

## essay

## The Convergence of Spatial Technologies

Here is a map test: Who is the biggest mapmaker in history? The Dutch map houses of Hondius or Mercator certainly published quite a few maps. But probably some government agency has published more—for example, the USGS has over 55,000 maps for the United States alone at the 1:24,000 scale. Or maybe someone more recently? The Defense Mapping Agency (now the National Imagery and Mapping Agency) put out thousands of maps during the Gulf War, working in special 24-hour shifts (Clarke, 1992).

Actually it is none of these. The biggest mapmaker in history, putting out more maps than anyone else, is undoubtedly MapQuest, an as yet little known unit of GeoSystems Global. According to the trade press, MapQuest produces over 1.5 million individual maps per day (*Internet World*, April 6, 1998). It is one of the reasons why CP Editor Mike Peterson claims that the Internet sees the publication of as many as 10 million maps per day and leads him to say that the impact of Internet mapping "will likely be greater than that of the printing press" (Peterson, 1997a, p. 2).

Despite this productivity, MapQuest does not carry the "weight" of more traditional cartography. Undoubtedly, one of the reasons for this is that its maps are mostly basic street maps automatically generated from databases, are fairly poorly designed, and are at low resolutions. MapQuest is very new, starting only on Feb. 3, 1996 (Peterson, 1997b). The cartographic community does not yet know what to make of these maps, so they must be put in some context.

Online mapping, which produces what may be called "user-defined, on-demand maps," is part of a convergence of spatial technologies (digital cartography, GIS and the web) that have been rapidly developing over the last few years. The web, and GIS in particular, are each other's next most logical growth area. The web offers GIS users the opportunity to distribute their capabilities more widely, including the analytical capabilities of GIS—not just finished maps. The Internet may be able to deliver "public participation" GIS (PPGIS), or GIS "for the rest of us." On the other hand, GIS offers the web something it mostly lacks, that is good content, especially of an analytic nature. Online maps can be called up on-demand, and reflect the data the user wants to analyze; they are user-defined. This is very different from choosing a map from a map archive of finished maps where the cartographer has tried to anticipate the user's needs.

The convergence of spatial technologies is leading to a wider adoption of an exciting type of map use called "visualization or geographic visualization" (GVis). To some extent, visualization is what cartographers have always been doing in that they make aspects of the world visible, but there are important differences. Visualization, in this sense, also refers to the added capabilities of interactive mapping software such as rotating the data in three dimensions, adding or stripping away data layers during data exploration, or querying the map interactively. The map information changes in response to user input. But as Alan MacEachren, the Chairman of the ICA Commission on Visualization points out, "visualization is

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foremost an act of cognition, a human ability to develop mental representations that allow geographers to identify patterns and to create or impose order" (MacEachren, 1992, p. 101). There is, therefore, a sense that GVis allows *different kinds of questions to be asked*. The differences between visualization and traditional cartography can be captured using MacEachren's concept of "*cartography cubed*."

Cartography cubed is a method of understanding the different kinds of map uses. The "*cube*" contains three dimensions; private-public, high interactivity-low interactivity, and revealing knowns-exploring unknowns. Traditional cartography has emphasized public use, low interactivity and revealing knowns, while visualization emphasizes private use, high interactivity, and exploring unknowns (though perhaps without ignoring presentation of information). The ICA Commission is especially interested in full-blown visualization, map uses that meet all three of the latter criteria. But, it is suggested here that using maps in highly interactive, exploration of unknowns in a public setting is a more critical and far-reaching component of visualization. That is, of course, delivering mapping capabilities via the world wide web.

Mapping and the web has so far received less attention than other kinds of visualization. It is important, however, for a number of reasons because doing and thinking about geography (the goal, it can be argued, of all cartography and GVis) increasingly requires a virtual component; a feature that has elsewhere been labeled the "*virtuality of geography*" (Crampton, forthcoming). Web-based mapping is a part of this increasing virtuality and has obvious benefits (e.g., increased accessibility to data by the public in community GISs) and costs (e.g., increased merging of databases containing personal information for marketing and surveillance).

*"What happens to map quality if this widespread access to online mapping means that anyone can now be a cartographer?"*

What happens to map quality if this widespread access to online mapping means that anyone can now be a cartographer? The fear is that online maps and GIS capabilities will permit only low-quality maps and superficial renditions of data (i.e., data poor) due to low Internet bandwidths. This is a technical problem which will probably be alleviated to some extent, though it may never entirely go away (the Internet's First Law: information expands to fill the bandwidth available). Indeed it could be argued from this perspective that online maps of lower graphic quality are a trade-off for higher levels of interactivity.

Is that an acceptable tradeoff? There is a danger in online mapping that the user's experience with that spatial data, be it for exploration (GVis) or communication (traditional cartography/GIS) will be superficial, or just plain incorrect. This danger (or map misuse) has two components: low data dimensionality and misunderstanding of cartographic/geographic spatial data principles by online map users.

Visualization was initially proposed as a way of dealing with the huge quantities of data available to the modern scientist from remote sensors such as The Mission to Planet Earth satellite AM-1, due to launch later in 1998. If the dimensionality of that data in online mapping/GIS (data-poor maps) is now reduced, the full potential of GVis will not be realized. We will have an immensely powerful tool but no data to put in it.

Misuse may occur by misunderstanding basic geographic requirements such as reprojecting the data for minimum error when the user moves from a world map to a regional map (online mapping capabilities typically do not reproject data on zoom-ins), ignoring the effects of scale, being unable to select appropriate data classification categories and so on. Misuse is especially likely among users with little or no familiarity with

principles of spatial data analysis. This danger is separate from the lack of familiarity users may have with the capabilities of the software.

Both of these dangers are implications of the convergence of spatial technologies and suggest that anyone can now be a cartographer. As cartographers, therefore, it is our responsibility (though not ours alone) to ensure well-designed, data-rich maps are part of any online geographic visualization system, and to be "Internet activists" in developing good content. It is now, while the web is relatively young that we have the most opportunity to shape it.

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