Analysis of the terrestrial global digital model using fractal geometry and harmonic expansion into spherical functions

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Abstract

© 2018 by IOP Publishing Ltd. During the implementation of space missions on study of the Solar system a large amount of information on planets geophysics and their morphological properties has been obtained, that could be investigated using fractal geometry. The present paper describes the analysis of the GDEM terrestrial digital model built from the ASTER's observations. GDEM is global digital elevation model and ASTER is advanced spaceborne thermal emission and reflection radiometer. ASTER was installed on the platform of Terra (NASA) orbiter. In our study we used robust methods and fractal analysis. The fractal dimension values for the terrestrial surface, which has a heterogeneous structure, are obtained. The fractal dimensions are determined for geographical latitudes. Independent estimates of the Earth's macrostructure that could be used for a new interpretation of geophysical processes have been obtained as well.

References

[1] Turcotte D L 1987 Journal of Geophysical Research 92 597

[2] Stepinski T F, Collier M L, McGovern P J and Clifford S M 2004 Journal of Geophysical Research: Planets 109 E02005-1

[3] Linkevich A D 1999 Nonlinear Phenomena in Complex Systems 2 93

[4] Massopust P R 1994 Fractal Functions, Fractal Surfaces, and Wavelets (New York: Academic Press) 383

[5] Lapaeva V V, Meregin V P and Nefedjev Yu A 2005 Geophysical Research Letters 32 L24304

[6] Abrams M 2000 International Journal of Remote Sensing 21 847

[7] Yue L, Shen H, Zhang L, Zheng L, Zhang X and Yuan Q 2017 ISPRS Journal of Photogrammetry and Remote Sensing 123 20

[8] Gulick D and Scott J 2010 The beauty of fractals : six different views (Washington, D.C.: Mathematical Association of America) 95

[9] Mandelbrot B B 1982 The Fractal Geometry of Nature (San Francisco: W.H. Freeman and Company) 468

[10] Peitgen H O, Jürgens H and Saupe D 2004 Chaos and Fractals (New York: Springer-Verlag) 864

[11] Demin S A, Andreev A O, Demina N Y and Nefedyev Y A 2017 Journal of Physics: Conference Series 929 012002

[12] Varaksina N Y, Nefedyev Y A, Churkin K O, Zabbarova R R and Demin S A 2015 Journal of Physics: Conference Series 661 012015

[13] Andreev A O, Demina N Y, Demin S A, Nefedyev Y A and Churkin K O 2016 Nonlinear Phenomena in Complex Systems 19 271

[14] Varaksina N Y, Nefedyev Y A, Churkin K O, Zabbarova R R and Demin S A 2015 Journal of Physics: Conference
       Series 661 012014