Mapping and GIS-Analyses of the Lunokhod-1 Landing Site. E. Gusakova[1], I. Karachevtseva[1], K.Shingareva[1], J. Oberst[1,2,3], O. Peters[2], M.Wählisch[2], and M. S. Robinson[4]. [1]Moscow State University of Geodesy and Cartography (MIIGAiK), Gorokhovskiy per., 4, 105064, Moscow, Russia; [2]German Aerospace Center (DLR); [3] Technical University of Berlin, Germany; [4]Arizona State University, USA

Introduction: The Soviet spacecraft Luna 17 was launched towards the Moon in November 1970 and deployed Lunokhod-1, the first rover to explore an extraterrestrial surface. Until October 1971, Lunokhod-1 acquired about 20,000 TV pictures and 206 stereo images along its traverse [1]. Using recent new high resolution images we mapped the landing site and traverse route, using automated GIS-oriented mapping.

Sources: We used high resolution Digital Elevation Model (DEM) and orthoimage from photogrammetric processing of Lunar Reconnaissance Orbiter Camera (LROC) Narrow Angle Camera (NAC) stereo images [2] with a spatial resolution of 0.5 m/pixel (M150749234, M150756018).

GIS-analyses of the Lunokhod-1 area: We identified about 99% of the Lunokhod's wheel tracks in the orthoimage, which we determined to be 9.5 km long. About 1% of the traverse (150 m) is in shadow in the images we used. We built a vertical profile along the traverse indicating that heights of lunar mare surface along the profile range from -2488.4 m to -2462.3 m (see red points in *Fig.1 and Fig.4*). With high probability we identified coordinates of surveying points (*Fig.2*) from where stereo images were acquired which had been used for large-scale topographic mapping in the early mission (*Fig.3-a*). Also, we digitized craters in the Lunokhod traverse area using CraterTools for ArcGIS [3]. We created a crater catalog as geodatabase which now consists of about 45 000 crater objects and includes their diameters and depths, obtained from the DEM. The crater statistical data allow us to carry out in-depth geomorphological analyses (*Basilevskiy et al, 43th LPSC, these Proc.*). Using GIS tools we also calculated various morphometric parameters of the Lunokhod-1 area (about 8.75 sq. km), including topographic roughness, crater spatial and cumulative densities [4]. Slopes were calculated in GIS (*Fig.3-b*) and show good agreement with the slopes from the earlier topographic maps [1].

Lunokhod-1 mapping: The DEM and the orthoimage were used to map the Lunokhod traverse rover (*Fig.4-a, purple line*) from the spacecraft landing site (L) to the final resting position (F). Other representations include colored relief (*Fig.4-b*), height contours and thematic data from the crater geodatabase.

Conclusions: The aim of our future work is a more detailed GIS analyse using complementary images in the same area taken under different viewing and solar elevation angles. The LRO NAC provide an important information for research in morphologies of small craters, which could be compare with results of mapping that had been carried out during the Lunokhod-1 mission. We conclude that LRO NAC images can be used for cartography support at high level of detail for characterization of future landing sites such as LUNA-GLOB and LUNA-RESOURCE.

Reference: [1] Barsukov V.L. et. al. (1978) Peredvijnaya laboratoriya na Lune Lunokhod-1, Vol. 2. *Nauka* (in Russian). [2] Oberst J. et al. (2010) *LPSC XLI, Abstract #2051*. [3] Kneissl T. et al. (2011) *Planet. Space Sci., 59*, 1243-1254. [4] Karachevtseva I. et al. (2011) *The Book of Abstracts of the 2-nd Moscow Solar System Symposium (2M-S[3]), Space Research Institute (IKI)* P. 113-114.

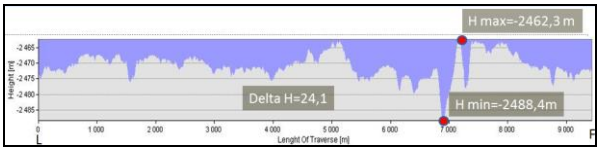
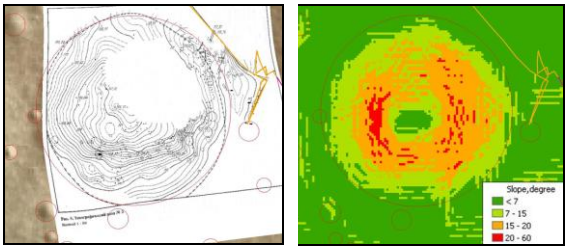


Figure 1. Vertical profile along the traverse

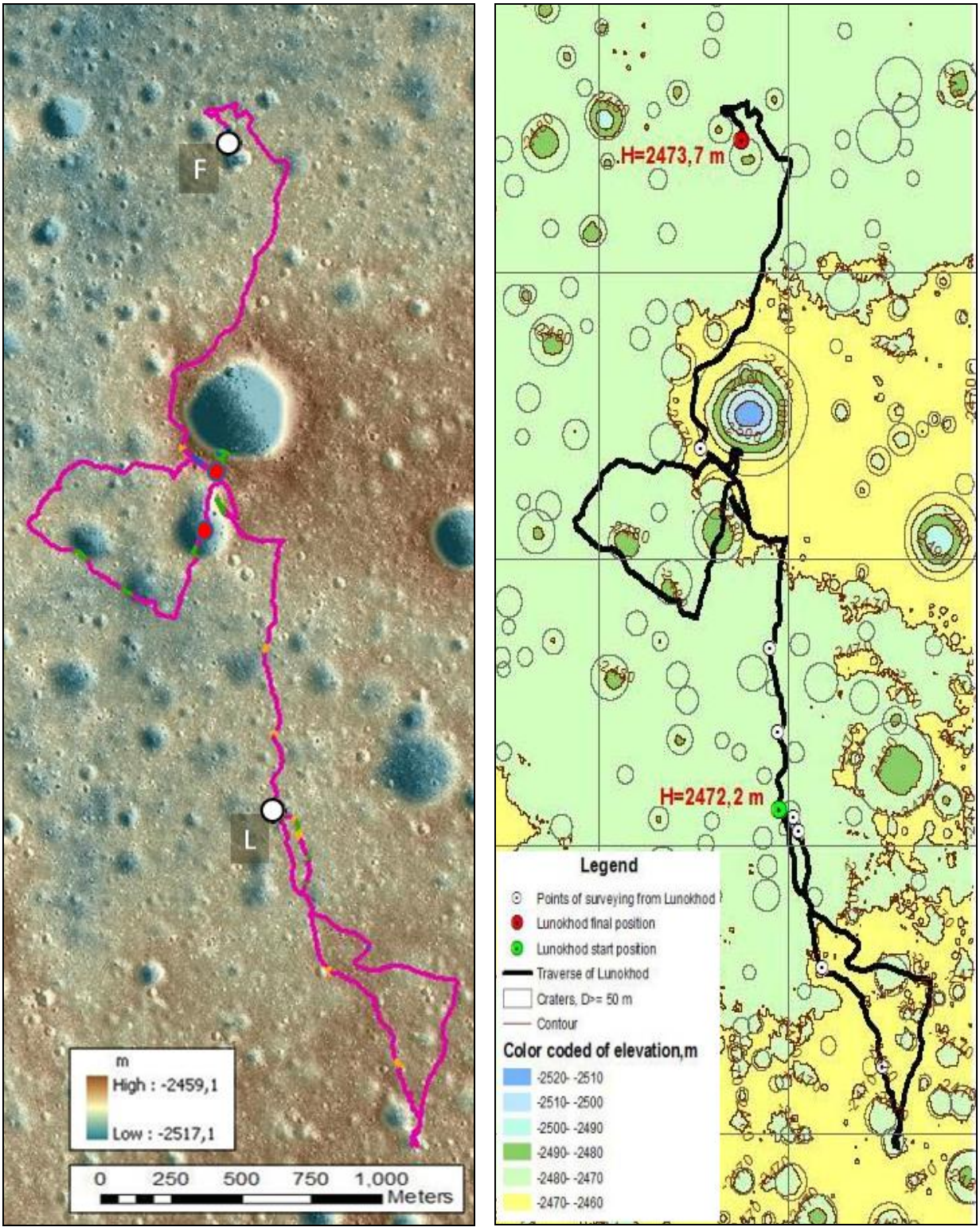
Date	Name of points	Longitude	Latitude
17.11.70 1 Lunar day	Landing site of Luna-17	-34°,998775	38°,236749
13.12.70 2 Lunar day	Large-scale map № 3-1	-34°,993811	38, ° 219254
13.12.70 2 Lunar day	Large-scale map № 3-2	-34°,993801	38°,219246
29.09.71 11 Lunar day	Final Position of Lunokhod-1	-35°,007964	38°,315158

Figure 2. Coordinates of 2 surveying points, spacecraft landing site and Lunokhod-1 final position obtained from GIS measurements



a *b*

Figure 3. Sample of the Geodatabase: (a) Referencing and loaded into GIS large-scale map №3 derived from Lunokhod-1 stereo images (inner slopes varies between 16°-22°[1]); (b) Slope map of the crater corresponding the large-scale map № 3



a *b*

Figure 4. Lunokhod-1 area map: (a) Mapping using color shaded relief; (b) Mapping using crater geodatabase (Stereographic Projection, Central meridian -35°, Latitude 38°)