Geophysical Research Abstracts
Vol. 17, EGU2015-10022, 2015
EGU General Assembly 2015

Statistical analysis of planetary surfaces

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In the last decades, a huge amount of topographic data has been obtained by several techniques (laser and radar altimetry, DTM…) for different bodies in the solar system, including Earth, Mars, the Moon etc.. In each case, topographic fields exhibit an extremely high variability with details at each scale, from millimeter to thousands of kilometers. This complexity seems to prohibit global descriptions or global topography models. Nevertheless, this topographic complexity is well-known to exhibit scaling laws that establish a similarity between scales and permit simpler descriptions and models. Indeed, efficient simulations can be made using the statistical properties of scaling fields (fractals). But realistic simulations of global topographic fields must be multi (not mono) scaling behaviour, reflecting the extreme variability and intermittency observed in real fields that can not be generated by simple scaling models. A multiscaling theory has been developed in order to model high variability and intermittency. This theory is a good statistical candidate to model the topography field with a limited number of parameters (called the multifractal parameters). In our study, we show that statistical properties of the Martian topography is accurately reproduced by this model, leading to new interpretation of geomorphological processes.