THE MULTI-TEMPORAL DATABASE OF PLANETARY IMAGE DATA (MUTED): WEB-PROCESSING OF ORBITAL IMAGES OF MARS. T. Heyer[1], H. Hiesinger[1], J. Raack[1], and R. Jaumann[2],

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Introduction: The Multi-Temporal Database of Planetary Image Data (MUTED) is a comprehensive web-tool to identify and access orbital images of Mars. The database enables location-driven and data-driven image searches for the identification of multi-temporal images of all major Mars missions as a basis for diverse surface change analyses.

In the past 50 years, all spacecraft missions combined acquired more than one million orbital images of Mars and revealed that the planet's surface is shaped by diverse active processes, including, e.g., eolian activity [e.g., 1], surface frost- and ice-related processes [e.g., 2], mass movement activities [e.g., 3], as well as crater-forming impacts [e.g., 4]. The continuously increasing number of orbital images 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.

Processing service: In order to facilitate the access to orbital images of Mars, MUTED provides a processing service for selected datasets (e.g., HRSC). The processing 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.

In the map area of the web-user-interface, users are able to define an area of interest (AOI) on the basis of global spectral, topographic, and geological information. Images of selected datasets are presented in the map panel or within a timeline. Using filter options, the image selection can be filtered in terms of spatial resolution, acquisition date, as well as solar longitude. By starting the processing service, images covering the AOI as well as corresponding metadata are listed in chronological order in the processing panel (Fig. 2). Here, users are able to exclude image from processing based on metadata or spatial coverage of the AOI. Furthermore, users are able to specify processing settings, e.g., cropping of the images to the user-defined AOI. When a processing order is sent, the processing server obtains raw data from PDS/PSA and processes the image data using ISIS [5]. The processing includes the calibration, georeferencing, and clipping of the images to the user-defined AOI. Finally, the processed images are available in a standard image file format (GeoTIFF).
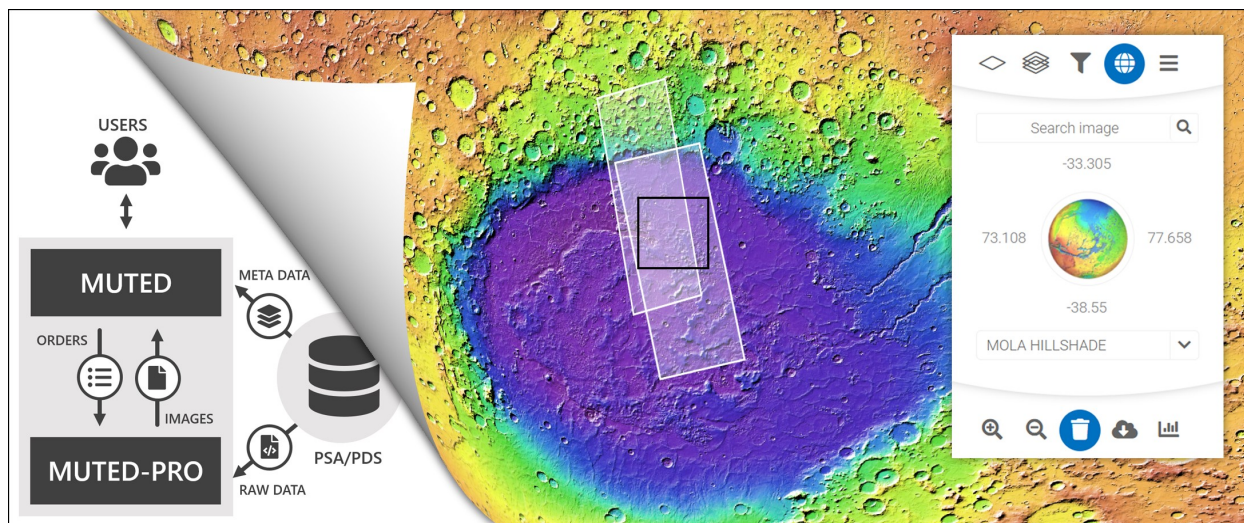

Fig. 1: User interface of MUTED (right) and architecture of the processing service (left). On the basis of user-selected research area and data, the processing server (MUTED-PRO) obtains raw data from the planetary archives, processes data using ISIS [5], and stores the reduced data products. Users are able to download and import the processed data directly into GIS applications for further analyses.
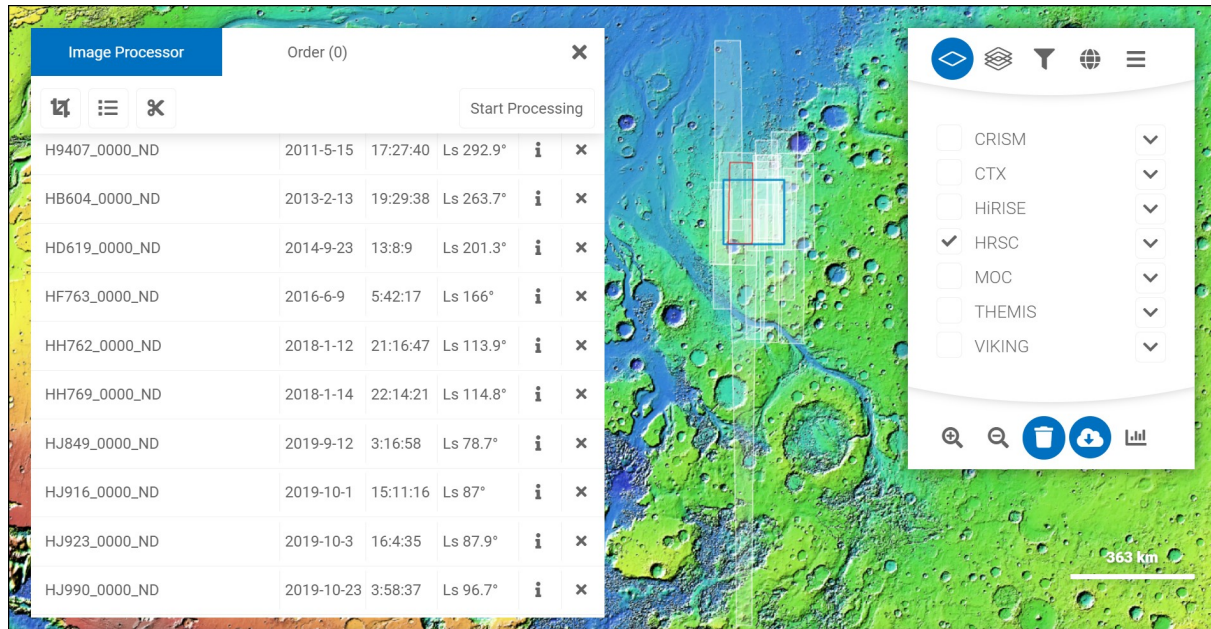
Fig. 2: User interface showing the coverage of HRSC images for a research area at the Oxia Planum landing site (18.2° N, 335.4° E) for the ExoMars mission. Available images and corresponding metadata are listed in the processing service panel (left). Users are able to refine the research area, exclude images from processing, and define processing settings. After data processing, resulting image products are available for download in a standard image file format (GeoTIFF).

Additional datasets, e.g., VIKING, HiRISE, and CTX will be integrated in the processing-service in the near future.

Scientific applications: MUTED has been used in recent projects on past and present-day changes of the surface of Mars [6-11].

In particular, the database was used to analyze the contemporary activity of dark slope streaks and gullies, which represent the most widespread active processes on the present-day martian surface [e.g., 9, 12]. The multi-temporal search enabled the identification of overlapping images to constrain the duration of the slope streak formation [6] and to estimate seasonal formation rates of slope streak activity [7]. Furthermore, slope streak triggering was analyzed on the basis of high-resolution preview images [8, 13]. Analyses indicate a dry formation process in form of avalanching of air-fall dust deposits. The observed seasonal peaks of activity could be explained by temperature-related trigger mechanisms, e.g., thermal-induced rockfalls [14] and gas flows [15], dust devils [8], as well as strong near-surface winds [12, 16].

For the analyses of martian gullies, the database was used to identify seasonal surface frost and contemporary gully activity [9]. The observed activity at the end of defrosting of the surface indicates a frost-related gully formation mechanism, where sublimation of CO_2 slab ice destabilizes surficial materials and induces gas-lubricated flows of the material [9]. Furthermore, the database was used for morphologic analyses of martian gullies in order to identify lobate deposits on the basis of high-resolution preview images [10].

Finally, MUTED was used in geological mapping of the martian surface [11]. Due to continuous data acquisition by spacecrafts, the amount of image data is steadily increasing and enables further comprehensive analyses of martian surface changes. The flexible structure of MUTED allows a fast integration of upcoming data sets, e.g., from ESA's ExoMars Trace Gas Orbiter (TGO) mission.

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