

GOVERNMENT FREWARE FOR VIEWING U.S. GEOLOGICAL SURVEY DIGITAL CARTOGRAPHIC DATA

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ABSTRACT

The commercial success of Windows 95 made it possible to write graphics software that would run on a large proportion of personal computers. In early 1997, the U.S. Geological Survey (USGS) wrote two Windows 95/NT programs for displaying USGS cartographic data sets. The *dlgv32* program displayed digital line graph (DLG) data as colored lines with attributes, and the *dem3d* program displayed digital elevation model (DEM) data as perspective terrain models. Later versions of *dlgv32* display a variety of other data formats. Between June 1997 and August 1999, about 78,000 copies of the two programs were distributed over the Internet. They continue to be downloaded at around 100 copies per day.

The primary purpose of the software is to allow easy and cheap previews of USGS products. The viewers contain no analysis or editing functions and therefore do not compete with commercial geographic information system (GIS) products. Despite these limited capabilities, the viewers fill a need for some USGS customers. Many potential users of GIS data are unfamiliar with the field, own no GIS software, and appreciate free software to help them visualize digital cartographic data. The experience suggests that limited government development of freeware may be appropriate in support of earth science data programs.

INTRODUCTION

From the early days of digital cartography until the mid-1990's, geographic information system (GIS) technology was used mostly by professionals in resource management, earth science, cartography, and similar disciplines. Digital cartographic data have tended to be relatively complex, the formats nonstandard, and application software expensive and complicated.

Through the 1980's, neither GIS software nor data were friendly to personal computer (PC) environments. Common PC hardware was too weak to handle large data sets, and the DOS and early Windows operating systems did not adequately support graphics programming.

Digital mapping therefore required powerful scientific computers, advanced software, and specialized knowledge. This changed rather suddenly in the mid-1990's with the release of Windows 95. By late 1996, GIS graphic applications and desktop PC's that could handle large data sets were becoming common. At the same time, use of the Internet was increasing rapidly. These technical trends combined to change the environment of Government data production and distribution.

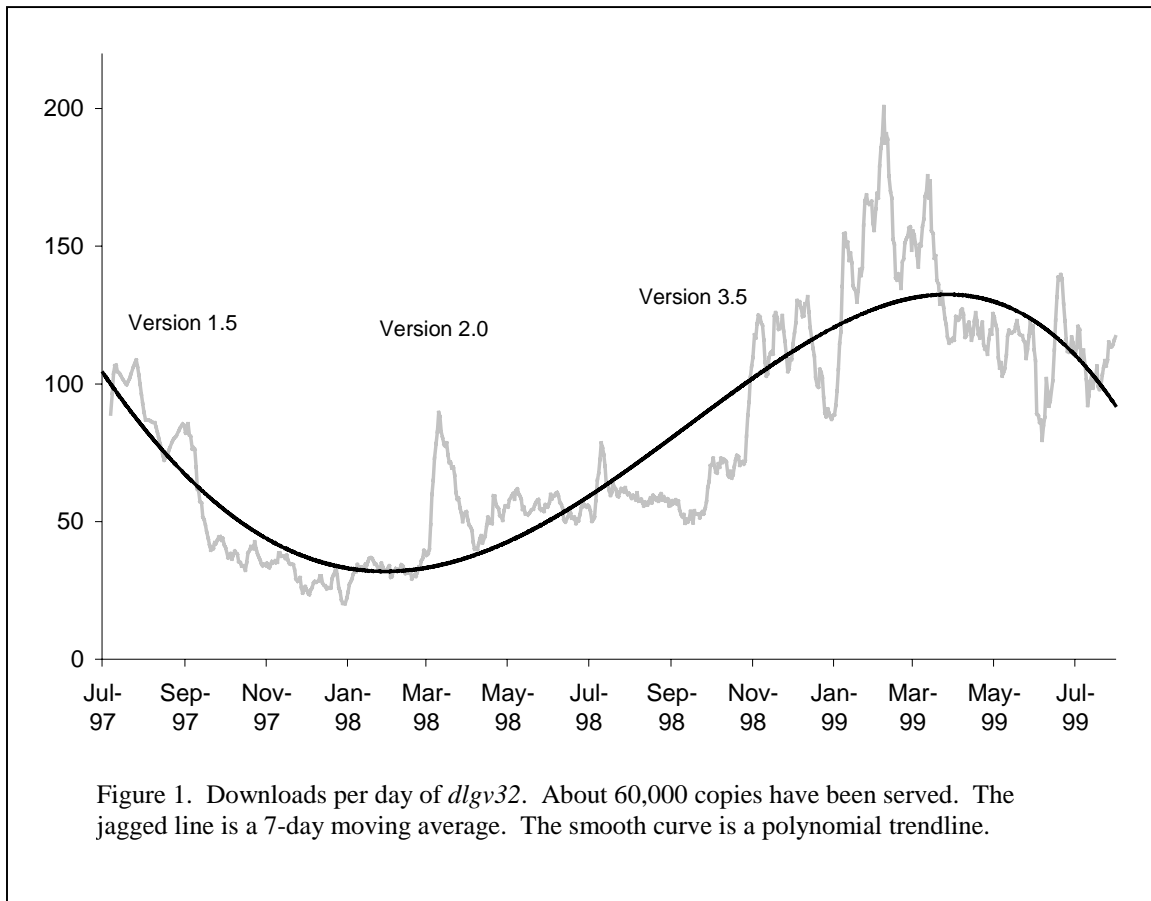
USGS GIS DATA PRODUCTION

The National Mapping Division (NMD) of the U.S. Geological Survey (USGS) has been making digital cartographic data since the early 1980's. At present, the NMD offers four major digital products:

- Digital line graphs (DLG) use topologically structured vectors to represent cartographic features.
- Digital elevation models (DEM) are regular grids of elevation points.

Any use of trade, product, or firm names is for descriptive purposes only and does not imply endorsement by the U.S. Government.

This paper was originally presented at American Society for Photogrammetry and Remote Sensing (ASPRS) annual conference, Portland Oregon, May 1999. This text of this version was updated in August 1999, and an appendix with updated statistics was added in March 2000.



- Digital orthophoto quadrangles (DOQ) are scale-correct aerial photographs that cover standard quadrangles.
- Digital raster graphics (DRG) are raster images of USGS topographic quadrangles.

Before 1996, the USGS had never written, sold, or directly endorsed consumer software for using any of these data products. The USGS is an earth science organization whose mission is to gather, organize, archive, and distribute data. Government agencies, with congressional encouragement, view software as a private-sector function and try not to compete with commercial software development.

Nevertheless, the lack of cheap software to display USGS digital cartographic data has been a problem. Potential customers who are new to GIS's are reluctant to spend thousands of dollars on new software. But gaining an understanding of GIS technology and data is very difficult without display software.

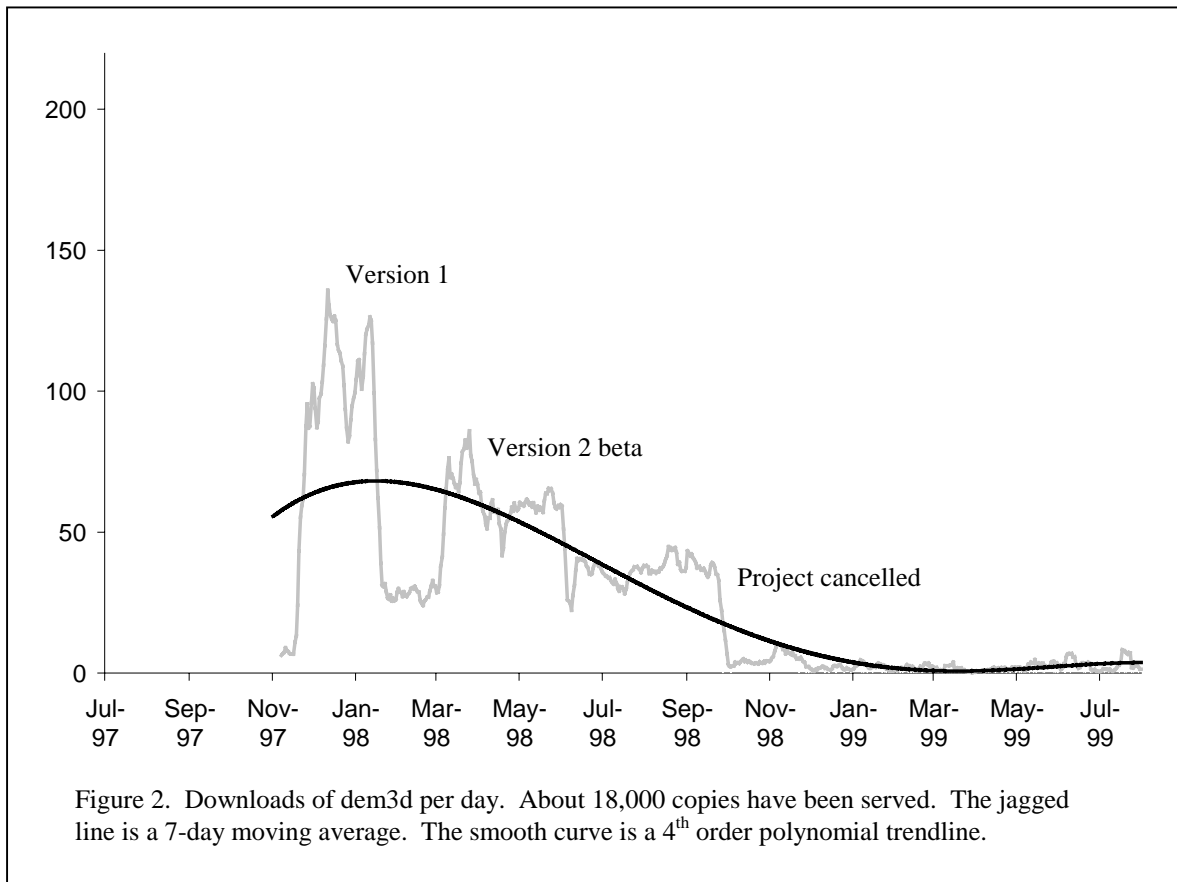
DEVELOPMENT AND DISTRIBUTION OF *dlgy32* AND *dem3d*

By mid-1996, it was apparent that Windows 95 and NT would be very important for the near future of GIS software. The new Intel/Windows computers were powerful enough to handle GIS data sets, and major GIS software vendors had begun porting their systems from Unix to Windows.

The USGS at this time relied primarily on Unix systems with X/Motif interfaces. In 1995 USGS programmers recognized the importance of becoming familiar with Windows graphics programming techniques.

A programming exercise

The *dlgy32* viewer began as an exercise to learn graphics programming techniques, and it later grew into a research project to explore ways to display USGS cartographic data. Similarly, *dem3d* began as a research



project in applying video game programming techniques to cartographic data. Creating consumer software was not the original objective of either project.

But it soon became apparent that the viewers had real uses. The viewers were convenient for some quality control tasks. USGS managers with Windows PC's and without hands-on GIS experience could use the software to view data. Sales clerks without direct access to GIS software could answer some kinds of customer questions without consulting a GIS specialist.

Sales personnel also recognized the viewer as a solution to a common customer service problem. USGS data are sometimes purchased by inexperienced users who assume that digital maps can be displayed with common desktop software. It surprises these customers to learn that they must purchase hundreds or thousands of dollars worth of software to use the data. A freeware viewer for Windows would provide a way for such customers to inspect data samples at little or no cost before deciding to make major data purchases.

Public release of the viewers

Nevertheless, USGS personnel hesitated to release the viewers to the public. There were concerns that the private sector would consider the release of Government-built software to be unfair competition and that the release would raise customer expectations to levels the USGS would not be able to meet. Software development is not part of the USGS's primary mission, and there was no guarantee that the agency would be able to provide support and updates.

After considerable discussion, the USGS released *dlgv32* through a Web site. The Web site contains the viewer, appropriate user documentation, sample data, and disclaimers about the nature of the software. The first public release was designated version 1.0. This version displayed native-format DLG-O data only. The release was announced by posting brief messages to two GIS newsgroups in late June 1997.

Version 1.5 followed within a few weeks; this version displayed DRG data in addition to DLG's. DRG's are a very popular product, particularly with computer map users who are not GIS professionals, and this enhancement marked the real beginning of the viewer's popularity. Figure 3 shows a *dlgv32* screen with a DRG displayed. Within 6 weeks, more than 4,000 copies had been retrieved. Eight additional formats have since been added.

A second program, later named *dem3d*, was a result of the technical success of *dlgv32*. The same programmers became interested in applying video-game visualization techniques to render elevation models as three-dimensional perspective images. Version 1 of *dem3d* was released in November 1997. Figure 4 shows a typical *dem3d* screen.

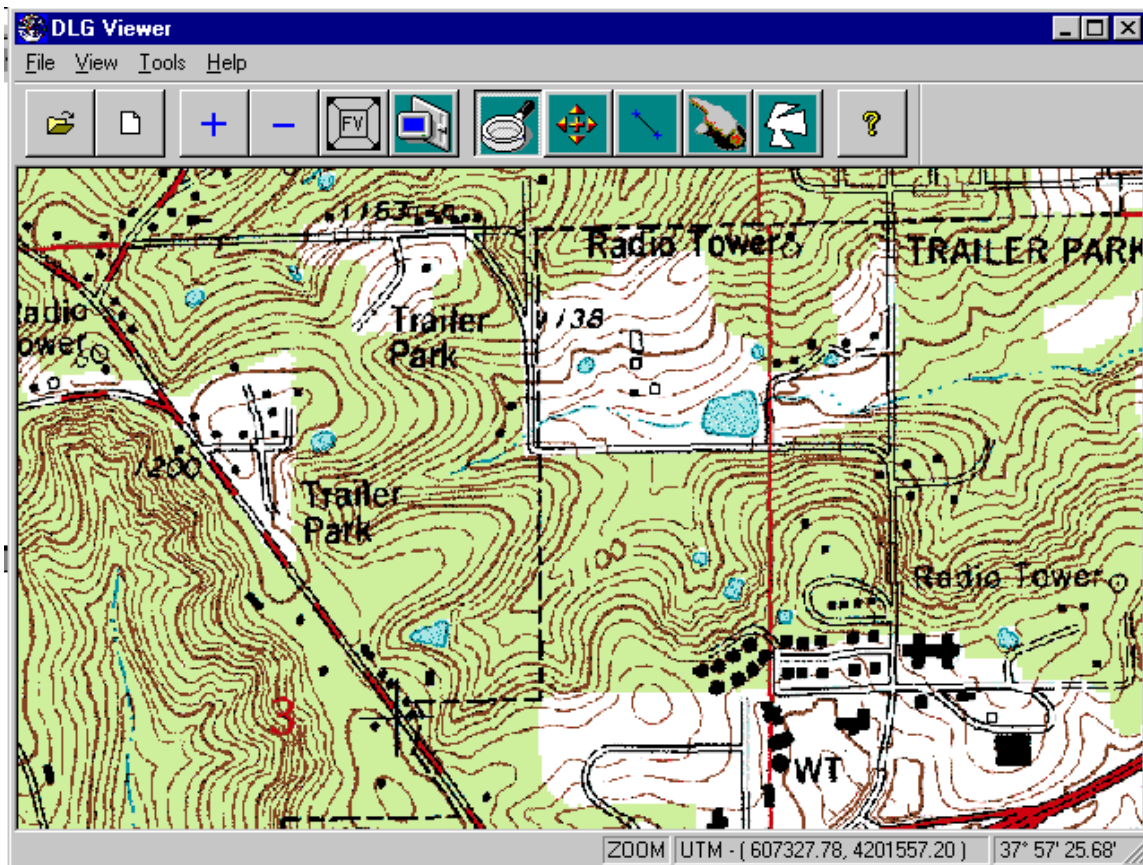


Figure 3. Screen shot of a *dlgv32* display, showing part of a DRG. The viewer can display a variety of different digital data types.

Development of both viewers continued into the spring of 1998. Although enhancements to *dlgv32* were influenced by the extensive use of the program by non-USGS customers, the project did not lose its research flavor. The viewers remained relatively low-priority projects, outside the mainstream of USGS work.

The most significant enhancement to *dlgv32* was the ability to change map projections and datums at run time. In version 3.5, the display space of the viewer adapts the datum and projection of the first data set loaded. Subsequent data sets are reprojected to this coordinate space as they are loaded. This is a very powerful feature that removes one of the greatest barriers to use of digital map data by GIS novices.

Close of the viewer projects

The viewers were designed and coded primarily by two people, one of whom was a part-time university student. This student graduated in May 1998 and left USGS employ. Coincidentally, the other programmer resigned later in the summer.

The two resignations showed that the earlier concerns about inability to support software were justified. Software developers and other technical professionals have been leaving the USGS at a steady pace in recent years as private-sector salaries and opportunities have grown increasingly attractive.

By this time, *dlgv32* had reached a state of reasonable maturity and stability. The software is expected to remain useful for some time to come with only minor maintenance. The stability of the software also permitted release of the source code, in the hope that other programmers would contribute to maintenance. So far, this has not happened.

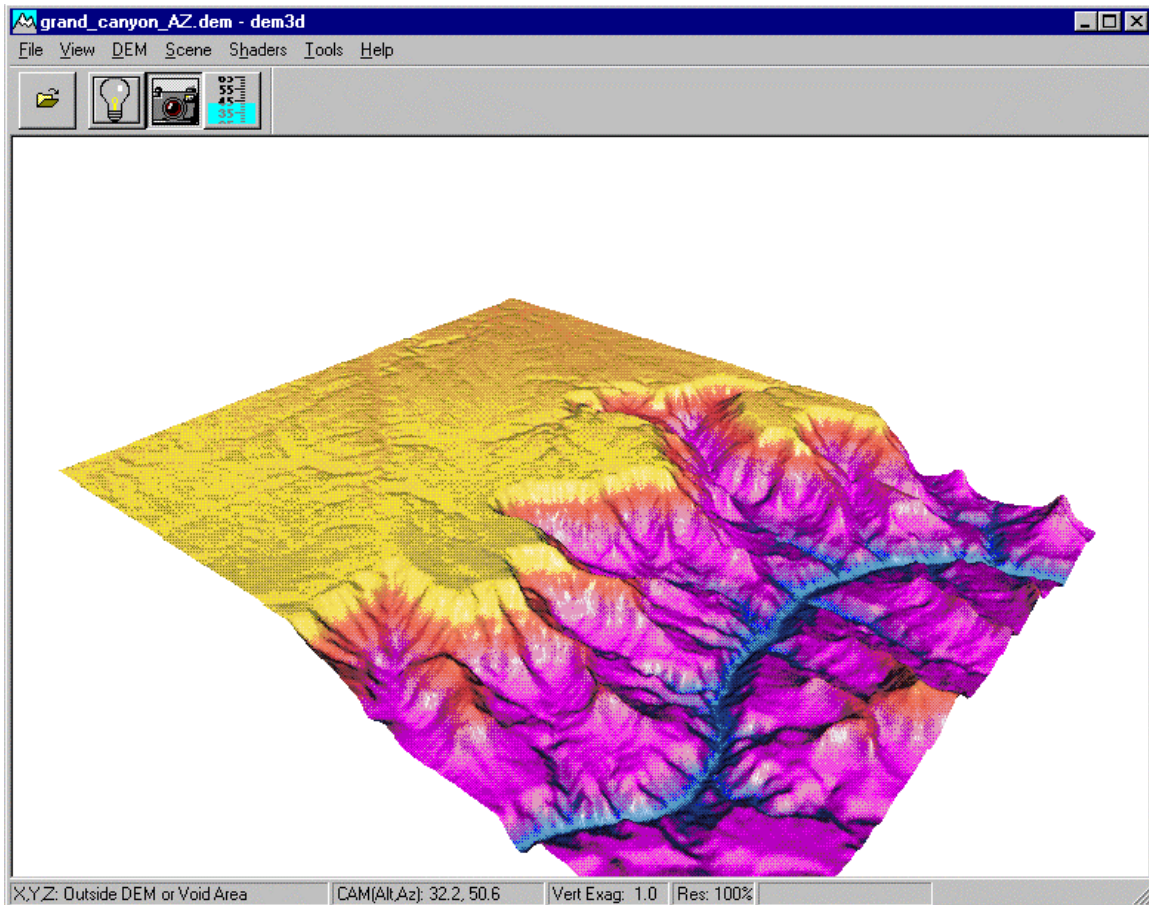


Figure 4. Screen shot of *dem3d*. The image shows a 7.5-minute DEM along the south rim of the Grand Canyon. The view is toward the southwest.

However, *dem3d* had been largely “taken apart” as part of a redesign to add fly-through capabilities and other relatively exotic features. Versions 2.x had been released as expiring betas during a period of relatively intense development. The executables for these versions stopped working in June 1998 and could not be easily rebuilt. This management error, combined with the misfortune of the developer’s resignation, left the project in a state of near collapse. The *dem3d* Web site was closed down, although version 1.0 was left on the distribution ftp site. Several copies per day continue to be retrieved, even though the site is not linked from any public Web page.

DISCUSSION

The viewer projects illustrate several things about Government-sponsored GIS software.

On the one hand, it is apparent that the viewers fill an important niche in entry-level GIS software. Users new to GIS can use the software with cheap or free data sets to obtain a basic understanding of the technology. These data are much easier to understand when displayed on a screen than when described in text.

Before these viewers were written, USGS sales clerks had no satisfactory answer to the question “how can I look at your data to decide if I want to buy a lot of it?” Most people who ask such a question are understandably reluctant to make an upfront investment in GIS software. Because the viewers contain no editing or analysis functions, they can help these customers without competing with commercial GIS vendors.

On the other hand, the projects illustrate some of the reasons that Government agencies hesitate to sponsor software development. Negative experiences with the viewers include the following:

- Nonprofessional computer users are often confused about the difference between data and software. Providing Government software with data encourages this confusion and sometimes raises customer expectations to unreasonable levels. Some customers become upset when they discover the viewers are not complete map-publishing systems.
- Because software development is not a primary Government function, continued support for the viewers is problematic. Even though the software is free, end users still expect that bugs will be fixed and questions will be answered. These expectations sometimes go well beyond normal software support to requests for GIS tutorial assistance.
- Users of MacIntosh, Unix, and other non-Windows operating systems feel slighted that free viewers are not also available for their systems.

CONCLUSIONS

The *dlgv32* and *dem3d* projects illustrate that Government-sponsored freeware can benefit end users without competing with private software vendors. The viewers allow USGS data customers to preview data at no cost. The software is simple, fast, and very easy to use, even for mapping novices. Because it is freeware, it can be distributed over the Internet and copied without constraint. Because it contains no editing or analysis capabilities, it does not compete with commercial GIS software. Despite limited promotion, the *dlgv32* viewer continues to be downloaded at a rate of about 100 copies per day after more than a year of distribution.

However, maintaining the software in a manner that meets end-user expectations has been difficult. It is still not certain that the USGS will be able or willing to make a long-term commitment to viewing software.

INTERNET ADDRESSES

The *dlgv32* Web site is at <http://mcmcweb.er.usgs.gov/viewers/>. The software, documentation, and other information can be downloaded from this address.

An Acrobat PDF version of this paper, with the figures in color, is available at <ftp://ftpmcmc.er.usgs.gov/release/viewers/document>.

dem3d version 1.0 is still available at <ftp://ftpmcmc.er.usgs.gov/release/viewers/dem3d/>

Some time after leaving the USGS, the primary designer of *dem3d* created a DEM viewer for the Linux operating system. See <http://home.i1.net/~jamoyers/kdem/>

APPENDIX – MARCH 2000 UPDATE

