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Dynamic map server for accessing and downloading HRSC data products

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Abstract

At the Planetary Sciences and Remote Sensing Group of Freie Universitaet Berlin we have set up a map server for dynamic data queries of the High Resolution Stereo Camera (HRSC, [1, 2]). Various pre-processed image data products, converted to common raster formats (GeoTiff and GeoJP2000), are provided for download from within the web interface. The HRSC products can be downloaded in a fluent and intuitive zoom-, pan- and click- environment.

1. Introduction

Exploring Mars since 2004, about 90 % of the surface has been covered by HRSC in stereo and color with resolutions of up to 12.5 m/pixel (archived in the PDS as *level 3*). Digital elevation models (DTMs) of up to 50 m grid spacing and derived ortho-rectified images (archived as *level 4*) cover about 40 % of the planet's surface [3]. The high lateral and vertical accuracy of the data products together with a precise photogrammetric alignment to MOLA make HRSC DTMs and images an unique dataset perfectly suited for data fusion with other spectro-photometric and topographic data from the broad range of available remote sensing instruments at Mars. Fundamental assets for data analysis and data fusion are spatial and temporal queries, metadata search, data download and finally the ingestion of the data into desktop-based Geographic Information Systems (GIS). A dynamic web map server has been set up at Freie Universitaet Berlin in order to ease accessibility of HRSC data in the scientific community – compliant to geospatial standards and ready-to-use in the full range of GIS environments. The native HRSC data format is VICAR [4] which poses several limitations when attempting to fuse data from standard software tools. We promote HRSC data interoperability by providing pre-processed data products, converted to common geospatial raster formats.

2. Dynamic map server frontend

HRSC products are made available by an open-source driven dynamic map server optimized for orbit search and direct file download at:

http://maps.planet.fu-berlin.de

Its frontend is based on the OpenLayers framework and access to the image data is provided by a Mapserver backend [5]. Hillshaded MOLA datasets are selectable as base layers in a grayscale and a color-coded variant. Two query layers for HRSC product downloads are based on the footprints as described by Walter et al. [6]. By selecting an orbit footprint, a context window informs the user about basic image properties, metadata and the direct links to the product downloads. The mineralogical context can be blended in on demand as transparent overlay layers of the OMEGA global maps [7]. Figure 1 displays a browser screenshot showing the color-coded MOLA background and a selected HRSC orbit.

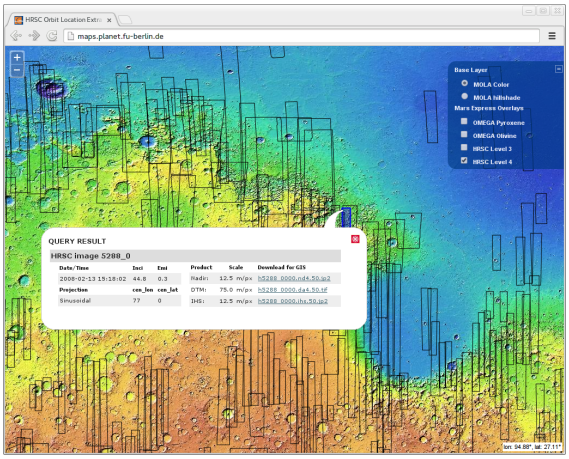

Figure 1: Dynamic map server frontend for orbit location and download. http://maps.planet.fu-berlin.de

3. Interoperable data products

The Geospatial Data Abstraction Library (GDAL) is a cross-platform translator library for raster geospatial data formats [8]. The formats are implemented as specific drivers, some of which rely on external libraries. With VICAR being the native file format for HRSC, the development of a GDAL driver for VICAR turns the conversion to modern raster file formats such as *GeoTiff* or *GeoJP2000* into a one-step process while providing fine-grained control over the preservation of HRSC's spacecraft- and instrument-specific metadata properties. Such a driver has been developed at Freie Universitaet Berlin, partly based on code of GDAL's existing driver for the PDS format [9]. This enables elementary features of modern file formats: the spatial reference system (SRS) containment makes the image appear at the exact position in the correct geometry; the associated nodata value shows only valid pixel values in the GIS while rendering non-valid values transparent and excluding them from image operations or statistical calculations; embedded statistics of bands show them properly stretched without the need of time-consuming calculation; pre-rendered in-image overviews in reduced resolution (known as pyramids) allow for fast file access while panning and zooming; radiometric scale- and offset-values enable tracing back the original radiance/reflectance values of the HRSC instrument calibration.

Three commonly used datasets of HRSC are precalculated from archived level 4 products – the panchromatic, highest-resolution **n**a**d**ir channel (up to 12.5 m/px) in 8 bit (ND), the **D**TM referenced to the **a**reoid in 16 bit (DA) and a color composite sharpened by **IHS**-transformation as 24 bit data (IHS). For archived level 3 data, orthorectification is based on MOLA, only nadir-channel data is processed. While the ND and the DA files are directly converted from their VICAR-based archive products, the IHS files are pre-processed from the nadir and the red, green, blue channel, if available. The two datasets based on 8-bit bands (ND and IHS) are converted to GeoJP2000 by making use of GDAL's Kakadu™ driver with a reversible (lossless) compression setting. As this driver has currently issues with reversible compression quality in 16 bit, the GeoTiff driver is used for the conversion of the DA product. All three products are ready for quantitative ingestion to GIS environments prerendered with band statistics, nodata values, pyramids and complete geo-referencing. Original data values, SRS and meta information of the image sequences or DTM properties are maintained. An example dataset for all three products from orbit 5288 is shown in Figure 2.

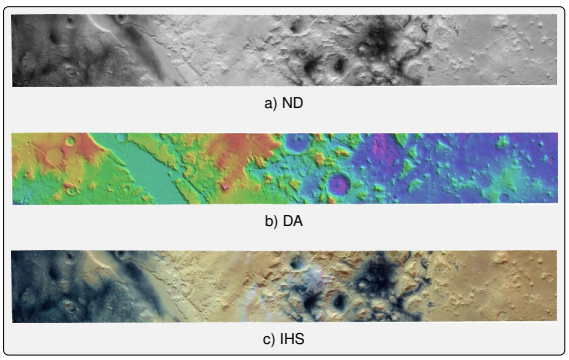

Figure 2: Converted HRSC data product (orbit 5288). a) panchromatic nadir image, b) DTM, height over areoid (color-coded and shaded for illustration), c) pan-sharpened color-composite.

4. Outlook

For the future, we aim at providing the DA products also in GeoJP2000 format as soon as the problem with the GDAL Kakadu driver is solved. Photometrically and/or topographically corrected image products [10] are to be incorporated for download if required by the community. Metadata filter options for HRSC data properties may be added for optimized data queries.

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