THE MULTI-TEMPORAL DATABASE OF PLANETARY IMAGE DATA (MUTED): A COMPREHENSIVE WEB-BASED TOOL TO STUDY MARS, MOON, AND MERCURY. T. Heyer[1], H. Hiesinger[1], W. Iqbal[1], and N. Schmedemann[1], [1]Institut für Planetologie, Westfälische Wilhelms-Universität, Wilhelm-Klemmstr. 10, 48149 Münster, Germany (thomas.heyer@uni-muenster.de).

Introduction: The Multi-Temporal Database of Planetary Image Data (MUTED) is a comprehensive web-tool to identify and access orbital images of planetary bodies, including Mars, Moon, and Mercury. The database enables location-driven and data-driven image searches for the identification of multi-temporal images of the major space missions as a basis for diverse surface change analyses [1, 2].

MUTED is accessible at https:\\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 of Mars, Moon, and Mercury. 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.

Tools and services: The multi-temporal database provides several tools for the selection, visualization, and processing of planetary data.

Users can explore the planetary bodies (Mars, Moon, and Mercury) using diverse global base maps (spectral, topographic, geologic information). In the map area, the planetary bodies are visualized as spheres or in Mercator map projection (Fig. 1). On top of the global base maps, planetary data of various missions can be visualized globally or for a user-defined region of interest. The data can be filtered by various attributes (e.g., acquisition date or solar longitude). Additional information, e.g., data acquisition time, the temporal and spatial context, as well as preview images and raw data download links are available for each image.

The intersection tool is a unique tool to identify the multi-temporal coverage of planetary surfaces. Based on user-defined parameters, such as datasets and the time interval between overlapping images, the intersection areas of overlapping images are visualized on the map. High-resolution previews as well as metadata, including e.g., download links of multi-temporal images provide the basis for diverse analyses of short- or long-term surface changes and processes.

The timeline tool is another feature to explore the multi-temporal coverage of planetary surfaces. Images within an area of interest can be displayed in chronological order, allowing a quick overview of data availability and temporal context. Amongst others, it can be used to identify an overlapping dataset with the smallest or the longest time-interval (Fig. 2).

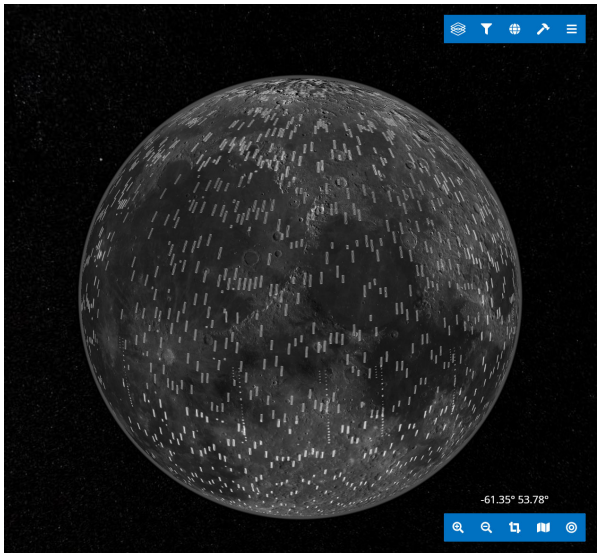

Fig. 1. User interface of the multi-temporal database showing about 12,600 LROC [3] image footprints acquired within a single month (January) in 2020 on top of the LROC WAC global mosaic [3]. The entire LROC dataset comprises more than 2.1 million images and represents an essential basis for diverse surface analyses.

The processing tool is a service to facilitate the access to planetary image data. The 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. Users are able to define an area of interest and select images for processing from several planetary datasets (e.g., HRSC, THEMIS, Viking). Using filter options, the image selection can be filtered in terms of spatial resolution, acquisition date, as well as solar longitude. Furthermore, users are able to specify processing settings, e.g., cropping of the images to the user-defined AOI. After processing of the images which includes the calibration, georeferencing, and clipping of the images to the user-defined AOI, the processed images are available in a standard image file format (GeoTIFF).

The download tool is a service to facilitate the access to planetary data products. For example, for the Moon, users can select and obtain tiles from the global Kaguya [4] mosaics (e.g., ortho, morning, and evening datasets) directly.

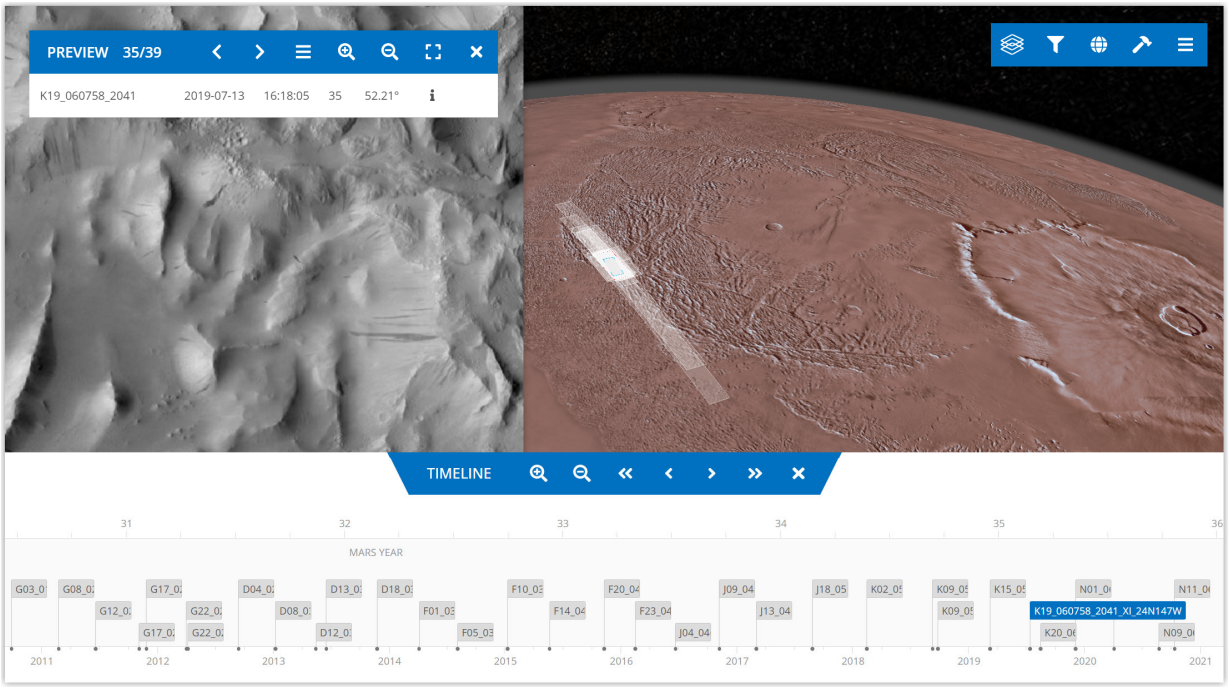

Fig. 2: User interface of MUTED showing the multi-temporal coverage of CTX images for a research area at the Olympus Mons aureole. This region is well known for present-day slope streak formation [5, 10]. The timeline tool at the bottom reveals a good temporal coverage in order to analyze seasonal streak occurrence and formation rates. Slope streaks in this region were found to form redominantl durin autumn when surface tem eratures ea [5, 9].

Scientific applications: MUTED has been used in recent projects on past and present-day changes of the surface of Mars [1, 5-8].

In particular, the database was used to study the contemporary activity of dark slope streaks and gullies, which represent the most widespread active processes on the present-day martian surface [e.g., 7, 10]. 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 [5] (Fig. 2). Furthermore, slope streak triggering was analyzed on the basis of high-resolution preview images [6, 11]. 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 [12] and gas flows [13], dust devils [8], as well as strong near-surface winds [10, 14].

For the analyses of martian gullies, the database was used to identify seasonal surface frost and contemporary gully activity [7]. The observed activity at the end of surface defrosting 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 [7].

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 [8].

Upcoming datasets

Due to continuous data acquisition by spacecrafts, the amount of planetary image data is steadily increasing and enables further comprehensive analyses of planetary surface changes. Furthermore, the flexible structure of MUTED allows a fast integration of upcoming data sets, e.g., from BepiColombo [15, 16], Europe's first mission to Mercury.

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