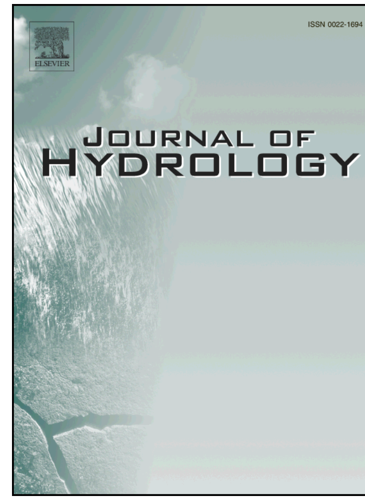
Accepted Manuscript



Research papers

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PII:	S0022-1694(18)30104-5
DOI:	https://doi.org/10.1016/j.jhydrol.2018.02.028
Reference:	HYDROL 22577

To appear in: *Journal of Hydrology*

Received Date:	10 November 2017
Revised Date:	19 January 2018
Accepted Date:	12 February 2018

Novel Patch Modelling method for efficient simulation and prediction uncertainty analysis of multi-scale groundwater flow and transport processes

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Abstract

The application of global sensitivity and uncertainty analysis techniques to groundwater models of deep sedimentary basins are typically challenged by large computational burdens combined with associated numerical stability issues. The highly parameterized approaches required for exploring the predictive uncertainty associated with the heterogeneous hydraulic characteristics of multiple aquifers and aquitards in these sedimentary basins exacerbate these issues. A novel Patch Modelling Methodology is proposed for improving the computational feasibility of stochastic modelling analysis of large-scale and complex groundwater models. The method incorporates a nested groundwater modelling framework that enables efficient simulation of groundwater flow and transport across multiple spatial and temporal scales. The method also allows different processes to be simulated within different model scales. Existing nested model methodologies are extended by employing 'joining predictions' for extrapolating prediction-salient information from one model scale to the next. This establishes a feedback mechanism supporting the transfer of information from child models to parent models as well as parent models to child models in a computationally efficient manner. This feedback mechanism is simple and flexible and ensures that while the salient small scale features influencing larger scale prediction are transferred back to the larger scale, this does not require the live coupling of models. This method allows the modelling of multiple groundwater flow and transport processes using separate groundwater models that are built for the appropriate spatial and temporal scales, within a stochastic framework, while also removing the computational burden associated with live