

INTERNET MAPPING: A COMMUNICATION PATHWAY TO ENVIRONMENTAL QUALITY RESEARCH

Rex G. Cammack and Robert T. Pavlowsky
Department of Geography, Geology and Planning
Southwest Missouri State University
901 S. National
Springfield, MO USA 65804

INTRODUCTION

Water, air and soil are three principle elements that sustain humanity on the earth. The quality of these three elements at any given location is the basis of environmental quality. Scientists in agriculture, biology, geology, chemistry, ecology, geography and others disciplines are investigating the current and past states of these environmental components. The pathway for communicating the results of this work has traditionally been publications and presentations. The majority of environmental research is disciplinary distributed. An example being that most of the herpetology research is published in herpetology publications. With the technological development of the Internet, an alternative pathway is available. One of the exciting aspects of the Internet is that it gives one a clean slate to start from. Instead of distributing information to a single discipline, one could distribute it in a spatial context. Two ideas can be served by this spatial approach. First, scientists can see and relate their work to other disciplines stimulating the highly prized cross-disciplinary research approach. Second, the public living near or concerned about a specific geographic area can go to one location and find all the environmental information from numerous fields of science.

The intent of this research is to investigate how organizing environmental quality data through an interactive Internet map could support both an Internet communication pathway for environmental awareness and cross-disciplinary scientific research. A small case study was developed and its effectiveness to achieve the aforementioned goals will be addressed.

ENVIRONMENTAL QUALITY COMMUNICATION

As a scientist completes a research project, the results should be published. The results are communicated to the public through a traditional path by means of professional academic publications, presentations, community meetings and educational materials. In many cases, scientific results are interpreted and presented to the public by media groups like publishing houses, radio, television, and newspaper (Figure 1). In Figure 1 the traditional path of communication is broken down into two models, verbal and library.

Verbal communication in this context would be conference or community meeting presentations. This model allows direct interaction between speaker and

audience making it a highly interactive form of communication. The library model represents scientific results being printed in journals, books and newspapers that are accessed through a library. With the scientific results stored in a written form the opportunities for interaction with the author are limited. When the results of scientific research are distributed through a mass communication path, the media is added to the process. Adding the media to the process alters both the verbal and library models (Figure 1) and adds a third and fourth model for traditional communication for scientific research. The media will interpret the scientific results. This added interpretation could distort the results from a scientific research project.

A generalization of the four traditional models (Figure 1) is that they are linear in form and message focused. The models interaction between scientists and the public in most cases are limited. With the development of the Internet a WWW model of communication has arisen. The simplest way of viewing the WWW model is as an extension to the traditional verbal or library model that is information focused instead of message focused.

In this paper, the information centered WWW model was used to distribute scientific data to the public. Instead of sending a directed message between the scientist and the public, the WWW approach focused on transmitting information to the public. The WWW model, like the traditional model, also has the effect of the mass media. One of the differences between the traditional models and the WWW models is that the public can choose the original source information or a media interpreted source. In the WWW model interaction between all three groups, public, media and scientists, would be interactive. The WWW structure allows for this type of interaction, but the likelihood of scientists corresponding with individuals of the public about their research is limited.

Before a WWW based model can be implemented successfully, the ability and willingness of the environmental community to use the Internet must be considered. In the past decade the Internet, and specifically the WWW, has created an alternative path of distributing environmental information (Feidt and Roos 1995, Katz and Thornton 1997). The environmental community has embraced the Internet from its earliest days. Katz and Thornton (1997) identified Usenet groups, Bulletin Boards, Gopher sites, Archie, File Transfer Protocol sites (FTP), Telnet servers, and Websites that specifically address numerous environmental issues. In many cases these Internet resources are narrowly defined based on a scientific discipline or environmental issues like water quality. In a small number of cases, geographic regions are covered.

The World Band (1995) started a program to distribute information about Sub-Saharan Africa over the Internet by means of a listserver AFRICA-EIS. The success of such efforts have been mixed. Voinov and Costanza (1999) reported on a public involvement project for watershed management of the Patuxent River of the Chesapeake Bay. The finding was that the Website had little impact. The lack of impact stemmed from three principle issues; the public lacked the skill to use the Website, the public was unaware of the Website, and the lack of principle environmental concern for the study

area. In the Patuxent River Website, the main goal was watershed management. The specific task of watershed management is a complex process for the non-professional to grasp. It is unclear whether the complexity of watershed management played a significant role in limited use of the Website.

Using a central Website design metaphor of watershed management could overwhelm the public. Most of the first attempts at using the Internet for environmental issues were focused on specific topics (Feidt and Roos 1995, Katz and Thornton 1997) so using a Website to promote environmental awareness of a specific region could benefit from the use of a map metaphor.

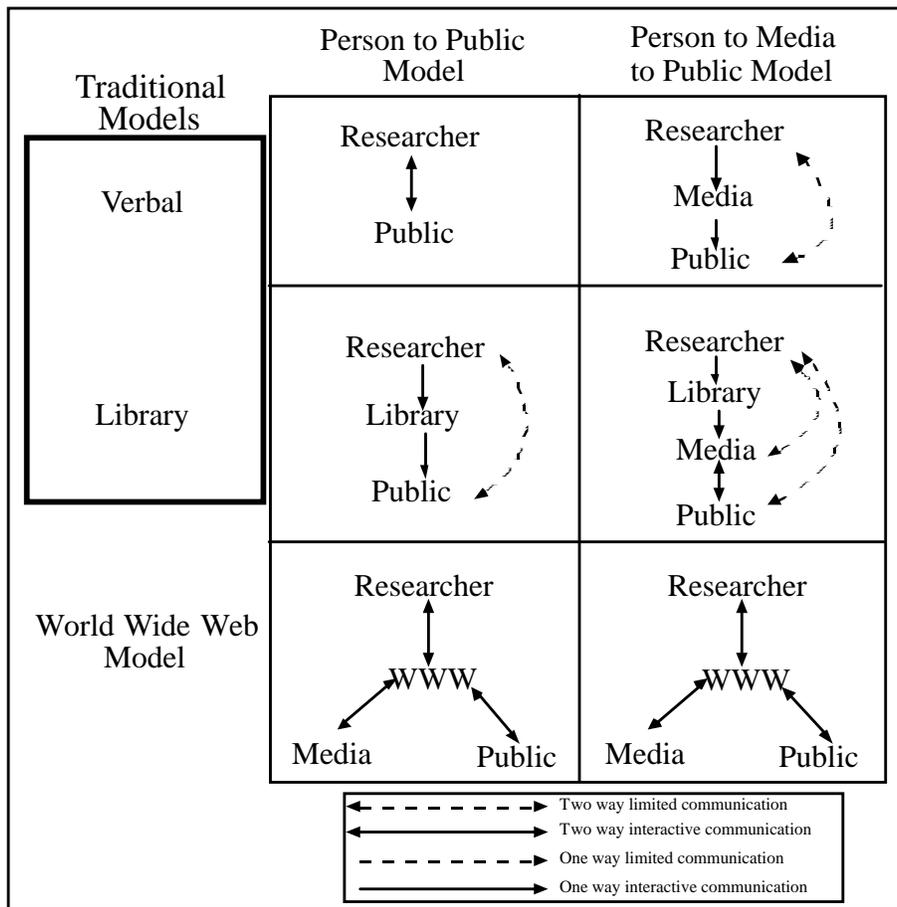


Figure 1. This illustration shows traditional and WWW pathways for communication of environmental information.

INTERACTIVE WWW MAPPING

Some of the most popular WWW map sites are interactive. MapQuest <http://www.mapquest.com> and National Geographic Society's- MapMachine,

<http://www.nationalgeographic.com/maps/> are two of the most popular with each receiving millions of hits each day. Having a Website with an interactive map will not automatically guarantee that millions of people will use it. The content of the Website and its benefit to the public, such as information or entertainment, could make a Website successful.

What makes a map interactive? Many cartographers have suggested that all maps are interactive. In the context of having a map-reader formulate a question and the map provide the answers this is true. This research will use a more narrow definition for interactive maps. For a map to be interactive the map must change physically in response to a map-readers input. Maps printed on paper do not change physically when queried by the map-readers. The map-reader provides all the action during this task. Using this definition, Cartwright (1996) describes several ways of delivering interactive maps such as FTP, CDROM, or DVD, however we are concerned with using the current WWW protocol for distributing interactive maps. Since we are working with the WWW, a HTML or one of its variants XML, DHTML or JAVA (Cammack 1999) based technology will be the means of delivering an interactive map. The HTML protocol has become more powerful since its first inception. Originally, hypertext was the main interaction function for HTML. With each upgrade of HTML, the types of interactions have increased. Cartographers are making use of this enlarged toolset of interactions to make maps that are more versatile.

Peterson (1995) attempted to categorize interactive maps based on graphic and attribute functionality from the map object. In most cases, the map is not the only part of the site interface. Miller (1999) shows that marginalia are an important interactive element for a multimedia map. The concept of marginalia is inherent in the frames designed for HTML. The use of marginalia for interactive WWW map design is seen at <http://www.mapquest.com> or <http://nationalatlas.gov/atlasvue.html>. From the work of Peterson (1995) and Miller (1999), the following groups of interactive functions for interactive WWW maps were constructed.

- Scale Based
 - ⇒ Pan, Zoom In, Zoom Out, and Zoom to Set scale
- Legend Based
 - ⇒ Draw/Omit Layer, Change Symbol, Color, and Size
- Attribute Based
 - ⇒ Identity, Reclassification, Proximity, Labeling and Selection
- Hyperlink Based
 - ⇒ Rollover, Hot Spot, Embedded Pictures, Text and Video.

With this set of interactive tools, cartographers can design a Website to store and distribute many forms of environmental data.

CASE STUDY

Study Site

The area of concern for this case study is the Little Sac River Basin. The Little Sac River Basin is located in the southwestern part of the state of Missouri in the United States of America (Figure 2). The geographic area of the Little Sac River Basin is 1,010 km². The creation of Stockton Lake in 1970 flooded this lower region of the river and created the Little Sac arm of Stockton Lake. The Little Sac River Basin is a Karst landform region with numerous caves, sinkholes, and losing streams.

The majority of the basin is a rural landscape with small family farms and single-family houses. The southern part of the basin contains part of the urbanized area of the city of Springfield. Several environmental groups are concerned about the water quality of the river. A principle reason for their concern comes from the fact that the Little Sac River is one of two surface water sources for drinking water for the city of Springfield and it is estimated to service a daytime population of 450,000 people.

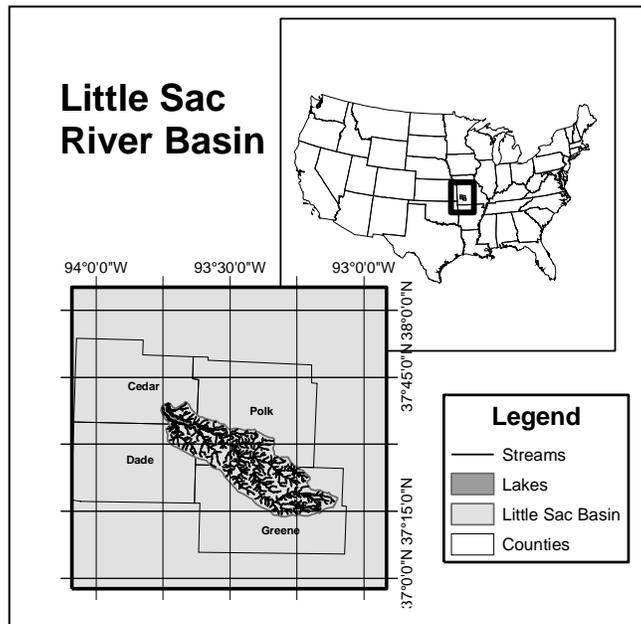


Figure 2. The map shows the location of the Little Sac River Basin.

Website

A Website was constructed to distribute scientific information for the Little Sac River Basin. The Website is located at <http://ozarksgeography.smsu.edu/LittleSacRiver>. The content of the Website is scientific data regarding the environmental quality of the Little Sac River Basin. Federal, state and local governments, education institutions, libraries, and scholarly journals and books were searched to find any environmental research conducted in the basin. Because of the small size of the basin few published

works were found. A significant amount of geographic data was found and added to the Website. A small number of unpublished masters thesis were also added to the Website. Several research projects are being conducted and data from these projects are being added as they become available. This background literature review is ongoing and as more data become available, it is being added to the Website.

The Website is divided into three sections: introduction and background information, scientific information and interactive maps. The introduction and background information provides visitors to the site information on how to use the Website, the reasons for constructing the Website and which users will benefit from it. The scientific information includes a reference list of all published materials pertaining to the Little Sac River Basin and how to locate them within libraries, archives, and other printed resource depositories. Original datasets made available to the Website, for download by public were located in this section of the Website.

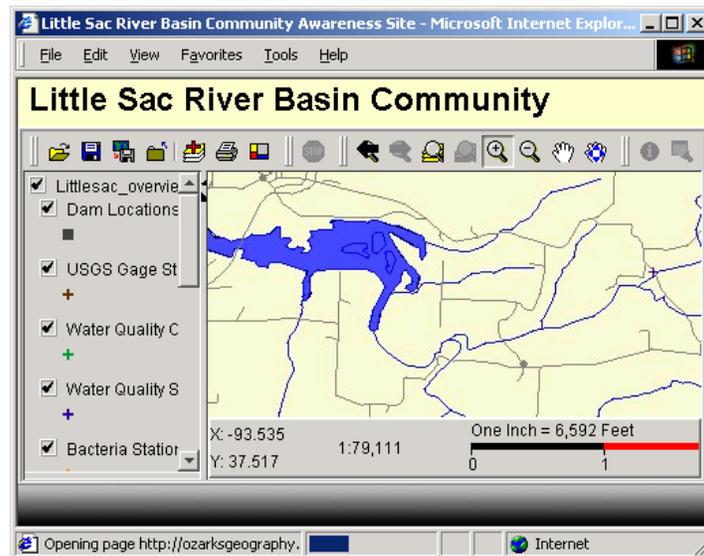


Figure 3. Illustration for one of the interactive maps created for the Little Sac River Basin's environmental Website.

Interactive Maps

The Little Sac River Basin Website contains several separate interactive maps. Figure 3 is an example of one of the interactive maps on the Little Sac River Basin Website. One general reference interactive map was developed to facilitate users getting directly to specific thematic information but also to show the spatial association between the different thematic information. The core design theme was a spatial card catalog. Unlike a library card catalog which organizes information in aspatial taxonomy, the interactive map is a spatial reference system that allows the users to see that a stream channel cross section was done 30 meters upstream from a stream gauge while a riparian corridor study was conducted of both locations. The intent of the spatial reference

system is to create a synergy between different scientific information and stimulate creative new associations between different research efforts.

In the context functions, all four of the map interactive categories were utilized in different parts of the Website. All of the interactive maps on the site used the scale-based tools. Map-readers could free zoom-in and zoom-out and pan around the basin. For the legend-based tools all of the map layers could be drawn or not drawn. The main reason for this was to allow the map-reader to reduce the amount of data being sent from the server to the map-reader. In many cases, the Internet connection rate is still the main factor limiting the type and amount of interaction used on a Website. In regards to attribute-base interaction, the following interactive tools were used. For each data layer on the map all the attribute information was viewable. Individual map-readers could select different map layers and identify or select individual data records. Currently an adequate method of porting metadata has not been devised. Metadata distribution is a critical feature that needs to be added to assist the public in their understanding of this environmental data. In addition to a sufficient metadata tool, few scientists in other disciplines provide sufficient metadata about their research. Lastly the marginalia (hyperlink-based interaction) of text, graphics and video streams were embedded into the maps at specific map scales. By tagging the marginalia on the map at a certain scale, the map design could be maintained. In the future, eliminating scale dependent design elements would enhance the functionality of the marginalia.

CONCLUSIONS

The number of interactive maps has grown steadily over the past several years. Several technological and societal issues still need to be addressed for interactive maps to flourish. Societal issues such as the digital divide between developed and undeveloped regions of the world and language translation still plague Internet cartography. Technological issues such as data compatibility, completeness, and metadata still limit the overall effectiveness of interactive mapping on the WWW.

In this research, a case study examined the ability of an interactive Internet map to function as a spatial index for environmental data for a small river basin. At this point three general conclusions can be made.

- Interactive maps on the WWW can spatially and thematically organize environmental research.
- The ability of the WWW to distribute data, text, sound, video, and virtual reality through a map pathway leads to unique juxtapositions of different environmental viewpoints.
- Research into the Internet cartographic interface will provide improved and refined uses for maps as a connecting point between the scientific community and the public.

Interactive maps on the WWW can be used to organize and distribute environmental quality data. Cartographers and their fellow scientists must improve their ability to

communicate the results of their work in regards to environmental quality data. Citizens living within and outside a geographic area must understand how the actions of people are affecting the condition of the environment. Cartography has a long history of communicating spatial information. As a discipline we should strive to improve and use our knowledge to maintain or improve the environment we live in.

REFERENCE LIST

Cammack R. G. (1999). New Map Design Challenges: Interaction Map Products for the World Wide Web." In Cartwright W., M. P. Peterson and G. Gartner (ed.) *Multimedia Cartography*. Springer-Verlag, Berlin Germany.

Cartwright, W. (1996). "Hardware, Software, and Staffing Requirements of Multimedia Cartography." In Ormeling F, Kobben B. Gomez P. G. (ed.) *Proceeding of the Seminar on Teaching Animated Cartography*. ITC Enschede, The Netherlands pp. 1-9.

Feidt, W. B. and C. Roos. (1995). "Environmental Information Resources on the Internet." *Bulletin of the American Society for Information Science*. April/May 22-23.

Katz, M. and D. Thornton. (1997). *Environmental Management tools on the Internet*. St. Lucie Press Delray Beach Florida USA.

Miller S. (1999). "Design of Multimedia Mapping." In Cartwright W., M. P. Peterson and G. Gartner (ed.) *Multimedia Cartography*. Springer-Verlag, Berlin Germany.

Peterson, M. P. (1995). *Interactive and Animated Cartography*. Prentice Hall, Englewood Cliffs, New Jersey USA.

Voinov, A. and R. Costanza. (1999). Watershed Management and the Web. *Journal of Environmental Management*. 56, 231-245.

World Bank. (1995). Environmental Information Systems ins Sub-Saharan Africa: An Internet Resource. *Bulletin of the American Society for Information Science*. April/May 24-25.