THE UNIFIED PLANETARY COORDINATES DATABASE. K.J. Becker[1], L.R. Gaddis[1], L.A. Soderblom[1], J.A. Anderson[1], J.M. Barrett[1], T.L. Becker[1], T.M. Hare[1], S.C. Sides[1], D.L. Soltesz[1], A. Stanboli[2], R.M. Sucharski[1], T.L. Sucharski[1], K.N. Winfree[1]; [1]U. S. Geological Survey, 2255 N. Gemini Dr., Flagstaff, AZ, 86001, [2]NASA Jet Propulsion Laboratory, Pasadena, 4800 Oak Grove Drive, Pasadena CA 91109 (kbecker@usgs.gov).

Introduction: Over the past 40 years, a vast array of remote sensing data has been collected for the terrestrial planets and outer planet satellites by orbital and flyby missions. Unfortunately these mapping data exist in a range of disparate coordinate systems, making it difficult to easily identify and correlate data from different instruments. The goal of the Unified Planetary Coordinates [1] project is to solve this problem—to provide easy access to planetary data in a set of unified, consistent coordinate systems.

The Unified Planetary Coordinates (UPC) database is being developed at USGS and JPL with funding for the Imaging Node by the NASA Planetary Data System (PDS). The UPC provides a geometric relational database with orbital remote sensing data stored in a set of uniform coordinate systems. The database can be accessed with geographic information system (GIS) tools so that geometric coordinate-based searches can be conducted for regions of interest (ROIs). All geometric data are computed using the ISIS 3 system [2] from the best available SPICE ephemeris data. SPICE initially comes from flight projects through the NAIF facility [3] and for each mission SPICE is continually refined by USGS mapping efforts [4]. We create control nets and new kernels that are fed back into the UPC.

Database Population: The UPC has been initially populated with Mars image data from the PDS [5]. New images are identified and staged in the UPC for download and processing in ISIS 3 [2]. For imaging and spectrometer data to be included in the UPC, ISIS 3 must be able to ingest the data and must have a geometric camera model for the instrument.

A series of ISIS 3 applications (Fig. 1) are run on the Planetary Data System (PDS) labeled images that compute all parameters that are inserted into the UPC. The first step is to extract the PDS label PVL keywords and values and insert them into the instrument-specific tables of the UPC. The SPICE inventory is searched to determine if sufficient ephemeris data exist to compute geometric parameters. If so, a full set of geometric parameters are computed and inserted into the UPC.

Data Selection: Web-enabled interfaces provide indirect access to the UPC database. This provides the greatest flexibility to users and developers, and will facilitate data access via the PDS Image Atlas (an online planetary image atlas developed and maintained by the Imaging Sub-Node at the Jet Propulsion Laboratory). A common set of geometric parameters has been selected for all data. Mission-specific parameters are also included but search capabilities using these are less flexible due to the diversity of possible parameters. Use of common parameters is an important characteristic because it allows many different datasets to be combined in a single query.

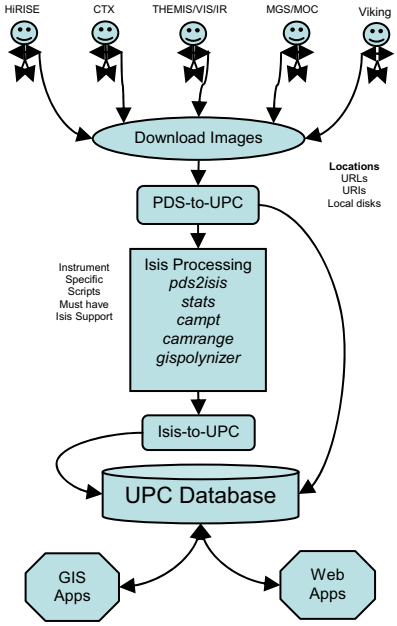

Figure 1*. Processing flow in ISIS 3 of new PDS image data into the UPC database system.*

Sample GIS Data Query: Regions of interest (ROIs) can be specified in terms of a latitude/longitude *bounding box*, a line segment or a point. GIS operators such as *intersects*, *contains*, and *disjoint* provide flexible selection options.

Figure 2 shows the GIS footprint plot from a UPC search for images covering a portion of the Mars Exploration Rover (MER) Spirit landing site in Gusev Crater. The ROI is the GIS *bounding box* defined by the lower left and upper right corners. The common geometric coordinate system for Mars is planetocentric latitude, and positive east, 0 to 360 degree longitude. For the example given, the search was further constrained to identify images with incidence angles greater than 60 degrees and less than 70 degrees. Data included in this search included all images from the Mars Global Surveyor (MGS) Mars Observer Camera (MOC) Narrow Angle (NA) and the Mars Odyssey (MO1) Thermal Emission Imaging System (THEMIS) VIS instruments. Outlines or footprints of all images from these datasets that *intersect*ed the defined bounding box are shown in Figure 2.

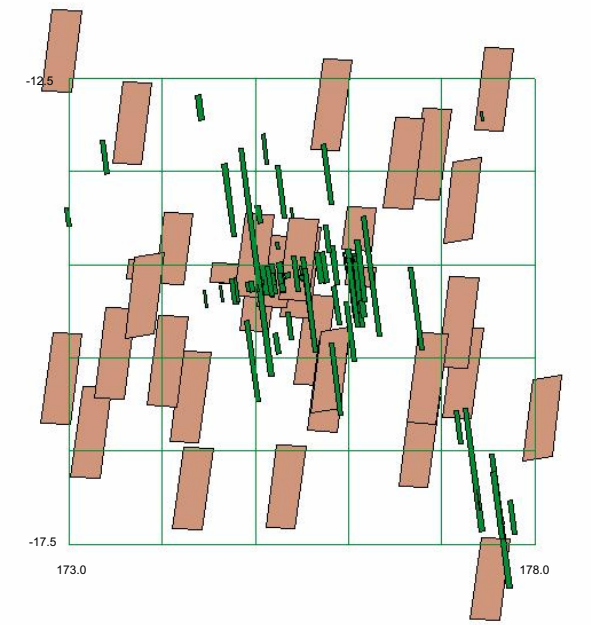

***Figure 2**. Footprint plot of MGS/MOC and THEMIS/VIS images of the Spirit rover landing site. Image identification was constrained to incidence angles between 60 and 70 degrees. THEMIS/VIS images are the larger, lighter colored footprints.*

Many additional common geometric parameters can be included to further constrain the data selection. These common parameters are consistent across all imaged planets and bodies within the UPC, and can be readily retrieved from PDS image labels.

Processing Data with ISIS: ISIS 3 and older software versions are public domain 'freeware' developed at USGS via NASA funding for cartographic and scientific data processing and analysis of planetary data (see http://isis.astrogeology.usgs.gov). A UPC query can be used to identify and download images with geometric data from the PDS archives and processed in ISIS. For example, Figure 3 shows an ISIS image mosaic in Mercator projection of MGS/MOC and THEMIS/VIS data for the area shown in Figure 2.

Database Maintenance: The UPC is designed to allow for continual updating as new SPICE ephemeris data become available. Several events (collectively called 'triggers') will cause the UPC parameters to be recomputed. Sample triggers are the availability of new SPICE data either from NAIF or resulting from cartographic processing (such as development of a refined USGS control network), a re-release of PDS products, changes to the ISIS system (such as a bug fix or other in geometric computations and/or addition of new functionality to the UPC). Updating of the UPC is handled through a series of automated maintenance procedures in ISIS 3.

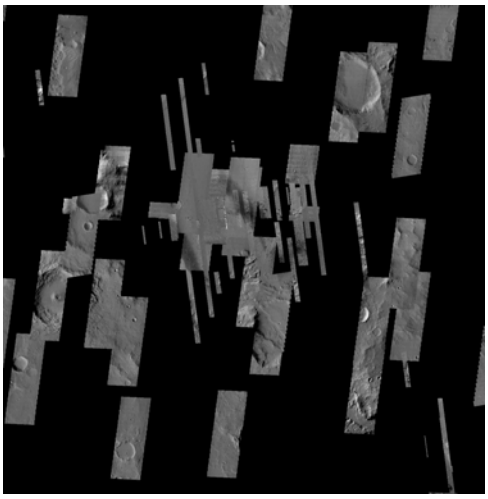

***Figure 3**. Merged Mercator projected mosaic processed by ISIS of the MGS/MOC and THEMIS/VIS images from the UPC query for the region of the Spirit Rover landing site.*

Conclusion: The UPC will be a very powerful tool for the scientific and engineering community to access and work with planetary data archived by the PDS. All image coordinates will be consistent for all mission data and each planet/body stored, and data identification and retrieval will be simple and straightforward. Dynamic aspects of the UPC will allow for continual improvements in both SPICE ephemeris and in ISIS tools for populating the geometric and instrument specific parameters. The inclusion of GIS and web technologies in the UPC make identification, integration and use of planetary data simple and easy. The UPC will be continually expanded to add images as they are released through the PDS and to support new missions and planets/bodies as needed. The UPC is expected to become the backbone of planetary image processing into the future.

References: [1] Becker, K. et al, Unified Planetary Coordinates System: A Searchable Database of Geodetic Information (2005), *LPSC XXXVI*, Abstract #1369. [2] Anderson, J.A. et al., Modernization of the Integrated Software for Imagers and Spectrometers (2004), *LPSC XXXV*, Abstract #2039. [3] Acton C.H., (1999) SPICE Products Available to the Planetary Science Community, *LPSC XXX*, Abstract #1233. [4] Archinal, B.A. et al, (2002) A MOLA-controlled RAND-USGS Control Network for Mars, *LPSC XXXIII*, Abstract #1632. [5] Hughes, J.S., Lavoie, S., Wilf, J., Joyner, R., Crichton, D., 2003, PDS-D–The planetary data system distribution system, LPSC XXXIV, 1496.