Geophysical Research Abstracts
Vol. 18, EGU2016-10879, 2016
EGU General Assembly 2016

A lacunarity-based approach to evaluate Martian surfaces

Balázs Székely (1,2,3), Adam Kania (), and Zoltán Magyar (1)

(1) Department of Geophysics and Space Science, Eötvös University, Budapest, Hungary (balazs.szekely@ttk.elte.hu), (2) Interdisziplinäres Ökologisches Zentrum, TU Bergakademie Freiberg, Institut für Biowissenschaften, Freiberg, Germany, (3) Atmoterm S.A., Opole, Poland

Terrestrial planets show great variety in terms of geomorphological patterns: the surface is shaped on one hand by the various phases of asteroid bombardment, on the other hand internal and external processes create or have created landform elements at various scales. This richness in forms have already been considered in terms of fractal or multifractal analyses, resulting in various considerations. However, so far the counterpart of the fractal analysis, the lacunarity analysis has been seldom carried out. Lacunarity, a measure of the spatial distribution of the empty space in a certain model or real space over large spatial scales, is found to be a useful descriptive quantity in many fields using imagery.

Lacunarity can be calculated in various dimensions; in most of the cases 2D calculation is performed. Our project also aims at calculating 2D lacunarity curves, however, we also use digital terrain models (DTMs) of the planet Mars, introducing partly the third dimension into the calculation. DTMs are converted to horizontal slices of the topography and these slices are then treated as images. The lacunarity analysis is performed on these stacks of images resulting in large amount of lacunarity curves. These curves can be compared locally or regionally, and the set of curves can be used for more global comparisons.

Our preliminary results show that characteristic differences can be detected between various Martian surface types, i.e. the lacunarity results, similar to fractal dimensions, have a certain descriptive power. As this type of lacunarity analysis provide larger amount of descriptors (multiple lacunarity functions) than the fractal dimension values and the scale of analysis (area of interest taken into account in the computing) can be selected according to the needs, it seems to be possible to create lacunarity libraries for general use. In this preliminary phase of the project tools and techniques are tested to compare effectively the resulting lacunarity patterns. In a longer perspective, we plan to create characteristic lacunarity libraries for comparative purposes, especially for those landforms that exist on other terrestrial planets.

We had access to the data used in this project as a co-investigator of the ESA Mars Express High Resolution Stereo Camera (HRSC) project (the project leader, late Prof. G. Neukum inspired partly these project ideas). BSz contributed as an Alexander von Humboldt Research Fellow.