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Hydrology and Earth System Sciences
Discussions

Interactive comment on "Ensemble modeling of stochastic unsteady open-channel flow in terms of its time-space evolutionary probability distribution: theoretical development" *by* Alain Dib and M. Levent Kavvas

Anonymous Referee #1

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General comments:

The authors derive PDF equations for the Saint-Venant equations, with the stochasticity stemming from an uncertain Manning's roughness coefficient. They discretise the PDF equation via a finite difference scheme. The discretised PDF equation is tested and analysed in the companion paper.

The topic of the paper is interesting and the derivations are concise, yet easy to follow. I believe that PDF methods will become important modelling tools for hydrological pro-

cesses. Nevertheless, there is room for improvements. For details, see the following specific comments.

Specific comments:

The authors repeat themselves more than once on specific topics and some parts are too detailed or even obvious. Some examples would be p.5 l. 2-3., p. 5, l. 14-26, or p. 9, l. 6-7.

If the PDF is obtained by a FPE, it implies that the PDF is approximated and completely determined by its first two moments. This is somewhat stated in the introduction, but not when introducing eq. (9). Please state this approximation explicitly. This restriction has to also be mentioned when comparing your method to MC approaches, from which any statistical moment can be derived, given enough particles and ensemble members.

You write that the FPE methodology is more efficient, because it can be calculated in one single simulation run. This is an invalid argument, as PDFs are highly dimensional functions and quickly become computationally unfeasible. The computational efficiency is to be proven, refer to the companion paper.

Can you give examples where neglecting the cross-covariance terms, like eq. (21), break down?

I know that Manning's equation is well established in the form you used in your work, but the conversion factor k is superfluous if the correct units are used consistently. I suggest that you consider taking k out.

How can the FPE methodology be expanded to problems with more uncertain parameters? Which parameters can be assume uncertain and how would the methodology have to be adapted?

Why did you chose the numerical scheme of Chang and Cooper? How does it compare to alternatives? Furthermore, please provide the reader with more information about the scheme, e.g. the accuracy, or the order of convergence.

In the outlook, please elaborate more on how to expand the methodology to problems with more or different sources of uncertainty.

Technical corrections:

Check the indentations at the beginning of chapters and after equations, delete them.

In equation (9), you use a semi-colon to separate the two arguments of the covariance function, but a comma in equation (10), be consistent.

When referring to Kavvas 2003 for equation (9), also state the equation number.

On p. 5., in l. 18 you state that finite difference schemes are defined on fixed rectangular x-t grid. But these schemes can be used on adaptive grids too.

The angular brackets in eq. (10) have different sizes, chose one size.

The arguments of a PDF are usually separated by a semi-colon into arguments for which the PDF is a density and normal arguments, e.g. Pope (1985).

Maybe eq. (19) can be written in vector notation for readability. Although I am not sure how much improvement this will bring.

Convection is a rather fuzzy term. You should stay with the mathematical rigorosly defined terms, like advection, diffusion, or transport terms. Please correct the terms on page 11.

On p. 13, l. 10 you write about the conservation of particles, although no particles where introduced in your paper. Reformulate this part. For example, you could write about the conservation of the normalisation.

For the weighting factors, you used the variable delta, which is already used for the delta function, please chose a different variable.

I suggest you remove equations (30) - (32), (34) - (36), and (38) - (40) and simply write "analogue for the other dimensions".

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