PIGWAD – OPENGIS AND IMAGE TECHNOLOGIES FOR PLANETARY DATA ANALYSIS. T. M. Hare and K. L. Tanaka, 2255 N. Gemini Dr., U.S. Geological Survey, Flagstaff, AZ, 86001; thare@usgs.gov

Introduction. Planetary Interactive GIS-on-the-Web Analyzable Database (PIGWAD) has been an experimental method for planetary analysis, for data distribution over the Internet, and for educating the planetary community in Geographic Information Systems (GIS). Many emerging technologies continually cause us to evaluate and modify the functionality of PIGWAD. This paper will look at technologies that will expand the capabilities of PIGWAD in the near future.

Approach. PIGWAD is built on technologies created by Environmental Systems Research Institute's (ESRI) ArcView Internet Map Server and Arc Internet Map Server (ArcIMS). Both applications permit us to generate a website with predetermined datasets and to then view, query, export, and annotate any combination of datasets [1, 2, 3].

PIGWAD Updates. Over the past, we have implemented the following changes and updates:

- Because ArcIMS's internal code was written for an Earth spheroid, we have made many modifications to the base Java code to allow for accurate scale and measurement calculations on Mars.
- A lunar on-line mapping page has been made available. This site will rapidly grow as we continue to convert more datasets into a GIS format. Datasets include Clementine base maps, derivative Clementine imagery, geologic maps, and nomenclature (Figure 1).
- The Mars Exploration Rover (MER) PIGWAD has been expanded and will continue to expand as we add new datasets and updated engineering constraints for the on-the-fly landing-site ellipse generator that provides comprehensive data statistics [3].
- The download section has been updated with many new geologic maps and their metadata. This section will continue to grow as more geologic maps are completed and digitized. Many new digital geologic quadrangle maps of Venus will be added to the download section this year.
- We have also updated and added new planetary GIS tutorials and tools. These tools give access to planetary projections, to GIS converters for Mars Obiter Laser Altimeter (MOLA) point data, and to Mars Orbital Camera (MOC) footprints hotlinked to an on-line MOC image database. We have also added a tutorial on creating digital elevation models (DEMs) or triangulated irregular network (TINs) in ArcView Spatial Analyst or 3D Analyst environment from MOLA data. Tools written in C, PERL, and Avenue have been added to help the conversion from the U.S. Geological Survey's Integrated Software for Imagers and Spectrometers (ISIS) images to GIS capable images, including specific tutorials on working with (MOC) imagery. Most of these tutorials have been focused on ArcView; however, we hope to include sections for Generic Mapping Tools (GMT), Geographic Resources Analysis Support System (GRASS), and other GIS tools.
- And lastly, much effort has been spent researching ways to make PIGWAD more compatible with different browsers and machine types. To help with this issue we upgraded to version 3.1 of ArcIMS, which contained some software fixes for compatibility. Our second approach involved researching OpenGIS protocols. While this technology is new, we are hoping this will help solve many of the remaining problems [3].

OpenGIS. The OpenGIS Consortium (OGC) was built to help establish and promote a series of Internet protocols for sharing GIS resources. The OGC works with a variety of technology hardware and software companies so that diverse OpenGIS technologies can easily communicate. Some of the goals are (1) to make geospatial information easy to find, (2) to allow easy access and acquisition of datasets, and (3) to permit data from different sites to integrate, register and be analyzed [5]. Nearly all GIS software manufacturers are working on adding support for OpenGIS standards. ESRI is fully supporting this protocol and has already proven that their software packages will conform. In the near future we are hoping to work with the Jet Propulsion Laboratory (JPL) and the Planetary Data System (PDS) to make sure this technology will be used in the planetary community.

Emerging Technologies. OpenGIS standards will help making the streaming of GIS datasets compatible on any platform. But the constant flux of exciting new tools for Internet mapping will always push the technology envelope. As new software advances become available, we will need to make hard choices to either support OpenGIS standards or to keep pressing technology to the limits. The solution will most likely have to be a compromise. We will need to support OpenGIS standards and also have options to give users more functionality.

ArcIMS, unlike ArcView, does not have a vast library of GIS functionality that it can access. ESRI is working on a solution that would give ArcIMS access to many functions contained in their most powerful GIS package, ArcGIS. ArcIMS would then be a window into one of the most powerful GIS tools

available. This product will hopefully be available in mid-2002.

PIGWAD currently does not contain many high-powered tools for image analysis due to limitations in ArcIMS and ArcView. A new tool, called Maplicity MapImager [6], now offers greatly enhanced image tools for ArcIMS. MapImager allows the user to work with multiple image bases. The user can swipe, compare, blend, fade or merge the image layers. This tool is extremely useful for multi-spectral datasets, because it has the ability to let the user choose which bands to view as an RGB image. The blend or transparency functions allow users to view datasets based on elevation or other derived datasets and then merge them with image bases of any sort. The program will save the derived image and the corresponding GIS header information. We will continue to test this tool and possibly add it to PIGWAD's growing toolbox. This tool will most likely not be compatible with the OpenGIS standard thus some users may encounter problems.

Summary. GIS continues to grow rapidly in functionality for planetary research. The ability to overlay datasets is becoming increasingly vital, as more diverse databases are created. The influence of online GIS websites will also continue to rapidly grow as the technology matures and the Internet becomes faster. By supporting OpenGIS standards, we hope to make our datasets available to the widest possible audience.

References. [1] Hare, T.M., et al. (1997) *LPSC Abs. XXVIII,* 515. [2] Hare, T.M and Tanaka, K.L. (2000) *LPSC Abs. XXXI,* #1889. [3] Hare, T.M. and Tanaka, K.L. (2001) *LPSC Abs. XXXII,* #1725. [4] http://www.opengis.org/ogcFaqs.htm#q5. [5] L. Plesea, "LandSAT Map of US" site hosted by JPL at http://mapus.jpl.nasa.gov/. [6] http://www.telemorphic.com

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

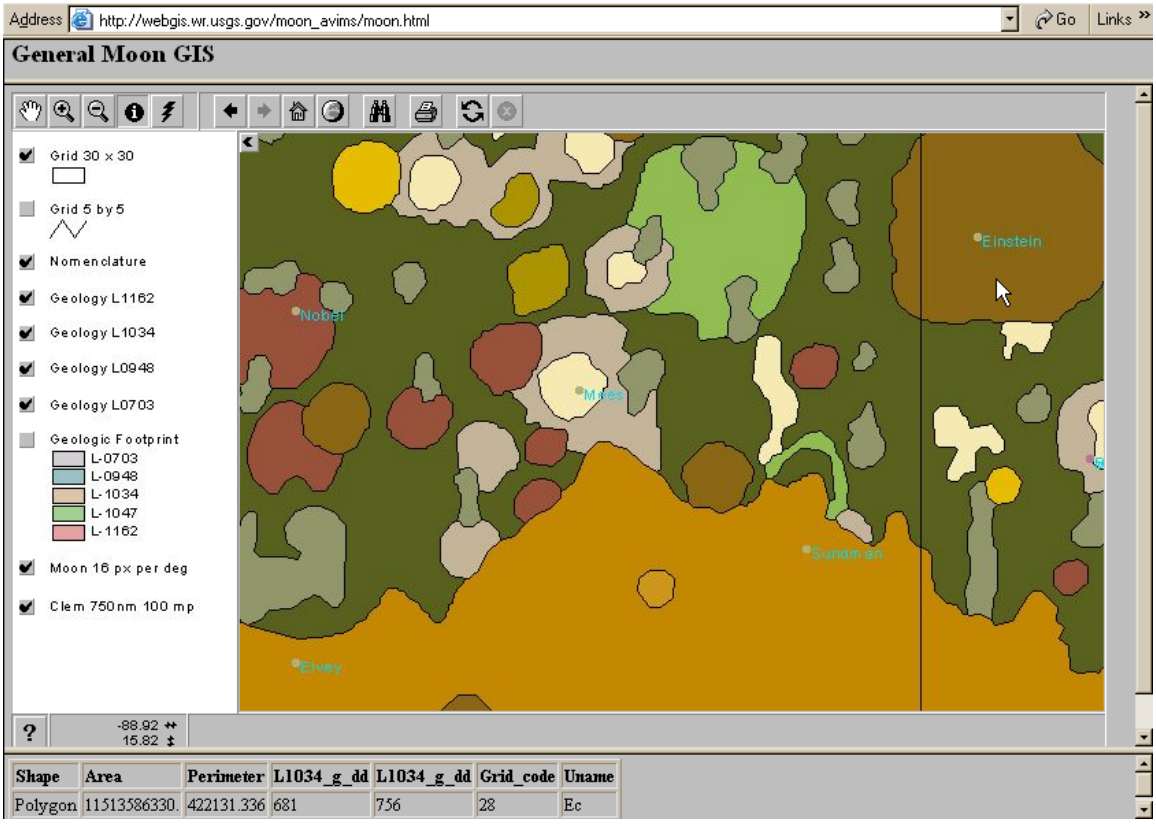

Figure 1. Example of PIGWAD lunar mapping page showing geology and nomenclature.