A New Level 3 HRSC Image Mosaic of Mars

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Introduction: The HRSC onboard Mars Express has been operational in Mars orbit since January 2004 and has ever since been acquiring images with both color and photogrammetric stereo. One main mission goal for the instrument is the creation of a global high resolution digital terrain model (DTM) and a global dataset of high quality digital image mosaics using these DTMs as a geometric basis [1]. These HMC-30 (HRSC Mars Chart) image mosaics combine a very high geometric accuracy with a resolution superior to other global datasets. In addition, the images in each mosaic are Lambert corrected, brightness adjusted, and all have all been contrast adjusted to ensure a homogenous general appearance [2].

These Level 5 image mosaics have a resolution of 12.5m/px and are produced in grayscale and in pan-sharpened color.

The HRSC Level 5 image mosaics are based on images orthorectified on the high-quality 50m/px block-adjusted digital terrain models derived from HRSC data. The creation of the Level 5-Mosaics is ongoing

The current goal is the completion of all Level 5 image mosaics until end of 2023.

Level 3 MC mosaics: The additional HRSC image mosaics based on Level 3 data (50m/px) are an intermediate step and allow image sorting and contrast optimization independently of the complex and time-intensive Level 5 processing [3]. The Level 3 images are orthorectified using the MOLA DTM and are created automatically directly after data downlink. With their lower geometric accuracy, they are not suited for color processing. Because of the lower precision of orthorectification, Level-3 colour composites tend to show fringing artefacts at topographic feature boundaries. For this reason, this mosaic is processed only from the nadir-pointing panchromatic images

The approach to determine image adjustments independently of the finalized Level 5 data greatly reduces lag time, and based on the Level 3 processing input files, a complete Level 5 mosaic can be produced within a week after the data becomes available. The complete set of equatorial quadrangles (Mars Charts MC-08 to MC-23) has now been completed and is available for download and for GIS integration.

New Map Chart organization: In the past, the mosaics were selected following the quadrangles in the MC-30 Mars Chart scheme. This approach was changed to better account for the north-south image extent and overlaps. Instead of creating one MC quadrangle at a time, the adjacent half quadrangles north and south of the equator are processed as a unit. This greatly reduces the number of images overlapping from one mosaic into the adjacent, and facilitates consistent contrast adjustment along-strip.

Gap fill: In HRSC Level 3 images, image gaps have been automatically filled with interpolated values. To bridge these gaps, the interpolated data is clipped and replaced by data from a suitable HRSC stereo or photometry channel. The data used for replacing is specified in the input parameters file.

Updating strategy: The HRSC is still operational and actively acquiring images. Images acquired since the image selection for a mosaic have not been added later. With the completion of the Level 3 mosaics of the equatorial regions, it was decided to update all mosaics. The mosaics are amended with those images acquired up to a fixed date, ensuring a consistent level of completeness.

A QGIS workflow was developed to ensure that all images would be placed at an optimal order, both in terms of image resolution as well as quality, and that all images would be inspected before adding them to the mosaic.

In the standard HRSC quadrangle mosaic creation process, the images are sorted by projected ground resolution [2,3]. The final sequence is modified by providing an „effective ground resolution“ in the input file for the mosaicking software, enabling lower quality

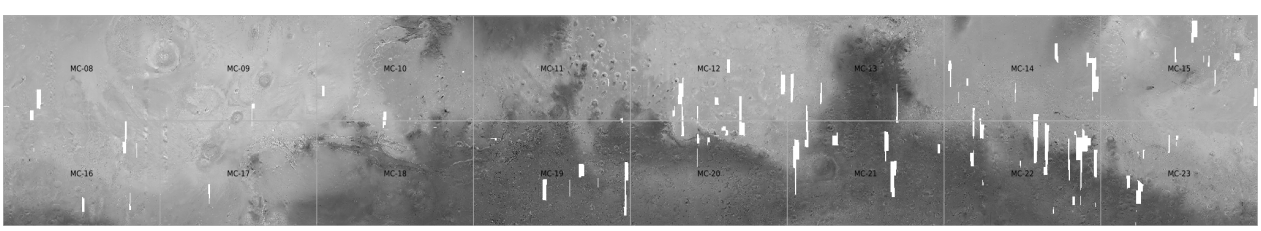

Figure 1: Level 3 HRSC mosaics currently (January 2022) available on the Mapserver at FU Berlin (https://maps.planet.fu-berlin.de/).

images to be moved downward from their nominal position in the image sequence.

The new observations are also inserted by default according to their projected ground resolution. In addition, a copy of the new images is displayed on top of the mosaic and with colorization. This way, these images can easily be identified to be compared with those used in the existing mosaic. If the image quality is considered an improvement for the mosaic, its optimal position in the image stack is determined. For all new images, the necessary contrast adjustments are determined and recorded for processing.

Mapserver: A central tool for the distribution of HRSC data is the HRSC Mapserver hosted at Freie Universität Berlin [4]. Every finished MC mosaic quadrangle is integrated into the Mapserver. The Level 3 mosaics are now also made available for use in COG (Cloud-Optimized GeoTIFF) format [5]. These files can be accessed remotely without the need for downloading and can be easily be added as layers in QGIS or other software supporting this file type. The COG format makes it possible to integrate the data into an existing GIS without requiring the download of the entire dataset. For use in ArcGIS, a VRT file is also made available. If required , the data is also available for download.

Map Links:
COG file (QGIS and others):
https://maps.planet.fu-berlin.de/level3/hrsc3-mos.tif
ArcGIS VRT file:
https://maps.planet.fu-berlin.de/level3/hrsc3-mos.vrt
Total download size of the dataset is around 60 GB.
HRSC Mapserver at Freie Universität Berlin:
https://maps.planet.fu-berlin.de/

Outlook: The updating and release of all equatorial quadrangles is planned for the first months of 2022. All HRSC Level 3 mosaics for the mid-latitudes are to be published until the end of 2023. It is expected that a number of new block adjusted DTM mosaics and Level 5 image data become~~s~~ available in the near future. The corresponding high-resolution image mosaics will be available shortly afterwards in both grayscale and color.

References:

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