Hydrol. Earth Syst. Sci. Discuss., 6, C2374–C2376, 2009
www.hydrol-earth-syst-sci-discuss.net/6/C2374/2009/

Hydrology and Earth System Sciences Discussions

Interactive comment on "Numerical analysis of Richards' problem for water penetration in unsaturated soils" *by* A. Barari et al.

Anonymous Referee #1

Received and published: 15 October 2009

The authors present two analytical methods for solving partial differential equations, homotopy perturbation (HPM) and variational iteration (VIM), and apply the methods to the one-dimensional Richards equation (RE). The RE application is under very restrictive conditions that are not clearly discussed, and the tests used to demonstrate the efficacy of the methods are very limited and unconvincing. I do not think the paper in its present form is appropriate for a hydrology journal. More detailed comments on some of the major shortcomings are elucidated below, as well as a few minor remarks.

1. The title of the paper is too general and does not reflect the very narrow focus of the work presented.

2. In their detailed Introduction the authors try to make a case for the use of analyt-

ical methods by presenting the weaknesses, as they see them, of numerical solution approaches. They would do better to present their work acknowledging the very limited (but still useful) niche that analytical methods occupy, compared to the much more general applicability of numerical schemes, especially for a strongly nonlinear equation such as RE, and for a much broader range of problems (2D, 3D, heterogeneities, complex boundary conditions) than the very simple or limited cases addressed in this paper. There is nothing gained by trying to discredit numerical methods (as they do in the last sentences of the Introduction); much better for the authors to place their work in the context of other analytical schemes, and to discuss and illustrate the comparative advantages and limitations of their HPM and VIM relative to other published analytical RE methods.

3. Of the 15 references provided on the HPM and VIM methods ([27]-[41]), all but two are by J. H. He or by the authors of this paper. If HPM and VIM are well-accepted methods in the numerical and mathematics literature, it would be reassuring (for a novice hydrology audience) to provide a more varied literature base.

4. In going from the standard Brooks-Corey eqns (8) and (9) to the transformed eqns (10) and (11), it would be important to know the relationship between parameter lambda in (8) and (9) and the new parameters n and k, especially given the rest of the paper imposes the restriction that k = n + 1, and then only the cases n=1 and n=2 are examined. The authors should also discuss the physical significance of restricting their analyses to these very select cases.

5. What is "m"? (3rd line after equation (11))

6. Given that "the generalized Burgers' equation is also obtained for general values of k and n" (2nd paragraph after equation (11)), what is the difference between the work presented in this paper and previous works (cited in the references) where HPM and VIM are applied to Burgers' equation?

7. The authors do not provide much insight or discussion on how many terms need to

be taken in the series solutions that result from their methods in order to ensure accuracy, nor of any possible difficulties (eg, analytical intractability) in deriving or evaluating higher order terms.

8. There is no discussion of the physical representativity of the two test cases used to demonstrate the HPM and VIM schemes. All we are told (above eqn (14)) is that "the values considered [n=1 and n=2] represent fine-textured to medium-textured soils". Moreover, two test cases (and two figures showing comparative results) does not constitute a very exhaustive or convincing demonstration of the methods proposed.

9. I'm not sure I follow what the problem with "negative z-values" is, as discussed at the end of section 5 and then repeated at the end of section 6.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 6, 6359, 2009.