Nonlinear Processes
in Geophysics

Discussions

EGU

Interactive comment on "Multifractal characteristic-based comparison of elements in soils within the Daxing and Yicheng areas of Hefei, Anhui Province, China" *by* X. Li et al.

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GENERAL COMMENTS

Interesting article that uses the multifractal spectrum to assess possible soil contamination by industrial and agricultural activity in two regions of China. An excellent data collection work and proper use of the chosen methods. The proposed use of the distribution of alpha singularity exponents to evaluate diffusion of contaminants in the soil is valid, but the conclusions require more robust criteria of causality. The main conclusions outlined by the authors are based on correlations and comparisons that were not carefully evaluated. The authors use visual and inaccurate comparisons to validate important statements in the paper argument. The following is a detailed description of

suggestions to improve the work.

SPECIFIC COMMENTS

Line 138: I would say it suggests a non-normal distribution a priori, only. The possible fractal/multifractal pattern is something to be evaluated a posteriori.

Thanks for the comments provided by J. Miranda. We have revised this sentence as follows: "All of the elements (barring Pb and Cu in the Yicheng area) in both the Yicheng and Daxing areas yield histograms that are positively skewed and contain some outliers (Fig. 2), indicating that these data have non-normal and potentially fractal- or multifractal-type distributions."

210: Why did you choose these values of q? Is there any argument (e.g., when the Dqxq curve stabilises)?

A range of q values between -10 and 10 with an interval of 1 is commonly used in these types of studies (Gonçalves et al., 2001; Xie et al., 2004; Dathe et al.,2006). To ensure that the results are reproducible we also replicated this analysis using a range of q values from -1 to 1 with an interval of 0.1, which yielded the same conclusions to the original range of q values.

Line 227: A comparison between the $\Delta f(\alpha)$ of the locations is considered here. The authors claim significant differences comparing only the order of the metals, sorted by $\Delta f(\alpha)$. Here a paired comparison statistic could prove the significant difference between areas.

We have added some text at lines Line 246-259 to compare the differences in heavy metal pollutions in the Daxing and Yicheng areas.

232,234: In my point of view, Figure 3 shows no sufficient evidence to conclude about correlations between the spectra of the two regions. A correlation test between $\Delta \alpha$ (left and right) in Daxing and $\Delta \alpha$ (left and right) in Yicheng could give more support to the argument.

We want to use Fig. 3 to show the differences shapes of the spectra between the two different parts of the study area as well as demonstrating the different multifractal characteristics of the heavy metal pollution in these areas. However, we have revised the manuscript using three parameters ($\Delta\alpha$, Δf(a) and τ"(1)) to compare the heterogeneous patterns and degree of multifractality of the different heavy metals and areas, and we have rephrased the text to ensure this approach is described clearly.

255-257: A logistic correlation could substantiate the statement of significant correlation between the location of industrial/agricultural facilities and metals concentrations. 258-260: A very interesting hypothesis, associating the asymmetry of the spectra with the presence of anthropic actions. Whereas the single symmetric spectrum found was the Cu in the Yicheng area, we would expect a not significant logistics correlation between the presence of agricultural facilities and concentration of Cu in Yicheng (map in Figure 6) and significant correlation in the asymmetry cases. These tests would substantiate the argument of using multifractal for evaluation of anthropogenic changes.

We thank the reviewer for their suggestions, and we have added a new figure (Fig. 7) to show the relationship between heavy metal concentrations and the number of facilities in each area. This figure demonstrates a very good positive spatial correlation between the agricultural facilities in the Yicheng area and the high Hg concentration areas in this region and an even better positive spatial correlation between agricultural facilities in the Yicheng area and the high Cu concentration areas in this region. However, although this figure cannot show the degree of heavy metal pollution, it does demonstrate the spatial correlation between the location of industrial/agricultural facilities and areas of high metal concentrations, indicating a significant logistical correlation between the multifractality of the datasets and the industrial and agricultural activities in this area.

TECHNICAL COMMENTS

143: Just a suggestion: Make the legend a bit clear. The legend information is spread in the figure.

We have edited the legend in Fig. 1 as suggested.

197: I would say more heterogeneous patterns, given the non-binary feature of heterogeneity.

We changed the words "heterogeneous distribution patterns" to "more heterogeneous patterns".

214: "that describing the multifractality" - Unnecessary text.

We have removed "that describing the multifractality" from the table caption.

221: The f spectrum is only another way to characterise your set. I am not sure if 'best measure' is the most suitable term.

We have used three indexing methods $\Delta\alpha$, Δf(a) and τ"(1)) in the revised paper to allow a better analysis of the multifractal characteristics of the heavy metal pollution in soil in urban or developed areas.

234: Asymmetry concept could be better explained, it is presented in a way which might lead to misunderstandings. I would suggest an explanation based on the equations of the lines 191, 192 and 193.

We have added an additional comment in brackets as per the equation between lines 162-164 as follows: ($\Delta\alpha$L is significantly different from $\Delta\alpha$R, equations 5-6).

238: Just two missed commas – "All of the heavy metals analyzed during this study, barring Hg, have higher Δf(α) values in soils from the Daxing area, with Hg having higher values in soils from the Yicheng area (Table 2)."

We have added the two missing commas.

241: "The only significant heavy metal pollution associated with the agricultural activity in the Yicheng area WOULD BE the Hg contamination".

We have revised this sentence according to the suggestions provided by both Miranda

and Miras Avalos as follows: "This suggests that the industrial activities in the Daxing area generate multi-element heavy metal soil contamination, whereas the only significant heavy metal pollution associated with the agricultural activity in the Yicheng area is Hg contamination."

Please find the revised manuscript in supplement.

Please also note the supplement to this comment:
http://www.nonlin-processes-geophys-discuss.net/npg-2016-15/npg-2016-15-AC2-supplement.pdf

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