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Fractal analysis of the earth topographic models using multi-parametric harmonic analysis

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Abstract

© SGEM2017. All rights reserved. The study of the Earth's topographic models has been conducted on the basis of fractal analysis. The mean values of fractal dimension for the Earth's surface on longitudes and latitudes are obtained. It is well known that self-similarity is inherent to many natural objects and space systems; this is why they can be described with fractal dimension – quantitative measure of geometric complexity of a set (an object). Determining fractal dimensions of different objects allows studying not only their structure but processes of their formation as well. During the implementation of the solar system exploration programs a significant amount of data on morphological properties of surfaces, planets' geology and their atmospheres was obtained, and that contributed to formation of comparative planetology aimed at not only developing cosmogonic and evolution concepts, but at detailed understanding of mechanisms underlying the nature of the Earth and its place as an object of the solar system, too. The methods of determining fractal properties-scale invariance (scaling) and objects' self-similarity – allow quantitative describing systems, such as polymers, colloid aggregates, rough and porous surfaces, branching structures, the Earth's surface areas. In the present work results of determining fractal dimensions for inhomogeneous surfaces of the Earth with defining community of their properties are represented. During the construction of the Earth's physical surface model multi-parametric harmonic analysis of altitude data expansion in spherical functions has been used. The fractal analysis of the Earth's surface has enabled us to obtain independent estimates of the Earth's macrostructure which give a new vision of geophysical processes. It has been shown that based on comparative analysis one may conduct a precise investigation of topographic maps and analyze macrosurfaces of reference systems. A good agreement of fractal dimensions has been found on different geographical altitudes of the Earth. Further application of comparative fractal analysis for space measurements reduction is undoubtedly going to yield interesting results which will allow solving many problems of space geodesy.

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Keywords

Fractal analysis, Geoinformatics, Geophysics, Space geodesy

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