



Multifractal analysis of topography: a case study at the regional scale

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Topography is one of the main soil formation factors and influences climate pattern at different scales. The first objective of this study was to analyze the multifractal characteristics of complex topography at the regional level in Galicia, NW Spain. A second objective was to compare topography structural features as assessed by multifractal and geostatistical analysis. The study data set consisted of 118,492 altitude point measurements on a square grid of 500 x 500 m. The total surface area was estimated at 29,750 km². The exploratory statistical analysis revealed that the data set did not follow any well-known natural distribution, nor exhibited any heteroscedacity of importance. Multifractal analysis was carried out using the moment method. Remarkably good multifractal scaling was obtained when analyzing measures constructed from altitude. Results show a rather good definition of both, singularity and generalized dimension spectra. Values of capacity, information and correlation dimensions were 2.00 ± 0.00 , 1.853 ± 0.039 and 1.784 ± 0.067 , respectively. The singularity spectrum showed a typical concave downward parabolic shape characterized by a wide aperture and relatively small asymmetry. Moreover, the right branch of the singularity spectrum was longer than the left branch, which is in accordance with predominance of low altitudes at the regional level. The multifractal study demonstrates that the spatial arrangement of the topography of Galicia can be quantified by the properties of their singularity and generalized dimension spectra. Semivariogram analysis showed that the studied altitude data set exhibits spatial dependence. The pattern of spatial dependence of the experimental semivariogram was stationary at small distances and non-stationary at longer distances, where it exhibited a large amount of tendency. An exponential semivariogram model with no discontinuity at the origin, i.e. without nugget effect, could be fitted to the experimental data until 60 km distance. It was concluded that singularity and generalized dimension spectra are useful for describing and comparing topography variability in Galicia. Topographical maps are needed for data visualisation and also as an aid in data interpolation at the regional scale, for example soil and climatic variables. Multifractal information might be useful to determine the best interpolation procedure for mapping purposes.