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Nonlinear Processes in Geophysics
Discussions

Interactive comment on "Joint multifractal analysis: further developments and implementation on rainfall data" *by* Auguste Gires et al.

Anonymous Referee #2

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This work studies the behaviour of fields which are composed of a product of two universal multifractal (UM) fields. First, the properties of UM fields are briefly reviewed. Then the properties of multiplicative combinations of UM are discussed and it is shown how approximate UM parameters can derived from products of UM fields. The authors warn for the possible confusion between the phase transition causing diverging scaling moment functions K(q) and the combined nature of the field, both of which give rise to K(q) which are higher than predicted by UM theory. The authors then perform a numerical experiment with the discussed set-up of one UM field ϕ and one combined field ϵ. They estimate the parameters of the underlying fields using their newly developed methodology, and demonstrate the use of a simplified correlation indicator. The validity

of the approach seems to be constrained to UM fields with sufficiently similar values of α in this symmetric case.

The technique is then applied to observational rainfall data from a disdrometer to infer correlations between different properties such as rain rate, liquid water content, drop concentration and mass weighed diameter. For these fields the validity ranges of the parameters seem to be well respected. The result of such an analysis can be used to simulate one of these quantities, based on another known quantity and a random one.

General comments:

This paper shows a new technique to infer the properties of multiplicative fields, which could be useful to investigate correlations between UM fields and simulate a field based on a given one, if the correlation is known. The application to rainfall data nicely highlights the potential of this method.

The title does not capture the subject of the paper, that is the analysis of correlation between approximate UM fields. "Further developments" is very vague for a title. I would also say "application to" instead of "implementation on".

The structure of the manuscript is fine, the formalism is explained clearly and the results are shown in a logical way. The figures could be improved somewhat (see specific comments below). The equations, however, contain errors. I hope these are merely typographical, but to remove any doubts on the correctness of the results I suggest the authors provide their code and/or data as supplementary material or through a citable repository (e.g. Zenodo). This would also be in accordance with the best practices of this journal.

Finally, there are many grammatical and spelling errors throughout the manuscript (e.g. "betwen", "dash line", ...). Articles seem to be missing, e.g. p.2 l.44: Similar formalism -> A similar formalism. Please check the whole manuscript carefully for spelling and grammar; the list below is not complete.

Specific comments:

p.1 l.2: across wide -> across a wide

p.1 l.9: to retrieved -> to retrieve

p.2 l.24: Reader is -> The reader is

p.2 l.42: of define -> to define

p.2 l.50: relying this -> relying on this

p.3 l.68: an homogeneous -> a homogeneous

p.3 l.59: Please specify the "outer scale" more clearly.

p.4 l.88: as follow -> as follows

p.4 Eq. (40): I think the RHS should read $\lambda^{S(h,q)-K_\epsilon(q)-K_\phi(h)} \approx \lambda^{r(h,q)}$

Fig. 1: Spurious "=" in the caption.

p.5 Eq. (7): in the second line, the second term should start with b^{α_Y}, not a^{α_Y}.

p.7 l.156 Please mention the meaning of TM again here for clarity

l.157 Please mention the meaning of DTM again here for clarity

p.7 l.161: The fact that the empirical K(q) in section 3.4 are lower than expected seems in contradiction with earlier remarks that the empirical K(q) would in both cases be higher than expected: please clarify this or clearly disentangle the two kinds of phase transition that can occur.

p.7 l.158, 163 and 172: "inputted" does not exist

Fig. 4: It would be helpful to visualize the line $ha + q = q_s$ on the surface (mentioned in p.8 l.177)

Fig. 5: It would be helpful to visualize the intersection between the two planes.

p.10. Eqns. (12) and (13) are not consistent with each other. For the first line of Eq. (13), for example, I obtain:

$$\frac{\langle \phi_\lambda^{aq+h} \rangle}{\langle \phi_\lambda^{aq} \rangle \langle \phi_\lambda^{h} \rangle}.$$

For the third line I obtain

$$\frac{\langle \epsilon_\lambda^{a'h+q} \rangle}{\langle \epsilon_\lambda^{a'h} \rangle \langle \epsilon_\lambda^{q} \rangle}$$

and likewise for Eq. (14) and what follows. Please check carefully whether this affects the presented results. Also verify whether a and a' are not swapped in the rest of the manuscript (e.g. Eq. (16))

Fig. 6: It would be helpful to visualize the intersection between the two planes. Also it seems that the blue plane is covering the red plane where I would expect the red plane to be visible. Please improve this figure and mention the meaning of the different colours in the caption.

Table 2 caption: "using the notations of 12" -> "using the notations of Eq. (12), "; "line" -> "row"

p.16 l.286: the one obtain -> the ones obtained

p.17 l.298: "the two the" -> "the two"

p.18 l.315: "The characteristic parameters [...] as long as the power law exponents [...] can the obtained through [...] of the studied fields." I don't understand this sentence, please correct.

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