# PIGWAD - PLANETARY INTERACTIVE GIS ON THE WEB ANALYZABLE DATABASE.

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***Introduction.*** We are producing a web-based, user-friendly interface built on a powerful Geographic Information System (GIS), that will integrate statistical and spatial relational tools for analyses of planetary datasets. The interface, known as "Planetary Interactive GIS-on-the-Web Analyzable Database" (PIGWAD), will provide database support for the research and academic planetary science communities, particularly for geologic mapping and other surface-related investigations.

***Background.*** GIS is an organized collection of computer hardware, software, and geographic data whose operations can be tailored to efficiently capture, store, update, manipulate, analyze, and display all forms of geographically referenced information [1]. Application of GIS in the planetary sciences has grown dramatically over the past few years, as scientists have been able to prepare thematic maps and determine spatial relations among multiple datasets [2-10]. However, the creation of a GIS can be an expensive and daunting task for an organization that does not have the necessary hardware, software, and technical expertise. Such investment is not justifiable for most planetary projects.

NASA's Planetary Geology and Geophysics Program, under the auspices of the Planetary Cartography and Geologic Mapping Working Group (PCGMWG), has chosen to support a planetary, web-based GIS that the entire science community may utilize. The USGS Astrogeology Team in Flagstaff will provide this service, given our expertise in both terrestrial and planetary GIS [7]. Datasets that will be incorporated must be approved under the scientific oversight of the Geologic Mapping Subcommittee (GEMS) of PCGMWG. In addition, specialized interfaces to support the distinct needs of particular spacecraft missions or science projects also may be constructed.

***Approach.*** Planetary datasets incorporated into PIGWAD will preserve the quality and resolution of the original data to the extent possible. A key element to the utility of a planetary database will be the spatial coregistration of the datasets. This requirement will necessitate the adjustment of datasets into a common geodetic framework. In addition, as geodesy is updated for a planetary body, the GIS datasets also will require modification.

Several software companies have released GIS network-oriented solutions. Each company has been trying to meet the demand of rapid data delivery over an already strained World Wide Web. Environmental Systems Research Institute, Inc. (ESRI), which has been in the GIS business for more than 25 years, has recently released two web-based GIS solutions. The solution we have chosen is the Internet Map Server (IMS) extension to ArcView. ArcView, ESRI's most popular desktop GIS application, when combined with IMS, optimizes network flow by using small compressed images. Some other advantages for choosing ArcView include: (1) many of the tools needed are already built into ArcView, (2) it has already proven capable of handling planetary data [7], and (3) it permits great flexibility by making it possible to customize the user interface and the tools that accompany it. Thus users do not need to learn the intricacies of ArcView; instead, they just need to become familiarized with an easy-to-learn graphical user interface. For the planetary GIS, we plan to construct three different user levels—beginner, intermediate, and advanced.

The first time a user connects to the web-site interface via Netscape or Internet Explorer, a small JAVA applet will be loaded into their machine. Each time the user submits a request with the JAVA applet, the web server will process the request and return either a compressed image or tabular information. This approach allows the user to browse the data as if it were on the user's computer. Subsequent requests will result in a refresh of the map, guaranteeing the most up-to-date version of the database. The user also has the option of downloading the data to use on their own machine. When possible, we will use ESRI's Shape file format, which nearly all GIS packages can recognize.

The beginner interface will allow one to view a base image and any number of GIS layers in different, commonly used projections (see Fig. 1). From this interface, one can zoom, query, add text, and draw simple graphical additions like arrows or boxes. Then the user can create a layout that automatically adds a key, scale bar, and title for printing.

The intermediate interface will incorporate all the above and add some easy-to-use analysis and spatial relationship tools. This functionality will allow users, for example, to select a geologic feature and find the nearest volcano in ground units, or calculate the sum area of rock outcrops for a particular geologic period. This interface also will allow one to set up multiple selection routines. For example, one may ask the system to highlight and select all the outcrops of geologic units from Mars' Amazonian Period with an area greater than 60 km$^2$ and then print out a list of results.

The advanced interface will give the user hundreds of options from user-defined parameters for map projections to complicated buffering and layer-intersection functions. Possible future advance additions include 3D virtual reality capabilities, video simulations, and anaglyph creation.

***Schedule.*** PIGWAD is currently on line, but will still be in a testing mode for a few months. Thus some sites may be down for brief periods of the day. web sites presently available include datasets for the Mars Lander 1998 and Mars Lander 2001 missions. Both sites contain the Viking digital image mosaic, geologic unit, USGS topography, and other remote-sensing datasets. Please visit http://webgis.wr.usgs.gov to test the beta version. Soon we hope to add a Viking image resolution map, a Viking stereo coverage map, searchable Mars Orbiter Camera (MOC) footprints, MOC imagery, Mars Orbiter Laser Altimeter (MOLA) topographic data, and any other layers that may help with the landing site selection. 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 and the NASA Ames Virtual Landing Site Catalog.

***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 Method*, GeoInformation International, United Kingdom, *i*, 1-10. [2] Carr, M.H. (1995) *JGR 100*, 7,479. [3] Zimbelman, J.R. (1996) *GSA Abs. 28*, A-128. [4] Lucchitta, B.K. and Rosanova, C.E., (1997), *LPSC Ab. 28, 839-840*. [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 Abs*. 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.*

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

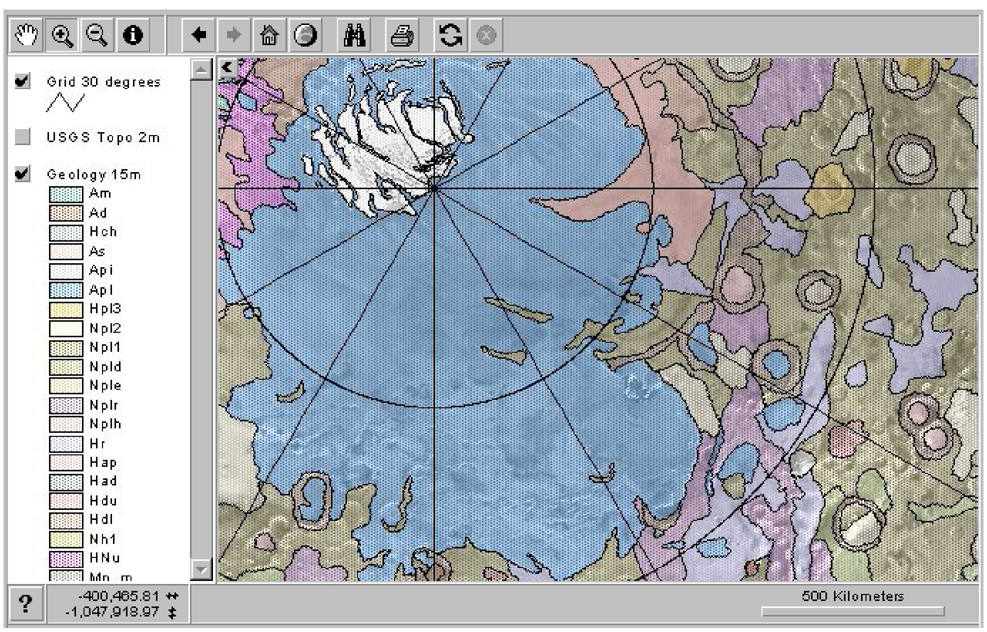


Figure 1. The beginner PIGWAD interface showing the South Polar region of Mars, which is being designed to help with the 1998 Mars Lander site selection.