EPSC Abstracts
Vol. 11, EPSC2017-591, 2017
European Planetary Science Congress 2017

High-resolution topography from MESSENGER orbital stereo imaging – The Southern hemisphere

F. Preusker (1), J. Oberst (1,2), A. Stark (1), K.-D. Matz (1), K. Gwinner (1) and T. Roatsch (1)

(1) German Aerospace Center, Institute of Planetary Research, Department of Planetary Geodesy, D-12489 Berlin, Germany (Frank.Preusker@dlr.de), (2) Technical University Berlin, Institute for Geodesy and Geoinformation Sciences, Berlin, Germany

1. Introduction

The MErcury Surface, Space ENviorment, GEochemistry, and Ranging (MESSENGER) spacecraft entered orbit about Mercury in March 2011 [1] to carry out a comprehensive topographic mapping of Mercury. Measurements of Mercury's topography have been made with stereo imaging [2,3], laser altimetry [4], limb profiling [5], and radio occultation [6]. We are concerned with the production of high-resolution digital terrain models (DTM) using stereo photogrammetry. While we recently reported about the production and delivery of DTMs for the northern quadrangles H6 "Kuiper" [7], H3 "Shakespeare", H5 "Hokusai", and H7 "Beethoven" [8-10], we now report about the status of Mercury's Southern hemisphere quadrangles (Fig. 1).

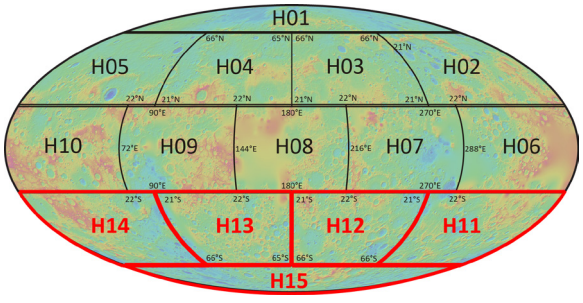

Figure 1: Mercury's 15 tiles quadrangle scheme. The selected Southern hemisphere quadrangles H11 – H15 are highlighted in red.

2. Data

The Mercury Dual Imaging System (MDIS) onboard MESSENGER spacecraft consists of a wide-angle camera (WAC) and a narrow-angle camera (NAC) co-aligned on a pivot platform. In almost 4 years MDIS has acquired more than 200,000 images to map the surface. Owing to MESSENGER's highly eccentric near-polar orbit, the WAC is primarily used for the northern hemisphere and the NAC to cover the southern hemisphere, respectively.

3. Method

The stereo-photogrammetric processing for Mercury is based on a software suite that has been developed within the last decade and has been applied successfully to several planetary image data sets. The suite comprises photogrammetric block adjustment, multi-image matching, surface point triangulation, DTM generation, and base map production.

4. Results

Each quadrangle tile contains between 8000 and 15,000 individual images. Approximately 105,000 images have been used to date. We first corrected for errors in the nominal navigation (pointing and position) data using a photogrammetric block adjustment. This step improved the three-dimensional (3D) point accuracy in all tiles from about ±800 m to about ±50 m. Next, individual image matching runs were carried out to produce tens of billion object points (surface points). The mean ray intersection error of the surface points was ±50 m. Only triple-overlapping images were used for the matching. Then, we generated a DTM for each tile with a lateral spacing of 192 pixel per degree (~222 m/pixel) and a vertical accuracy of about 50 m (Fig. 2.). Finally we will merge all DTMs.

Acknowledgements

The MESSENGER project is supported by the NASA Discovery Program under contracts NASW-00002 to the Carnegie Institution of Washington and NAS5-97271 to The Johns Hopkins University Applied Physics Laboratory. We thank MESSENGER's MLA and MDIS team members for their support, especially Susan Ensor, Haje Korth, Erwan Mazarico, Gregory Neumann, Michael Reid, and Sean Solomon.

References

[1] Solomon S.C et al.: Mercury after six months of MESSENGER orbital observations, EPSC-DPS Joint Meeting Abstracts and Program, abstract EPSC-DPS2011-430, 2011.

[2] Oberst J. et al.: The morphology of Mercury's Caloris basin as seen in MESSENGER stereo topographic models, Icarus, 209, 230–238, 2010.

[3] Preusker F. et al.: Stereo topographic models of Mercury after three MESSENGER flybys, Planet. Space Sci., 59, 1910–1917, 2011.

[4] Zuber, M.T. et al.: Topography of the Northern Hemisphere of Mercury from MESSENGER Laser Altimetry, Science, 336, 217-220, 2012.

[5] Elgner S. et al.: Mercury's global shape and topography from MESSENGER limb images, Planet. Space Sci., 103, 299-308, 2014.

[6] Perry M.E. et al.: Measurement of the radius of Mercury by radio occultation during the MESSENGER flybys, Planet. Space Sci., 59, 1925-1931, 2011.

[7] Preusker et al. et al.: Toward High-Resolution Global Topography of Mercury from MESSENGER Orbital Stereo Imaging: A Prototype Model for the H6 (Kuiper) Quadrangle, Planet. Space Sci., in press, 2017.

[8] Preusker et al. et al.: High-Resolution Topography from MESSENGER Orbital Stereo Imaging – The H3 quadrangle „Shakespeare", LPSC, 48, 1441, 2017.

[9] Stark et al. et al.: High-Resolution Topography from MESSENGER Orbital Stereo Imaging – The H5 quadrangle „Hokusai", LPSC, 48, 2287, 2017.

[10] Oberst et al. et al.: High-Resolution Topography from MESSENGER Orbital Stereo Imaging – The H7 quadrangle „Beethoven", LPSC, 48, 1442, 2017.

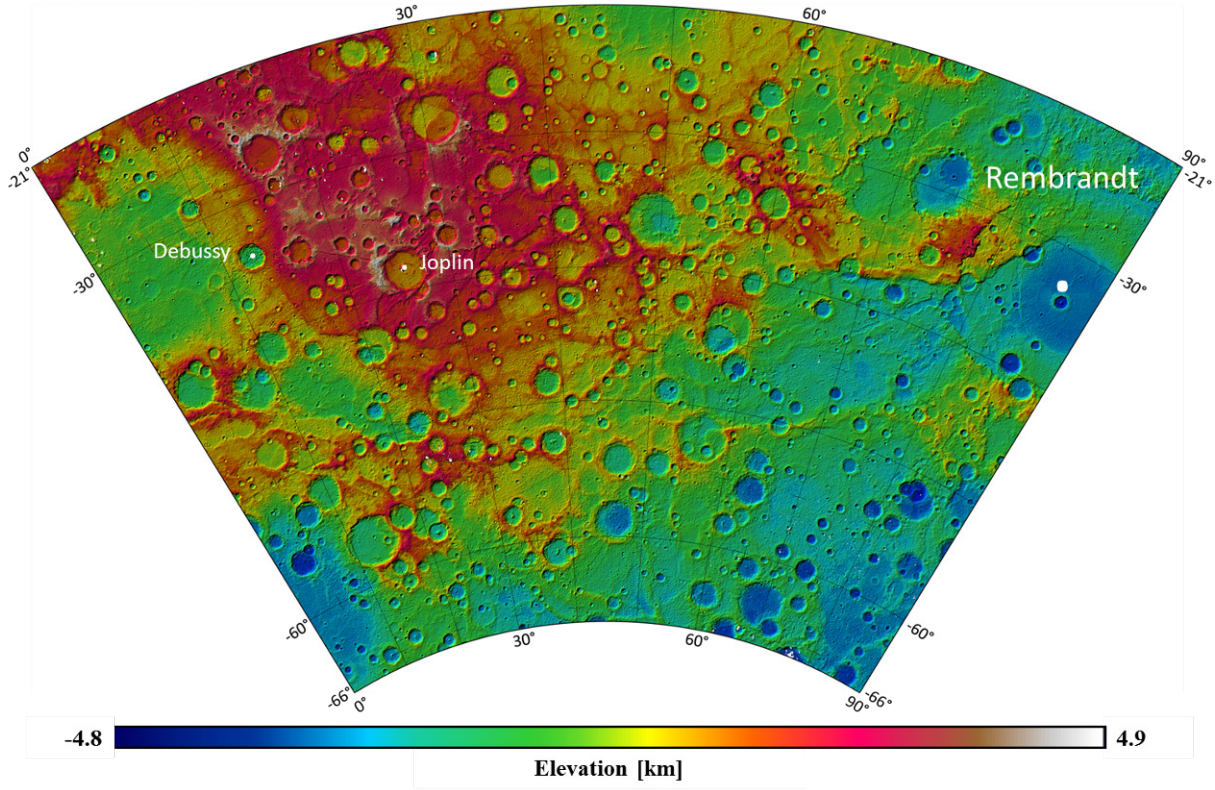

Fig. 2. H14 ("Debussy") quadrangle DTM (hill-shaded color-coded heights) with a lateral spacing of 192 pixel per degree (~222 m) in Lambert two-parallel (conformal) projection.