HRSC ON MARS EXPRESS – IMAGE MOSAICKING FOR PUBLIC OUTREACH: KOROLEV CRATER.

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Introduction: Since the launch of Mars Express 15 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].
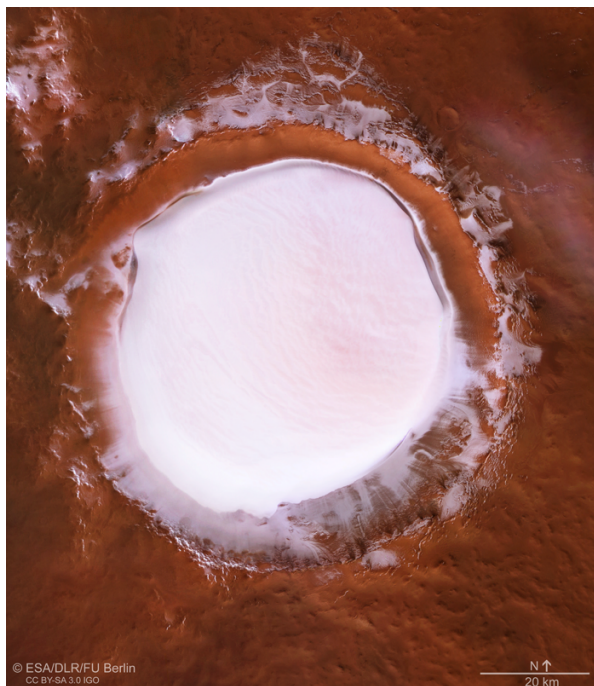

Figure 1: Korolev Crater Colour Mosaic.

Data Processing:
Based on orthorectified level-4 data the image strip of an orbit is cut to include the area of interest. From the red, green and blue channel a colour composite is derived which is then merged with the high resolution nadir channel (pan sharpening) to obtain best detail. For anaglyph images nadir and stereo channels (level-2

data) are combined to create a true stereoscopic view as seen from different camera positions. Within the standard product line all non-colour channels (stereo, photometric, nadir) contribute to the calculation of the digital terrain model, which is needed for virtual perspective views of a scene. To cover a larger area on the surface it is necessary to combine two or more adjacent orbits if these are available. The challenge with this so-called mosaicking is to adjust the corresponding images, which spotted the surface at different daytimes and seasons, with different illumination angles, and different atmospheric conditions, with different resolution, to result in an overall uniform representation. This means local colour and contrast balancing between and within neighboring orbits and careful selection of these if multiple coverage is available. Due to uncertainties in camera position and resulting geometric offsets between orbit images, for a mosaic these need to be processed from scratch to make use of overlapping regions (bundle block adjustment). After adjusting colour and nadir images of all orbits separately these are merged to a high resolution mosaic. Together with the orbit adjusted terrain model mosaic, perspective views can be produced and sequencing these along a virtual flight track delivers a movie.

Our Korolev crater mosaic (Fig. 1) uses HRSC orbits 1412, 5726, 5654, 5692, 18042 for terrain generation and orbits 5726 and 18042 from all available colour orbits (Fig. 2) for colour mosaicking. Draping the mosaic over the terrain model gives a perspective view of the scene (Fig. 4). Korolev crater is located in Utopia Planitia at 165°E, 73°N and has a diameter of 82 km.
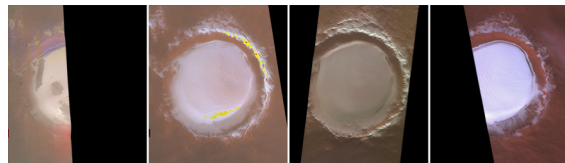

Figure 2: HRSC images from orbits 1412, 5726, 5692 and 18042.

Ice Volume Measurement: A slope map derived from the terrain model (Fig. 3) has been produced to determine the morphologic limits of the ice mound, seen as a bright ring (flat slope) around the central

concave structure within Korolev crater. As a next step the surface within the ring around the ice body was linearly interpolated from edge to egde to define the supposed crater floor. Substracting this ground surface from the original terrain gives a volume estimation of about 2400 km^3 for the ice body, which is roughly the water content of the Great Bear Lake in Canada. This number lies between estimated values from other authors: 1356 km^3 [4] and 3848 km^3 [5].
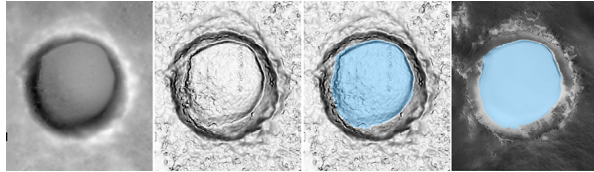

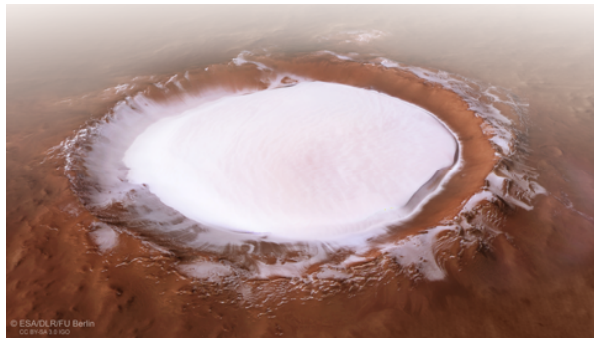Figure 3: Ice volume measurement: Terrain model, slope map, masked ice in blue, nadir image with mask.

Figure 4: Oblique view of Korolev crater.

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/eng/index.php
[4] Garvin, J.B. et al. (2000) Icarus, 144, 329-352.
[5] Conway, S.J. et al. (2012) Icarus, 220, 174-193.