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Nonlinear Processes in Geophysics
Discussions

Interactive comment on "Multiscale analysis of nitrogen adsorption and desorption isotherms in soils with contrasting pedogenesis and texture" *by* J. Paz-Ferreiro

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(1) Comments from Referee # 3 (Received and published: 16 March 2016 a) The multifractal analyses of nitrogen adsorption and desorption isotherms is obtained from soil samples of 6 different profiles in São Paulo State, Brazil and the effect of soil texture on the multifractal patterns of the isotherms is studied. A similar paper wrote by Paz-Ferreiro et al. (2013) presented a similar analysis with a different database from a different experimental site.

b) In my opinion the basis of the analysis that has been performed has serious problems, even if the potential value of the conclusions of the analysis in the context of soil sciences is high. This is because the analysis itself is not well founded from a numer-

ical point of view. Specifically, it is not clear that any conclusion about the multifractal behaviour of a one dimensional series (temporal, spatial or of any other nature) with 41 or 52 data points could be reliable. In that respect I would put forward the work of A. Turiel, C. J. Pérez-Vicente and J. Grazzini entitle "Numerical methods for the estimation of multifractal singularity spectra on sampled data: A comparative study" (Journalof Computational Physics 216 (2006) 362–390). They study appropriate methods to assess multifractality over experimental discretized data and establish criteria to measure the confidence degree on the estimates. Manuscript npg 2105-72 do not complywith that criteria.

c) I understand that a mayor revision of the work should be undertaken in order to adapt the length of the series the authors use in their investigation to the type of analysis they propose. It is imperative to insure the consistency of the work done taking into account the potential benefit of the implications of this type of analysis for the "soil community".

(2) author's response Thank you very much for your valuable comments, The comments from Referee # 3 have been provided in three paragraphs, namely: a), b) and c). Author's responses have been organized following this paragraphs.

a) Multifractal analysis from Nitrogen adsorption (and some times also Nitrogen desorption isotherms) has been carried out before. As quoted in our manuscript (Page 3, Lines 23 to 26), in addition to Paz-Ferreiro et al. (2013) also Paz-Ferreiro et al. (2009, 2010), and Vidal-Vazquez and Paz-Ferreiro, (2012) analyzed multifractality of Nitrogren isohterms of soils, whereas Lado et al. (2013), addressed multifractality of artificial organoclays. Therefore, we agree with Referee #3 in that the analysis presented in not new. However, the data set and the aims in the previous work published by Paz- Ferreiro et al. (2013) and this work are not similar. In the former work the data set contained mainly clayey textured soil samples with a relatively wide range of organic matter content, which allowed assessment of the effect of organic matter. The main novelty of this work, is the contrasting texture of two groups of soil sample, i.e. medium versus clayey textured soils. So, the sampling strategy was chosen to evaluate

texture effects and to the best of our knowledge this is a new issue. Also we focused in agronomical and environmental characterization of the two soil types selected using multifractal analysis, which not addressed previously. This is explicitly stated at the end of the Introduction section and in the objectives (Page 3). We wrote: “Here, we hypothesized that analysis of the information contained in NAIs of NDIs of these two contrasting soil groups may provide further insight for its agronomical and environmental characterization.”, and also (the objectives were): “to examine and to compare the scaling property of NAIs and NDIs in soils with contrasting texture”.

b) Thank you very much for this comment. We agree that this is a substantial point. We performed multifarctal analysis using 5 partitions, as we would need 64 or more data points to use 6 partitions in the log-log relationship between partition function and scale. We are also aware of the study by Turiel et al. (2006) dealing with appropriate methods to assess multifractality over experimental discretized data and establish criteria to measure the confidence degree on the estimates. On the other hand, many authors stated that, on practice, one of the main drawbacks in multifractal analysis, when using the box counting method may be due to instabilities associated to the use of the Legendre transform. Please, note that we estimated the singularity spectrum using a direct method and we didn’t employ the Legendre transform for this estimations. In this respect, also it should be pointed out that Turiel et al. (2006) discussed mainly the use of the Legendre transform and also they compared several methods including some methods, which perform trend removal prior to multifrcatal analysis (as for example wavelets) and therefore are much more demanding regarding the length of the data set. However, in practice many data sets used for multifractal analysis in several disciplines such as Geochemistry or Soil Sciences are much smaller. Please, see for example Wilson et al., .2016, Vadose Zone Journal, 15, doi:10.2136/vzj2015.04.0063, or Siquiera et al., 2014 Nonlinear Process. Geophys. 20, 529-541, in addition to the papers quoted in the previous paragraph. Indeed, the MF technique applied in this work is not an issue, the method is standard and the authors have published similar work involving other sites/properties. In our opinion, also it should be taken into ac-

count that we analyzed the scaling heterogeneity of several Nitrogen isotherm data sets and we focused in the use of the multifractal approach for assessing differences between soils with contrasting texture. It can be considered that to compare Nitrogen isotherms between different soil types is less demanding than to exhaustively characterize a unique soil data set (for example a single adsorption or desorption isotherm, using multifractals. In this respect the patterns of distribution of NAIs and NDIs assessed by multifractal analysis and new parameters obtained can be useful, as they are the result of physical processes occurring during adsorption or desorption of gas Nitrogen into soil aggregates. In addition, the q-moments choice is an issue which has been very much discussed in the literature (please, see our response to Referee # 2). This choice also depends from the number of data points used. The motivations are also related to the use of Legendre Transform (LT) and for the negative q-moments, in this last case the problems are well known. Admittedly, we decided to use q=+/-5 moments, but his aspect has not been stressed in our manuscript.

c) Also, thank you very much for stressing the need to assess clearly the viability of the analysis upon considering the number of data available. In fact we are aware that this is a critical point, and it has been also stressed by reviewers of previous works dealing with multifractal analysis of similar data sets. In the revised version we will try to clearly show why a multifractal analysis can provide improved knowledge that traditional analyses in the context and with the amount of data analyzed (again, please, see also our response to Referee # 2). In summary in the revised version (and also in previous work) we present arguments to prove unambiguously the strength of our results.

(3) author’s changes in manuscript We tried to improve the basis of the analysis that has been performed and to increase the strength of the manuscript from a mathematical and numerical point of view. In this respect we paid more attention to the characterization of the multifractal spectra.

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