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

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

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7 **Abstract**

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

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