THE MULTI-TEMPORAL DATABASE OF PLANETARY IMAGE DATA (MUTED): NEW FEATURES TO STUDY DYNAMIC MARS. T. Heyer[1], H. Hiesinger[1], D. Reiss[1], J. Raack[1], and R. Jaumann[2], [1]Institut für Planetologie, Westfälische Wilhelms-Universität, Wilhelm-Klemm-Str. 10, 48149 Münster, Germany, [2]German Aerospace Center (DLR), Berlin, Germany. (thomas.heyer@uni-muenster.de)

Introduction: The Multi-Temporal Database of Planetary Image Data (MUTED) is a 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., 1-3]. The observation of surface changes and processes, including eolian activity [e.g., 5, 6], mass movement activities [e.g., 6, 7, 8], the growth and retreat of the polar caps [e.g., 9, 10], and crater-forming impacts [11] 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 [12]. 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 extend. A GeoWebCache is used to cache map tiles and accelerate, as well as optimize, the WMS delivery. All services are combined and visualized in the web-based user interface. The user interface was built using HTML, PhP, JavaScript, and Openlayers and provides several features for data selection, filtering, and visualization (Fig 1).

Location-Driven Search: Using global spectral, topographic or geological information, users are able to define a region of interest and explore the local image coverage. 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 [13], are presented.

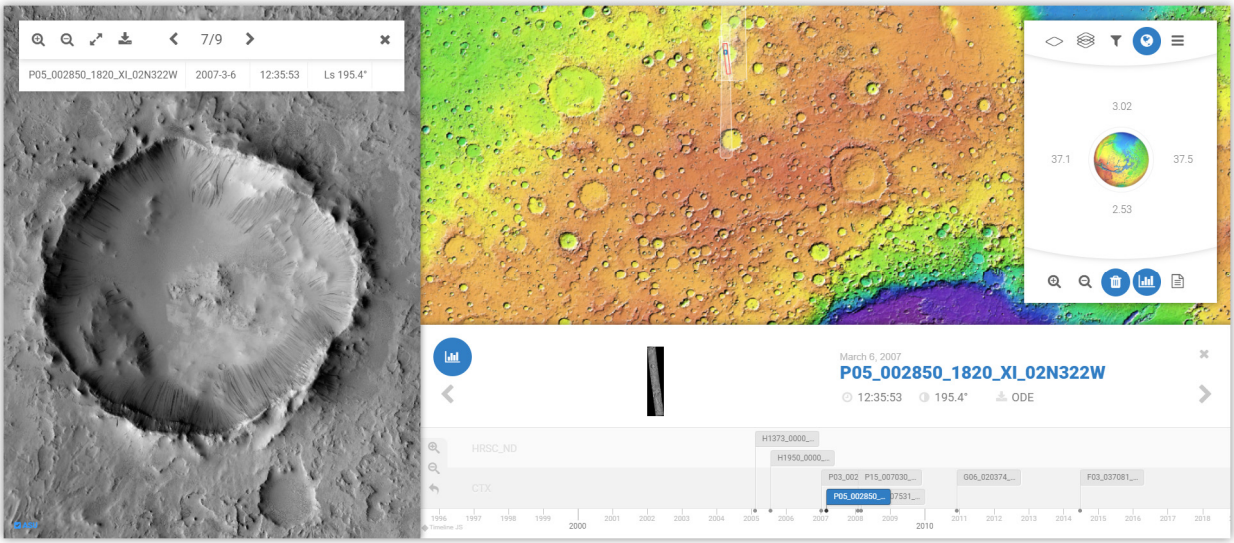

Fig. 1. Web user interface of MUTED showing the spatial (top right) and temporal (bottom right) coverage as well as high-resolution data preview (left) for a region of interest (e.g., Janssen crater (37.3°E, 2.8°N)).

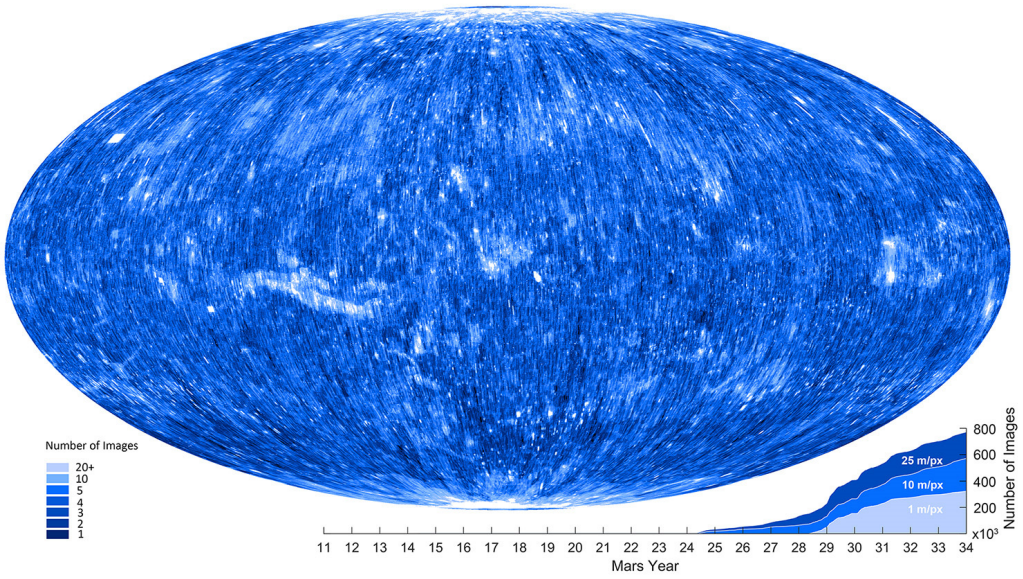

Fig. 2. Global coverage of high-resolution images (spatial resolution better than 25 meter/pixel)

Data-Driven Search: The multi-temporal search enables users to find spatially overlapping images, which are separated by a user-defined temporal interval. Repeat images with a specified time interval (minutes, hours, days) or season (solar longitude) can be identified at a global scale. 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.

Updates: A new feature enables users to save and share areas of interest and data availability with others via a link. The generated permanent link stores the user defined area, datasets as well as filter options. This enables a fast and convenient way to exchange research areas and orbital images with other scientists or save the current progress for future work.

An interactive tutorial advices new users how to explore the multi-temporal coverage of Mars with MUTED and informs them about the available data sets. Due to frequent integration of available images, today about 1.3 million orbital observations of most past and current Mars missions are accessible via the database (Fig. 2).

Scientific Applications: MUTED supports the identification of orbital images and their spatial and temporal context as a basis for various change detection analyses. In particular, the definition of a time timespan between repeated images enables users to discover surface changes caused by very short-term and temporally highly variable processes, e.g., dust devils. The number of images within a certain time period can be specified according to solar longitude, for example to observe seasonal changes and processes. The number of overlapping images can be defined to ensure data availability, e.g., long-term changes of the surface of Mars.

MUTED has been used in recent projects on past and recent changes of the martian surface [12, 14, 15]. In particular, the database has been used to identify multi-temporal high-resolution coverage and analyze the formation of slope streaks [12] and gullies throughout the martian year [14]. MUTED has also been used to support the data selection for geological mapping [15].

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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Acknowledgements: This research has been funded and supported by the German Aerospace Agency (DLR) (Grant # 50QM1801).