

Lunar and Mercury morphometric crater catalogues (diameter 1-10 km)

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Abstract

The work presents first results and future plans in creation of Lunar and Mercury crater catalogues for analysis of morphologic peculiarities of craters and comparative studies of extraterrestrial territories.

1. Introduction

The work is aimed at getting the new information about morphology of the Moon and Mercury via studying morphometric parameters of craters. We suppose that quantitative measurements of craters' characteristics will give new opportunities for comparative analysis of the Moon and Mercury.

2. Methods and Techniques

Generation of a morphometric catalogue can be presented in several steps.

First step is manual visual identification of craters using orthomosaics or/and DTMs. Assuming that the majority of craters have circle rim, we are trying to draw crater boundary at the highest points of the rim (Fig. 1). For this step we are using ArcGIS CraterTools software [1] and as a result we obtain a catalogue with position and diameters of craters.

Second step includes calculation of main morphometric parameters, such as maximum steepness on inner slopes and crater depth. To determine slope steepness we use DTMs and simple combination of ArcGIS functions. Measurement of depth is more challenging because it is highly influenced by relief of the surrounding surface. So we suggest using special program modules:

- d/D Calculation [2]
- CraMo [3]

These two modules are using different algorithms for calculation of crater depth, so they can complement each other and verify the results. Combining coordinate catalogue with computed parameters we

obtain morphometric catalogue. However, automated measurements still work not for all craters. For craters which intersect or lay on each other, highly degraded craters, or craters located on inclined surface the algorithms may fail. So, not all craters with selected size have morphometric parameters in our catalogue. We are working to improve the technique for crater measurements.

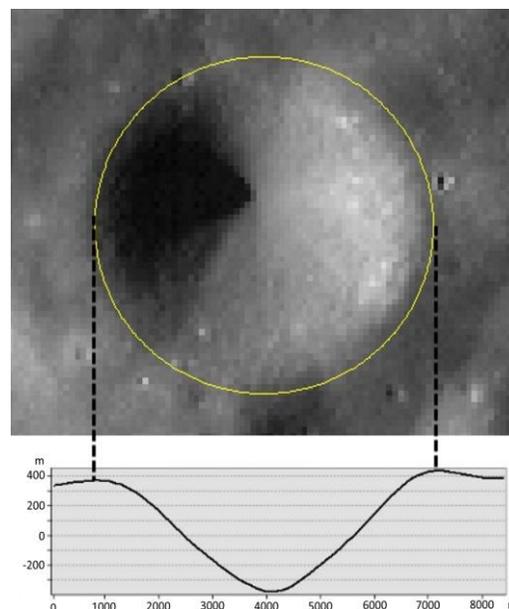


Figure 1: Visual identification of craters.

3. Lunar Crater Catalogue

We have completed global morphometric catalogue of Lunar craters 1-10 km in size which includes about 300 000 craters [4].

Crater identification was based on WAC_GLOBAL orthomosaic with pixel size 100 m. Morphometric parameters were determined based on DEMs with the same resolution: LDEM45 for polar areas and GLD100 for the rest parts. Such resolution of the

input data provided us opportunities to measure craters more than 1 km in diameter.

Such dataset can be used as an instrument for statistics and comparative studies, e.g. Fig. 2 presents depth to diameter ratio (d/D) for craters of studied diameters in some selected mare and highland regions. The graph shows that mare craters have typically higher depth to diameter ratio that is in agreement with theory of slower crater degradation rate in mares.

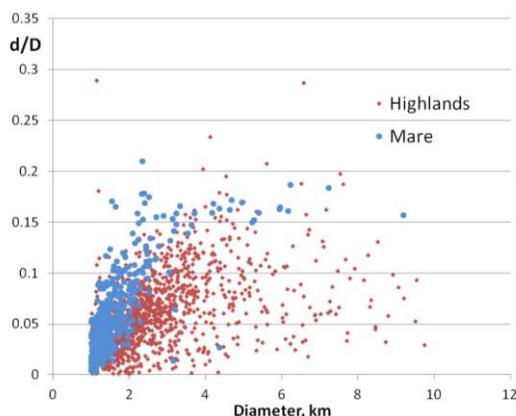


Figure 2: Depth to diameter ratio (d/D) for craters of studied diameters in mare and highland lunar regions.

4. Mercury Crater Catalogue

Existing global Mercury crater catalogue includes craters more than 10 km in size [5]. So in this study we aim to investigate craters less than 10 km.

To create Mercury morphometric catalogue we will use the newest data obtained by MESSENGER spacecraft, such as image mosaics and terrain models, created in 2017 and later, including:

- Global morphology mosaic with resolution 166 meters/pixel (http://messenger.jhuapl.edu/Explore/images/MESSENGER_Mosaics/Monochrome_Morphology_20170512_PDS16_equirectangular_thumb.png) produced from MESSENGER'S MDIS (Mercury Dual Imaging System) Wide Angle camera images.
- Global Mercury DEM with the resolution 665 m/pixel, obtained with the photogrammetric processing of the MESSENGER data [6].

- DTMs on Mercury quadrangles with resolution ~222 m/pixel and a vertical accuracy of about 30 m [7] based on photogrammetric processing of MESSENGER stereo images.

5. Summary and Conclusions

Study of large arrays of craters (ranging in size from 1 to 10 km) based on the morphometric catalogues of the Moon and Mercury will allow evaluation of differences and similarities between the endogenous and exogenous processes, crater morphology and degradation rate at the studied celestial bodies.

Acknowledgements

Creation of Lunar crater catalogue (1-10 km) was supported by Russian Foundation for Basic Research (RFBR), project No. 16-37-00323.

The works on Mercury crater catalogue and surface analysis are planned in the frame of Russian Science Foundation (RSF) project No 18-77-10053.

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