Google Sparks Search Wars

Jonathan W. Lowe

In the Internet giants' battle for market share, it's the public that wins — fast, free geospatial viewers.

During the past four months, Google, Yahoo, Microsoft, and Amazon have launched geospatial viewing tools linked to text-based search engines. They are free, fast, easy to use, rich in global data, and — as public users enthusiastically testify — they're cool!

Though few (if any) of their spatial capabilities are new to the GIS community, the tools' smooth online interfaces are capturing wider audiences than traditional GIS products have. The public is responding in unexpected ways, including serving their own map data through the new tools. This column investigates the market impetus for this sudden burst of geospatial offerings, their technical underpinnings, and their relevance to the traditional GIS industry.

Searching for Dollars

Because Internet search services are many users' point of entry to everything else online, several Internet giants — Google, Yahoo, Microsoft, and Amazon — are battling heatedly for market share in what some call the "search wars." In an Internet search context, market share means the percentage of total Internet searches performed using a given company's search engine. According to Web analytics firm WebSideStory, Google's share of U.S. searches rose to 52 percent in June, while Yahoo's and MSN's (Microsoft Network) shares slipped to 25 and 10 percent, respectively. All of these companies want to win the search wars because leaders in market share attract the most revenue from advertisers (who pay as much as 50 cents per click to appear atop a Google results list, for instance).

Google makes 99 percent of its money by offering advertisers a business model called online keyword advertising, or pay-per-click. Google might agree to list "sponsored links" (advertisements) for Nike in search results where the query contained the keyword "shoe" but would only charge Nike when a user then selected Nike's link and visited Nike's Web site. Promoters of keyword advertising claim it supports ratios of 1,000 potential buyers to every $50 spent on advertising. And, touted as more precise than radio, television, billboard, and other "buckshot" ad campaigns, keyword advertisements supposedly reach buyers who are already searching for whatever their advertisers are offering.

Is it a good business model? A cursory survey of various online offerings suggests that an advertiser must spend approximately $1,000 to set up a keyword ad campaign, then pay the search engine company ongoing pay-per-click charges determined by public usage. In the year since its initial public offering, Google's revenues have rocketed by more than 100 percent quarter over quarter. As a result, its stock price has tripled, hovering at

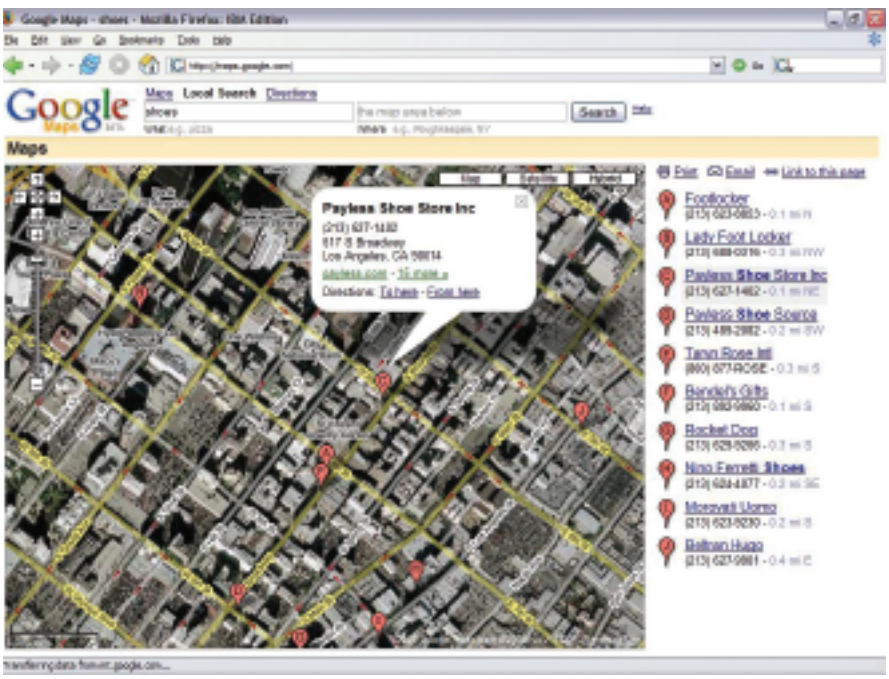

Figure 1. This Google Maps interface shows shoe store locations only within the downtown area of Los Angeles in the map extent. The ability to filter searches by local extent makes Google's keyword advertising more attractive to local businesses.

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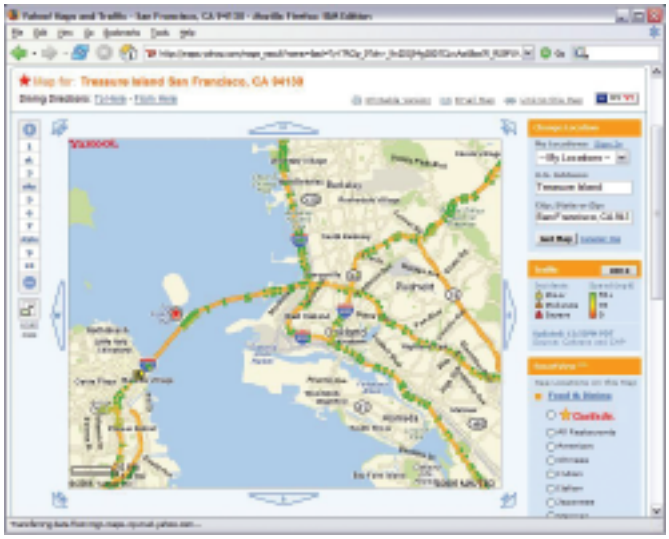

Figure 2. In addition to plotting search results on maps, Yahoo Maps locates traffic incidents, road construction sites, and speed of vehicle flow at fixed sensor points. (Though it's rarely the case, traffic conditions look good in this San Francisco Bay Area Sunday afternoon snapshot.)

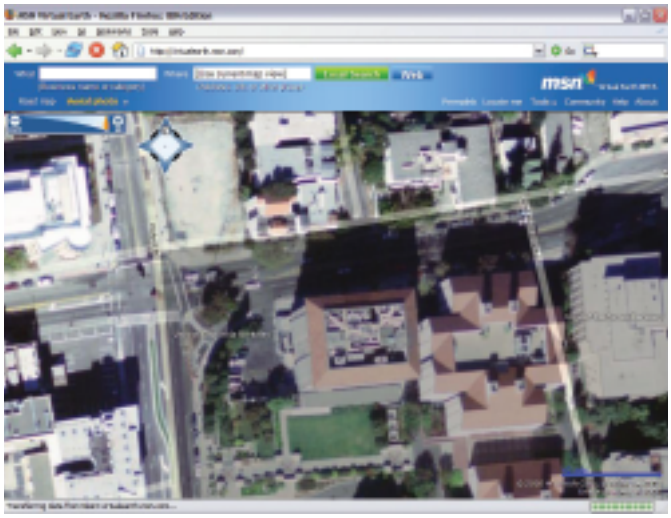

Figure 3. This combination view of imagery (by the U.S. Geological Survey in this case) and labeled roads (from NAVTEQ) shows the degree of detail possible with MSN's Virtual Earth viewer.

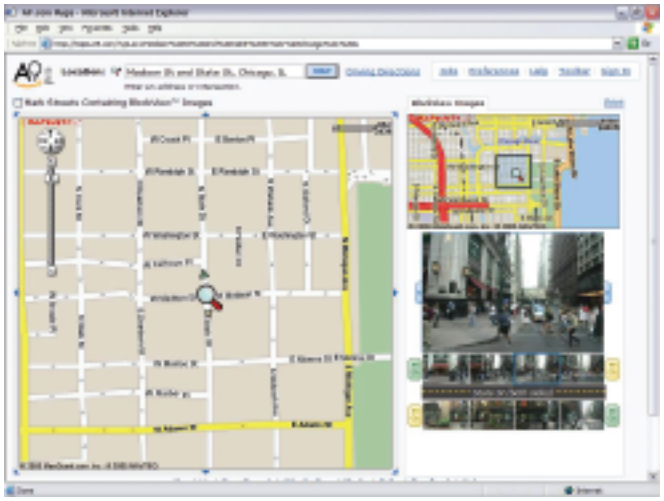

Figure 4. Amazon's A9 Web site links map views to pedestrian-level street façade photographs (BlockViews) that scroll as users move their point of interest along the street segment. In September, A9 did not yet include a local search for keyword advertising.

around $300 per share in early September. Apparently, the keyword advertising model is indeed lucrative.

Localize Local Eyes. One limitation of the model, however, is that simple text searches don't effectively put keyword advertising in front of local eyes and so have limited appeal to small local businesses. The millions of Internet searches this month that contain the word "shoe" originate from millions of worldwide users, most of whom care only about the handful of shoe stores within 10 minutes of their current location — not the thousands of others sprinkled throughout the world. With a combination of what they call "local search" and a geospatial interface, however, the four giants are convincing millions of small, local businesses that keyword advertising now can connect local eyes to both their locally relevant advertising and their brick-and-mortar retail locations.

Freebie Fallout

We, the public, are the direct beneficiaries of search wars — gaining several free online or desktop mapping tools. For those just discovering this embarrassment of riches, here's a brief rundown. The online map viewers are Google Maps (see Figure 1), Yahoo Maps (see Figure 2), MSN Virtual Earth (see Figure 3), and Amazon's A9 (see Figure 4). Only Google also offers a free three-dimensional global desktop map viewer known as Google Earth (see Figure 5). The tools all offer contextual map data from various providers, such as NAVTEQ and Tele Atlas, sometimes in combination and sometimes bearing other branding (as with Amazon's A9, which cites MapQuest). Google and MSN also offer aerial imagery (from DigitalGlobe, ORBIMAGE, and others) with or without annotation, and Amazon offers what it calls "BlockView" images of the landscape (typically building frontages) on both sides of the selected road segment. In addition to combining Internet search results with graphic maps, each site has its own extras, such as Yahoo Maps' real-time traffic mapping option showing vehicle flow at roadway sensor locations.

Functionally, the online tools are simple viewers designed to plot points on contextual maps. Their technical innovation is in the design of their interfaces, which behave more like desktop applications than online tools. Pans — accomplished by clicking and dragging a map — reveal new map graphics seemingly without a browser refresh. Zooms seem to happen only within the map

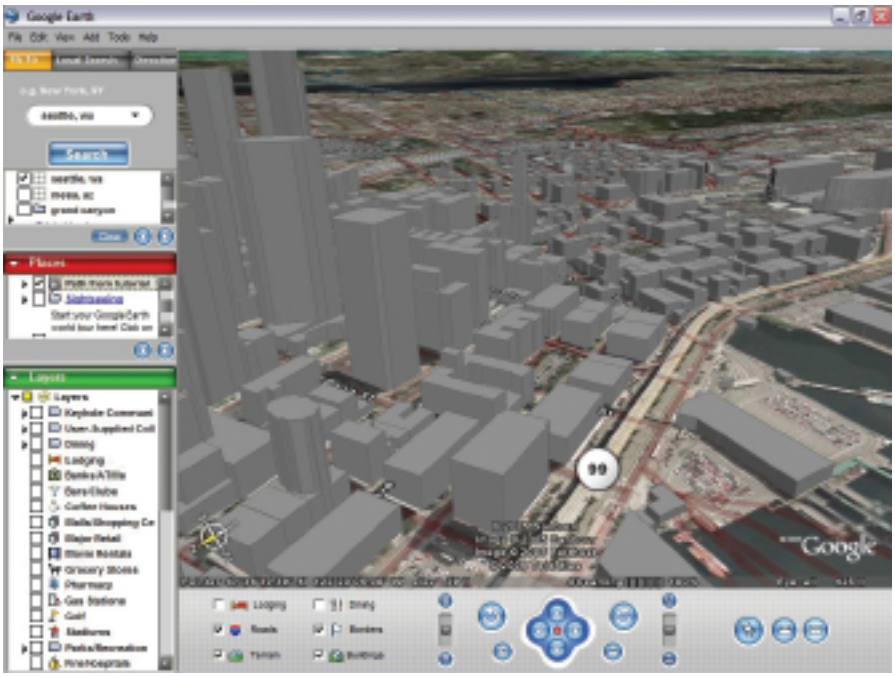

Figure 5. Google Earth is a visually mesmerizing desktop tool with animated fly-throughs over extruded buildings and three-dimensional terrain surfaces. As evidenced by Keyhole's bulletin board, Earth also accepts user-generated placemarker data and KML files.

image borders and without the usual blink-and-pause of a full-page refresh.

Map zooms in Google Maps and MSN Virtual Earth refresh tile by tile — each tile's rapid sequential appearance distracts the user during the one or two seconds required for re-rendering, simulating a faster response. Amazon's A9 demonstrates this same desktop responsiveness with their BlockView images, which scroll simultaneously to the left and right as a user shifts the point of interest down the street segment on the map.

Old Parts, New Whole. Technically, Google Maps, MSN Virtual Earth, and Amazon's A9 achieve these slick interfaces using Asynchronous JavaScript and XML (eXtensible Markup Language), also known as AJAX. AJAX is not a technology in itself, but a term describing a group of technologies comprising HyperText Markup Language, cascading style sheets, the Document Object Model, JavaScript, and the XMLHttpRequest object. Though Microsoft's Outlook Web Access team first applied the AJAX approach in 1998, Jesse James Garrett coined the term in February 2005 in "Ajax: A New Approach to Web Applications." The online essay provides a good overview of AJAX, as does Wikipedia (www.wikipedia.org), a free online encyclopedia.

AJAX enables those comfortable with JavaScript to update portions of a Web page without having to refresh the whole page. Only changed information needs to travel between the browser and remote Web server. JavaScript routines handle simple data validation and edits, respond to map navigation clicks, and, while responding to the user, also exchange messages asynchronously with the remote Web server. By processing asynchronously and reducing the data-transmission size, the new map interfaces provide a faster perceived performance compared to the stammering pauses we expect from a Web browser (see Figure 6). AJAX-based mapping interfaces are relatively straightforward to implement, as evidenced by a small, free product called ka-Map that enables Web masters to mimic Google's and Microsoft's technological approaches.

AJAX doesn't use a browser plug-in, but it does require users to enable JavaScript in their browsers. Consequently, AJAX must account for the many variations of browsers and platforms or risk excluding some users. Of the online offerings, only Yahoo's maps still work (or degrade gracefully) in the absence of JavaScript (in part because Yahoo Maps doesn't use AJAX to begin with). With the others, if JavaScript is disabled, you'll receive a page explaining the problem and recommending that you please turn JavaScript back on (Security be damned! What Web Accessibility Initiative? Full steam ahead!).

Solitary Google Earth. Thus far in a class by itself, Google Earth is the only free desktop viewer yet to emerge from the search wars and merits an article unto itself. In a nutshell, Google Earth is a relatively small (10-MB), free, downloadable application that allows users to animatedly "fly" over three-dimensional terrain surfaces draped with DigitalGlobe imagery and extruded (in some urban areas) with building shapes; the experience is mesmerizing. The application is small in part because most of its data

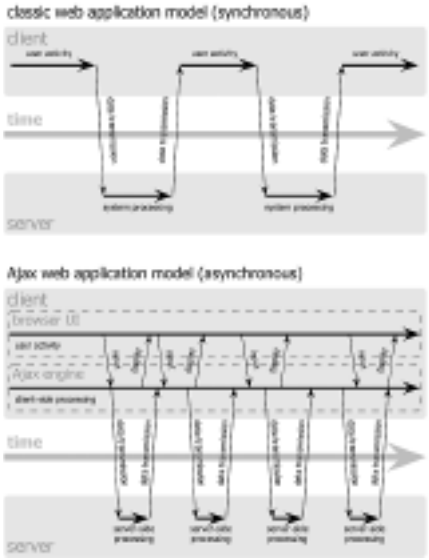

Figure 6. As diagrammed by Jesse James Garrett (www.adaptivepath.com/publications/essays/archives/000385.php), AJAX applications interact with their remote Web servers asynchronously, disguising the processing breaks common to classic Web applications.

Figure 7. Craig's List housing classified ads plotted against Google Maps give home hunters a quick neighborhood overview of the current listings.

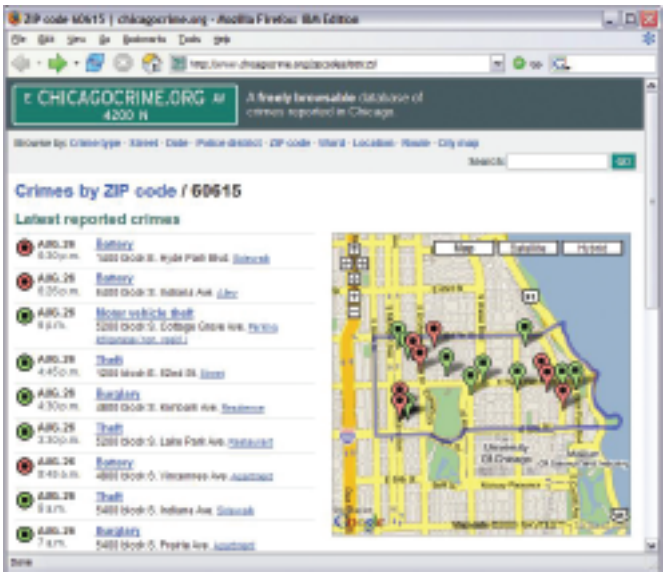

Figure 8. Chicago Crime Maps (www.chicagocrime.org) color-code publicly available crime data by type and plot them to street intersections on Google Maps.

are remote — Google Earth pulls imagery into view, as needed, via the Internet. As with its Google Maps AJAX interface, Google Earth's performance is surprisingly quick and steady over a fast network. Like Google Maps and the other search warriors, Google Earth provides Internet searches and plots results on the terrain.

Google created Google Earth by acquiring Keyhole Technologies, modifying their product, and eventually rebranding it ("Good thing they didn't call it Goohole," writes one blogger). Google Earth annotates the view with user-generated data when fed a file format called Keyhole Markup Language (KML) that is an extension of XML and is accessible even to non-programmers. Google Maps' first release prompted some popular public hacks, such as Craig's Real Estate (see Figure 7). Google realized it had stumbled onto a good source of promotion and made the Google Maps application programming interface (API) public. In like fashion, Google Earth provides a Network Link capability to enable viewing of KML or even slightly modified Web Map Server feeds superimposed over the tool's existing terrain. The open interface to these tools has prompted unexpected public mapping activity and upped the ante in the search wars. (For example, by the time this article is published, Microsoft will have released a public API to MSN's Virtual Earth.)

Public Groundswell

Before categorizing the new map viewers as simply marketing plays by big companies, it's worth investigating their adoption by enthusiasts. By providing a public API to their viewers, Google in particular has fostered a formerly unknown and creative public mapping community eager to share their map data. For instance, the Google Earth community (http://bbs.keyhole.com/ubb/) already contains more than 30,000 posts in 31 different user forums. Some enthusiasts are pure altruists; others are canny entrepreneurs keen to mine the revenue opportunities that Google, Microsoft, Yahoo, and Amazon have exposed.

For instance, Chicago Crime Maps (see Figure 8) plots Chicago's "latest reported crimes" by crime type, street, date, police district/beat, ZIP code, ward, point of interest, the whole city, or along a route. Adrian Holovaty, a Chicago-based Web developer "with a background in journalism and databases," created the site by combining Google Maps with cross-street text identifiers from the Chicago Police Department's public database of reported crimes. Holovaty's site is free, but he reportedly has been offered paid consulting contracts to set up similar crime-mapping sites for other cities.

Another hack by Paul Rademacher, technical lead of animation tools at DreamWorks Animation, combines housing listings from Craig's List (a free, localized classified ad Web site) with the Google Maps interface. Yellow and red markers pinpoint listings with and without photos, respectively. The increased traffic benefits both Google and Craig's List (whose business model is similar to Google's — charge companies a nominal fee to list job openings, and post all other listings for free). It's not clear why Rademacher created the service, though his career path suggests that it was at least partly for the fun of it.

Beyond these simple geocoding examples, even more labor-intensive data integration by a non-technical general public has materialized in the wake of Hurricane Katrina. Purely out of desire to help, people with no career history in traditional GIS (a science-fiction editor? a disc jockey?!) have made post-hurricane imagery available to those desperately curious about flood damage in their neighborhoods. These innovative

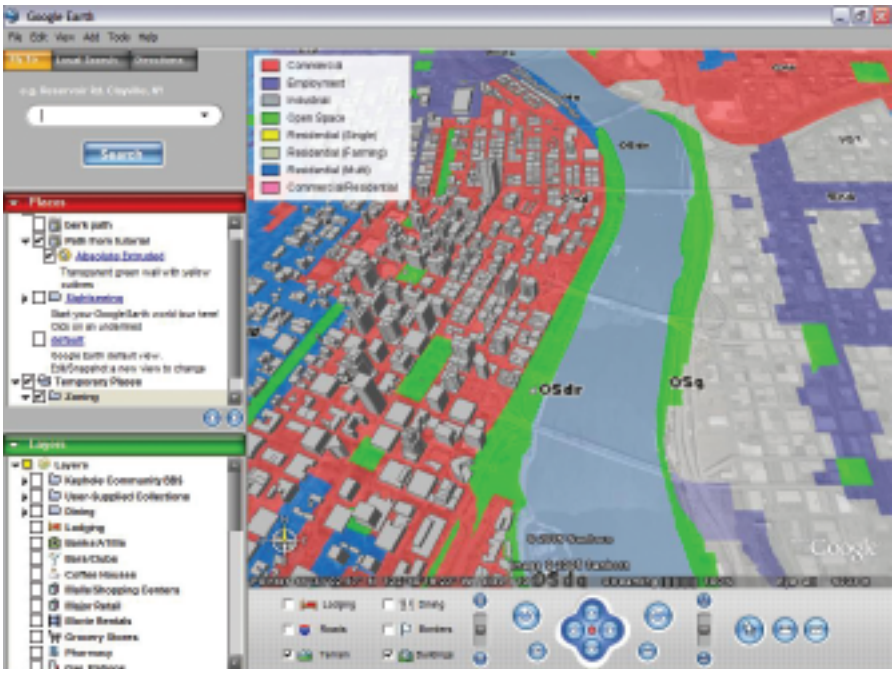

Figure 9. The color-coded zoning areas and legend illustrate how the City of Portland, Oregon, has (rapidly) extended its ESRI-based geodatabase and middleware to deliver municipal map data directly to Google Maps or Google Earth (www.portlandmaps.com/google.cfm).

volunteers downloaded publicly available aerial images flown in a Cessna Citation jet by the National Oceanic and Atmospheric Administration's Remote Sensing Division, loaded them into Google Earth, tweaked them to roughly correct geoposition, and posted dozens of them to Google Earth's bulletin board for worldwide access. Shortly thereafter, Google, NASA (the National Aeronautics and Space Administration), and Carnegie Mellon University formally incorporated nearly 4,000 post-hurricane images directly into the Google Earth database for public use. When Web-founding visionary Tim Berners-Lee set out to design an inclusive technology, he never could have predicted it would extend this far.

And speaking of extension, well-established municipal GIS departments are also taking advantage of the public's interest by modifying their existing geospatial databases to render in the new map viewers. Through years of in-house customization of a combination of ESRI products, the GIS department for the City of Portland, Oregon, has been refining its geospatial Web interface for increasing ease of use. The department's goal is to reach the widest possible audience, and Google currently has the public eye, so within weeks of the release of Google Maps (and again, of Google Earth) their developers were able to serve Portland's municipal data, from crime to hazards to property to zoning (see Figure 9), from their ESRI geodatabase to either of Google's interfaces. They have not abandoned their commercial GIS software at all, but they hope to have extended its effective reach by also providing data through Google viewers.

Consumer Mapping Meets GIS

GIS vendors must be scrutinizing activity such as Portland's. Are the search engines' inclusive new mapping tools upstaging and undercutting traditional GIS offerings? Not only are the new tools free, popular, fast, full of data, and capable of customization, but they surprised us all by first materializing out of Google, not formerly considered a geospatial company at all. At the O'Reilly Where 2.0 Conference, a member of the audience asked Bret Taylor, product manager for Google Maps, whether his product would support Open Geospatial Consortium (OGC) standards. Taylor admitted candidly that he had never heard of OGC. Can our community provide a good reason why he should have?

ESRI's David Maguire, in his "GIS Matters" blog of July 17, 2005, has observations on the new viewers that are similar to many traditional GIS practitioners' opinions: "The things which these systems do not deal with (yet) are data updates, fusion of multiple services, data collection, more advanced applications (like high-quality cartography, geoprocessing, data delivery, custom work flow development), etc. This is really the key difference between geoviewers and GIS."

Maguire also recognizes that a rising tide lifts all ships, including ESRI's big boat; he closes with, "…well done Google, Yahoo, NASA, and others — the profile of GIS has been raised." (ESRI has since begun promoting a "geographic exploration" tool that bears some similarities to Google Earth.)

Though true in their context, comparisons based only on tool functionality miss the important innovation of the search engines' map offerings: their successful business model. Free, sexy map tools draw millions of eyes to their owners' Web pages, and that popularity becomes ad revenue. The tools are indeed just viewers, but Google, Yahoo, Microsoft, and Amazon are already deriving significant returns on their initial investment in tool development and data provision. If I were a traditional GIS vendor, I would be watching closely too — the hype surrounding public mapping may fade with time, but the business model looks robust. In what geospatial technology might the search engines next invest their steady revenue streams?