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Discussions

Interactive comment on "Technical note: Comparison between two generalized Nash models with a non-zero initial condition" *by* Baowei Yan et al.

Baowei Yan et al.

bwyan@hust.edu.cn

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We would like to thank J. Szilagyi for his comments on our manuscript. The main ideas of Szilagyi are that the DLCM is the exact solution of the discrete system, and the GNM is the analytical solution of the continuous system which is useless in practical as the derivatives required are non-existent. So he think there is no need to compare these two models. Our responses are as follows. (1) Both the DLCM and GNM are derived from the Nash cascade model with a non-zero initial condition. Theoretically, such problem with the same initial condition should have a unique solution. But whether the expressions or the simulation results of these two models are differently exhibited.

This may confuse the model users. It is necessary to distinguish these two models for the users. The main purpose of this manuscript is to clarify the relationship and difference between these two models. (2) Szilagyi repeatedly argued the DLCM is a solution of the so called discrete system. In fact, the river flow system is originally a continuous natural system though the streamflow are rarely measured continuously in time in practice restricted to the sampling technique. The discrete streamflow data are just an approximation of the natural river system. The theories or models built based on the continuous natural system, e.g. the Saint Venant equations and the Nash cascade model, are certainly valid to the discrete data system. For the discrete streamflow data system, the derivative term in the GNM doesn't exist, but it can be numerically calculated by using the finite difference method which can be seen in the reference of Yan et al. (2015). Hence, the GNM derived from the continuous Nash cascade model is certainly applicable to the discrete data system. The simulated results of the illustrative example have also proved this. (3) One key issue Szilagyi skirted round is the identification of the initial state which is also the main difference between these two models. How to estimate the initial state determines the solution is exact or approximate. In the DLCM, the identification of initial state is treated as an inverse problem, which also means that the state at the end of time step is initially available. It seems paradoxical because the state at the end of time step is still unknown at the initial time. As a result, the initial state in the DLCM is an approximate value. Therefore, even for a discrete system, the DLCM is still an approximate solution of the Nash cascade model. But for the GNM, as interpreted in the manuscript, the initial state is strictly calculated by the linear storage-outflow relationship suggested in the Nash cascade model. It is only depending on the initial value of the outflow. The GNM is mathematically derived from the nth order nonhomogeneous linear ordinary differential equation of the Nash cascade model. It is the unique exact solution of the Nash cascade model.

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