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**Regional scale flow and transport modelling for the management of groundwater and surface water bodies in the framework of the EU Water Directive**

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**Abstract**

The Water Framework Directive requires from EU member states to manage water resources at the scale of surface water and groundwater bodies in a sustainable way, without altering the different functions provided by the system in natural conditions. Efficient management also requires qualitative tools to assess the evolution of water quality regarding the activities performed in the area of interest. In this context, the objective is to discuss the needs in terms of groundwater flow and transport modelling as a support to the Water Framework Directive and to present a methodological and numerical approach that fits with these requirements. Different variably-saturated models have been implemented for selected case studies ranging between 500 and 1700 km<sup>2</sup> in the Walloon Region of Belgium. The implementation of such models is challenging because of the scale and the processes that have to be simulated. However, when calibrated and used adequately, they are able to deliver most information required, such as the estimation and evolution with time of groundwater reserves, the calculation of different indicators on groundwater replenishment and exploitation, the base flow to rivers and surface water bodies, under different stress conditions such as pumping, rainfall and climate change. They are also used for the evaluation of regional groundwater quality status and for contaminant trend assessment (e.g. nitrate) under different alternative management scenarios and mitigation measures that could be implemented in the future. This study illustrates perfectly the efficiency and usefulness of regional scale groundwater flow and transport modelling as a tool for the management of groundwater bodies.