

Interactive comment on “Percolation properties of 3-D multiscale pore networks: how connectivity controls soil filtration processes” by E. M. A. Perrier et al.

Anonymous Referee #1

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The paper addresses the problem of straining efficiency in filtration processes. The model proposed exploits the multiscale nature of the pore size distribution, extending to the 3D case a method published by two of the Authors (Bird and Perrier 2009) for the 2D case. The Authors use (1) analytical renormalisation methods and (2) numerical methods, to study the CFS (critical filtration size) as a function of the structural and geometrical parameters of the network.

The paper is relevant to Biogeosciences and the results are worth being published. However, the Authors should consider the following points:

(1) In the Introduction (3001, line 18), the Authors state "we provide an improved algorithm for numerical simulation". The algorithm is never explained in the paper. On page

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3005, line 20, I find: "An algorithm has been developed ... and has been validated". Since the results in section 3 (Numerical experiments) rely on such new algorithm, I think it would be worth spending a paragraph explaining the novelty of the algorithm and the advantage with respect to "classical" percolation algorithms.

(2) Section 2 deals with iterated maps, fixed points etc. without providing all the necessary background, so that, e.g., when "tangent bifurcation" is mentioned (page 3004, line 20) the reader can only have a vague idea of what a "bifurcation" is. The previous paper (Bird and Perrier 2009) managed to explain these basic points, and I think that the Authors should provide a similar explanation here.

(3) I find the mathematical wording of the last paragraphs of section 2 quite unsatisfactory. I understand that the purpose of the section is to give a "mainly qualitative" theory that is going to be improved with numerical simulations. Still, I think that assertions like "only 2 levels enable the pore network to percolate with a probability close to 1" (page 3004, lines 7-8), and "the probability... drops toward zero within only 6 iterations" (page 3004, lines 8-9) should be made more quantitative. What do "close to 1" and "toward zero" mean here? I assume that a threshold is used, e.g. $1 - 10^{-6}$ for "close to 1" and 10^{-6} for "toward zero". The values used for the threshold should appear in the text. Moreover, writing, e.g., that "for high values of q ... only two levels enable the pore network to percolate" lacks precision, since the only example is given for $q = 0.4$. I think that for even higher values of q (say, $q = 0.8$) the number of required levels (according to some threshold) could be just 1, and for lower values of q it could be 3 or more. The Authors should explain more precisely how the number of iterations depends on q . Moreover, I think that the numerical value of the threshold ("near $q = 0.3$ " on page 3004, line 11) should be given with at least two digits of accuracy.

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