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Teaching and learning hydrogeology using a physically-based modelling framework

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Hydrogeology involves studying the occurrence, distribution, movement and quality of water in geological formations. Hydrogeology typically enters in the curriculum of physical geography as well as civil and environmental engineering courses, is a multidisciplinary subject which encompasses several scientific areas including mathematics, physics, geology, geochemistry and numerical analysis. For applications such as resource management, decision and policy making, and an understanding and interpretation of uncertainty and risk assessment is also necessary.

Teaching hydrogeology is not only challenged by its multidisciplinary nature, but also since groundwater occurrence and movement is hidden from view in the subsurface, and is generally inaccessible to direct observation. Field experiments are often costly and time consuming, and laboratory experiments limited in scale. However, suitably designed computational systems can help address such issues by providing numerical modelling investigations of field conditions.

This contribution presents results from a recent project dedicated to develop an open-source, interactive, visual numerical modelling tool for teaching/learning hydrogeology, based on current pedagogical understanding of learning in higher education. It provides physically-based groundwater flow solutions within an intuitive user-friendly interface, which does not require advanced technical skills to operate. The aim is to be able to improve student's learning by providing immediate and visual feedback on groundwater flow and contaminant transport problems. The development and implementation of the tool as part of a teaching framework to address subsurface flow concepts and phenomena is presented, discussed and evaluated. By linking theoretical problem-solving exercises with modelling tasks in a learn-by-doing approach, we further discuss how student's learning experiences can be enhanced.