POW AND MAP2: JOB MANAGEMENT AND ADVANCED PROCESSING. Scott W. Akins, T.M. Hare, R.M. Sucharski, M.S. Bailen and L.R. Gaddis. U. S. Geological Survey, Astrogeology Science Center, 2255 N. Gemini Dr., Flagstaff, AZ, 86001 (sakins@usgs.gov).

Introduction: In July of 2013, the USGS Astrogeology Science Center publicly released a tool called the Map Projection (on the) Web Service (POW). This free online service transforms Planetary Data System (PDS) Engineering Data Record (EDR) image files supported by the Imaging Node to science-ready, map-projected images [1] (***Figure 1***). In March of 2014, Map-A-Planet 2 (MAP2) [2] was released to provide similar functionality to POW for higher-level or derived map products to allow for user-defined map projections and band math calculations. POW and MAP2 use PDS Imaging Node tools (PILOT, UPC [3, 4], and the USGS Astropedia data catalog [5]) to locate image data products and enable the user to select and submit images to be projected. This process uses Astrogeology's image processing package called the Integrated Software for Imagers and Spectrometers (ISIS, currently in version 3) [6]. Since the public release of these two services, we have had over four hundred users register and the system has processed thousands of images (*432 users; 1638 POW, 543 MAP2 jobs).*

Relevance: To make PDS EDRs useful for science analysis, they must be radiometrically calibrated and then map-projected [7]. While some instrument teams deliver map-projected data, these products may not be in the most useful projection for the region studied. POW provides users with calibrated cartographic images and MAP2 provides derived data products. Both services provide map projection and processing to create derived data products that can be used readily for geologic mapping, change detection, merging of dissimilar instrument images, analysis in a Geographic Image System (GIS) and use in a host of other scientific applications (e.g., ArcMAP, ENVI, Matlab, JMARS, QGIS, Opticks, etc.).

POW is dependent on ISIS and the instruments it supports [6]. As new instruments are added to ISIS, POW will also increase the number of supported instruments. Currently, instruments supported in POW include:

- Cassini Imaging Science Subsystem (ISS) and Visible and Infrared Mapping Spectrometer (VIMS)
- Clementine Near Infrared (NIR), Ultraviolet and Visible (UVVIS), High Resolution (HIRES)
- Galileo Solid State Imaging (SSI)
- Lunar Reconnaissance Orbiter Wide Angle Camera (WAC), Narrow Angle Camera (LROC-NACL, LROC-NACR)
- Mariner 10 vidicon cameras (VID A, VID B)
- Mars Express High Resolution Stereo Camera (HRSC)
- Mars Global Surveyor Mars Orbiter Wide Angle Camera (MOC-WAC), Narrow Angle Camera (MOC-NAC)
- Mars Reconnaissance Orbiter Context Camera (CTX)
- Messenger Mercury Dual Imaging System (MDIS-WAC, MDIS-NAC)
- Mars Odyssey Thermal Emission Imaging System (THEMIS-IR, THEMIS-VIS)
- Viking Orbiter 1 & 2 vidicon cameras (VIS-1B, VIS-2A, VIS-2B)
- Voyager I & II Imaging Science Subsystem (ISS) vidicon cameras (NAC-1, NAC-2, WAC-1, WAC-2)

Learning Tool: While ISIS3 is free to the public, it can be a difficult toolset to learn. Currently, ISIS must be installed on a UNIX platform (e.g., Linux or Mac OSX) and requires the user to be familiar with UNIX operating system commands. POW and MAP2 allow researchers to make use of a wealth of PDS science data without having to install or learn how to run ISIS. Users also benefit from a validated data processing pipeline as defined by USGS and the instrument teams. This service can be used as a learning tool or an introduction to ISIS because a detailed log of the ISIS commands and their settings is provided along with the processed data products.

Using the POW front-end, a user is allowed to 1) select and submit a list of up to 50 PDS EDR images. Both the POW and MAP2 processing interfaces enable a user to 2) define an output map projection and its parameters

(e.g., Polar Stereographic, Sinusoidal), 3) define the output bit type (8, 16, or 32 bit), and 4) select an ISIS or PDS output format or a geospatial format such as GeoTiff, GeoJPEG2000, PNG, or JPEG. Conversion to output image formats are completed using the Geospatial Data Abstraction Library (GDAL), which passes all cartographic information into the output format [7].

Improvements to POW/MAP2: The following improvements to POW and MAP2 are in development and will be available to users through the existing POW/MAP2 interfaces.

Reuse Processing from Templates or Prior Jobs: This enhancement will provide the option in both interfaces to reuse settings from previously run jobs and from recommended templates provided by the USGS. For example, there will be a template defined for GIS users which will select an optimal map projection and output format or another template which will stage files for further ISIS processing. Once settings are defined from a previous job, the user can refine them to correct a problem or improve on previous processing requests.

Selectable Backplanes: A new option for POW processing will be to select a backplane of the EDR data products, such as the incidence angle or phase angles, as the source for the derived data product.

Tonal Matches and Photometric Steps: POW processing will include new photometric correction steps, image equalization and new stretches to create more visually uniform data products from the products submitted. ISIS also supports the capability to tonally match multiple images to each other. This is accomplished using photometric corrections and/or pure statistical equalization methods. Both methods are especially useful for minimizing image seams in a mosaic.

Simple Mosaics of POW Images: A new feature for POW processing requests will be to have the individual images combined into a derived uncontrolled mosaic. Unfortunately, EDR data typically are geometrically referenced to a planetary surface only as well as the spacecraft pointing allows. Depending on the instrument and spacecraft, each image still could have meter to kilometer spatial offsets between adjacent images. Because ISIS3 continues to add more robust methods for automatically controlling images to each other, POW will be able to take advantage of these ISIS methods along with any improvements to SPICE to enhance the registration of delivered images. Our goal is to allow users to quickly and easily build seamless image mosaics from supported PDS image products.

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References: [1] Hare, T.M. et al., (2013), LPSC 44, abstract #2068. [2] Akins, S.W. et al., (2014), LPSC 45, abstract #2047. [3] Akins, S. W. et al., (2009), LPSC 40, abstract #2002. [4] Bailen, M.S. et al., (2013), LPSC 45, abstract #2246. [5] Bailen, M.S. et al, (2012), LPSC 43, abstract #2478. [6] Keszthelyi, L. et al., this volume. [7] Hare, T.M., et al., (2007), LPSC 38, abs #2364.

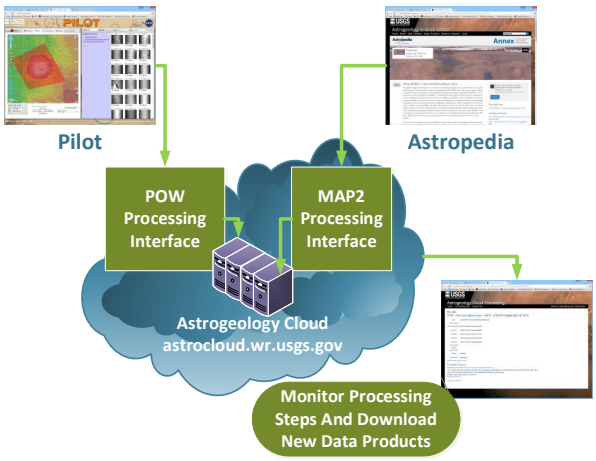

Figure 1. Simple graphical workflow for POW and MAP2.