Geophysical Research Abstracts
Vol. 18, EGU2016-12820-1, 2016
EGU General Assembly 2016

Mass Conservative and Total Variation Diminishing Implementation of Various Hydrological Flow Routing Methods

Dirk Schwanenberg (1,2) and Rodolfo Alvarado Montero (3)

(1) University of Duisburg-Essen, Essen, Germany (dirk.schwanenberg@uni-due.de), (2) Deltares, Operational Water Management, Delft, Netherlands (dirk.schwanenberg@deltares.nl), (3) University of Duisburg-Essen, Essen, Germany (rodolfo.alvarado-montero@uni-due.de)

Hydrological flow routing methods are widely used as components of distributed hydrological models and in operational flow forecasting systems, often in combination with data assimilation and predictive control techniques. The most popular ones such as the Muskingum-Cunge approach implement variable parameters to relate the storage to the topology of the river reach and numerical parameters of the schematization. Although this often increases the accuracy of the approach, it may also lead to mass errors and other numerical issues. Whereas fixes for the mass error has been previously discussed by several authors, the numerical robustness is still not properly addressed.

We present a novel approach to reformulate hydrological routing schemes as a cascade of implicit pool routing models. Its numerical implementation is mass conservative and total variation diminishing, i.e. the solution does not oscillate or overshoot, for arbitrary time steps. It is shown that these numerical properties are achieved regardless of the accuracy of the scheme and its physical routing characteristics. Numerical experiments compare the computational performance and accuracy of the novel, reformulated approach with existing schemes including linear reservoir routing, nonlinear reservoir routing, and the original Muskingum-Cunge method. We show that the approach can reproduce the original schemes, if these are already mass conservative, otherwise fixes the mass conservation in the reformulated version and improves the solution at sharp gradients by suppressing numerical oscillations, overshooting or negative flows.