Lecture Notes in Geoinformation and Cartography

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Cartography in Central and Eastern Europe

Selected Papers of the 1st ICA Symposium on Cartography for Central and Eastern Europe

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Preface

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The region of Central and Eastern Europe has a rich and long history in cartography. Many important improvements in mapping and cartography have been proposed and performed by cartographers and researchers of that region. The long and outstanding history has led to a lively and vivid presence. Now contemporary methods for depicting the earth and its cultural and natural attributes are used. This book focuses on the contemporary activities in all major realms of cartography in Central and Eastern Europe. It covers aspects of theoretical, topographical, thematic and multimedia cartography, which have been presented at the first Symposium on Cartography for Central and Eastern Europe, which took place from February 16th to 17th, 2009 in Vienna, Austria and was organized by the International Cartographic Association (ICA) and the Vienna University of Technology.

The symposium's aim was to bring together cartographers, GI scientists and those working in related disciplines from CEE with the goal of offering a platform for discussion and exchange and stimulation of joined projects. About 130 scientists from 19 countries followed the invitation and visited Vienna, Austria. A selection of fully reviewed contributions is edited in this book and is meant as a mirror of the wide range of activities in the realm of cartography in this region. The innovative and contemporary character of these topics has lead to a great variety of interdisciplinary contributions. Topics cover an enormous range with heterogenous relationships to the main book issues.

The production of this book would not have been possible without the professional and formidable work of Manuela Schmidt. The editors are grateful for her help.

Georg Gartner and Felix Ortag
August 2009 in Vienna, Austria

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Chapter 1

From Ortelius to OpenStreetMap – Transformation of the Map into a Multifunctional Signpost[1]

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1.1 Introduction

My first job, in 1970, when I started my university career, was to help prepare an exhibition on the 400th anniversary of Ortelius' first atlas. If I compare the practice of Ortelius with the general cartographic practice in the 1970s and the situation now, it would appear that more things changed in cartography after this exposition than before it. One exponent of those changes is the recent *OpenStreetMap* project, in which volunteers collect topographical information on their own. This is an exponent of the current goal of achieving a "well-mapped society", whereby everyone has access to the spatial information that she needs. It is such changes, and their consequences with respect to the future of cartography, that I wish to discuss with you.

1.2 Ubiquitous Cartography

Just imagine a world in which up-to-the-minute spatial information is always available to everyone who needs it, anytime and anywhere – this is referred to as *ubiquitous cartography.* Imagine you can request and receive information about your environment anywhere you want it, using a mobile computer. Where is the nearest hospital, or theatre, and what is the telephone number you can ring to find

[1] abbreviated, translated version of Ferjan Ormeling's valedictory address, held in the Aula of Utrecht University, April 23, 2008

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out whether there are still tickets available for tonight's show? What type of soil am I standing on, and how do people vote around here? Through the evolution of GPS systems, mobile computers and wireless networks, the realisation of this fantasy is coming more and more within our reach (see *Figure 1.1)*. Over the course of time, we will all get to a point where we can combine dynamic information from satellite images with static digital topographic files, so that we can indeed see on our TomTom whether we will run directly into a rain shower if we turn left, or on Google whether the car belonging to the person we want to visit is standing in front of his house or not – so far we still receive the image that was recorded a year ago.

In my country, with the exception of the Topographical Survey, all of the geospatial data-oriented services have now for some time been switched over from paper maps to the establishment and maintenance of information systems from which their employees can obtain the information they need for their own use. However, if these files have indeed been made accessible at all to people who are not employees of specific agencies, their use now does require a high level of technical knowledge

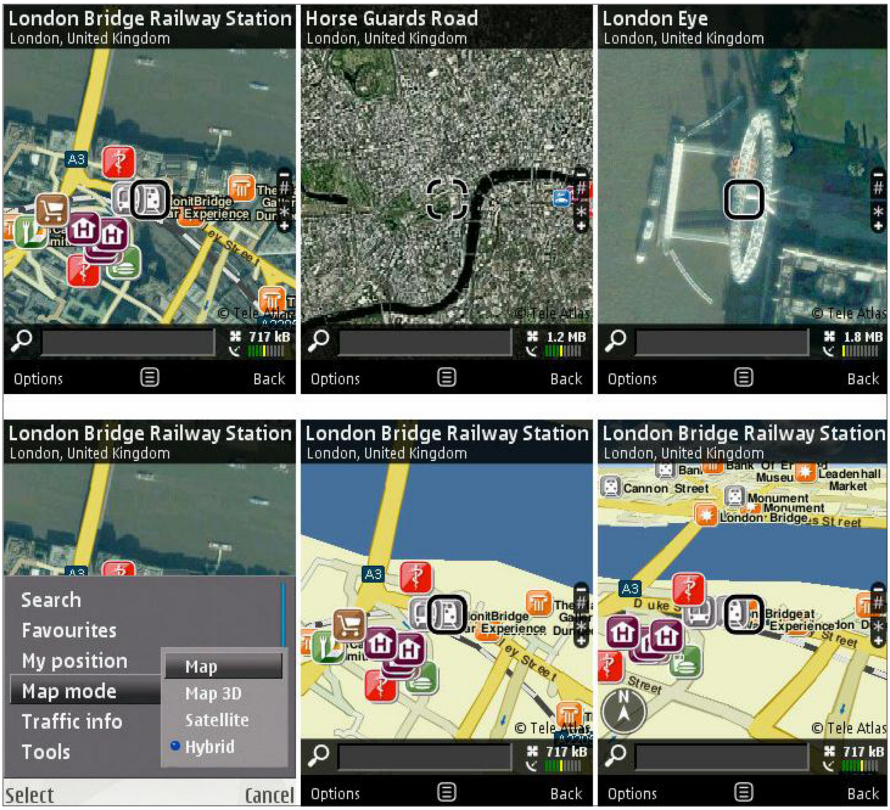

Fig. 1.1. Various use modes of the Nokia with the Maps 2.0 system (http://www.allabout-symbian.com/news/item/6704_Nokia_Maps_20_hits_beta.php)

and a well-filled wallet: it is usually only engineering firms that can afford to acquire the files they need in order to carry out their projects. And thus has the provision of spatial information to the greater public been compromised considerably. The same has taken place outside our country, and there it has led to the development of Public Participation GIS, or Participatory GIS (Sieber 2006), an attempt to make GIS techniques and government data files clear and accessible to a broader public, which is to result in the actual establishment of realistic possibilities to share in decision-making as the transparency of government decisions based on GIS activities becomes greater.

On the other hand, some government departments at different levels have developed websites where the non-professional can obtain information about a number of environmentally-related topics free of charge. In addition, the commercial sector has taken over a number of tasks from the government. Our city maps used to be based on cadastral maps, but now they are more frequently based on information obtained by commercial map production companies themselves. Such companies as TeleAtlas and NavTeq, who specialize in car navigation systems, as well as Google and Microsoft, have recording vehicles driving around that collect geographical information and convert that information to files from which they can also make road maps. Google (Earth), Microsoft (Virtual Earth), and Terravision produce files based on satellite or aerial photographic recordings with which we can zoom in on Internet, at the expense of advertisers, on any area down to such a level that we can even see our own houses . We can navigate through a city on our own and see the city in three dimensions at any point, in the direction of our choice. The quantity of maps in the media has increased tremendously, as has the quality of that visualisation. Government departments produce map images or even atlases for the web. An example is the National Atlas of Public Health of the National Institute for Public Health and the Environment (RIVM) *(Figure 1.2)*. In addition to the increased range of maps that are available, the interest in these maps has increased as well.

Therefore, in addition to there being a wider range of spatial information from the commercial sector, it has become in some ways more difficult and in other ways easier to acquire specific spatial information from the government. How is the public reacting to this?

1.3 Geotagging, OpenStreetMap and Web 2.0

Well, map production has been democratized. Maps can be adapted more and more to the interests of the user, not only with a bit of reality chosen by that user, given form with the symbols of his preference, in the desired perspective, and also with his own notations, but also – more generally – equipped with information that he adds. At

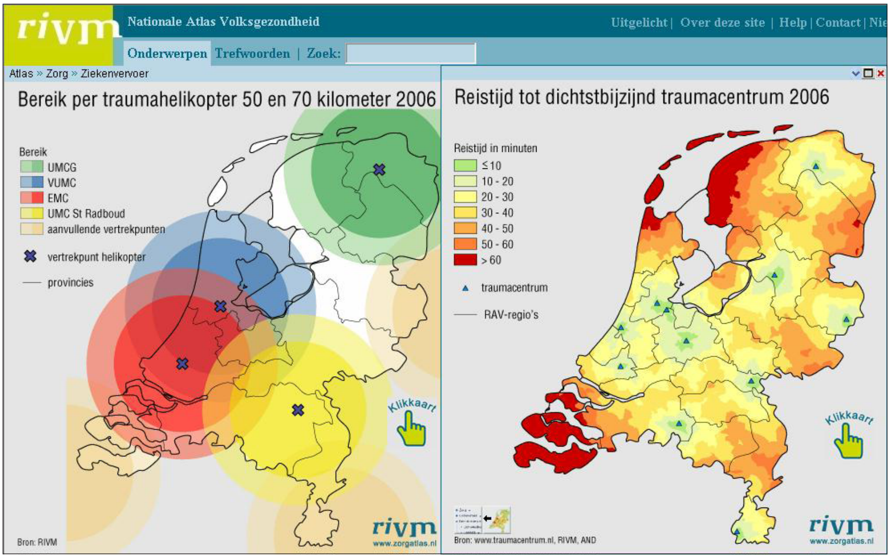

Fig. 1.2. Two maps from the National Atlas of Public Health of the RIVM (http://www.rivm.nl/vtv/object_document/o4235n21143.html)

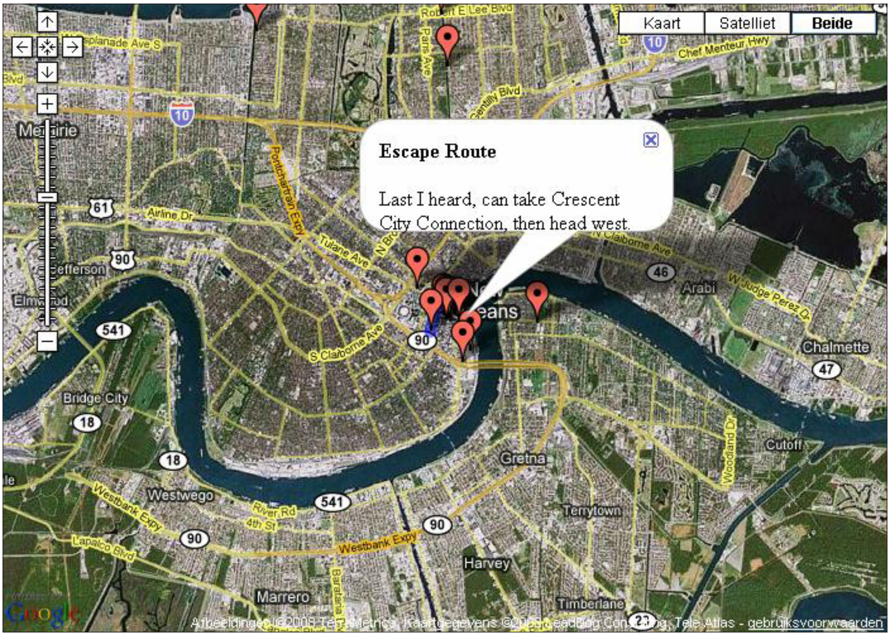

Fig. 1.3. View of a Katrina map, where residents or refugees could paste information to their families or neighbours on their former homes.

the time of the hurricane Katrina in 2005, the widespread use of *mash-ups* was made clear on a broad scale for the first time: Due to the suboptimal provision of information by the American government, victims themselves were forced to seek ways to find their lost relatives: by referring to a map of the city on Internet, and linking their houses on that map with information about, for example, their temporary address or information about the condition of their house (see *Figure 1.3)*.

Geotagging, or assigning geographic coordinates, for example to holiday photos, is the latest manifestation of our desire to pinpoint our position. Flickr.com is a website where you can upload your photos so that you can show them to everyone. Last month, some 2 million geotagged photos were added to the site. This has led to a gigantic reservoir of photos of which it is known precisely where they were taken, and if you search at a certain location you will find many photos of that location. By means of geotagging with photos, it is possible to determine more than an exact location; you can also find out about the altitude, time, date and compass direction of the view, so that the photo is almost reproducible, given the right weather conditions and camera. Therefore, because it is now possible to carry out searches in terms of coordinates, geotagging uses the organising power of mapping. So mapping something also means organizing spatial information! A comparable initiative is *Wikimapia*, where a person can attach sub-maps or remarks to objects on a map.

Another application of the 'mapping urge' is the already mentioned *OpenStreetMap* initiative of making maps oneself; it is a project focused on generating freely available geographic data, such as for road maps and city maps, for anyone who wishes to do this. These are all cartographic applications of Web 2.0, the platform on which people join forces to create their own information, of which Wikipedia is also a manifestation. It is participants who determine and control their own data; not data suppliers.

Therefore, a great deal of spatial information has become available, from the government, from companies and from private parties, because people are making maps more than ever before. But to what extent does this information reach its users? Let us look again at cartography, in order to answer this question.

1.4 Paradigm Changes in Cartography

The definition of the term *cartography* has gone through quite a few changes during the period that the term has been in use. In approximately 1820, when the term was first introduced in Germany, it encompassed the *production of maps*. When I started my university studies cartography was regarded as *projection theory*, a multiple of ways in which one could depict the earth on a flat surface. Only in the 1960s it started to be defined as the *visualization of spatial information*. This was a process subject to clear-cut rules, as was demonstrated by Jacques Bertin (1967), who in 1967 elaborated a grammar of the language of graphics. By following his rules, when designing maps, one could be assured of the proper presentation of geographic information. That term, *geographic information,* in 1967 had just been introduced in a model by the Czech cartographer Kolačny (1969), and that provided the impetus for a scientific approach to the transfer of information. This was based upon empirical research: by comparing what map readers read off a map (A', see *Figure 1.4)* with what cartographers placed on it, (A), one could measure the effectiveness of a map design. The model of this information transfer is no longer used, but it did once play a key role in the development of cartography, because it opened the door for psycho-physical research (that is the comparison of such physical stimuli as map symbols with the perceptual-psychological reactions to those stimuli). It also led to a new definition of the term *cartography*: that definition had then become, in the 1980s, *the production and use of maps* (Ormeling & Kraak 1987).

We did not have enough time to elaborate its research possibilities sufficiently, as this was followed rather too closely by the development of automation. In my university we carried out research into automatic line generalisation and experimented with a digitalization unit. We experimented with the production of line printer maps; these are maps on which we simulated the various shades of grey by printing letters in various combinations over one another. We learned to work with plotters that could draw borders of areas and also shade those areas. After 20 years of automation, then, we had reached a point where we could use the computer to make maps that were almost as good as the ones that used to be made by hand.

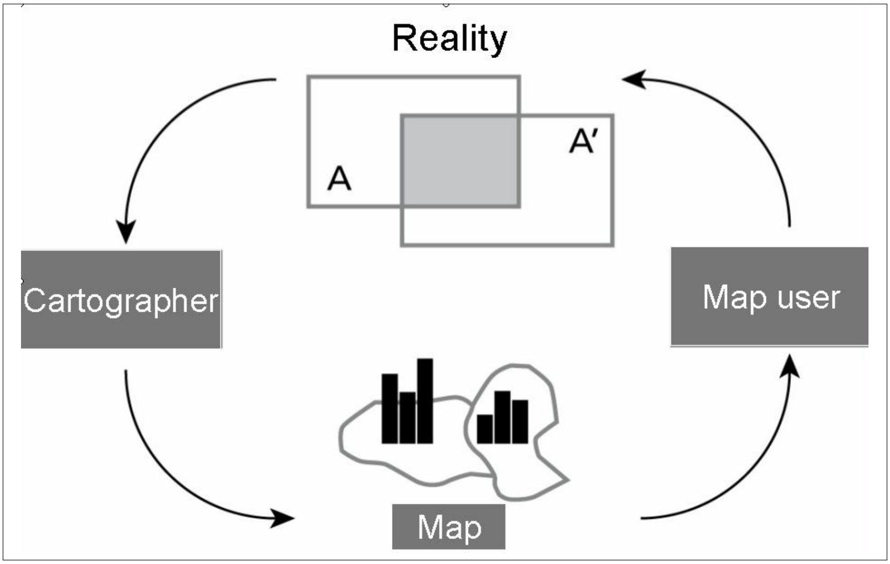

Fig. 1.4. The cartographic communication model by Kolačny (1970)

Simultaneously, however, it became clear that the computer could do more than only produce maps: once one had stored the spatial information needed to draw maps in the computer, one could also begin doing some calculations: determining surface area, measuring distances, and carrying out visibility analyses. The part of the field that encompassed this work was called *analytical cartography* or, in more modern words, geo-visualisation. With the new methods of analysis, we had opened the door to geographic information systems.

The arrival of digital geographic files led to a revolution in map production – not so much because we were able to work faster (because if you include all the preparation time, it was certainly not faster!), but because now the map image could be flexibly adapted for various purposes. Once the information was digitally stored in a file, one could easily visualise that which was needed for a certain purpose from that file. In the past, we produced nautical charts that contained all the information that helmsmen might need somewhere at any given time: now all we need on a monitor is the information we require for our own ship: we only need to see the depth contours that are crucial to the draught of our own vessel, making the image considerably clearer (see *Figure 1.5).*

The fact that we were able to use the computer meant that we were able to separate the *storage function* of the map or, in digital form, the geographic file (which describes all the measured aspects of the surface of the earth), from the *communication function* (with which the only objective is to pass on whatever knowledge is required). This breakthrough changes the content of the term cartography once again: now cartography stands for *passing on spatial information to support decision making*.[2] Sometimes this involves maps indirectly, such as in a navigation system in which one listens only to oral instructions, but usually this still takes place based on maps, where we use their unique quality of being able to predict spatial reality as it applies at any given time.

[2] In the Mission of the NVK it was stated in 1996: "Cartography is making accessible and transferring spatial information with a view of solving spatial issues, emphasizing visualisation and interaction" (Kartografie is het toegankelijk en hanteerbaar maken en overdragen van ruimtelijke informatie met nadruk op de visualisatie en interactie, afgestemd op het oplossen van ruimtelijke problemen." (NVK adresboek 1996/97, The Hague: Netherlands Cartographic Society, p. 6). In 2003 cartography was described in the Strategic Plan of the International Cartographic Association as: "the unique facility for the creation and manipulation of visual or virtual representations of geospace – maps – to permit the exploration, analysis, understanding and communication of information about that space." http://www.icaci.org/documents/reference_docs/ICA_Strategic_Plan_2003-08-16.pdf

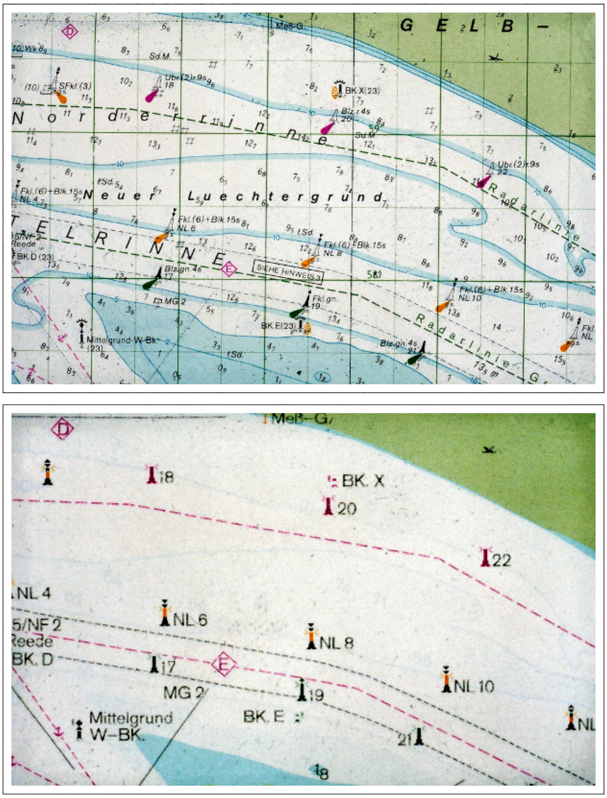

Fig. 1.5. Complete nautical chart and digital version for individual use

1.5 Maps as Predictive Tools

We view maps as models of reality. The map of *Treasure Island*[3] is a model of a renowned Caribbean location. While searching for the treasure, we replace reality by the model, imagining ourselves in that model as in a sort of immersion *(Figure 1.6)*. However, when the story ends and the treasure has been found, that process nonetheless confronts us with the most important characteristic of the map, namely that it displays what is in store for us in a spatial sense. If we identify our position in reality, our orientation and destination, on the map, we can determine how we get from one point to the other, and what we will encounter on the way. This is true, in any case, assuming that the map is an accurate model of reality and we obtain the correct impression of reality from that map. Because, after all, this is what it is all about, not that the map is correct but that what we expect in terms of reality from that map is correct. Then we can take relevant and correct decisions.

[3] Robert Louis Stevenson (1883).

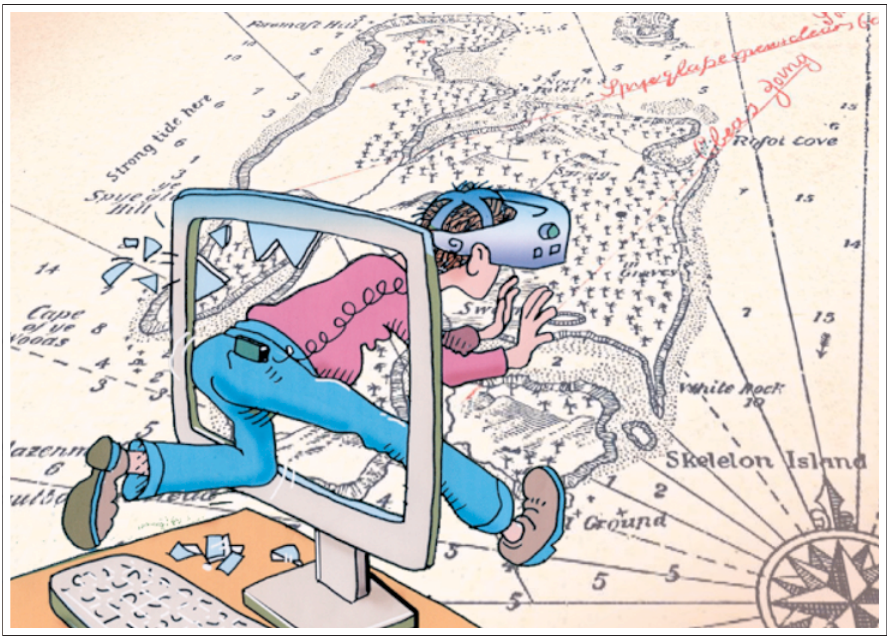

Fig. 1.6. Immersion in the map (drawing A. Lurvink)

These days, searching for a treasure has become a sport: it is called *geocaching*. With their GPS units set at specified coordinates, the innumerable aficionados of this sport *(Figure 1.7)* search for a treasure in a box hidden somewhere that contains a logbook or camera with which they can confirm that they have found the *cache*.

It is not only cartographers who make such a GPS application possible – the task also requires specialists in information technology, photogrammetry, remote sensing and geodetics. But it is indeed cartographers that ensure the transfer of spatial information. Cartographers know how to draw information and generalise it correctly if it is to appear without distortion, and how to adapt images to a limited bandwidth and our small mobile screens. We call this *context-specific design* of spatial information.

So we use maps in order to predict a situation at a certain place and at a certain time. Or we use them to determine by which route we can best reach a faraway place. Of course, maps also have other applications, such as analysis, the storage of information, education and advertising. However, being able to make a statement concerning expectations of a situation in some other place is, after all, the most important application. The success of every prediction depends upon the quality of maps – their suitability for an envisaged use – answering the questions of whether they are indeed up to date and complete, whether they contain the right amount of detail, whether their area has been effectively measured, and whether reality

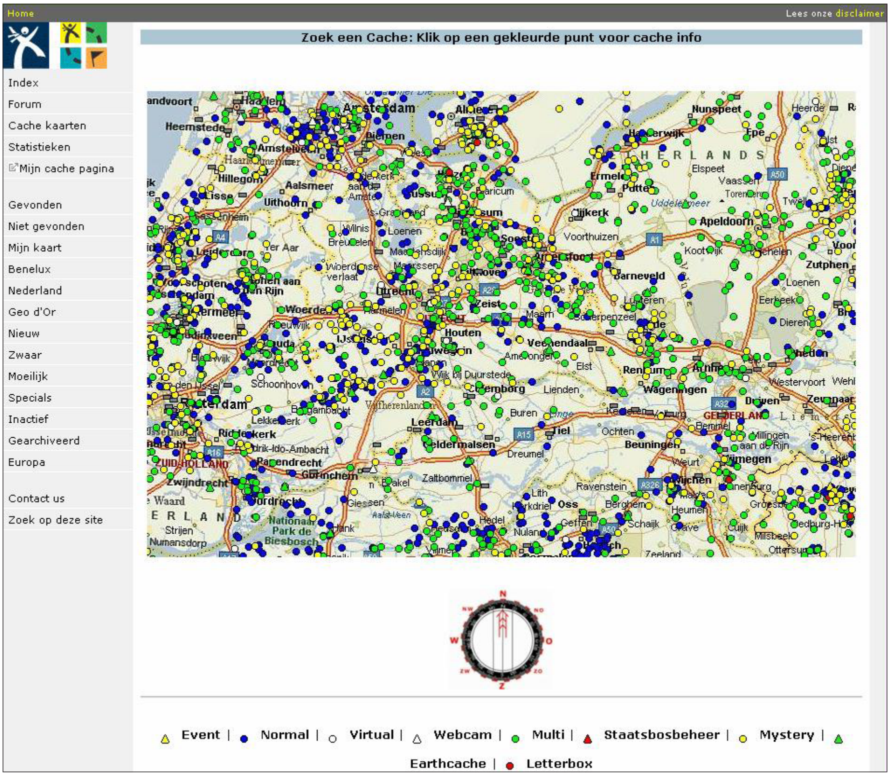

Fig. 1.7. Modern treasure hunting: geo-caches in part of the Netherlands (http://www.geocaching.nl/maps/DisplayCachemaps.php?action=nederland)

has been modelled and categorized in a relevant manner. Together with Menno-Jan Kraak I recently studied which trends can limit the role of the map as a predictor of space (Ormeling & Kraak 2007).

The most important trend is the democratization of cartography: more and more map users are generating their own maps from statistical files that are at their disposal, using software packages. They often do this without sufficient cartographic knowledge, so that while the results indeed appear technically attractive they can also give readers an entirely incorrect impression of spatial reality. After all, if one is not aware of the characteristics and possibilities of the data to be shown and of mapping techniques, one cannot adjust maps for those areas.

A second limiting factor for the predictive capacity of maps is the increasingly larger gap that is growing between theory and practice. It is the easiest thing in the world for us to combine a wide range of data sets, to carry out overlay operations, or manipulate with buffers, but we do not know how accurate map images resulting from that work will be, even though we are indeed aware of the degree of accuracy of the original maps and files.

We do not even know to what extent, if at all, we may combine various types of sets of data with one another. In addition, we are still too unfamiliar with the degree of accuracy map images must have in order to guarantee sufficient support for spatial policy, nor are we aware of the likelihood of map users interpreting maps correctly. We do not know whether users read relationships between mapped objects as they are meant to be read, and this is made even more difficult because the range of digital analysis techniques continues to expand daily. Therefore, our field requires research inorder to answer those questions.

1.6 Cartographic Research / Research Agenda

Here I would like to ask your attention for the research agenda of the International Cartographic Association (Virrantaus & Fairbairn 2007). This is a programme that we have developed over the last eight years, the goal of which is to steer research efforts in the commissions of the ICA. This focuses partially on analysing large files in order to be able to identify changes based on *data mining* or *change detection* techniques. The development of spatial analysis techniques, the establishment of the quality of our geographic files, and the assessment of the uncertainty inherent to analyses of combinations of files are points that are high on the agenda.

In my opinion, the most fertile topic for cartographic research on this agenda, in addition to data quality and generalisation, are the psycho-physical studies already mentioned above, which now plays a role in *usability* studies[4] (here, that is research regarding the effectiveness and efficiency with which certain map users reach a specified goal in specific circumstances). We still know too little about how to use the information on maps and insert this into our current knowledge. During the last five PhD studies that I monitored, the thinking-aloud laboratory *(Figure 1.8)* was used during this type of study, a laboratory set up for usability studies at the

[4] "To date, virtually nothing is known about the usability of geospatial technologies. Even less is understood about the extent to which those technologies can be matched to human conceptualizations of geographic phenomena or about the use to which the information will be put. It will be necessary to develop new tools to track how individuals and groups work with geospatial technologies, to assess which approaches are most fruitful, and to identify the usability impediments imposed by the technologies. Such understanding will be vital for tailoring user-centered design and other usability engineering methods to the needs of general audiences working with geoinformation.
In particular, it will be important to establish which techniques can measurably improve how effectively and productively geo-information is used by the general public, students, and other non-specialist audiences. As noted previously, current HCI research methodologies look at people's interaction with technology rather than at how technology is applied to support people's interaction with information. Cognitive and usability assessment techniques do not address visually enabled technologies or ones intended for application to ill-structured problems." (National Research Council 2003, p. 93).

Fig. 1.8. Laboratory setup for thinking-aloud research on the usability of maps at the ITC (from Elzakker 2004)

International Institute for Geo-information Science and Earth Observation (ITC), where the test persons describes orally what task she is performing and why, and where both her comments, the image of the monitor and of auxiliary material used are registered.

This research listing of the ICA also contains the history of cartography, because it is necessary for those practicing the profession to know how spatial information was collected, visualised and used in the past. If one would look at an old map *(Figure 1.9),* one would usually just see an attractive graphic image. Historians of cartography, however, would see more: they would see a landscape as perceived through the eyes of a cartographer, containing the information that the client of that time considered important and which the cartographer gave form in his own specific way. So a map is both a source of knowledge of the landscape of a given time, of the society that had it mapped and a representation of the ideas and expertise of a cartographer.

Standardisation is a factor that is also part of the applied research that is vital to the many plans we have with regard to the exchange of information in the future. One aspect that we have actually neglected in cartography is the standardization of geographical names. These names are essential to maps; they form the most important interface for users who wish to know more about their environment. The

Fig. 1.9. Old map as a source of knowledge of the early landscape, but also of the cartographer and his patron (drawing A. Lurvink)

standardisation of geographic names is also important when it comes to searching for information based on those names. In that context I mention the eContent-project *EuroGeoNames*[5] financed by the European Commission, a predecessor of Inspire. Its objective is to create a virtual European database of geographic names by combining various different existing national databases. The use of unequivocal geographic names optimizes the search function of maps…and this brings me to the portal function of maps and atlases.

1.7 The Map as Data Portal

In the field of cartography, atlases are viewed as the ultimate challenge, because the information they contain must be coordinated not only within one map but also between various different maps. The best atlas is then a national one, the most detailed presentation of the spatial knowledge about a country. By way of Internet we can give the national atlas an extra dimension by geocollaboration, whereby different institutions collaborate in order to supply spatial information, via a central

[5] See for a description of the project http://www.eurogeographics.org/eng/03_projects_EuroGeoNames.asp

point or data portal. A website has been developed for this purpose in the United States, called (http://www.geodata.gov/gos), "your one stop for federal, state and local geographic data" (that is to say, the geo-spatial one-stop) (Goodchild et al. 2007) . An atlas structures our view of the earth, familiarises us with geographic concepts, and is therefore eminently suited to function as an interface with the GDI, the spatial data infrastructure. This makes an atlas more than just a costly cage in which one captures the earth. In the Netherlands we are working on creating such an interface in the context of a Geo-Information.

Drive research project[6], based on the national atlas of the Netherlands (Kraak et al. 2007). With that atlas as a metaphor, we are developing an alternative, sustainable map-oriented access to the geodata infrastructure, via user-friendly solutions, in order to make geo-information accessible to the greater public. This requires responsible, systematic visualization, because it is essential that the maps can also be compared with one another. See also *Figure 1.10.* Improving access to spatial information is also consistent with the objectives on a European level (European Umbrella Organization for Geographic Information 2000).

In order to keep up with the latest developments, atlases must also keep up with the possibility of including data from their users. The Canadian cartographer Fraser Taylor speaks, in this context, of *Cyber cartographic atlases*[7], atlases that form contexts within which user-generated data as well as such social digital networks as Web 2.0 and Wiki can be easily integrated. This sounds fantastic, because in this way we enable people to provide information that they consider to be relevant. But is this consistent with the concept of the atlas? Ortelius collected information from the world's best cartographers, whose approved map material (the best available at that time) he used, and this is what made his atlas such a success. So are we going in the right direction with Taylor's cyber-atlases? Is active civilian participation enough? The American movement of Critical Cartography (see Crampton & Krygier 2006) thinks that it is. But in my opinion we are running the risk, with such atlases to which anyone and everyone can contribute her own information, that – without exercising professional control over the contents to be added – we are replacing quality by consensus, so that in the long run no one will any longer be able to truly depend on the data. The cartographers of the future will have to monitor the processes of the collection, design and use of information (such as in the OpenStreetMap), in order to inform the public about what is already available in terms of spatial information, so as to ensure that the relevant information is collected and properly given form for each specific application, and they will also have to contribute to the professional use of visualised spatial information. There certainly are challenges enough in our profession!

[6] Ruimte voor Geo-Informatie (RGI)-project no 111, National atlas as portal to the Geodata-infrastructure.

[7] Challenge for the industry is brainware. Interview with Fraser Taylor, GIS Development, December 2007. http://www.gisdevelopment.net/interview/previous/ev0123tayler.htm