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# DuMux – an open-source simulator for solving flow and transport problems in porous media with a focus on model coupling

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DuMux (<https://dumux.org/>) is a general simulation framework (written in C++) with a focus on finite volume discretization methods, model coupling for multi-physics applications, and flow and transport applications in porous media. Its core applications are single and multiphase flow applications in porous media on the Darcy scale, embedded network and fracture models, and free-flow porous media flow interaction. However, it can also be used as a general-purpose finite volume / control-volume finite element solver for partial differential equations. Pre-implemented models, make it a versatile tool for many porous media applications.

In this poster contribution, we give a brief overview of the main features and application areas. Moreover, we present updates in recent years (including the upcoming release of DuMux version 3.9, Spring 2024) and how the capabilities have improved since the initial appearance of DuMux 3.0 (which is described in [1]). Novelty include additional (pore-)network modeling capabilities, 2D shallow water equations (e.g. for river modeling), new control-volume finite element schemes, methods for free-flow porous media coupling, fractured porous media, multithreaded assembly, and new tutorials and educational material.

Given the theme of the conference, we put a special emphasis on “Porous Media & Biology” applications and models in DuMux.

DuMux is based on the DUNE framework from which it uses the versatile grid interface, vector and matrix types, geometry and local basis functions, and linear solvers. DuMux then provides finite volume discretizations (Tpfa, Mpfa, Staggered) and control-volume finite element discretization schemes (P1, CR/RT, MINI); a flexible system matrix assembler and approximation of the Jacobian matrix by numeric differentiation; a customizable Newton method implementation, and many pre-implemented models (Darcy-scale porous media flow, Navier-Stokes, Geomechanics, Pore network models, Shallow water equations) and constitutive models. DuMux features a multi-domain framework for model coupling suited to couple subproblems with different discretizations/domains/physics/dimensions/... and create monolithic solvers.

Acknowledgement: DuMux has been developed since 2010 with contributions from over 80 developers. The poster contribution will mention the poster authors and acknowledge an updated list of developers actively contributing to DuMux since the release of version 3.0.

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### **References**

[1] <https://doi.org/10.1016/j.camwa.2020.02.012>

### **Conference Proceedings**

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