DIGITAL EARTH, CONVERGENCE, AND THE DISCURSIVE FOUNDATIONS OF GEOGRAPHIC INFORMATION SYSTEMS

Michael R. Curry
Department of Geography
University of California, Los Angeles
Los Angeles, CA 90095

Presented at the conference on
Data
Dept. of Architecture
Rensselaer Polytechnic Institute
Troy, NY
March 2000

As we know, all technological systems are defined in multiple and complex ways. As elsewhere, in the case of geographic information systems these multiple definitions have been employed, by those who use the systems, as means for undercutting critical discourse about the systems. But there are reasons to believe that certain developments are changing the landscape of geographic information systems, and at the same time the possibilities of engaging in certain forms of discourse about them. In what follows I shall suggest that we can expect a changed, though not necessarily more communicative, discourse to begin to surround the systems.

TWO TRADITIONS IN GEOGRAPHIC INFORMATION SYSTEMS

In order to see what I mean, it will be necessary first to say something about the systems themselves. In the development of geographic information systems I would distinguish two main streams. The first stream might best be seen as deriving from the

work of early geographers like Ptolemy, and later Varenius.[1] It imagines the task of geography to be to map the entire earth, and to establish the relationships among the objects on the earth. The focus is geometrical, with the earth imagined to be a surface on which are points and areas whose locations can be systematically described.

This stream continues after the European rediscovery of Ptolemy in 1400, more or less continuously to the present. Indeed, we might well see this as the intellectual center of cartographic practice, just insofar as it sees the initial concern to be the establishment of a scientific system of projection, and wishes to see any particular map as potentially an element of a larger, more inclusive map.

If the initial locus of activity here was mapping itself, in recent years this locus has spread--through the development of satellite-based remote sensing, the digital computer, and finally global positioning systems. What has developed has been a set of institutions and technologies all centered around this same image, of the whole earth.

At the same time, the development of geographic information systems can be traced through a second stream. Although this is perhaps stretching the matter, one might want to see this stream as deriving from the chorographic and topographic traditions in geography, the traditions of region and place description. But its more recent roots are elsewhere, in the ichnographic traditions of landscape architecture and planning.[2]

Within this tradition the cartographic concerns with projection and with location on the earth drop away; the concern is rather with a particular place or region. It is of course sometimes hard to see this, just because we are now so used to thinking of regions

---

[1] Ptolemy. "The elements of geography." In *A source book in Greek science*, edited by Morris Raphael Cohen, 1948; Bernhardus Varenius. *A compleat system of general geography : explaining the nature and properties of the earth*, 1734.

[2] Warren Manning. "The Billerica town plan." *Landscape Architecture* 3, no. 3 (1913); Ian L. McHarg. *Design with nature*, 1969.

and places as elements of a larger earth. But if you look at many regional or urban plans, the "actual" location is not--in numerical terms--stated--or relevant.

This is, in fact, the tradition within which the most popular GIS programs operate. Programs like ArcView and ArcInfo are designed, primarily, for the organization of georeferenced data at the local level; a look at the participant list of the annual ESRI users meeting will show that the great majority of attendees are planners within locally oriented organizations.

MORAL AMBIGUITY AND THE MULTIPLE DISCURSIVE FOUNDATIONS OF GEOGRAPHIC INFORMATION SYSTEMS

Now, until very recently there has been a striking thing about the way in which many users of geographic information systems have discussed their work. If one, for example, asked a person who was involved in the global tradition about the implications of the potential development of a global surveillance system, the response was almost inevitably, "That isn't what GIS is about; it is a matter of the development of locally useful tools. We just draw maps" There they would point to the local tradition as the "real" one.

If on the other hand one asked a person operating within the local tradition why, exactly, one ought to be excited about the systems, suggesting that in many cases they were more trouble and less easily used than a pile of sheets of vellum or Mylar, the response would very often be, "Yes, but we can move from the local to larger scales; we can integrate our data with other data." They would point to the global tradition as the "real" one. Putting the matter bluntly, members of the two streams tended to appeal to the separateness of the traditions when it suited their argument, and tended to appeal to the integration of the traditions when it suited other arguments.

But as I suggested at the outset, several developments appear to be making it more difficult to maintain these dual discourse. The first of these developments concerns what might be called the creation of an information-saturated landscape. On the one hand, this involves the proliferation of systems for data capture. I have in mind here the collection of information during commercial transactions, but also the collection of personal information from telephone calls, including calls to emergency response numbers, and data from intelligent transportation systems. And on the other hand is the recent commercial availability of high-resolution satellite imagery, where it is now potentially possible to obtain images of any place on earth.

The important issue here is not actually the "real" availability of the information. In both cases the information may be too expensive, or even too irrelevant, to be used within a local setting. But rather, the issue is the rhetorical role of its potential availability: its existence suggests that in some sense every place is equally visible.

The second development is the "spatialization" of information. I have in mind here the way in which SQL Release 7.0 allows for the attachment of spatial coordinates to data records, and for the carrying out of spatial searches. This move, in effect, makes every information system a geographic information system--albeit, not necessarily one that can be used by the faint of heart.

The third development draws on the first two. This development is an analytical method, termed "GKD," or geographical knowledge discovery. It involves the analysis of spatially-encoded data, and the attempt to discern patterns within those data. This is, of course, the geographical version of data mining.[3] GKD is promoted as a generically useful process, one that can be applied across the board, to environmental, social, and

---

[3] http://www.ncgia.ucsb.edu/varenius/discovering/description.html

commercial data. And the suggestion is that the analytical tools used in data mining will make it all the more worthwhile to increase the scale and scope of warehoused data.

The fourth development is a means to access all of the above. Projects like the Alexandria Project, a part of the broader digital libraries project, attempt to create vast virtual libraries of mapped data, and to provide means for searching the images held in those libraries and gaining access to maps found through those searches.[4]

Finally, the development of networked communications systems, and especially the Internet, has seemed to point to a means for making each of these other developments widely available.

In an important sense, each of these developments has a dual role; each is an element of a technological system that can be used for the collection, organization, storage, analysis, and representation of data. But each at the same time provides rhetorical support for the view we are moving into a world of which geographic information is a constitutive element. And in this way, these technological developments suggest the decline of the local stream of GIS.

Each of these, though, now operates in the context of a final development, simply an image, of the digital earth. This is the image promoted recently by Vice President Gore,

> Imagine, for example, a young child going to a Digital Earth exhibit at a local museum. After donning a head-mounted display, she sees Earth as it appears from space. Using a data glove, she zooms in, using higher and higher levels of resolution, to see continents, then regions, countries, cities, and finally individual houses, trees, and other natural and man-made objects. Having found an area of the planet she is interested in exploring, she takes the equivalent of a "magic carpet ride" through a 3-D visualization of the terrain…. To prepare for her family's vacation to

---

[4] http://www.alexandria.ucsb.edu/adl.html

> Yellowstone National Park, for example, she plans the perfect hike to the geysers, bison, and bighorn sheep that she has just read about. In fact, she can follow the trail visually from start to finish before she ever leaves the museum in her hometown.[5]

What made this scenario striking was its similarity to another one:

> Mirror worlds?
> What are they?
> They are software models of some chunk of reality, some piece of the real world going on outside your window.... A Mirror World is some huge institution's moving, true-to-life mirror image trapped inside a computer—here you can see and grasp it whole....
> The 'geography' perspective is a natural starting point, sometimes. The picture on your screen represents a real physical layout.... Now you see inside a school, courthouse, hospital, or City Hall.... Eavesdrop on decision-making in progress....[6]

This, of course, is from David Gelernter's Mirror Worlds; Gelernter's controversial work became even more visible after it--and he--was attacked by Theodore Kaczynski, the Unabomber.

THE END OF THE ICHNOGRAPHIC TRADITION

If these technological developments are pointing toward the demise of what has been the locally oriented version of geographic information and geographic information systems, what does this mean? One certain effect has been that within my own discipline of geography, those who have been engaged in the promotion and development of geographic information systems are taking a more aggressively promotional stance. Apparently sensing a widespread consensus in support of the digital-earth project, and

---

[5] Albert Gore. "The digital earth: Understanding our planet in the 21st century." California Science Center, Los Angeles, CA 1998.

[6] David Gelernter. *Mirror worlds: Or the day software puts the universe in a shoebox: How it will happen and what it will mean*, 1992.

under less pressure from funders like NSF to take a balanced view, they have dropped any pretense of supporting work that might undercut the direction of their work.

At the same time, the appeal to universality has been reflected in an attempt to redefine the term GIS to mean not "geographic information system" but rather "geographic information science." If the explicit claim here is that GIS is more than just a technology, the implicit goal is to take on the mantle of science, and by thereby establishing a set of alliances with a wide range of scientific institutions, further to undercut the possibility of critique.

If we turn away from the academic setting, though, the consequences of the move toward universality seem to me to be rather less certain. I would, though, suggest the following. We all know--at least I think we do--that the ways in which many of the documents used in architecture and planning are formatted and organized is a matter of local practice. Granted, there are sets of standards, that range from AIA-approved contracts, to sample specifications, to requirements for permit applications. But within those standards there has been room for substantial flexibility.

Much of what I have said above suggests a reduction of that flexibility. In part this reduction arises from a standardization of data; in part it arises from the way in which those involved in architecture and planning need to adapt to the requirements of the labor market. And this standardization seems to suggest the possibility of greater mobility of geographic-information professionals. So we can see a feedback loop emerging, one that in yet another way undercuts the value of local knowledge.

A second area of change concerns geographic information itself. Under the pressure of a perceived need to computerize their geographic information, many municipalities over the last several years have contracted with outside agencies, who have in return received substantial rights to that information. One consequence has been

the standardization of local information that I spoke of above. Another has been the destruction of a body of physical materials, of congealed local labor, acquired in some cases over a century or more.

But perhaps most important, this information has been transformed into what can only be described as an ambiguous form of intellectual property. Traditionally, in the United States, national and some state data have been considered to be in the public domain. And beyond that, the basic lineaments of many maps, believed to consist simply of objective representations of natural features, were not subject to ownership. But the transfer of rights to this information to private organizations has been complicated by the fact that those organizations have transformed geographic information, in the form of maps, into computerized databases, which in the US constitute a contested form of intellectual property. And the complexity of the situation is increased as one transforms those data, again, into a map. It seems fair to say that neither the courts nor legislative bodies have been able to develop a clear sense of the rights and responsibilities associated with those multiple transformations.

Finally--and this seems almost too obvious to mention--the development of data warehouses raises a series of issues concerning privacy and data protection. And the sense that this is the case is heightened once one recognizes that the routine suggestions by proponents of GKD that the databases to be analyzed will include "georeferenced multimedia" are referring to the products of video surveillance cameras, and not National Geographic specials on mating wildebeests. Here the proponents of the systems very often speak as though they are advocates of what David Brin has termed the "transparent society."[7]

---

[7] David Brin. *The transparent society: Will technology force us to choose between privacy and freedom?*, 1998.

Rather than going directly into the privacy issues raised by Brin's provocative work, I would just suggest that the assumption that information collected by government agencies will be widely available, and perhaps at low cost and with little expenditure of energy, has seemed over the last thirty years to have been one important motor driving the increased level of suspicion of government. And this suspicion has been connected to the rise--fueled in other ways within the computer industry--of a libertarianism that at once applauds the local and celebrates the universal liberal individual.

Now to conclude. It for many years was the conventional wisdom that changes in technology were leading to a world that is more and more homogeneous. But over the past dozen or so years, an increasing number of voices have pointed to the ways in which technological change--at least in its current economic context--has promoted the special and the unique. If what I have suggested above is true, though, there are today substantial forces at work to undercut the special. I have suggested that we can see this occurring in the ascendance of a global over a local model of geographic information. Ironically, though, many of those who have been most active in promoting these global systems see themselves as doing so in the name of the local, just because they find themselves unable to recognize that there have ever been two.

WORKS MENTIONED

Brin, David. *The transparent society: Will technology force us to choose between privacy and freedom?* Reading, MA: Addison-Wesley, 1998.

Gelernter, David. *Mirror worlds: Or the day software puts the universe in a shoebox: How it will happen and what it will mean.* New York: Oxford University Press, 1992.

Gore, Albert. "The digital earth: Understanding our planet in the 21st century." California Science Center, Los Angeles, CA 1998.

Manning, Warren. "The Billerica town plan." *Landscape Architecture* 3, no. 3 (1913): 108-18.

McHarg, Ian L. *Design with nature*. Garden City, NY: Published for the American Museum of Natural History by the Natural History Press, 1969.

Ptolemy. "The elements of geography." In *A source book in Greek science*, edited by Morris Raphael Cohen, 162-81. Cambridge: Harvard University Press, 1948.

Varenius, Bernhardus. *A compleat system of general geography : explaining the nature and properties of the earth.* Edited by Isaac Newton, James Jurin, Mr. Dugdale, and Peter Shaw. 2d ed. London,: S. Austen, 1734.