HRSC ON MARS EXPRESS – IMAGING FOR PUBLIC OUTREACH: GLOBAL COLOUR MARS VIEW.

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Introduction: Since the launch of Mars Express 16 years ago the Planetary Sciences and Remote Sensing Group of Freie Universität Berlin has been producing public outreach imagery for the Mars Express' High Resolution Stereo Camera (HRSC) [1], [2]. Among these are orthorectified high resolution colour images of selected regions on Mars, colour-coded digital terrain models and anaglyph images. Further we provide perspective colour views and virtual flights over the surface of Mars in plain and stereoscopic high definition video based on HRSC single orbit data or multi-orbit mosaics. These products can be downloaded from our webpage [3].

Data Processing:
Based on unorthorectified level-2 data the nadir and colour image strips of this global orbit are stretched to fit both visible horizons into a sphere's shape while maintaining best resolution. Due to the highest resolution of the nadir image it will be taken as a geometric registration reference for the red, green and blue colour channel to achieve a uniform geometry without colour offsets. During an automatic ENVI procedure a sufficient number of tiepoints between each colour image and the nadir image are generated to subsequently correct colour channels for local and global image distortions compared to the nadir image. As the atmosphere progressively obscures detail of the surface the closer it comes to the horizon a flipping channel approach (manually shifting an image region in x, y until it fits to the reference while showing both images in an alternating manner) in addition has been used for these areas.

A colour composite is then derived from all geometrically corrected colour channels which is then merged with the high resolution nadir channel (pan sharpening) to obtain best detail and contrast.

Recently, a series of orbits for such global image data have been performed to achieve consistent global colour aiding to compensate for colour variations among single orbit strips used for global mosaicking.

Description:
This planetary horizon to horizon sweep (Fig. 1) uses HRSC data from 17 June 2019 acquired during orbit 19550 with a ground resolution of approx. 1 km per pixel. The image is centered at 44° East and 26° North. The upper part of this global view of Mars shows the northern hemisphere and the North Pole ice cap in winter.

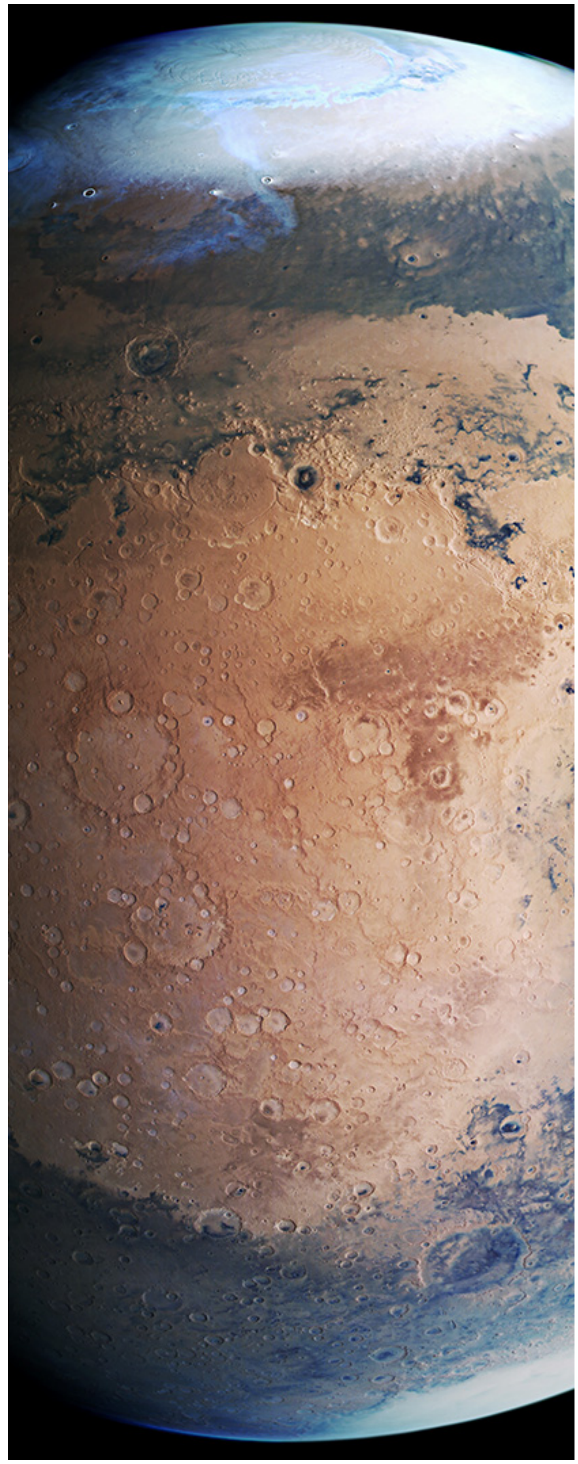

Figure 1: Global colour Mars view. Credits: ESA/DLR/FU Berlin

A thin veil of clouds stretches from there across the adjoining deep valleys, some of which are covered with dark sand. A prominent escarpment is visible in the image. This marks the border between Mars' northern lowlands and its southern highlands. Dark sands also cover some areas of the crater-strewn highlands. In the extreme south (bottom) of the image, part of the Hellas impact crater is visible, covered by white clouds. The view of the planet is slightly tilted towards the south, allowing the North Pole to be seen, but it only extends down to 40 degrees south. The South Pole is therefore not visible.

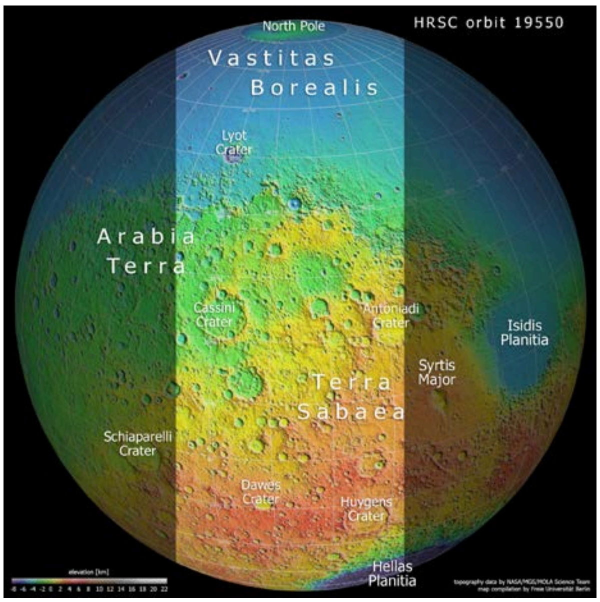

Figure 2: HRSC orbit coverage on Mars Orbiter Laser Altimeter (MOLA) map. Credits: NASA/MGS/MOLA Science Team, FU Berlin

The reddish plains of Arabia Terra and Terra Sabaea in the centre of the image are notable for the presence of many large impact craters, indicating that they are among the oldest regions on Mars. Along their northern border is a striking escarpment, with a difference of several kilometres in height. This separates the flat, barely cratered plains of the northern lowlands from the southern highlands, which have many more craters. This remarkable change in terrain, referred to as the Martian dichotomy, marks a fundamental topographical and regional division on Mars. This is reflected, most importantly, in the different crust thicknesses, but also extends to the magnetic properties of the crust and its gravitational field. There is still a certain amount of scientific debate over how this crust dichotomy came about. It could have originated from endogenous forces in the Martian interior and thus been caused by mantle convection or tectonics. If exogenous (external) forces were responsible, this effect could perhaps be traced back to one or more major asteroid impacts.

The intensely rugged landscape at the dichotomy boundary has been severely eroded over millions of years, and is now characterised by numerous tectonic faults, mesas and river valleys. Observations have revealed that fluvial, aeolian and, in particular, glacial processes have altered the transition zone. Analysis of the image data suggests that there may have been several episodes of glacial activity during the evolution of Mars [4].

References:

[1] Neukum, G. and Jaumann, R. (2004) ESA SP, 1240, 17-35.
[2] Jaumann, R. et al. (2007) PSS, 55, 928-952.
[3] www.planet.geo.fu-berlin.de/eng/index.php
[4] www.geo.fu-berlin.de/en/geol/fachrichtungen/planet/press/2019_total_mars/_content/text_kompakt/index.html

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