WEBCARTOGRAPHY: DISSEMINATION OF SPATIAL DATA ON THE WEB

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Introduction

However definite our maps and databases might look, in most cases the information they contain is passed its “sell-by date”. There are several reasons for this. Among them are the technical and financial constraints on the data collection process, that make constant updating, although possible, either impractical or undesirable. Another reason is the output medium used. Although the traditional printed maps offer superior quality and are usually the most practical to use, the production time involved invariably results in a built-in “out-of-dateness”. Map users in this age of information no longer readily accept “stale” information and therefore cartographers are looking for new ways to get mapped information to their users.

At the same time, cartography itself is changing: changing from being supply-driven to demand-driven. More people will be involved in making maps. More maps will be created, many of them only for a single use. These maps are changing from being final products presenting spatial information to interim products that facilitate our visual thinking. This process is being accelerated by the opportunities offered by hardware and software developments. These have changed the scientific and societal needs for geo-referenced data and, as such, for maps. Users expect immediate and real-time access to the data that allow for dynamic presentation and for user interaction.

Dissemination of spatial information on the Internet could offer solutions for both problems signalled above. This paper will address the question what role the World Wide Web (WWW) can and will play in cartography and geoinformatics and how maps can function on the WWW to meet the users needs. Finally, it will explain how WebCartography is being integrated into the education and research programmes at the Division of Geoinformatics, Cartography and Visualisation of the International Institute for Aerospace Survey and Earth Sciences (ITC).

Cartographic Visualisation on the Web

As stated before, cartography is changing. This has all to do with what has been called the “democratisation of cartography” by Morrison (1997). He explains it as *“…using electronic technology, no longer does the map user depend on what the cartographer decides to put on*

a map. Today the user is the cartographer". And *"…users are now able to produce analyses and visualisations at will, to any accuracy standard that satisfies them…."*. Those of us active in geoinformatics might feel a little uneasy here. Are the data available and if so are they of sufficiently high quality? Are the tools to manipulate and visualise the data available at a "fitness for the user" level? Without positive answers to these questions, map use may lead to the wrong decisions. However, it seems the trend is irreversible and will have a tremendous impact on our disciplines. A challenging question is "What will remain for the cartographer and other geoinformatics experts?"

The changes require a different type of cartographer, someone who is an integral part of the process of spatial data handling. As well as traditional cartographic design skills, cartographers must make their knowledge available to fellow geoscientists using interactive real-time maps to solve their problems. For both the cartographer and the geoscientist the necessary data will be retrieved from all over the country, if not world. The National Spatial Data Infrastructure will be the highway to travel to get to the data. The data to create or query maps as such is not only the 'goal' of using the infrastructure. Maps can also facilitate its use being the guide, en route, to the data.

Initially, the WWW was used simply as another medium to present spatial data. And for most maps found on the WWW this is still the case. We can ask: "Why are maps distributed via the WWW?" The answer is that information on the Web is virtually platform-independent, unrivalled in its capacity to reach many users at minimal costs and easy to update frequently. Furthermore, it allows for a dynamic and interactive dissemination of spatial data, offering new mapping techniques and use possibilities, not seen before with traditional printed maps.

The interactivity and ease of use of the WWW is currently limited by technology. However, developments are proceeding quickly, and what is not possible today certainly will be tomorrow. Increasingly those who offer maps and spatial data via the WWW try to make them more accessible for exploratory activities at the user's side. Already, one can currently experience on the Web:

- Depiction of movement & change. Animated maps can be used to show changing phenomena in real-time or according to some time-scale.
- Maps combined with other graphics, sound and moving images. Multimedia maps and atlases on CD-ROM have already proven popular and similar presentations on the Web are starting to appear. Animation, as mentioned above, is also used for serious purposes as well as to add excitement and pizzazz to maps of more static features.
- Virtual worlds: an alternative view from the traditional generalised and symbolised maps we know. These virtual worlds offer 3D realistic views of the landscape, either as static pictures, pre-set *flyby's* or even fully interactive 3D models.
- Maps to scientifically explore spatial data: This *exploratory cartography* will create an environment where geoscientists can work to solve their problems and make new discoveries. A challenge for cartographers is to create or improve mapping tools that allow exploration. They will put the map in its natural role as the access medium to a National Spatial Data Infrastructure.

Maps can be disseminated through the WWW both within organisations (Intranet) and to the world at large (Extranet). But one has to keep in mind that however fast the growth of the

WWW user community may be, only a limited group of people is connected to the Internet. This is especially true outside the Western World.

Another disadvantage of the Web is the difficulty to charge customers for access to your information. Basically, anything on the WWW is up for grabs and only techniques such as watermarking your maps or securing your site through access restrictions can solve questions of copyright and use costs.

Furthermore, the Web is a fast-moving medium. Users are generally impatient people: If your information takes to long to download, users will lose interest and go to other sites. Also, if the information on your site is not very frequently updated, the general user will consider it not valuable. For that reason, the most successful sites are the ones offering time-sensitive information, such as the weather or the rush-hour traffic situation. Another user need is the ability to be able “to click on something”. This expectation of interactivity coincides with the previously mentioned need for exploratory tools.

It is clear that the limitations and user needs mentioned dictates that maps on the Web have a special design needs. One can not simply take the maps we previously offset-printed and show them on the World Wide Web.

Design of Web Maps

Map and file size

From a cartographic design perspective there are not many differences between map design for the web or any other form of on-screen maps. As with these, the map size must be small because of the limited screen size and resolution (generally 800 x 600 pixels at 72 dpi, as opposed to a typical offset print of up to A0 size and a resolution of 1200 dpi or more). However, an additional point regarding size has to be considered. This is storage size, and which is critical with regards to retrieval time. Alternatives are that one offers the user different versions (in size and/or format) for different purposes. However, this might reduce some of the benefits of map distribution via the WWW for the providers, especially when there is a high degree of interactivity in the map. Because of these size constraints the maps may need to have only a limited information content. However, the design should be attractive and informative to compensate for waiting time.

File formats

Typically, graphics on the Web are in raster format. It is possible to use vector formats, but only when the clients browser is equipped with appropriate plugins. The raster formats directly supported by all major browsers are JPEG, GIF and PNG. Storing graphics in JPEG (Joint Photographic Experts Group) format results in small sized files, but the compression method is ‘lossy”, i.e. the quality suffers slightly. The compression technique used is more suited for photographs. The GIF (Graphics Interchange Format) uses a non-lossy compression method, which works best on images with large areas in uniform colours, and is therefore better suited for maps. The drawback is that is uses patented technology, and therefore producers have to be licensed. The newer PNG (Portable Network Graphics) format is growing in popularity, because it has the same qualities as GIF, it is tailor-made for network use and it is license-free.

Colour use

Information on the WWW is stored in platform-independent formats and should therefore appear similar for every user. However, especially for colours, practice is somewhat different. Because every operating system handles colour in a different way and because there are large colour calibration differences in monitors and graphic cards and in the handling of colour information by the software, the use of colour remains tricky. At the time, the only useable solution is to limit oneself to a limited colour palette of 216 pre-determined colours, the so-called “web-save palette”. This of course severely limits the cartographic design possibilities.

Interactive tools

In relation to exploratory cartography, the need for interactive tools is significant (Kraak, 1998). It requires tools that allow the user to pan, zoom, scale, and transform the map. At any time, the user should be able to know where the view is located and what the symbols mean. They should have access to the spatial database to query the data. To stimulate visual thinking, an unorthodox approach to visualisation is recommended, which requires the availability of alternative visualisation techniques such as the animated maps, multimedia elements and virtual worlds mentioned earlier.

Web-Mapping methods

If one looks at the mapping options, it is possible to distinguish between several methods that differ in terms of necessary technical skills from both the user’s and provider’s perspective. The overview given here (figure 1) can only be a snapshot, since development on the WWW is tremendously fast. This ‘classification’ is certainly not carved in stone, and one might easily find examples that would not fit these categories, or define new categories or combinations. Its objective is to give an overview of current possibilities, based on how the map image is used. The samples in the respective categories given are randomly chosen from the huge number of possibilities on the ever growing web, and not necessarily the most representative.

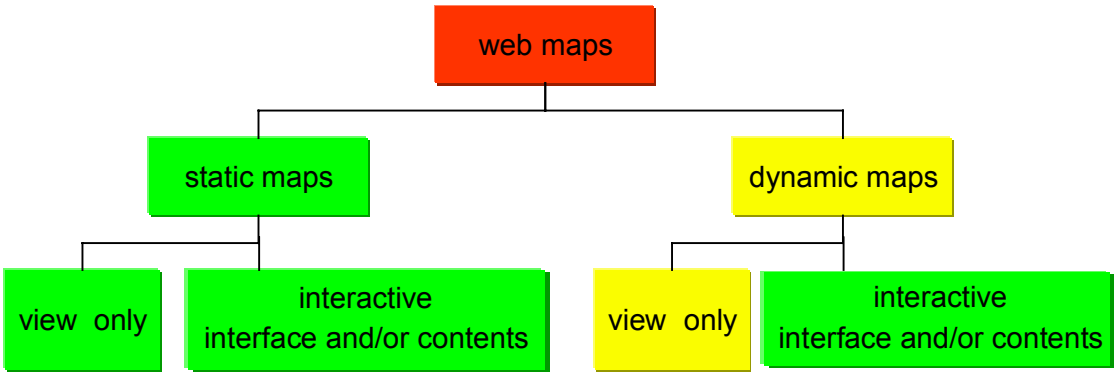

Figure 1: Web-mapping method

An important distinction is that between static and dynamic maps. Static maps offer traditional map images, mostly stored as bitmaps. Often the sources for these maps are original cartographic products, which are scanned and placed on the WWW.

Static maps

Most of these images are view-only. Many organisations such as map libraries or tourist information providers make their maps available in this way. This form of presentation can be very useful, for instance, to make historical maps more widely accessible, as can be seen at the http://odur.let.rug.nl/~welling/maps/blaeu.html, where rare maps by the famous Dutch cartographer Blaeu can be viewed. The quality of the images depends on the scan-resolution. Static view-only maps can also serve to give the web-surfers a preview of the products that are available from organisations, such as National Mapping Agencies.

When static maps offer more than view-only functionality, it can be to offer an interactive view to the user by offering zooming, panning, or hyperlinking to other information. The much-used “clickable maps” are examples of the latter and they can be very useful to have the map act as an interface to the spatial data. Clicking on geographic object could lead the user to quantitative data, photographs, sound or video or other information sources on the Web.

It is also possible to have the user interactively determine the contents of the maps, by choosing data layers, and even the visualisation of the information, by choosing symbology and colours (see for example the national Atlas Information System of Canada, at http://ellesmere.ccm.emr.ca/home-english.html).

Dynamic maps

Dynamic maps are about change; change in one or more of the spatial data’s components. On the WWW several options to play animation are available. The so-called animated-GIF can be seen as the view-only version of the dynamic maps. A set of bitmaps, each representing a frame from an animation are positioned after each other and the WWW-browser will continuously repeat the animation. These can be used for example to depict the changing weather over the last day (e.g. http://knmi.telegraaf.nl/radar/index12.html).

Slightly more interactive versions of this type of maps are those to be played by mediaplayers, in AVI, MPEG or Quicktime format. Plug-ins to the WWW-browser define the interaction options, which are often limited to simple pause, backward and forward. These animations do not use any specific WWW-environment parameters and have equal functionality in the desktop-environment.

Animations created via VRML or Quicktime VR offer interactivity to the user, e.g. the user can define the travel path, and make decisions on directions, height, etcetera. This is possible because these formats store a true 3D model of the objects, not just a series of 3D views. A nice example of this is the VRML model of Schiphol Airport (http://www.schiphol.nl/maps/3D.htm). Furthermore, they offer the incorporation of links and thus become a more interactive “clickable animation”. These links normally refer to other locations on the WWW or start another animations with more or less detail. In this context it is worthwhile mentioning that at the beginning of 1998 the VRML Architecture Review Board has accepted the GeoVRML Working Group Proposal. This should lead to the incorporation of spatial functionality in future VRML standards. Using these techniques, the “Virtual Worlds” mentioned before can be created and offered to WWW-users.

WebCartography at ITC

It is obvious that WebCartography is an important new output possibility for dissemination of spatial data. Therefore, at the Division of Geoinformatics, Cartography and Visualisation of the International Institute for Aerospace Survey and Earth Sciences (ITC) in The Netherlands, teaching and research activities have been developed to support these new possibilities.

Apart from introducing Web mapping techniques in the regular courses of Geoinformatics at MSc, Professional Master and Diploma levels, a specialised short course in WebCartography was developed for ITC students and others. As all ITC courses, it is an English language course, aimed at a broad international audience. This WebCartography course is tailored to people who have a background in cartography, but have no or little experience in publishing their maps on the Web. It is focused on cartographic design and publishing techniques to create different (interactive) Web maps. By offering theory and practicals on web maps, from simple static bitmaps, up to automated database-driven web maps and by gearing the practicals towards participants' own data and visualisation needs, we hope to offer a solid base for students to start disseminating their maps on the WWW in a professional and effective manner. The course lasts 5 days and is offered twice a year (the next one being in July 1999). As one would expect from such a course, support for students and other interested people is offered at a dedicated Web-site: http://www.itc.nl/~carto/webcar/basic.

Because we are of the opinion that ITC staff should be setting trends, not just following them (Kraak, 1998), part of the research project of the Division deals with methodology and functionality for exploratory cartography. This is focused primarily on the tools for, access to and efficiency of exploratory cartographic methods. In all these aspects, WebCartography plays a role. An ongoing research about monitoring spatial phenomena using animations, for example, makes use of an evaluation site for visualisation tools on the WWW to try to get feedback on their efficiency and usefulness (http://www.itc.nl/~carto/webcartoforum/).

Finally, the staff of the Division is summarising the expertise gained in the previous year or so in a book on WebCartography for Taylor & Francis, due to be published next summer. In this, we try to put web maps into a broad context, and then examining specific characteristics of these maps from a user perspective. Based on fundamental user questions (such as "I have these data what can I do with them?") the various functions of maps on the web are discussed. The website that accompanies the book will provide a dynamic environment for demonstrating many of the principles set out in the text.

References

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