



معهد قطر لبحوث
البيئة والطاقة
Qatar Environment & Energy
Research Institute

جامعة حمد بن خليفة
HAMAD BIN KHALIFA UNIVERSITY



25-29th
September 2016

Montpellier, France
CORUM CONFERENCE CENTER

43rd
IAH
congress



Laboratoire d'Hydrologie et
de Géochimie de Strasbourg

On the efficiency of ELLAM for mass transport in fractured porous media: Application to Qatar's aquifer storage project

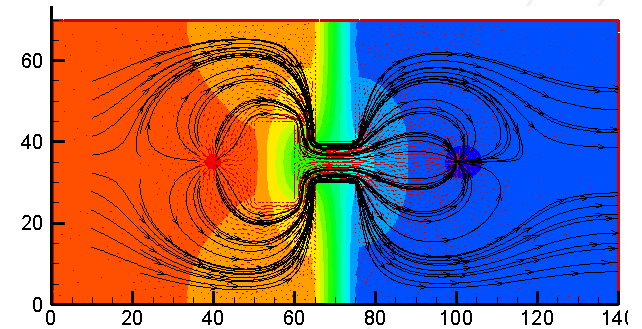
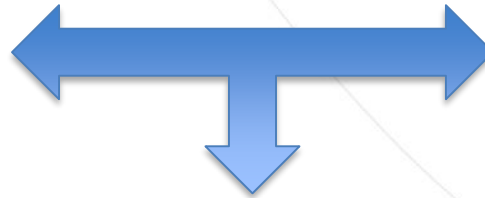
Fanilo Ramasomanana, Marwan Fahs, Husam M Baalousha, Nicolas Barth, Said Ahzi

Qatar is an arid country where aquifers, which are the only source of fresh natural groundwater, are over exploited.

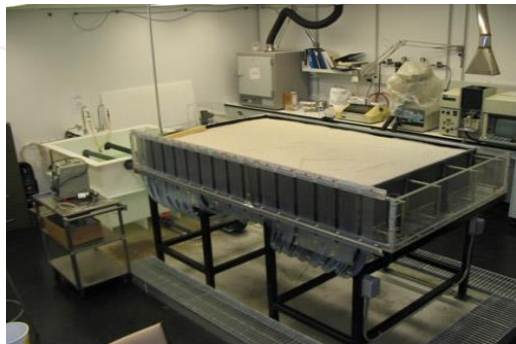
This study contributes to the Aquifer Storage and Recovery (ASR) project by developing a numerical model for flow and transport in fractured porous media. The model is based on the combination of **MHFEM** and **ELLAM**.



Field measurements



Modeling



Experiments

Mathematical model

Fluid flow is described by the combination of Darcy's law and the continuity equation

$$(1) \quad S_s \frac{\partial h}{\partial t} + \nabla \cdot \mathbf{q} = f_{ps}$$

Continuity equation

$$(2) \quad \mathbf{q} = -\mathbf{K} \nabla h$$

Darcy's law

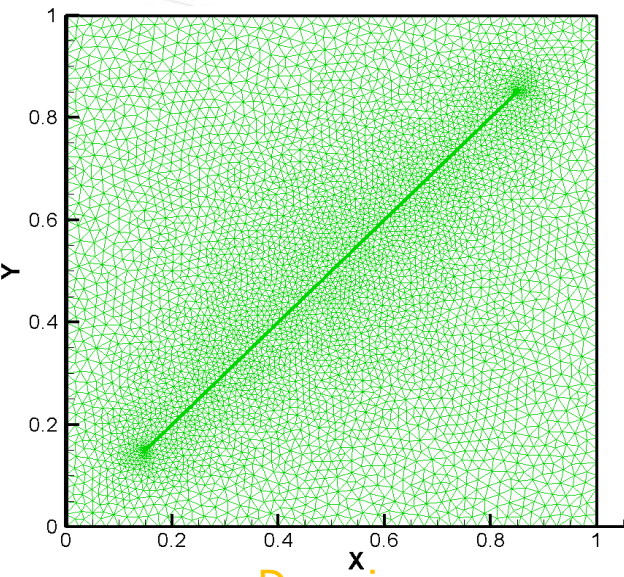
$$(3) \quad S_s \frac{\partial h}{\partial t} - \nabla \cdot (\mathbf{K} \nabla h) = f_{ps}$$

Diffusivity equation

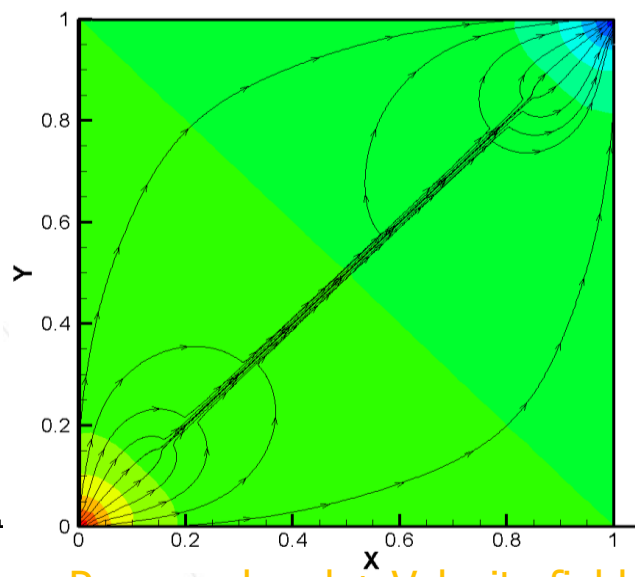
Solute transport is described by the classical advection-dispersion differential equation

$$(4) \quad \frac{\partial C}{\partial t} + \nabla \cdot (\mathbf{u}C - \mathbf{D} \nabla C) = 0$$

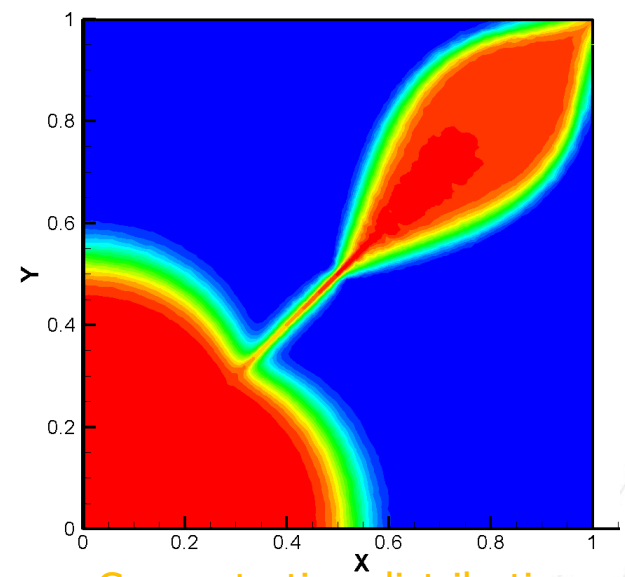




Domain



Pressure head + Velocity field



Concentration distribution

- Porous matrix + fracture
- 13000 elements

MHFEM

- Accurate approximation of velocities and pressures
- Continuity of velocities across interelement

ELLAM

- Advective part solved with Lagrangian scheme
- Dispersive part solved with Eulerian scheme
- Less numerical dispersion
- Use of large time step

Several fracture configuration are tested and compared with results obtained by Discontinuous Galerkin Method.

We plan to use these scheme to validate future experiments + 3D Extension

Thank You



معهد قطر لبحوث
البيئة والطاقة
Qatar Environment & Energy
Research Institute

جامعة حمد بن خليفة
HAMAD BIN KHALIFA UNIVERSITY

www.qeeri.org.qa