PIGWAD – NEW FUNCTIONALITY FOR PLANETARY GIS ON THE WEB. T. M. Hare and K. L. Tanaka, 2255 N. Gemini Dr., U.S. Geological Survey, Flagstaff, AZ, 86001; thare@usgs.gov

Introduction. PIGWAD or "Planetary Interactive GIS-on-the-Web Analyzable Database," has been operational since May of 1999. It currently provides GIS database support for the research and academic planetary science communities. Although the first year of operation has been very successful, the coming months will see many changes to the design, the use of newer emerging technology, more organized content, and GIS tutorials.

Background. The use of Geographic Information Systems (GIS) [1] has continued to boom in the planetary sciences [2-10]. Not only does it play a roll in post-mission datasets, but it now plays an important roll in pre-mission phases. GIS was used in the selection of landing sites for the Mars Polar Lander and Mars Lander 2001, and is being used for camera targeting for Titan. NASA's Planetary Geology and Geophysics Program (PG&G), which enabled PIGWAD to evolve from the drawing board to a useable system on the internet, continues to offer support and guidance as this product develops.

Approach. Planetary datasets incorporated into PIGWAD, have been geared toward Mars, although we have created one Venus site. The current design, based on Environmental Systems Research Institute's (ESRI) ArcView Internet Map Server, permits us to generate a website with predetermined datasets. This interface allows one to view any combination of datasets, zoom, query, and then create a layout that automatically adds a key, scale bar, and title for printing. While this design is extremely powerful, some crucial elements are still missing. In order to incorporate these elements it would be necessary to either purchase a new software package or write in-house software. Several software advances have been produced this year that will allow us to use pre-built tools, thus reducing the high costs of in-house customizations.

ESRI, which has been in the GIS business for more than 25 years, has just released their next generation GIS on the web application. This application, called ArcIMS, will supersede all of their previous web GIS technologies. Although we will lose some of the customization abilities in ArcView IMS, ArcIMS will offer many technology enhancements.

Like ArcView IMS, ArcIMS has the capability for image-streaming, which is the ability to stream small compressed 'snapshots' of the chosen map layers. But the ArcIMS image interface allows for an extremely flexible map extent and more complex queries. The on-the-fly map extent will greatly enhance the usability for those who use a simple Internet browser like Netscape Navigator or Microsoft Internet Explorer. The current interface defaults to one map extent, which most will find too large or too small. The new query engine has also been enhanced to allow one to build complex questions using multiple fields. The improvements made in the image-based solution were enough to justify upgrading, but the real improvements were made in vector-streaming capabilities.

As stated above, image-streaming sends small image 'snapshots' of the map. Vector-streaming actually sends the vector data as points, lines, or polygons. Once the data are downloaded in memory, the response rate is faster because the interface does not need to ask the server for every map. This also allows one to change how a layer is drawn. For example, if the user does not like the default color ramp for a contour layer, it can be changed. One can also change the order in which the layers are drawn. Since the vector features are in memory the user can actually edit the features within their browser. The client can move, change the shape, or even change the data values of any feature. Once the changes are final, the user submits the changes to the webmaster for acceptance. We will also provide blank layers that can be used for creation of new layers. The user can buffer a layer or a feature, which can then be used to intersect features from a completely different layer. Users can save a project to their own machine, which can be called up for later use or sent to a colleague. Any user may place map notes on a view with comments for others to see. If the client is interested in only downloading parts of the dataset, the interface will allow one to select a portion, which will then be automatically packaged and shipped out.

One of the greatest improvements worth mentioning is the design of a stand-alone viewer. This free viewer, called ArcExplorer Java (see Figure 1), will work independent of a web browser on any machine. It provides all of the options mentioned above as well as some additional powerful features, the most

noteworthy of these being the fact that one can incorporate data local to their machine to any map view. This will allow the user to create maps, and query data from multiple locations. If other institutions use this technology, their layers could be pulled in also. We highly recommend that new planetary efforts use these and other GIS applications. The conversion and maintenance of a dataset is much easier if stored in a digital format rather than hardcopy.

Schedule. PIGWAD is currently on-line, but will remain in a testing mode for a few months during the conversion from ArcView IMS to ArcIMS. Thus some sites may be down for brief periods of the day. Web sites presently available include several datasets for Mars and one for Venus. The Martian sites contain the Viking digital image mosaic, Viking image resolution map, a Viking stereo coverage map, geologic maps, USGS topography, Mars Orbiter Laser Altimeter (MOLA) tracks, Mars Orbiter Camera (MOC) footprints, and other remote-sensing datasets. Please visit http://webgis.wr.usgs.gov to test the beta ArcIMS version. Shortly, we hope to add MOC imagery, Mars Orbiter Laser Altimeter (MOLA) [11] topographic point data, the Mars digital image mosaic version 2 [12], and any other layers that may help the scientific community and that are deemed appropriate by PG&G. The user should be aware that until these datasets are brought up to date by using the new spheroid definitions, there might be slight misalignments in the data. We also may experiment with an idea that would allow the GIS web site to interact with other mapping web sites like the PDS Mapmaker web site.

Summary. GIS gives one the tools to not only view several different types of data together, but also to perform various data analyses including advanced spatial intersections, unions, and robust conditionals. By incorporating this functionality into a user-friendly web environment, a wide array of investigators and educators can easily implement the analytical power of a planetary GIS.

References. [1] Environmental Systems Research Institute (1995) *Understanding GIS The ARC/INFO Metho*d, GeoInformation International, United Kingdom, *i,* 1-10. [2] Carr, M.H. (1995) *JGR 10*0, 7,479. [3] Zimbelman, J.R. (1996) *GSA Abs. 2*8, A-128. [4] Lucchitta, B.K. and Rosanova, C.E., (199*7), LPSC Ab. 28, 839-84*0. [5] Dohm, J.M., et al. (in press) *USGS Map I-2650 (Thaumasia geologic map).* [6] Tanaka et al. (in press) *JGR-Planets (Thaumasia valley origin*). [7] Hare, T.M., et al. (1997) *LPSC Abs. 28, 515*. [8] Gaddis, L., et al. (1998) *LPSC Ab*s. 29, 1807-1808. [9] Rosanova, C. E. et al. (1999) *LPSC Abs. 30, 1287*. [10] Lias, J. H., et al., (1999) *LPSC Abs. 30, 1074*. [11] Hare, T.M., et al, *this volume* (*Using MOC and MOLA in a GIS).* [12] Kirk, R.L., et al, *this volume* (*MDIM 2.0*).

Additional Information. The PIGWAD web site can be found at the following address: http://webgis.wr.usgs.gov

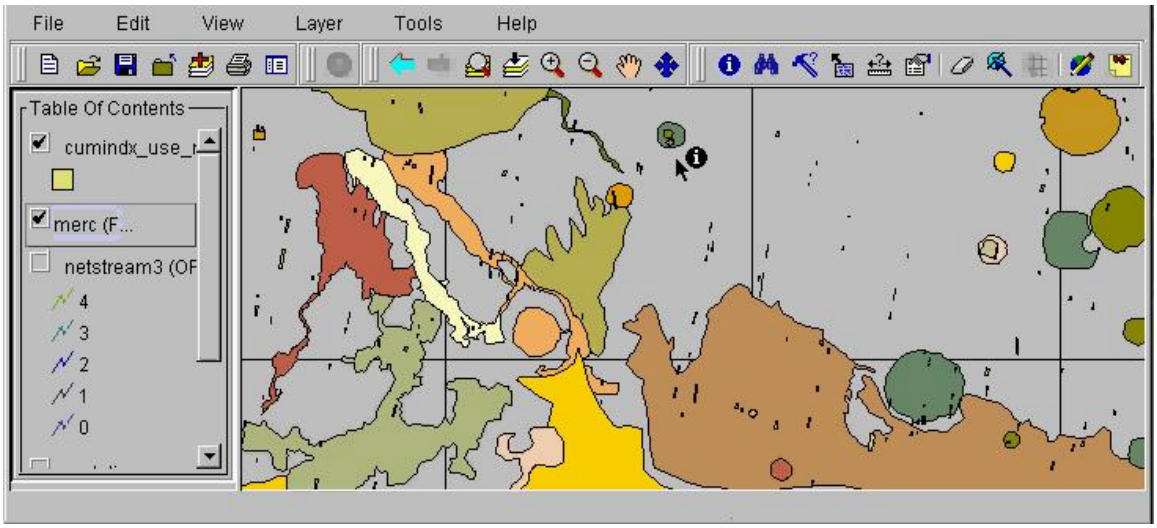

Figure 1. The ArcIMS interface showing Martian feature locations and MOC footprints.