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ANALYSIS OF DIGITAL MODEL OF TITAN USING FRACTAL GEOMETRY AND AUTOMATED COMPLEX

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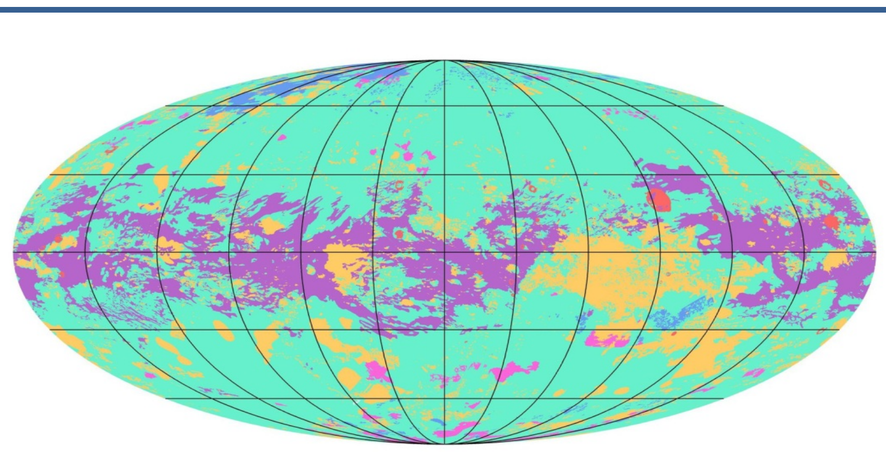

Fig.1 Titan globe

Introduction

This work aims at considering the issues of regression modeling of the surface of Saturn's moon – Titan (Fig. 1) and at studying the produced model by means of fractal geometry. Based on data collected by NASA's Cassini space probe, a global topographic database of Titan's surface was created [1, 2]. Currently, the main process analysis methods in complex systems are statistical ones [3]. Such multi-parameter systems should be studied by the methods of physics of complex systems, and fractal analysis is one of them [4].

Methods

The fractal analysis allows studying the structure of complex objects, taking into account their qualitative specifics, for example, the relationship between the structure and the processes of its formation [5]. When constructing a harmonic model of Titan, the method of expansion of topographic information into spherical functions was used. As a result, based on the harmonic analysis of the Cassini mission data, a topographic model of Titan was created. In the final form, the model describing Titan's surface includes the expansion of the height parameter depending on the spherical coordinates into a slowly converging regression series of spherical harmonics [6]. The number of qualitative stochastic data, such as external measures, were used together with the standard postulation of the harmonic system of the Titan model [7]. As a result of a sampling of self-similar regions (with close values of the self-similarity coefficients) on the surface of Titan, coinciding with the SRGB parameter (characterizes the color fractal dimension), the elements of Titan's surface were determined, which with a high degree of probability were evolutionarily formed under the influence of the same chemical processes [8].

Results

An analysis of the surface of Saturn's moon Titan was carried out by the multifractal method [9]. It has been determined that Titan, due to the large number of interactions with various kinds of space bodies, has a large number of shock formations on its surface [10]. Titan models built using satellite data are structured by pixels, within the boundaries of which the average values of the surface heights were determined [11]. These 2D and 3D surface models of Titan contain chromatic parameters and a K_ξ coefficient distribution (Fig. 2), according to which self-similar structures can be found. The problems discussed in this work are modern and urgent, especially if we consider the fact that Titan, according to scientists, is one of the promising places for its future development [12]. In similar works, to study the macrofigure of celestial bodies, a monochromatic analysis of topographic data is usually carried out, but at the same time with a large working time consuming. In this work, it was decided to obtain these data by an automated computer method [13]

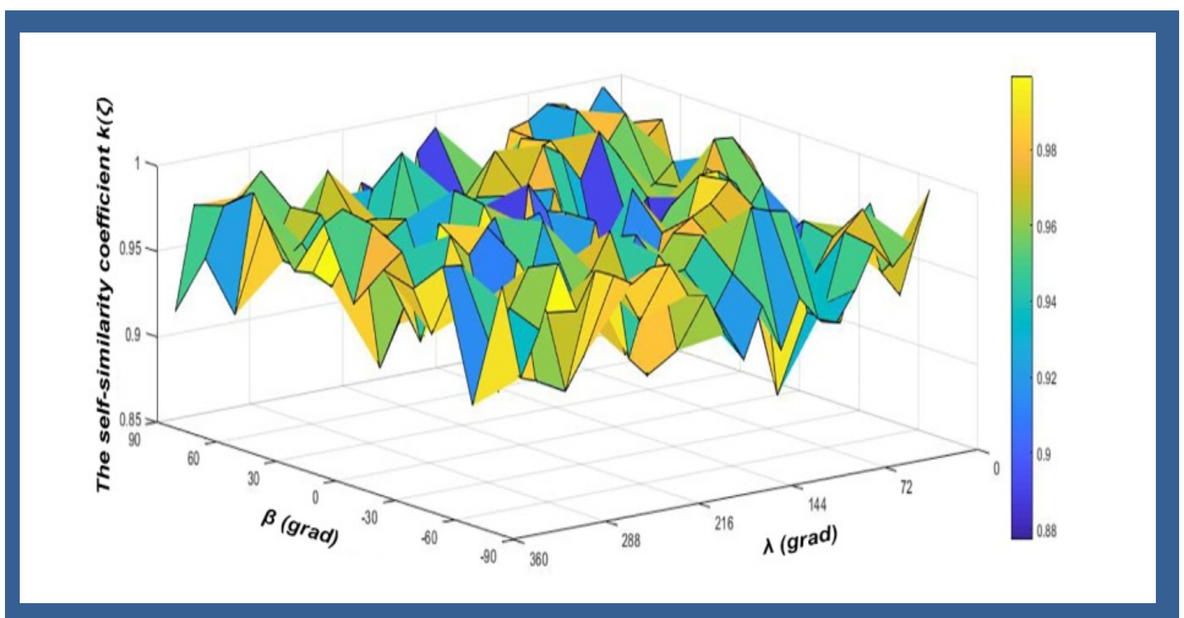

Fig.2 3D model of the distribution self-similarity coefficient

Conclusion

The analysis of the planetary parameters of Titan and their study was carried out, a method for studying altimetric satellite data and an algorithm of the author's method for analyzing the physical surface of the satellite of Saturn were developed**.** The essence of the developed method lies in analyzing the colors of certain points on Titan's surface distributed differently depending on geographic heights. The calculations were carried out using an automated software package developed in the Python 3 environment. The results of this work may be of certain interest in organizations that are engaged in the study of moons of the planets in the Solar system [14, 15].

Acknowledgements

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