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Hydrology and Earth System Sciences Discussions

Interactive comment on "Evaluation of 1-D tracer concentration profile in a small river by means of Multi-Layer Perceptron Neural Networks" *by* A. Piotrowski et al.

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We would like to thank the referee for his important comments, touching on the sense of the paper. These issues will be introduced in the final version of the paper text.

As the referee noted, in the paper we suggest future work, aiming to predict break-through curves (BTC) of solute concentration for rivers where no tracer tests were performed based on easily available morphological and hydraulic data. The present paper constitutes a necessary first stage of such an exercise using an excellent case in which numerous experiments were performed in the same river reach under different hydraulic conditions. That experimental data set was used to verify that the neural network based approach works in a satisfactory way, before tackling the more challenging task in the future.

The paper presents just an alternative approach to the traditional, physically-based ones, e.g. the Advection-Dispersion (AD) and the Transient Storage (TS) models. However, the proper identification of the parameters of physically-based models poses a difficulty even when tracer test data are available, as quite often different parameter sets are able to simulate the data with almost the same quality. In fact those physically based approaches may lead to ill-posed optimization problems. The situation becomes even more severe in cases when no tracer test was performed, so that studying alternative methods for estimating model parameters or even the BTCs themselves is likely to be a useful activity.

It has already been shown that it is possible to evaluate the longitudinal dispersion coefficient of the AD equation (Kashefipour et al. 2002, Rowinski et al 2005, Wallis et al 2007), and also even three parameters of the TS model (Rowinski and Piotrowski, 2007) by means of neural networks, using some general morphometric and hydraulic characteristics of the river. This paper is some kind of continuation of this theme in which we try to evaluate the entire temporal concentration curves (and not just the parameters of the AD or TS models). With this approach some river characteristics that are difficult to measure or to evaluate may be omitted, e.g. the shear velocity or the longitudinal dispersion coefficient. Also some behaviour of the simplest models, e.g. the AD equation, in which they do not match observed BTCs from natural rivers satisfactorily, may be avoided.

As mentioned above, to show the possibility of using such an approach, the data from one relatively simple river (the Murray Burn, Edinburgh, UK) were exploited. The approach produced satisfactory results, and now the work on extending its application to different rivers will be carried out. This will, as the referee noted, require taking into account additional information from river systems.

Concerning the time scales and extrapolation problems, mentioned by the referee, one must say that in most problems extrapolating the data far beyond the observation range is dubious and should be avoided. It was shown in this study that for much bigger discharges the results obtained were significantly worse (especially the timing of peak tracer concentration) than those for small or medium discharges - which somehow confirms the above statement.

The relative lack of success of empirical equations for predicting longitudinal dispersion coefficients, particularly over wide ranges of discharge, also exemplifies the problem of extrapolating to extremes. Another example is the case studied in Manson and Wallis (2004) that demonstrates that the magnitude of, and the flow dependence of, the dispersion coefficient during flood flows may be quite different to that during base flows. It is too early to state with any confidence whether neural network based methods will fare any better than physically-based ones in such situations. Interestingly, however, the results in the paper show that the physically-based UPA approach was generally poorer at predicting peak travel time and peak concentration than a neural network based method.

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