The study of the lunar macro-figure models using multi-parametric harmonic analysis and expansion in spherical functions

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Abstract

© SGEM2017 All Rights Reserved. The present work is focusing on construction and analysis of 5 lunar models using space and ground observations. Firstly, it should be noted that the task of building a model of the lunar macro-figure relative to its center of mass and axes of inertia does not have a definitive solution yet. Within the present work the models of the lunar macro-figure are developed on the basis of space and ground observations. The methods of observation had implied binding of lunar objects to stars, i.e. celestial coordinate system. As observations of that kind the data from "Clementine", "Kaguya", "LRO" space missions, and large-scale photographs of the Moon with stars were used. 5 models were constructed using the software "Automatic System of Scientific Investigation" (ASSI). Based on the results of the work the following conclusions are drawn after the analysis of the constructed models' cross-sections for longitudes λ = -40°, -20°, 0°, 20°, 40°: 1) The mean level of the lunar southern hemisphere is higher than the northern one; 2) The lowering for northern latitudes in the range of 30° - 45° according to the ground observations is of the same order as based on the data from the space missions. Then, however, altitudes taken from the ground observations are starting to increase up to latitudes of 70° - 80°. This leads to significant difference between the shapes of hypsometric curves. 3) The good convergence between cross-sections of the models constructed on the basis of "Clementine" space mission and "KSC-1162" (Kazan Selenocentric Catalogue) is achieved. 4) The results of comparing the relief of the lunar surface based on ground and space images of the Moon and ALSEP system are following: a) Differences in absolute values of altitude for the near northern side of the Moon in the given systems are systematic. In this regard an alternative hypothesis concerning the shape of physical surface of the near side of the Moon has been proposed; b) The results of the analysis of ALSEP experiment data do not reject the proposed new hypothesis about relief lowering of the lunar surface to the North of the parallel + 10 ° relative to the generally accepted level; c) The analysis of space missions data with elements of a spacecraft external orienteering confirms the relief lowering of the lunar surface up to 1,5 km in the area of -70° < λ < -30°, -10° < ψ < -63° relative to the generally accepted level.

Keywords

Lunar macro-figure models, Multi-parametric harmonic analysis, Selenodesy, Space astrometry

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