of the interactions to be included is to support and facilitate the interpretation (Figure 8-2). The technique of adaptive map images is part of these efforts for optimization.
The alternative is an open, more or less preliminary design which leaves a number of perspectives for changes to the user group. This approach holds a lot of potential when further analysis and cross-relations are foreseen as the main use of the atlas.

In this case the appropriate functionalities must be available within the atlas, that is tools for free symbol and diagram design, colour choice, layer management etc. (Figure 8-3).

Shortcomings of solutions as in fig. 8.3: The placement of the tags for the analysis as well as the legends or its parts seem to be steered by the empty space available. They may be often situated far away from the corresponding map element, so that the colors are hard to distinguish or to assign (e.g. in a geology map with hundreds of layer tints).

Cartographic visualization for 3D-maps

In a 2D-map the image plane displays the geospatial 2D-coordinates for the location of the map feature, while the symbolized attributes represent a virtual third dimension. The intention to use instead where appropriate symbols in real 3D-design, is therefore an obvious idea (Figure 8-4). The result is «an artificiallly produced vision, which is recognized by the visual perception system as being spatial, although there exists no real spatial model» (after Buchroithner and Schenkel, 2001).

However, in terrain representations, such as panoramas, perspective terrestrial or airborne camera views, as well as stereoscopic and holographic imagery, the spatial model is the real earth surface. Some of these representations also play a certain role in 3D-mapping.

Advantages of 3D-maps

Suggestive map image
The degree of abstraction of the maps symbols can be reduced by presenting a common view on symbol aspect or size (Figure 8-4).

Correlations with a familiar terrain aspect
The influence of terrain forms and height on the map features represented can be made directly visible by overlaying the terrain surface with thematic information as e.g. geology (Figure 8-5).

Naturalistic approach to terrain profiles
The familiar aspects of the horizons or profiles in a landscape can be recognized mucheasier than through the substitute methods of terrain representation.

Notion of volume
The presence of real z-coordinates allows for a rough estimation of volumes of both, terrain forms and 3D-symbols.

New insights in unknown structures
The 3D-visualization may provide for an easier access into unknown spatial structures or regions.

Disadvantages of 3D-maps

Loss of easily accessible 2D-geometry
Relative distances cannot be measured or estimated. The image plain is more or less distorted.

Considerable parts of the terrain are hidden
Due to the elevation of terrain forms in z-direction smaller forms and valleys in the background may be covered by the foreground (Figure 8-5, above).

Base map hidden by 3D-symbols
Due to the 3D-effect of the symbols and the inclined position of the projection plain large parts of the base map may be hidden (Figure 8-4).

Difficulties in the allocation of labels
In a 2D-map each name is attributed to a visible object or area. In certain 3D-maps many of these are hidden behind the fore-ground ridges or symbols, which causes problems in the correct allocation of the respective names.

Interactive functions can reduce these deficiencies

Moving origin and direction of viewing
With a dynamic module that allows to vary the projection origin and the direction of viewing the problem of hidden areas and symbols can be minimised (Figure 8-6). But the user can read the map only sequenti-ally and never as a whole.

Additional alpha-numerical information
With a mouse over function each map feature can be addressed. The respetive numerical data or elevation can be displayed and in this way replace critical estimations (Figure 8-7).

Polygon driven labelling
Individual map features can be namedwhen the map area is divided in label areas. The name appears with mouse over on the object or in a name box (Figure 8-7).

A 3D-map is a perspective representation of geodata which is perceived by the user as three-dimensional.

FIGURE 8-4

PERSPECTIVE 3D-MAP SYMBOLS SHOWING THE NUMBER OF INHABITANTS. HIDDEN INFORMATION CAN BE OVERCOME BY ROTATING THE IMAGE, BUT THE BACKGROUND INFORMATION (SATELITE IMAGE) IS WIDELY COVERED. AOS 3.0

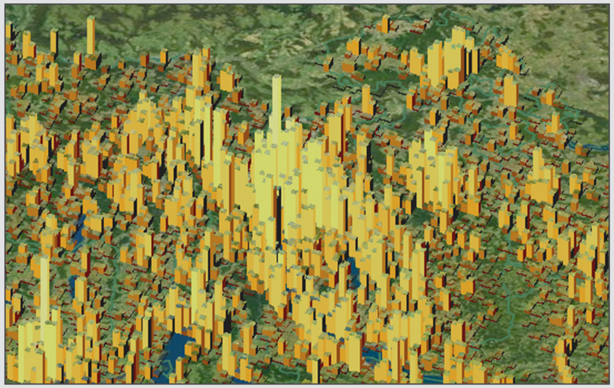


FIGURE 8-5

THE 3D-VERSION OF A TERRAIN MAP OPENS ENTIRELY NEW INSIGHTS, IN THIS CASE IN THE GEOLOGICAL STRUCTURE. THE INTERPRETATION IS FACILITATED BECAUSE OF THE FAMILIAR SCENERY OF THE CRESTLINE (AOS 2.0)

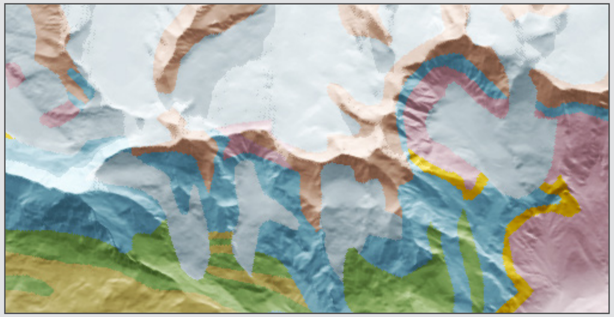


FIGURE 8-6:

CHANGING THE DIRECTION OF VIEWING IS AN INDISPENSABLE TOOL FOR EVERY 3D-MAP TO REACH ALL THE HIDDEN AREAS (SWA INTERACTIVE)

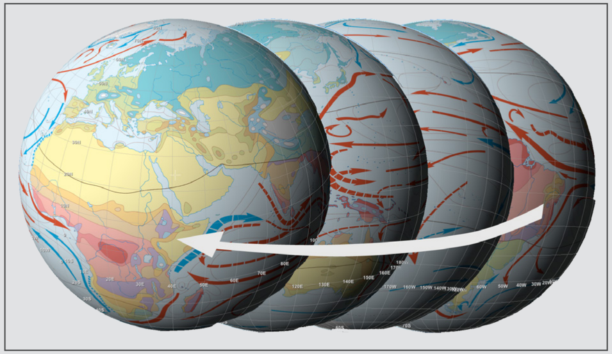
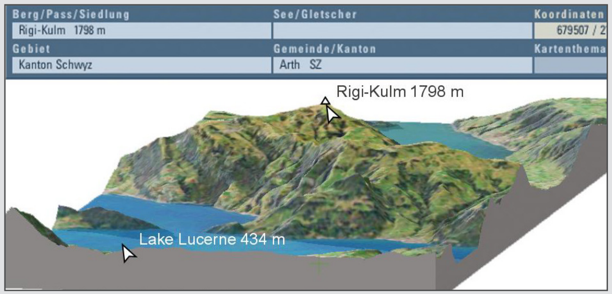


FIGURE 8-7:

INTERACTIVE LABELLING AND COORDINATE MEASURING FEATURE, ACTIVATED BY MOUSE OVER IN A 3D-MAP, A SUBSTITUTE FOR LABELED AND SCALED 2D-MAPS



8.2 BASE MAPS

Rectangular and insular map frames

Rectangular map frames are more or less standard for maps on displays, because the computer windows are rectangular as well (Figure 8-8).
Insular map frames (within a rectangular window!) may be useful or necessary if the data to be mapped is restricted to an otherwise delineated area, as e.g. an administrative boundary (Figure 8-9). A problem may arise if there are isolated data also outside that boundary, because the user expects a homogenious symbolization on both sides, which may not be supported by the available data.

Geocoding the map data

The electronic atlas has the great advantage that the data can be geocoded. Whenever necessary the coordinates of any point in the map are displayed in a little box or window (Figure 8-7). Geocoding of the map data is highly recommended.
This does not mean that we can dispense with base map elements. They provide for a quick orientation which is often just enough.

Map projection and map graticule

In general the map data will be displayed in a projection according to specific needs. For the map grid or graticule a separate level should be provided that can be switched off if not needed. Labelling the graticule poses some problems. If the map is rotated the labels should always hold a horizontal position and show up within the map frame (Figure -10).

Strategies for the selection of base map layers

The advantage of the electronic atlas is, that there is no need to conceive a carefully balanced base map for all purposes of map use. With a series of clickable base map layers all needs can be met without overloading the map image. A certain minimum should however be present all the time for orientation.

Criteria for the selection of base map features

Mind map of the potential map users
Map features with elements the map user is familiar with, as e.g. names of important towns, prominent lakes, bays, mountains are important. Such landmarks allow for positioning the other map features in the user's mental background.

Allowing approximative geographic location
The user must be able to localize each map element relatively to base map elements which are known to him or for which he has means to identify (Figure 8-5).

Interdependencies between the topic and the base map elements
Base Map features, which have a close relation to specific thematic layers of the map, are especially important to support the search for correlations in map analysis.

Base map layers which do not interfere graphically with the other map layers
The selection of the base map features must take care of the graphic structure of the different map layers. Superposition of equal structures is to be avoided or must be handled very carefully, e.g. contour lines as base for a topic shown by isorithms.