First of all, authors would like to thank the two referees for agreeing to spend time reviewing this paper. Their thoughtful remarks and suggestions enabled to enrich the paper and bring other information and details that make it more straightforward. We fully accept their comments and suggestions and all requested modifications were considered and the text was updated accordingly.
Thank you also for reporting in details in your remarks (line indications, suggestions…) which has made the correction work easier.

Please find below, a point-by-point response to your comments and also an indication of changes made on the paper based on your feedback.

Anonymous Referee #2

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General Comments

It is disappointing that this seven author paper has not been better prepared for peer review. A simple comparison with the related excellent paper by Gires et al. (2017) in HESS, applying similar fractal analyses to semi-distributed models for a variety of catchments, illustrates what might have been achieved if the seven authors had combined their respective strengths to prepare the paper thoroughly for peer review. This takes time and requires attention to the detail of presentation. I would encourage the authors to do just that in a resubmission.

Some pointers are:

1.Introduce equations as part of a sentence and define symbols as they are introduced.

This was updated in the text following your remark, especially for page 10 and 11.

2. Comply with the preparation guidelines of HESS: Table caption at top etc.

The HESS guidelines were checked and updates were made.

3.The English should be improved to the standard of Gires et al. (2017). The abstract provides a good example of where improvement is needed. Punctuation, plurality (data are) and use (omission) of the definite article requires attention, for example.

The paper was carefully proofread to improve the English.

4. Be considerate of the peer reviewers' task. Prepare a paper fit for external review through a process of thorough internal review. It should be a delight to read like Gires et al. (2017).

As suggested by the referee, we carefully did it for the revised manuscript.

Now turning to the science contribution of the paper.

The paper complements and goes beyond that by Gires et al. (2017) by focussing on a single urban catchment (Sucy-en-Brie) and using a model (Multi-Hydro) that is distributed.

A key feature investigated through fractal analysis is how different spatial properties (land use, impervious cover, sewer structure) are introduced into a distributed hydro-logical model configuration at different scales (model resolutions) and how this impacts performance. Priority and Majority rules are compared: obviously this can make a big difference to model response as a function of scale (model resolution) and this is demonstrated for impervious cover. The authors do not consider alternatives to these rules to make the formulation more scale invariant such as a fractional approach. This deserves some comment.

The referee raises an interesting point. It was actually thought of during the PhD of the first author that served as a basis for this paper. Indeed, the possibility to implement other rules was investigated, but the model formulation allows only one land use class (characterized by few parameters such as the conductivity) per pixel. It means that implementing a fractional approach as suggested by the referee would require to strongly increase the number of classes as well as to develop a multifractal spatial characterization of key parameters such as conductivity. Those are possible motivating future investigation paths but they are outside the scope of the current study. Hence it was chosen to limit the study to two rules for affecting pixels'class; while keeping the number of classes reasonable.

As suggested by the referee, this point was clarified in the manuscript.

The paper seems more motivated by creating and observing multifractal behaviour than addressing the modelling problem it presents: some more discussion of the latter would be good.

In fact, the paper was motivated by the fact that on the one hand the inputs of the hydrological models exhibit scale invariant features while on the other hand distributed models are implemented at a single resolution.
Hence the question we tried to investigate in this paper is "at which resolution should we implement the model?"; keeping in mind practical constraints such as missing data at high resolution or longer computation time. The main goal of the paper is to investigate the existence and try to identify the appropriate resolution (or a range of resolution) for Multi-Hydro implementation. To this hand we first used fractal analysis (not multifractal) to analyze the features of the inputs of the model and in a second part we performed multi-scale modelling work.

As these points were raised by the referee, this was added in the introduction section, and highlighted in the conclusion section to make more explicit the goal of the paper.

Also, more detail needs to be given on how these properties function within the model to gain clearer insight and understanding (for example, the precise meaning of imperviousness coefficient needs to be understood in terms of model function).

The imperviousness coefficient is actually not a parameter of the modelling formulation. It is simply a quantity used to gain some insight on the inputs of the model and how its overall features changes with resolution. It refers here to the proportion of those impervious pixels (road, building…), i.e. the ones that participate directly to the rapid runoff. A precision was added to the text page 16 to make this clearer.

The science of the paper, and the practical application addressed, is of interest and deserving of publication in HESS. However, the paper presentation requires thorough revision followed by re-review.

Some more detailed comments follow.

Detailed Comments

P1 Very brief guidance on improving the abstract follows (as an example). "Hydrological models are...activities. There is a growing interest in the development..such model implementation. . . .crucial problem, and model performance. . .Both the structure. . .modeling investigation is. . .17 spatial resolutions. Results demonstrate scale. The fractal concept. . .with the Multi-Hydro model. . .and confirmed through modelling. This work also discussed. . .requirements. The principal findings. . ."

Thank you for your detailed comments and suggestions. The text was updated.

P2 huge amounts of data...hydrological models becomes relevant aggregation and disaggregation. . .is obtained using a high-resolution grid. . .

This was modified in the text.

P3 . . .representation. They found. . . physically-based models: a 10 m . . .used to configure urban storm models. . ...the multi-Hydro. . .assigned to each pixel

This was modified in the text.

P5, 6 imperviousness coefficient

This was modified in the text. Thank you

P7 ...sensitivity of the Multi-model to land use...(should this be the Multi-Hydro model???)

Yes, the necessary modifications have been implemented. Thank you

P10, 11 These equations need to be introduced properly as part of a sentence and terms defined as they are introduced.

The text was updated following your remark.

P10, 11 and elsewhere. More care needs to be taken with the word "parameter". NSE is Nash-Sutcliffe Efficiency (a performance metric or statistic, not a parameter).

The referee is indeed right and this was changed.

P11 The inequality is wrong. P12 The purpose of this selection. . . P14 imperviousness coefficient ???

This was modified in the text. Thank you

P14 Section 5.1.3 heading – remove : (and elsewhere)

This was modified in the text.

P14 which assigns a unique land cover

This was modified in the text.

P14 land use classes (not soil)

This was modified in the text.

P17 . . .spatial variability among these properties. (not parameters)

This was modified in the text.

P17 In fact all indicators reveal a similar trend of higher performance at smaller scales. (Not parameters.)

This was modified in the text.

P19 Improve style of "We found it important here. . ." P23 Dehotin et al. is no longer in HESS Discuss. P23 Gires et al. now published in HESS 2017. P24 Rafieeinasab et al. (2015) – correct reference to Journal of Hydrology P24 Thibault and Crews (1995) – correct reference to "Flux, 19, 17-30, 1995." P25 Yanshi and Kaixuan – Change title to mixed case.

This was corrected in the text; thank you for your careful reading.