

THE MULTI-TEMPORAL DATABASE OF PLANETARY IMAGE DATA (MUTED): A WEB-PROCESSING SERVICE FOR ORBITAL IMAGE DATA OF MARS. T. Heyer¹, H. Hiesinger¹, J. Raack¹, and R. Jaumann², ¹Institut für Planetologie, Westfälische Wilhelms-Universität, Wilhelm-Klemm-Str. 10, 48149 Münster, Germany, ²German Aerospace Center (DLR), Berlin, Germany. (thomas.heyer@uni-muenster.de)

Introduction: The Multi-Temporal Database of Planetary Image Data (MUTED) is a comprehensive web-based tool to support the identification of surface changes and time-critical processes on Mars. The database enables scientists to quickly identify the spatial and multi-temporal coverage of orbital image data of all major Mars missions. Since the 1970s, multi-temporal spacecraft observations have revealed that the martian surface is very dynamic [e.g., 1-8]. The observation of surface changes and processes, including eolian activity [e.g., 3], mass movement activities [e.g., 4, 5], the growth and retreat of the polar caps [e.g., 6], and crater-forming impacts [e.g., 7] became possible by the increasing number of repeated image acquisitions of the same surface areas. Today more than one million orbital images of Mars are available [8]. This increasing number highlights the importance of efficient and comprehensive tools for planetary image data management, search, and access.

MUTED is accessible at <http://muted.wwu.de> and will assist and optimize image data searches to support the analysis and understanding of short-term, long-term, and seasonal processes on the surface and in the atmosphere of Mars. In particular, images can be searched in temporal and spatial relation to other images on a global scale or for a specific region of interest. Additional information, e.g., data acquisition time, the temporal and spatial context, as well as preview images and raw data download links are available.

Structure: MUTED is based on open source software and standards from the Open Geospatial Consortium (OGC). Metadata of the planetary image datasets are integrated from the Planetary Data System (PDS) into a relational database (PostgreSQL). In order to provide the multi-temporal coverage, additional information, e.g., the geometry, the number and time span of overlapping images are derived for each image respectively. A Geoserver translates the metadata stored in the relational database into web map services (WMS) and web features services (WFS). Using Common Query Language (CQL), the web services can be filtered by date, solar longitude, spatial resolution, incidence angle, and spatial extent. All services are combined and visualized in the web-based user interface. The web-user-interface was built using HTML, PHP, JavaScript, and Openlayers and provides several features for data selection, filtering, and visualization.

Location- and data-driven search algorithms are combined in the user-interface. Using global spectral, topographic or geological information, users are able to define a region of interest and explore the local image coverage (Fig. 1). All available orbital images can be filtered by date, season, or spatial resolution. By selecting image footprints, metadata, including, e.g., product ID, acquisition time, download links, as well as high-resolution preview images [9], are presented.

The multi-temporal search enables users to find

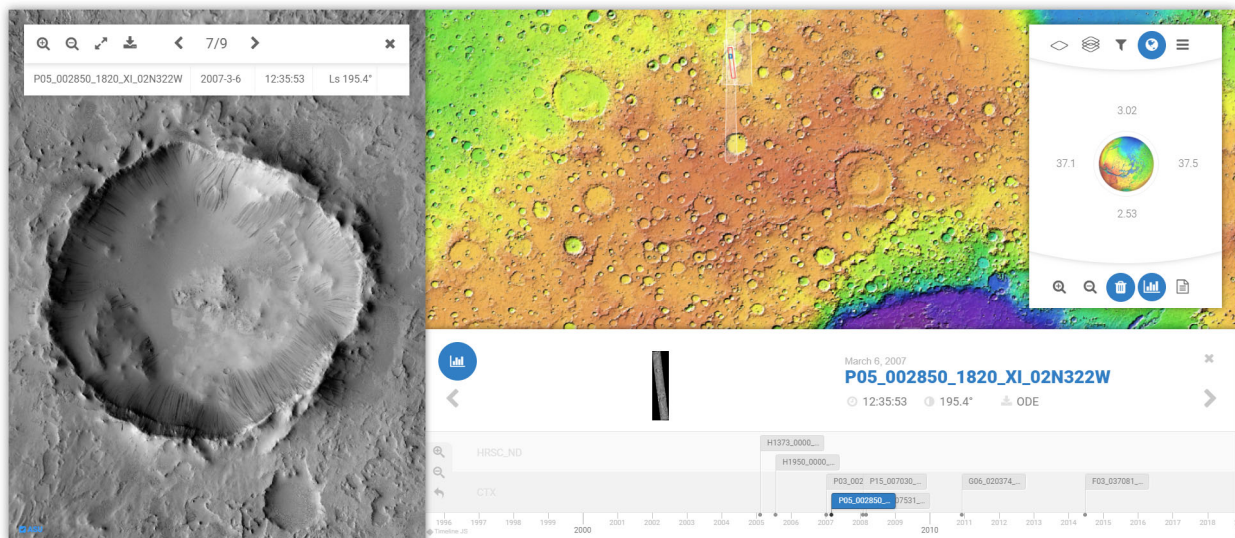


Fig. 1. Web user interface of MUTED showing the spatial (top right) and temporal (bottom right) coverage as well as high-resolution data preview (left) for a region of interest (e.g., Janssen crater, located at 37.3° E, 2.8° N).

spatially overlapping images, which are separated by a user-defined temporal interval. The spatial and temporal context of the images is presented on the map or within a timeline. Additionally, queries can be listed and exported as text files.

Image processing service: The new web-based service will provide customized image data as a basis for various surface analyses.

For many studies, only portions of high-resolution images intersect with the research area (Fig. 2). Consequently, large amounts of unneeded data have to be obtained and processed. The new processing service helps to reduce the amount of data as well as processing time by providing image data on demand, fitting to the user-defined research area and settings.

The web-user-interface enables users to define an area of interests based on global spectral, topographic, or geological information. Datasets from various missions and instruments, e.g., Mars Express High Resolution Stereo Camera (HRSC) [10] can be selected, filtered, and previewed. Using the processing service, raw data of the selected images within the research area will be processed and cropped automatically, based on user-defined settings (e.g., data projection, pixel size, etc.). Finally, the service will provide the reduced data using standard image formats.

Scientific applications: MUTED has been used in recent projects on past and present-day changes of the surface of Mars [12-14]. In particular, the database has been used to identify multi-temporal high-resolution coverage and analyze the seasonal activity of martian slope streaks [12] and gullies [13]. MUTED has also been used to support the data selection for geological mapping [14].

Due to continuous data acquisition by spacecraft, the amount of image data is steadily increasing and enables further comprehensive analyses of martian surface changes. The flexible structure of MUTED allows for a fast integration of upcoming data sets, e.g., from ESA's ExoMars Trace Gas Orbiter (TGO) mission.

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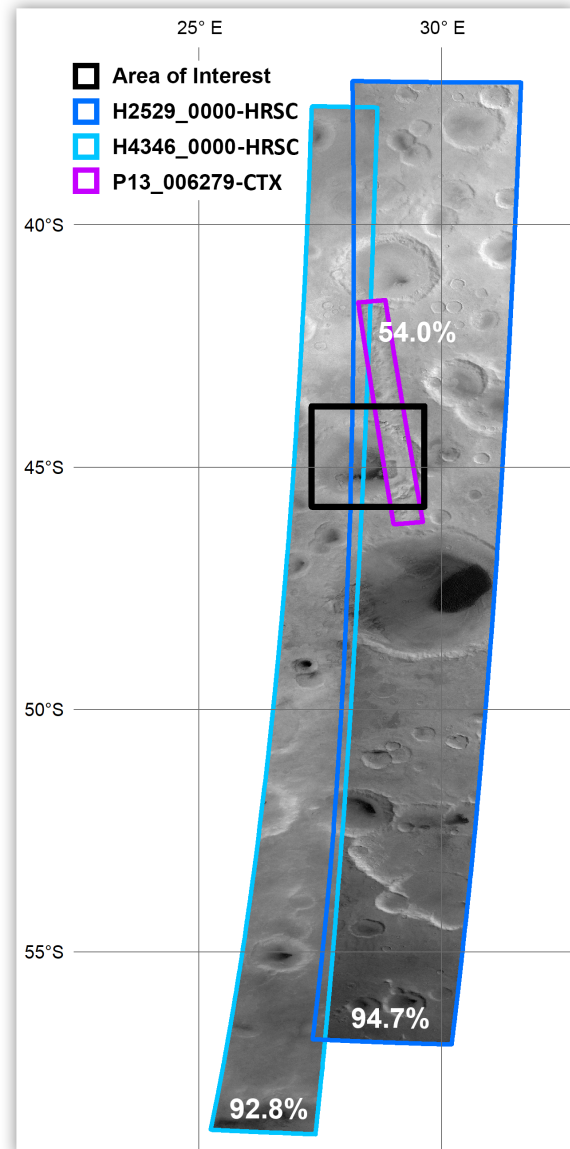


Fig. 2. Portions of high-resolution images (HRSC [10] and CTX [11]) covering a research area at Neukum crater (28° E, 45° S). The processing service provides image data fitting to the user-defined research area, excludes image data outside the specified area (white percentages), and thus reduces the overall amount of data.

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