IMAGE ENHANCEMENT AND MOSAICKING FOR HIGH QUALITY PUBLIC AND EDUCATIONAL OUTREACH IMAGERY OF PLANETARY IMAGE AND ELEVATION DATA. B. P. Schreiner[1] and G. Michael[1], [1]Planetary Sciences and Remote Sensing Group, Institute of Geological Sciences, Freie Universität Berlin, Malteser Str. 74-100, 12249 Berlin, Germany (bjoern.schreiner@fu-berlin.de, gregory.michael@fu-berlin.de).

Abstract: At the Planetary Sciences and Remote Sensing Group of Freie Universität Berlin a major part of public outreach imagery of the Mars Express' High Resolution Stereo Camera (HRSC) [1], [2] is produced. 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 data. These products can be downloaded from our webpage [3].

Introduction: For every successful mission funded with a fair amount of public money there should be the obligation, certainly apart from producing valuable science results, to deliver impressive and hopefully easy to understand images to the interested public, especially if a mission has as powerful a camera as the Mars Express' HRSC on board. At the Institute of Geological Sciences' Planetary Sciences group we have accompanied this mission since the first image data arrived from Mars in 2004. During that time several methods have been used and developed to provide a range of image products derived from raw data. By now about 98% of Mars' surface has been covered resulting in a wide variety of features encountered on the planet which include impact craters, valleys, volcanic activity, source regions, aeolian phenomena, glacial and icy landforms and tectonism. HRSC delivers a ground resolution of up to 12.5 metres/pixel for the highest resolution nadir channel.

Image products and techniques: In a batch processing of VICAR [4] commands a group of othorectified images are cut out of the orginal level-4 orbit strip and scaled to equal size. These are the high resolution nadir, three colour channels and the corresponding digital terrain model (DTM). To achieve *high resolution colour images* a composite of the red, green and blue colour channels are pan-sharpened with the nadir channel by IHS transformation. After that, due to slight changes in colour by this transformation nonlinear histogram stretches on each colour are applied to regain the initial colour. As digital terrain models have a significantly lower resolution than the corresponding nadir images, we employ a local edge based terrain adjustment to achieve enhanced DTM detail for sharp surface features as crests, ridges or rims.

For *the colour-coded DTM* (Fig. 3) surface elevation is coded as different colours following an adjustable look-up table allowing to provide a maximum of height distinction. The result is merged with the corresponding high resolution nadir image, which has been histogram stretched for optimal contrast.

Derived from level-2 data is the *anaglyph image* which is composed of the nadir channel and one of the stereo channels providing an almost natural 3D-impression due to the fact that these images are derived from two different along-track camera positions. In case of flat terrain the two stereo channels are used instead to substantially enhance perceived terrain dynamics.

Draping high resolution colour over the digital terrain model a *virtual oblique view* (Fig. 4) is generated where adjustment of the virtual camera position, height exaggeration and lighting among other settings allow us to find interesting scene compositions. This is done with Lightwave Software [5].

For larger scenes several orbits are mosaicked (Fig, 1), which geometrically in most cases works very satisfactory due to overall orbit adjustments. But as illumination, viewing angles and atmospheric conditions can vary considerably, a large amount of colour and histogram adjustment is often necessary to ensure seamless transitions between orbits (Fig. 2). This is accomplished either manually or automatically. Also the appropriate choice of orbits available may strongly influence the quality of the resulting *mosaic*. For cutting out colour edges from colour composit orbit stripes and other recurring operations IDL [6] batch programs are used when large quantities of orbits need to be preprocessed for mosaicking.

Finally, the virtual view can be extended to a *movie* by programming a virtual camera movement and calculating the camera view frame-by-frame along its track through the scene, which can also be stereoscopic.

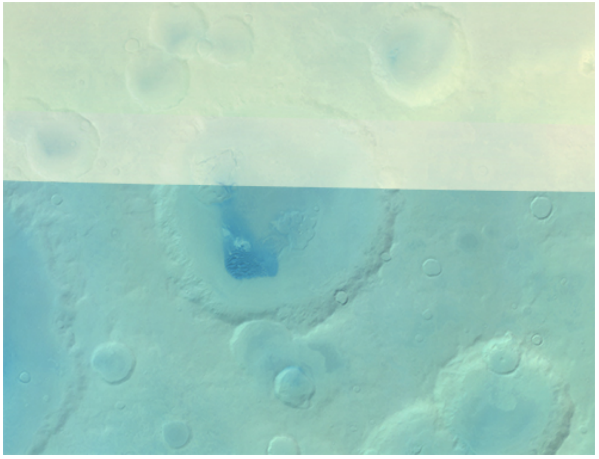

Fig. 1: Mosaic of 3 unprocessed Orbits (Neukum Crater).

Fig. 2: Above mosaic processed, North direction to the right.

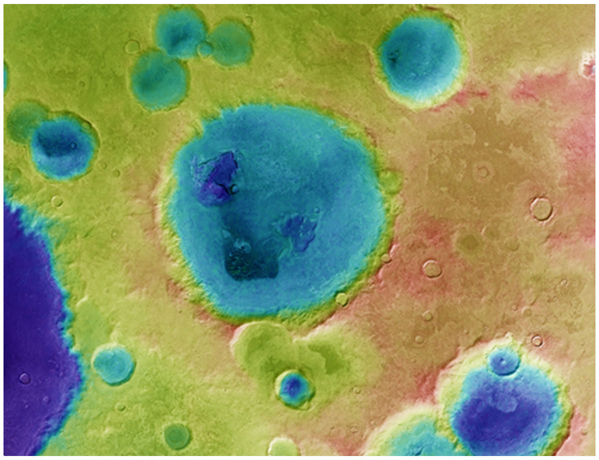

Fig. 3: Colour-coded DTM (same area). Height range approx. 3500m.

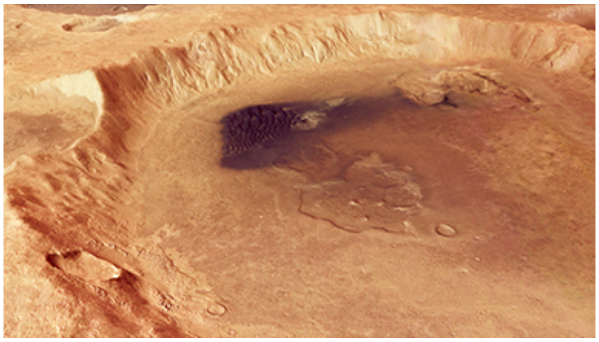

Fig. 4: Perspective view of Neukum Crater mosaic.

References: [1] Neukum, G. and Jaumann, R. (2004) ESA SP, 1240, 17-35. [2] Jaumann, R. et al. (2007) PSS, 55, 928-952.
[3] http://www.planet.geo.fu-berlin.de
[4] http://www-mipl.jpl.nasa.gov/vicar.html
[5] https://www.lightwave3d.com
[6] http://www.exelisvis.com

Acknowledgements: We acknowledge funding by the Space Administration of the German Aerospace Centre (DLR) with means of the Federal Ministry for Economic Affairs and Energy. We also would like to thank D. Neu for processing level-4 data.