H2OLAB: A NUMERICAL PLATFORM FOR THE STOCHASTIC MODELING OF COMPLEX POROUS AND FRACTURED MEDIA

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The H2OLAB platform has been developed in the past 7 years to integrate in a modular structure physical models and numerical methods for simulating flow and transport in highly heterogeneous porous and fractured media. It includes stochastic models and Uncertainty Quantification methods for dealing with stochastic modeling. It relies as much as possible on existing free numerical libraries such as parallel sparse linear solvers. This policy increases its global reliability and efficiency. The software is also fully parallel, follows a powerful object-oriented approach in C++ and is developed in a cross-platform way (Unix/Linux, Windows OS). H2OLAB is especially suited to 3D highly heterogeneous and complex geological settings like fractured media.
H2OLAB is designed as an incubation platform for the development of new numerical and theoretical methods. It provides an efficient framework including common XML parameter interface, template launcher classes, easy-to-use automation tools, visualization tools, code repository and versioning. Reliability of existing codes is ensured by day-to-day validation of numerous non-regression tests. The platform is linked to a searchable database designed to store simulations and metadata (e.g. code name and version number)
H2OLAB is currently used in several projects in highly heterogeneous porous and fractured media. These projects are for example the simulation of flow in large 3D fracture networks, the implementation of Mortar methods for decoupling mesh generation and geological domains, the development of reactive transport methods by Lagrangian and Eulerian methods, a generic implementation of particle-tracking methods, and 3D free surface regional flow. Each of these projects will issue an open source library that could be either reached through H2OLAB or integrated independently in other platforms.
The H2OLAB platform offers a privileged way to develop new numerical and theoretical methods because of the large range of already existing geometrical and heterogeneity structures. Full specification and documentation as well as a practical graphical user interface are currently developed to release H2OLAB as an easily accessible open-source software.