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Hydrology and Earth System Sciences Discussions

Interactive comment on "Modeling geophysical complexity: a case for geometric determinism" *by* C. E. Puente and B. Sivakumar

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We would like to thank the referees and the editor for their thoughtful comments and suggestions on our paper. Here we explain the actions we have taken on the manuscript in response to such comments.

Referee #1

We are pleased with the positive assessment given by this referee. Following his/her suggestion, we have added in the Conclusions a statement on procedures aiming at capturing mathematical morphology (e.g. Pattern Spectrum). Such a statement also includes a general response regarding the suitability of the work for the special issue, as requested by the editor.

Referee #2

We are also pleased with the positive review provided by this referee. Herein we consider a series of five points as raised by the reviewer, as follows:

1. The referee's statement that "studying the dynamics of geophysical processes in the compressed parameter space still appears to be far from a real possibility because the procedure still lacks a physical interpretation" is, in our opinion, not entirely correct. In the paper, we do acknowledge the lack of such a complete interpretation (Section 3, Page 1411, Line 20), but we also report on our ability to model and predict the dynamics of a groundwater contamination plume using the approach (Section 3, Page 1412, Last Paragraph and Page 1413, First Paragraph; Puente et al., 2001a, b). As such, we have not made any changes to the manuscript in this regard.

2. The reviewer's assertion that it is easier for our fractal-based procedure to deal with rainfall, rather than width functions, has been clarified by emphasizing that the parent multifractals used by the geometric procedure correspond to general cascade mechanisms that, while including the ones yielding turbulence, also encompass those used on a stochastic framework to describe the intermittencies of width functions. Please see minor corrections on Section 2 where the turbulence-related measure is introduced that also includes a pertinent citation to the work of Veneziano et al. (2000).

3. Contrary to the reviewer's opinion, it is our view that modeling complex rainfall data sets, even if only representing a single realization, is an interesting and unsolved problem in its own right. As argued in the paper, if such a parameterization of contiguous chunks of data could be done, one may then envision modeling the dynamics of rainfall in time in a wholistic fashion, which would definitely be quite relevant in real applications. As Section 3 amply discusses these issues, we felt that there was no need to make any additional clarifications to the text in this regard.

4. The reviewer suggests that we are endorsing a stochastic viewpoint. This turns out not to be correct, but quite the contrary as suggested by the title of the article. In the

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paper and in our previous work we have shown how a deterministic fractal-multifractal (geometric) approach produces indeed a host of outcomes that are consistent with the seemingly stochastic signatures as found with real data. That by varying the parameters we can obtain a great variety of sets relevant to diverse fields speaks volumes to the goodness of the ideas. As there are relevant references to our previous work in this matter, we have also decided not to amend the manuscript.

5. Finally, and in regards to the last few lines of comments, we ought to further clarify the following. Figures 1 and 2 are just examples of complex-looking data sets that resemble rainfall records in time. As such, there is no interpretation that needs to be advanced other than highlighting the specific geometric features of the "series" and the naturally-looking autocorrelation function and power spectra. The coefficients d1 and d2 (the vertical scalings of the affine mappings, for the example) were just fixed in order to arrive at the shown graphs that exhibit the general features that we wanted to stress, i.e., rainfall-like patterns.

Some features that the reviewer questions as missing are as follows. The iteration frequencies are just the 30 and 70% usage of the two affine maps [as indicated on Page 1410, Lines 5 and 6], the fractal dimension of the interpolating function is 1.485 [as indicated on Page 1410, Line 8], and the projection angle is zero degrees implied by the projection direction being over y. To clarify this last point a bit, there is now a brief explanation on such prior to Equations 1 and 2.

The referee is correct in saying that the article does not include an in-depth discussion on a catalog of process signatures; however the reader should be able to find ample references to our previous work in the references to the text.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 3, 1407, 2006.

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Interactive Comment