AUTOMATED CREATION OF THE LUNAR HYPSOMETRIC MAP: TECHNIQUES OF COMPILING.

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Introduction. Two types of data were used for the compiling of the hypsometric map of the Moon hemispheres at a scale of 1:10 000 000 (fig.2). The first type is the data obtained by *Clementine* altimeter. This database consists of 1036800 high-altitude points with the precision of $0{,}25^{o}$. And the second one is the database, obtained from the raster images of the Lunar Subpolar regions (higher than latitude ±60°) where brightness of each pixel depends on its height [1].

Techniques of the map compiling. The main method of planets hypsometric maps compiling and particularly of lunar hypsometric maps is the analysis of stereoimages. There are several types of such analysis, for example [1] or [2]. Through the comparing of both these techniques it was shown that the discrepancy between them totals 1 – 2 km [3]. But using these techniques for this work was impossible for two reasons:

1. There were no free available *Clementine* images, which might be used for matching stereoimages and obtaining DEMs;
2. There was no special photogrammetric software like GOTCHA [1] or ISIS [2].

Due to these reasons it was necessary to develop the special 10-stage methodology of data processing and map compiling. The flowchart of this methodology and software used are shown at fig.1.

On the **first stage** it is necessary to obtain the data at the Lunar Subpolar areas located not in the Clementine altimeter coverage. To the effect, raster images all over the north and the south Subpolar regions obtained by A. Cook et.al. [1] were used. Since at these images brightness of each pixel depends on its height it is possible to create DEM of Subpolar regions, i.e. to accomplish so-called backward analysis of these rasters or vectorization of each pixel and then convert brightness into height values.

Editing of database obtained is fulfilled on the **second stage**. The problem is there are black areas with NoData pixels which give wrong height values. To extract and then to remove from the DEM these “black” points and adjacent ones, buffer zones are created round “black” points.

Map projection and scale are assigned on the **third stage**.

Correlation between DEM of Subpolar regions and DEM compiled from the data obtained by *Clementine* altimeter is achieved on the **fourth stage**. The fact is accuracy and number of altimeter points at the lunar Subpolar areas are not high enough [4,5]. According to results of correlation it becomes clear whether it is necessary to merge these DEMs with each other or only to attach them.

Generalization of Subpolar DEMs is fulfilled on the **fifth stage**. For it the special method of “generalization by polygon network” was developed.

On the **sixth stage** two DEMs are attached to each other or merged in a case of high correlation, which had been already estimated on the fourth stage.

Correlation between DEM obtained on the sixth stage and the most up-to-date and precise lunar network ULCN 2005 [6] as a reference model is accomplished on the **seventh stage**. The correlation values were got to be high enough, namely 83,77% for the Nearside and 94,26% for the Farside.

Further, on the **eighth stage**, the map compiling directly begins, i.e., firstly, a high-resolution raster is created on the base of DEM obtained using method of regularized spline and, secondly, vector contours themselves are drawn on the base of this raster. On this stage the contour generalization is fulfilled too and it is important to define the degree of generalization before depending on map scale and print resolution. During this stage height level intervals and colors of height scale are developed as well.

Relief shading, coordinate network and selenographic names are plotted on the map during the **ninth stage** and on the final **tenth stage**, after developing map layout, the map is being printed.

Conclusions. The height data were obtained and the lunar hypsometric map was created according to the 10-stage methodology. This methodology can be used for creation hypsometric maps of other planets with solid surface and their moons.

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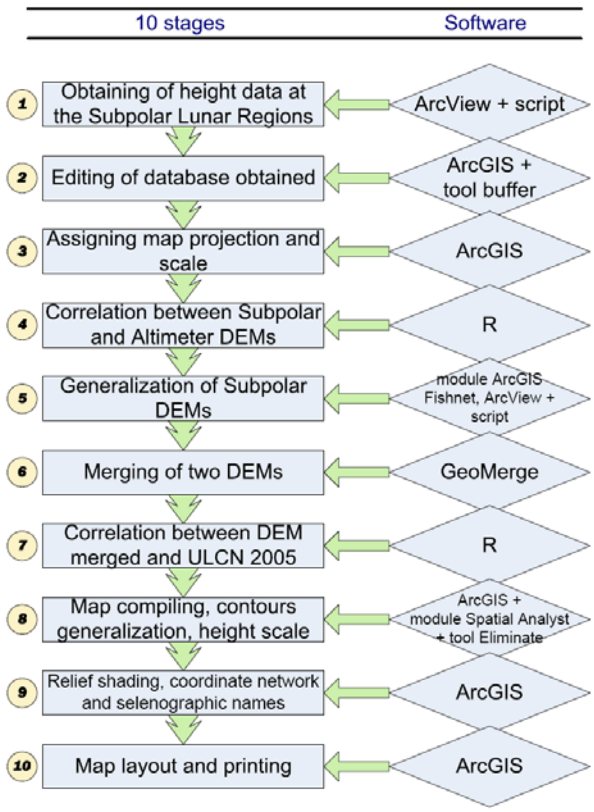

Fig.1. 10-stage methodology flowchart of data processing, map compiling and software used

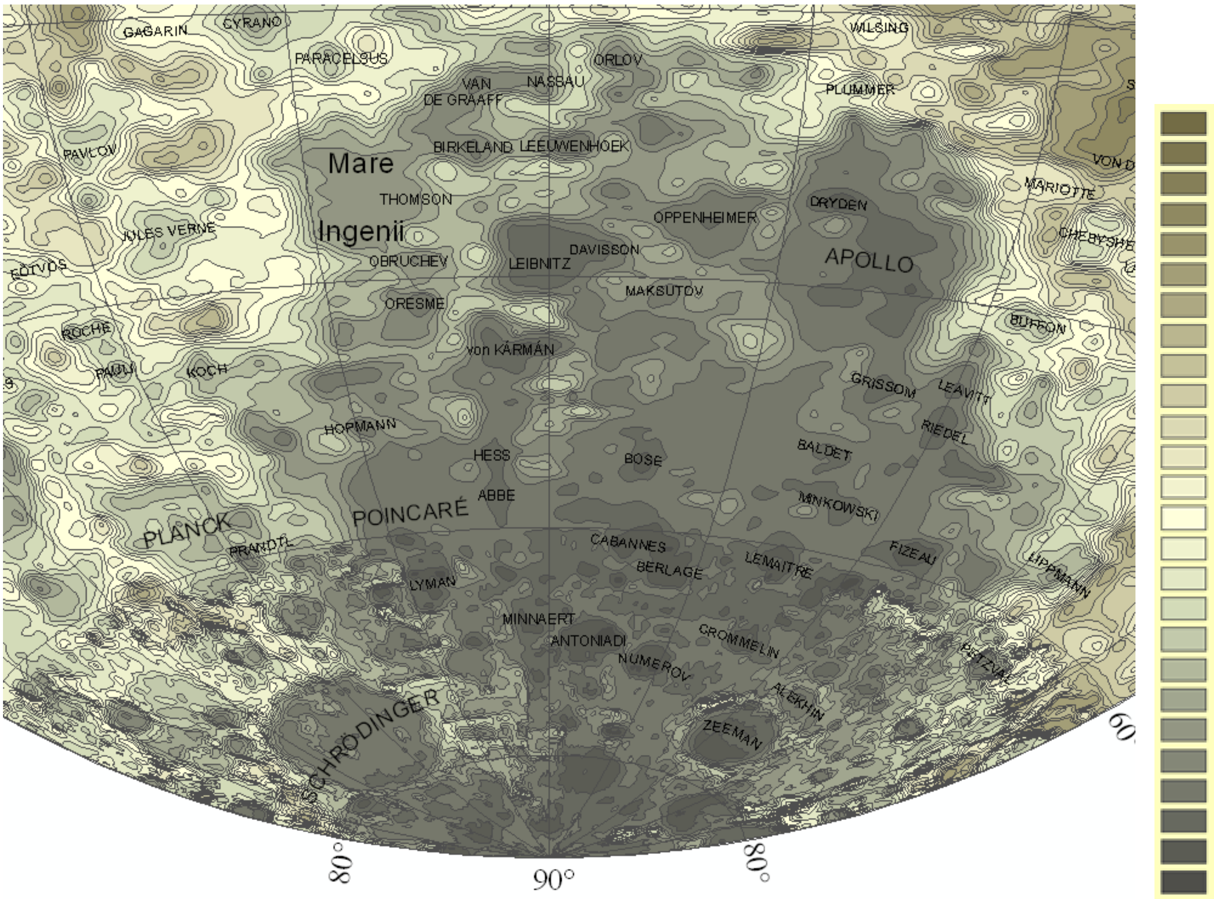

Fig.2. The fragment of the hypsometric map of the Moon (provisional) and the height scale (km)

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