Community Access to the Report Data from the IAU Working Group On Cartographic Coordinates and Rotational Elements

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Approximately every 3 years since 1979, the Working Group on Cartographic Coordinates and Rotational Elements (WG) of the International Astronomical Union (IAU) has issued a report recommending how coordinate systems and related parameters (body orientation and shape) should be established and maintained, so that maps of solar system bodies can be shared and compared by the scientific community. These recommendations are intended to facilitate the use of a standardized set of mapping parameters. They are open to further modification when indicated by community consensus and revision of parameter values. The WG encourages input and is available to assist users, instrument teams, and missions. See our website [1] for additional information. This abstract is intended to draw attention to the WG’s efforts, to our previous reports (e.g. [2]), and to the 2015 report now nearing completion. We would also like input on the best ways to share the recommendations from the report with the community, e.g. via Planetary Data System NAIF node, in their “Planetary Constants Kernel” (PCK) [3]. The recommended body spherical shape information is also available via Open Geospatial Consortium (OGC) Well-Known Text (WKT) [4] and Esri WKT [5] projection files and an OGC web service called SECC [6]. To better support the community, several questions should be asked. (1) Are these current compilations useful? (2) Are there other formats that would be useful to adopt or create to provide easier access to the data? (3) How should different versions (updates) of the recommendations be provided? (4) Is a complete update with every report desirable, or only constants that are changed at the time of a given report, and at what resolution are the changes important, e.g. by body, or individual equation or number? (5) Would it be useful to apply some designation at one of these levels, such as a DOI citation? Any input from workshop participants is welcome.

References

The PSA uses PostgreSQL/PostGIS as a tool to store and process geometrical information coming from ESA planetary datasets. PostGIS is an open source software program that adds support for geographic object database. PostGIS follows the Simple Features for SQL specification from the Open Geospatial Consortium (OGC). This technology facilitates the task of having geometrical information stored in the PSA and ready to be processed by GIS tools. The proper geometrical handling and ingestion in the PSA will be of crucial importance for future missions like ExoMars Rover and Surface Platform, where we will keep track of the Rover route across Mars using the data captured by the camera instruments together with footprints generated by other planetary missions like Mars Express and ExoMars16.
Barnes Robert Imperial College London

Quantitative analysis of digital outcrop data obtained from stereo-imagery using an emulator for the PanCam camera system for the ExoMars 2020 rover

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A key focus of planetary rover missions is to use panoramic stereo camera systems in order to characterise their geology in search of ancient life. 3D reconstructions of the terrain were obtained using the Mars Utah Rover Field Investigation (MURFI 2016) which was a Mars Rover field test in collaboration with the Canadian Space Agency (CSA). It consisted of a team including an instrumented Rover platform at the field site near Hanksville (Ut: Emulator 3 (AUPE3) camera system was used to collect stereo panoramas of the trials. Stereo-imagery processed in PRoViP is rendered as Ordered Point Clouds (OPCs) in PRo3D, enabling the user to zoom, rotate and translate the 3D outcrop model. Interpretations are digitised directly onto the model. The outcrop and sedimentary features, including grain size and the dip and strike of bedding planes, can be measured in-simulation. AUPE3 was mounted onto the rover mast, collecting 16 stereo panoramas over 9 'sols'. 5 out-of-simulation datasets were collected in the Hanksville-Burpee Quarry. Stereo panoramas were processed through an ftp server. PRo3D was used for visualisation and analysis of this stereo data. Features of interest in the area could be annotated, and their distances to the rover position measured to aid prioritisation of science targeting. Interpretation and measurement of the sedimentological features of the outcrops was also carried out. Development of Pro3D in preparation for the ExoMars 2020 and NASA 2020 missions will be centred on data validation and tool development. Collection of in-situ field data by a human geologist allows for direct comparison of viewer-derived measurements with those taken in the field.

Acknowledgements: The research leading to these results has received funding from the UK Space Agency Aurora programme and the European Community’s Seventh Framework Programme (FP7/2007-2013) ESA PRODEX Contracts 4000105568 "ExoMars PanCam 3D Vision" and 4000116566 "Mars 2020 Mastcam-Z 3D Vision".

Burtsev Mikhail IKI/Russia

Geosmis technology: creation of spatial data analysis user interfaces for Web-IO. Balashov, O. Batanov, M. Burtsev, V. Nazarov, V. Tolpin

Space Research Institute of the Russian Academy of Sciences (IKI)

The report describes the features of the GEOSMIS technology developed by the Academy of Sciences (IKI). It is designed for creation of spatial data analysis user systems, especially for working with satellite data. The main goal of the technology is to create convenient tools for remote data access, online processing and analysis just with integration of the access and analysis tools with large distributed multi-dimensional data products and flexibility of toolset creation and expansion. The described technology has proven itself stable and effective. Now it is proposed for use in Express and other Mars missions data access, visualisation and analysis toolkit. GEOSMIS main capabilities, structure and architecture of integrated software tool development techniques for creation of satellite data analysis interfaces with use of capabilities are illustrated with IKI's experience in creation of several specialized tools.
During the last two decades, a fleet of planetary probes has acquired several hundred gigabytes of images of planetary surfaces. Since 1996, Mars has been particularly well covered thanks to the Mars Global Surveyor, Mars Odyssey, Mars Express and Mars Reconnaissance Orbiter spacecrafts. HRSC, CTX, HiRISE instruments allowed the computation of Digital Elevation Models with a resolution from hundreds of meters up to 1 meter per pixel, and corresponding orthoimages with a resolution from few hundred of meters up to 25 centimeters per pixel. On the ground, Spirit, Opportunity and Curiosity rovers have acquired tens of thousands of color and stereoscopic images. The integration of such huge data sets into a system allowing user-friendly manipulation either for scientific investigation or for public outreach can represent a real challenge. We are investigating how innovative tools can be used to freely fly over reconstructed landscapes in real time, using technologies derived from the game industry and virtual reality. We have developed an application based on a game engine, using planetary data, to immerse users in real martian landscapes. The user can freely navigate in each scene at full spatial resolution using a game controller. The actual rendering is compatible with several visualization devices such as 3D active screen, virtual reality headsets or...
Mapping the northern plains of Mars: the ISSI project

Introduction: An International Space Science Institute (ISSI) team project has been convened to study the northern plains of Mars. It uses geomorphological mapping to compare ice-related landforms in the three northern plains basins: Acidalia Planitia, Arcadia Planitia, and Utopia Planitia. This becomes problematic when attempting regional or global-scale studies of meter-scale landforms. However, we needed to map the distribution of such landforms across very large latitudinal swaths in the Acidalia, Arcadia, and Utopia areas (see results [2-3]). Rather than traditional mapping with points, lines, and polygons, we used a grid “tick-box” approach to efficiently determine where specific landforms are preferentially located (see [4] for details).

Method: We conducted a geomorphological study of all landforms along a 3-stripe mapping belt from 25°N to 75°N latitude, 250 km wide. The goals are to: (i) map the geographical distribution of the ice-related landforms; (ii) identify their association with subtly-expressed geological units; and (iii) discuss the climatic modifications of the ice-rich permafrost in Utopia Planitia (UP). Our work combines a study with CTX (5-6 m/pixel) and MOLA, supported by higher resolution HiRISE (25 cm/pixel) and Earth images. The mapping strips were divided into grids of squares for each study area, e.g., 20×20 km.

Preliminary Results: A grid-based mapping was finally used for rapidly determining the spatial distributions of small features over very large areas [5]. Then the basemap data are systematically examined, grid-square by grid-square 20×20 km at full resolution. Over the 3 regions, ice-related landforms were identified and recorded as being either “present”, “dominant”, or “absent” in each sub-grid square displayed in a Cassini projection. The end result of the mapping is a “raster” showing the distribution of the various different types of landforms across the whole strip, providing a digital geomorphological map.

Conclusion: We find that grid-based mapping provides an efficient solution to the problems of mapping small landforms over large areas, by providing a consistent and standardized approach to spatial data collection. Acknowledgements: This work is a joint effort of an International Team sponsored by ISSI (International Space Science Institute).

References:
Semi-automated surface mapping via unsupervised classification

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Due to the increasing volume of the returned data from space mission, the human search for correlation and identification of interesting features becomes more and more unfeasible. Statical extraction of features and machine learning methods will increase the scientific output of remote mission and aid the discovery of yet unknown features hidden in dataset. Those methods exploit algorithm trained on features from multiple instrument, returning classification maps exploring infra-dataset correlation, allowing for the discovery of unknown features. We present two applications, on Mercury and on Vesta. Mercury surface has been mapped in the 400-1145 nm wavelength range by the Mercury Atmospheric and Surface Composition Spectrometer (MASCS) instrument during orbital observations by the MESSENGER spacecraft. We have conducted k-means unsupervised hierarchical clustering to identify and characterize spectrally distinct groups: polar and equatorial units, possibly linked to compositional differences or weathering due to irradiation. To explore possible relations between composition and spectral behavior, we have compared the spectral derivate from MESSENGER's X-Ray Spectrometer (XRS). Nonetheless, by comparing datasets and investigating the links between them, we can provide further clues to the formation and evolution of Mercury's crust.

For the Vesta application, we explored several Machine Learning techniques: multi-step clustering method is developed, using an image segmentation method, a stream algorithm, and hierarchical clustering. The DAWN Visible and infrared spectrometer (VIR) data from Vesta is testbest for our algorithm. The algorithm successfully separates the Olivine outcrops around two craters on Vesta's surface. New maps summarizing the spectral and chemical signature of Vesta's surface could be automatically produced.

References:

[1] E Ammannito et al. "Olivine in an unexpected location on Vesta's surface". In: I
Geographical Information Systems (GIS) are favored tools in geologist community amount of available data and the increasing of distant interactions between scientists collaborative tools for planetary science. Unfortunately, current GIS tools, including for planetary sciences since they do not take into account specific definitions for coordinates systems, projections. We will present our Web GIS application for planetary sciences. Cesium is An open-source JavaScript library for world-class 3D technology and contains several tools for Earth mapping. For Planetary mapping Cesium in order to allow users to map other planets/satellite of the solar system. OGC codes for each Solar System bodies have been added. For a given planet or satellite, several layers can be displayed in the Virtual Observatory Data can also be displayed. Using Cesium native features, we the user to draw lines, circles and polygons on the surface of the current body and furthermore, we offer the possibility to flag entities displayed on the globe with a custom legend (see Anthony Langain presentation for a use case). Current developments are centered onto map projections. Actual Mercator projections. We are implementing the Sterographic projection for a polar view.

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Despan Daniela LESIA, Observatoire de Paris
Geographical information systems (GIS) is becoming increasingly used for planetary science. GIS are computerised systems for the storage, retrieval, manipulation, analysis, and display of geographically referenced data. Some data stored in the PSA have spatial metadata associated to them. To facilitate users in handling and visualising support interoperability with interfaces implementing the standards approved by the Open Geospatial Consortium (OGC). These standards are followed in order to develop open interfaces and encoding that allow applications, well-known examples of which are Google Earth and NASA World Wind, OpenLayers (2D) and Cesium (3D). Access to this data for use in World Wide Web Service (OWS) implementations. An existing open source server is GeoServer, an instance of which has been deployed for the PSA, that uses the OGC standards to allow the sharing, processing and editing of data through the Web Feature Service (WFS) standard. Our final goal is to convert the recently released PSA (archive which enables science exploitation of ESA’s planetary missions datasets) into an archive which enables science exploitation of ESA’s planetary missions datasets. This can be facilitated through the GIS framework, offering interfaces (both web GUI and scriptable APIs) that can be used by the community, and that will also enable the community to build added value services.
Introduction to Planetary Spatial Data Infrastructure (PSDI)

Here we introduce the concept of a planetary spatial data infrastructure (PSDI) and provide ongoing efforts regarding the creation and maintenance of a broad range of PSDI goals. Spatial data are any data with sufficient positional information such that the data can be located on a body (e.g., Mars). As described in the existing U.S. Federal initiative [1], the National Spatial Data Infrastructure (NSDI) consists of "The technology, policies, standards, human resources, and related activities necessary to acquire, process, distribute, use, maintain, and preserve spatial data (e.g., information and process discovery, publishing data, publishing symbol libraries, query filtering, data fusing, Earth imaging, photogrammetry, location processing, and spatial analysis)."

Though the NSDI report and a similar initiative in Europe called INSPIRE [2], clearly focuses on terrestrial applications, we find that rationale, background, and resultant organizational themes and recommendations are entirely portable to the planetary science domain.

References


the open source viewer’s spirit, an opportunity to do collaborative science with
Impact craters on terrestrial bodies are useful to date geological units and help us
processes active on planetary surfaces. There are many crater databases availab
Robbins one [1] which counts more than 380 000 craters larger than 1 km on the
manual, without automatic identification, and adapted to surface dating. However,
distort results obtained on unit dating or other statistical studies. Two categories o
craters and other types of circular structures, a taking into account ghosts and se
such. The aim of this study is to check one by one each crater of the Robbins’ dat
categories: 1-Valid corresponding to a crater without specific characteristics, 2-Inva
 crater, 3- Ghost crater when an impact structure is covered by another geological
impact feature formed from the ejection of materials during the formation of a large
 crater whose ejecta are lobate [4]. Checking and manually classifying more than 3
time. Cesium Viewer is a collaborative and interoperable platform making possible
About thirty people from eleven laboratories are working on this project. Participar
classification and one or several geojson files containing the craters of the Robin
started in August 2016 and for the moment, 60% of the database has been check-
Among craters that have been checked, 3.8% of them have been identified as bei
detections are not associated with any circular structures. However the most impo
structures can be confused with impact craters (tectonic or periglacial features). W
comparative study between Robbins’ and ours will be performed. Several dating tr
the database will also be done.

References

NASA’s Lunar and Planetary Mapping and Modeling Program (LMMP) produces a suite of online visualization and analysis tools. Originally designed for mission planning and science, these portals also offer great benefits for education and public outreach (EPO), providing access to data from a wide range of instruments aboard a variety of past and current missions. There are currently three web portals in the program: the Moon Trek (http://moontrek.jpl.nasa.gov), Vesta Trek (http://vestatrek.jpl.nasa.gov), and Mars Trek (http://marstrek.jpl.nasa.gov). Portals for additional planetary bodies are planned (e.g., Ceres Trek, CG Trek, and Phobos Trek). The portals provide analysis tools for measurement and study of planetary terrain. Planetary mapping is a critical component of these portals. The discussion of mapping standardization will be of great interest to the expansion of this Program. Demonstration of these web portals will be given.
Hyperspectral analysis of CRISM images using PlanetServer Python API.

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Mineralogical characterization using band math combination on hyperspectral images so called CRISM products [1] are used on CRISM TRDR imagery. Commonly this has been pursued by using IDL code on the non-open-source tool ENVI thus forcing researchers to buy licensing to analyze the mineralogy. PlanetServer [2] is the Planetary Data Analysis service of the Horizon 2020 Earthserver project and is made up of a web open-source Python API in the form of a Jupyter Notebook allowing the user to create output mosaics. Ongoing work includes the option of performing spectral analysis of a pixel by clicking the output image in the notebook and automatically extracting the spectra.

References


Status update on interoperability of VO and GIS

M. Minin (1), A. P. Rossi (1), C. Marmo (2)

(1) Jacobs University Bremen, Germany (2) GEOPS, Université Paris-Sud, France

Geospatial data collected by remote sensing experiments can be accessed via Open Geospatial Consortium (OGC) data portals [1] or through Virtual Observatory (VO) tools [2]. The latter is being developed as part of EPN-RI H2020 VESPA [3]. As part of VESPA JRA4 [4] are developing interoperability between the OGC-compliant GIS geospatial data via a Table Access Protocol (TAP) [6].

To improve planetary data distribution, we have upgraded DaCHS //epntap.rd mixin [7] to meet the EPN-TAP 2.0 standard and made it accessible at [8]. We have created a JavaScript wizard for generating new resource descriptors using a form-based interface, accessible at [9]. We used the new mixin and the wizard to populate tables mars_craters, usgs_wms, and crism; source data for which was obtained input data was made to adhere to EPN-TAP 2.0 standard, and the epn1 server was making it accessible to VESPA VO applications [15]. The access_url field of the t request, which can be used to open the map in QGIS [16]. Additionally, a web interface provided for each layer. We provide a subgranule access to crism data using a JavaScript-based wizard for generating new resource descriptors for crism images and mars_craters granules can be transmitted via SAM.

To provide VO to GIS portability, we have developed a QGIS plugin which provide possible to send tables from VO data mining applications such as TapHandle or TVO table sent via SAMP and converts it to a geospatial format, such as GeoJSON whose geometry is defined by their footprints. The dataset referenced by the granule downloaded and georeferenced in a single step using another plugin we have developed.

To provide VO to GIS portability, we have developed a plugin which can send a display a polygon shape. Also, a python parser for WMS GetCapabilities XML has from WMS servers.

The usage example of our services has been described on GitHub [22]. The ongoing QGIS-SAMP plugins, as well as expanding the data available on EPN1.

References

One GIS-based data structure and visualization for 15 map sheets - Geological Mapping of Ceres

Andrea Naß, and the Dawn Mapping Team

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One aim of the NASA Dawn mission is to generate global geologic maps of the asteroid Vesta and the dwarf planet Ceres. To accomplish this, the Dawn Science Team followed the technical recommendations for cartographic base map production. The geological mapping campaign of Vesta was completed and published, but mapping the dwarf planet Ceres is still ongoing. The tiling schema for the geological mapping is the same for both planetary bodies and is divided into two parts: four overview quadrangles (Survey Orbit, 415 m/pixel) and 15 more detailed quadrangles (High Altitude Mapping HAMO, 140 m/pixel). The most detailed view can be expected within the 15 mapping quadrangles based on HAMO resolution and completed by the Low Altitude Mapping (LAMO) data with 35 m/pixel. For the interpretative mapping process, one responsible mapper was assigned. Unifying the geological mapping of each quadrangle and bringing all statements together are already a very time-intensive task. However, another challenge is to consider how the 15 individual mappers can generate one homogenous GIS-based project (w.r.t. geometrical and visual character) thus produce a geologically-consistent final map. Therefore, the computer-based GIS environment used for the interpretative mapping process must be designed in a way that it can be adjusted to the unique features of the individual investigation areas. Within this contribution, a template will be presented that uses standards for digitizing, visualization, data merging, and synchronization and adapted these to the individual requirements on the multiuser mapping project of Ceres. Using this template, the map results are more comparable and better controllable. Furthermore, merging and synchronizing individual maps, map projects, and sheets will be far more efficient. Beside the specific use case of Ceres, the template can be easily adapted to any other planetary body and or within future discovery missions (e.g., Lucy and Psyche which were selected by NASA) for generating reusable map results.

Nava Jacopo

University of Padua, Italy
### Introduction to OpenPlanetaryMap

OpenPlanetaryMap (OPM) is a new OpenPlanetary [1] project, supported by CARTO [2], to build an Open Planetary Mapping and Social platform for planetary researchers and mappers, space enthusiasts and students, educators and storytellers. Our goal is to enable them to easily and collaboratively create and share location-based knowledge and maps of our Solar System. The project is a follow-up and evolution of the "Where On Mars?" outreach.

**References**


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### Interoperability in the Planetary Science Archive (PSA)

As the world becomes increasingly interconnected, there is a greater need to provide applications that are commonly being used globally. For this purpose, the development of the European Space Astronomy Centre (ESAC) Science Data Centre (ESDC), an archive that takes into account internationally recognised standards in order to provide access to the archive through tools from third parties, for example by the NASA Planetary Data System (PDS), the VESPA well as other international institutions.

The protocols and standards currently being supported by the recently released new version of the Planetary Science Archive at this time are the Planetary Data Access Protocol (PDAP), the EuroPlanet-Table Access Protocol (EPN-TAP) and Open Geospatial Consortium (OGC) standards.

We explore these protocols in more detail providing scientifically useful examples.

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The Planetary Science Archive (PSA) is the European Space Agency's repository of science data from all planetary science and exploration missions. The PSA provides access to scientific datasets through various interfaces at http://psa.esa.int. All datasets are scientifically peer-reviewed by independent scientists, and are compliant with the Planetary Data System (PDS) standards. The PSA is currently implementing a number of significant improvements, mostly driven by the evolution of the PDS standard, and the growing need for better interfaces and advanced applications to support science exploitation.

The newly designed PSA will enhance the user experience and will significantly reduce the complexity for users to find their data, promoting one-click access to the scientific datasets with more customized views and enhanced integration with Planetary GIS analysis tools and Planetary interoperability services. It will be up-to-date with PDS3 and PDS4 standards. Users will have direct access to documentation, information and tools relevant to the scientific use of the dataset.

The new PSA interface was released in January 2017. The home page provides a direct and simple access to the scientific data, aiming to help scientists to discover and explore its content. The archive can be explored through a set of parameters that allow the selection of products through space and time. Quick views provide information needed for the selection of appropriate scientific products.

In the coming months, the PSA team will focus their efforts on developing a map search interface using GIS technologies to display ESA planetary datasets, an image gallery providing navigation through images to explore the datasets, and interoperability with international partners. This will be done in parallel with additional metadata searchable through the interface and dedicated to improve the content of 20 years of space exploration.
Impact Geology of fresh simple craters on Moon

The detailed mapping of fresh simple craters for their structure, geometry, morphology, and mineralogy will help us to understand the early stage modification processes of simple craters on earth and other planetary surfaces.

The Lunar Reconnaissance Orbiter (LRO) Narrow Angle Camera (NAC) datasets and Chandrayaan-1 Moon Mineralogy Mapper (M3) hyperspectral datasets having spatial resolution are used to study the morphology and mineralogy of the impact features.

In this study, we identified 37 craters out of ~1349 craters of lunar surface that fall under the diameter range of 3-6 km and also display freshly preserved impact structures. Interestingly, all of the 37 craters are found in the lunar nearside. 30 out of 37 are formed in the basaltic terrain.

One of these craters is Litchenberg B which has a diameter of ~5 km located at 33.25°N, 61.52°W. It is a fresh crater formed at the boundary of two lava flows in Oceanus Procellarum, namely P9 (~3.47 Ga) and P53 (~1.68 Ga). This crater preserves various morphological features including melts, fractures, boulders, slumping of the crater floor, polygons, detailed ejecta morphology with wrinkled symmetrical crescent ridges, and the rock outcrops in the wall flows of Oceanus Procellarum as old as ~3 Ga.

We estimated the absolute model age of this crater using Crater Size-Frequency Distribution (CFSD) and found to be ~17.9±0.6 Ma.

Though terrestrial craters are studied in detail through field geology, these craters have undergone continuous weathering since their formation. One such example is Lonar crater on Earth which is formed in ~66 Ma in Deccan flood basalts at 19°58′N, 76°31′E, near Lonar village in Buldhana district of Maharashtra State in India. Morphologically, Lichenberg B is comparable to the Lonar crater as both are formed in flood basalts and Deccan plateau respectively. The detailed mapping of both geologic and mineralogic units of Lichenberg B and Lonar will improve our understanding of the early impact scenario.

References:
The development of MATISSE [1] started in late 2012 with the main aim of providing a useful tool for visualization of data coming from small and irregularly shaped bodies. Therefore, its natural first application was the ESA Rosetta Mission, where a strong collaboration with the VIRTIS [2] science team quickly grew. During these years new applications have been set up, such as the one regarding the NASA Dawn VIR [3] team. Another example is within the Moon Mapping [4] program, the first one that required a dedicated application concerning the coma dust distribution around comet 67P Rosetta [7, 8].

Even though its original modular structure really allowed expanding the functionalities four years from its first release, MATISSE needs sensible modifications in order to be ready for the upcoming challenges, such as its complete integration within the VESPA Planetary VO project [9]. Therefore in 2017 a completely new version of the tool is planned, making use of:

1. A new BDMS best suited for geographical data (e.g., PostgreSQL + PostGIS);
2. Optimization and parallelization of the algorithms used to process the data;
3. New solutions for online visualization, so that high resolution DTMs and shape models could be correctly viewed directly on the output page, without the need to download data;
4. Implementation of standards used by VESPA (e.g., SAMP and EPN-TAP).

This new version of MATISSE will allow not only the visualization of data from the Rosetta mission, but also an easy way to search and analyse data from a large variety of Solar System exploration missions, following the path already traced by projects such as Open Planetary [10] and Open Universe [11] that currently base their developments upon our tool.

References
The iMars WebGIS – Spatio-Temporal Data Queries and Single Image Map Webservices

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(1) Freie Universitaet Berlin, Planetology and Remote Sensing, Berlin, Germany; (2) Space Science Laboratory, University College London, United Kingdom; (3) Depa Seoul, Korea

Introduction: Web-based planetary image dissemination platforms usually show or offer metadata as well as preview and download, e.g., the HRSC Mapserver (Walter approach for a system dedicated to change detection by simultaneous visualisation context. While the usual form of presenting multi-orbit datasets is the merge of the single image as an important snapshot of the planetary surface at a specific time, we process and ingest vast amounts of automatically co-registered (ACRO) image precision HRSC multi-orbit quadrangle image mosaics, which are based on bundle-adjusted HRSC single images. To demonstrate the presented features is available at http://imars.planet.fu-berlin.de

Multi-temporal database: In order to locate multiple coverage of images and select available coverage catalogs for various NASA imaging missions into a single geometry support. We harvest available metadata entries during our processing pipeline. Currently, this database contains image outline MO/THEMIS instruments with imaging dates ranging from 1996 to the present. F20 database which we automatically update with custom software based on the VCS.

Web Services with time support: The MapServer software is connected to the database and Web Feature Services (WFS) with time support based on the START_TIME parameter in the request. The values of its lower and upper bounds. As the WMS/WFS time standards only supports one time stamp are considered. If no time values are submitted with the request, the full time rang

Dynamic single image WMS: To compare images from different acquisition times, every image as a single WMS layer. Due to the vast amount of single images we have, the map server does not know the images to be served beforehand. We use the MapServer’s objects and configure the file name and path of the requested image on-the-fly each representing only one single image. On the frontend side, the vendor-specific WMS request parameter PRODUCTID has to be appended to the regular set of WMS parameters. The request instance.

Web Map Tile Cache: In order to speed up access of the WMS requests, a MapServer pipeline. As it is not aware of the available PDS product IDs which will be queried, additional dimension of the cache. The WMS request is received by the Apache module. If the tile is available in the tile cache, it is immediately committed to the client. If not, the Apache and the MapScript module. The Python script intercepts the WMS request chain, loads the layer object from the map file and appends the file name and path as the product ID. Further image processing inside the script (stretching, color matching), the request then delivers the response back to the MapCache instance.

Web frontend: We have also implemented a web-GIS frontend based on various layer services, global color-hillshaded HRSC bundle-adjusted DTM mosaic with a resolution of 50 m per pixel. The new bundle-block-adjusted HRSC quadrangle mosaics of the MC-11 quadrangle, both image and DTM, are included with opacity slider options. The layer user interface has been adapted on the base of the ol3-layerswitcher and extended by foldable and switchable groups, layer sorting (by resolution, by time and alphabetically) and reordering (drag-and-drop). A collapsible time panel accommodates a time slider interface where the user can filter the visible data by a range of Mars or Earth dates and/or by solar longitudes. The visualisation of multiple images is controlled by a specific toolbar enabling the workflow of image selection (by point or bounding box), layer filtering, image entry and reordering (drag-and-drop). A collapsible time panel accommodates a time slider with time-series of single images is controlled by a specific toolbar enabling the workflow of image selection (by point or bounding box), layer filtering, image entry and reordering.

Conclusions/Outlook: The iMars webGIS is an expert tool for the detection and visualization of temporally co-registered images. The system is capable of serving up to 10 simultaneous users on-demand. The system is capable of serving up to 10 simultaneous users on-demand. The system is capable of serving up to 10 simultaneous users on-demand.

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