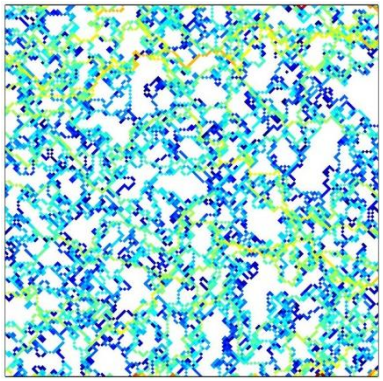
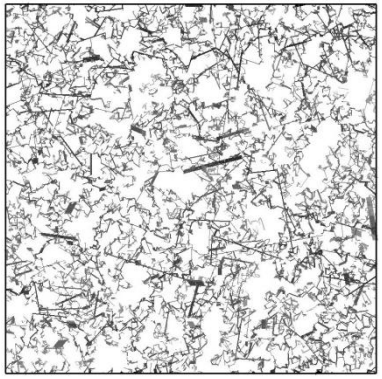
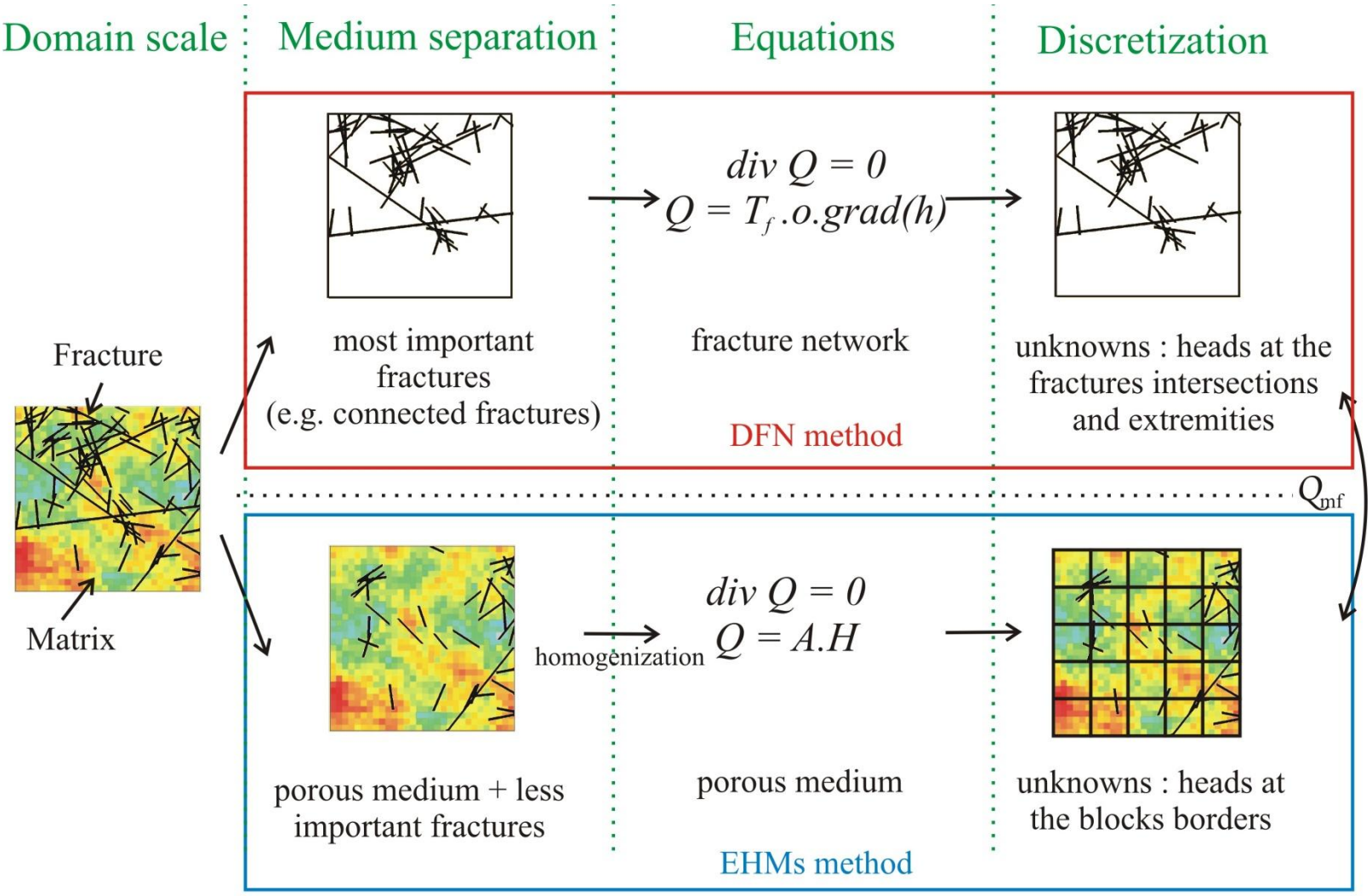
A discrete dual-porosity model for flow in heterogeneous porous fractured media





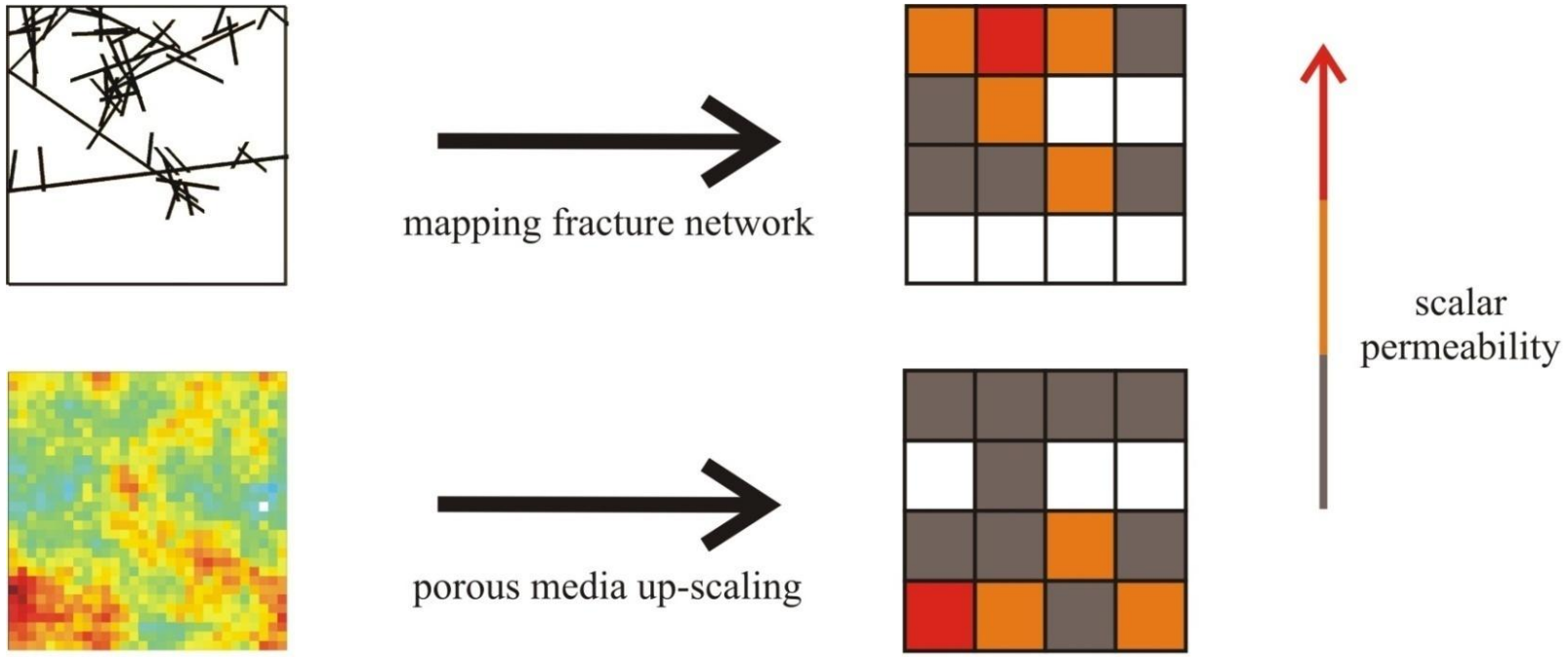
A discrete dual-porosity model



Homogenization methods

1. *Scalar permeability*

$$q = k.\nabla h$$

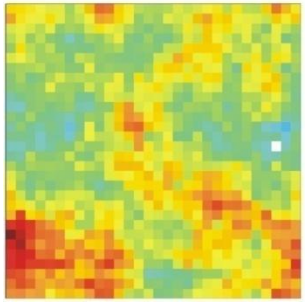


2. Tensor permeability

$$\begin{pmatrix} q_x \\ q_y \end{pmatrix} = \begin{pmatrix} k_{xx} & k_{xy} \\ k_{xy} & k_{yy} \end{pmatrix} \begin{pmatrix} \nabla h_x \\ \nabla h_y \end{pmatrix} = K_n \begin{pmatrix} \nabla h_x \\ \nabla h_y \end{pmatrix}$$

tensor determination by simulations at the cell scale

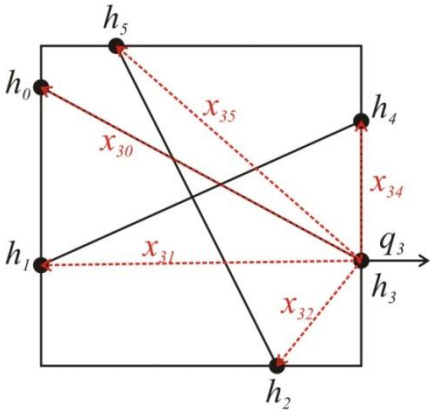
K_4	K_8	K_{12}	K_{16}
K_3	K_7	K_{11}	K_{15}
K_2	K_6	K_{10}	K_{14}
K_1	K_5	K_9	K_{13}

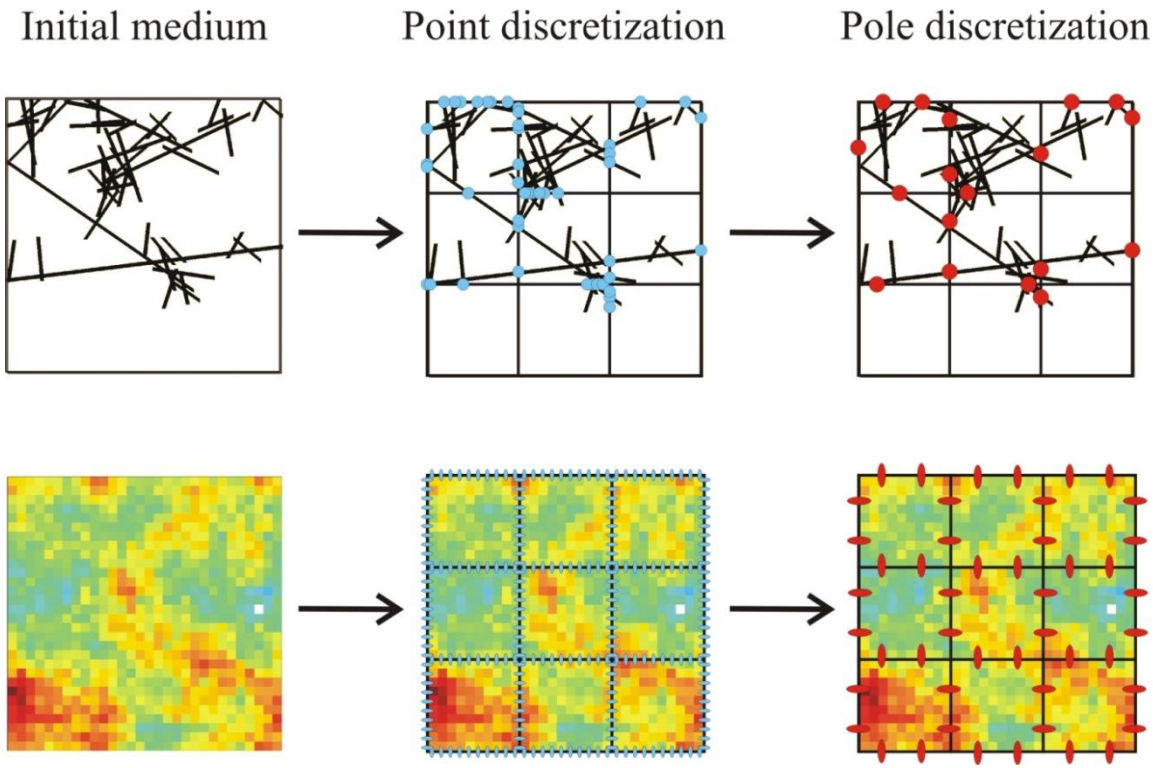


K_4	K_8	K_{12}	K_{16}
K_3	K_7	K_{11}	K_{15}
K_2	K_6	K_{10}	K_{14}
K_1	K_5	K_9	K_{13}

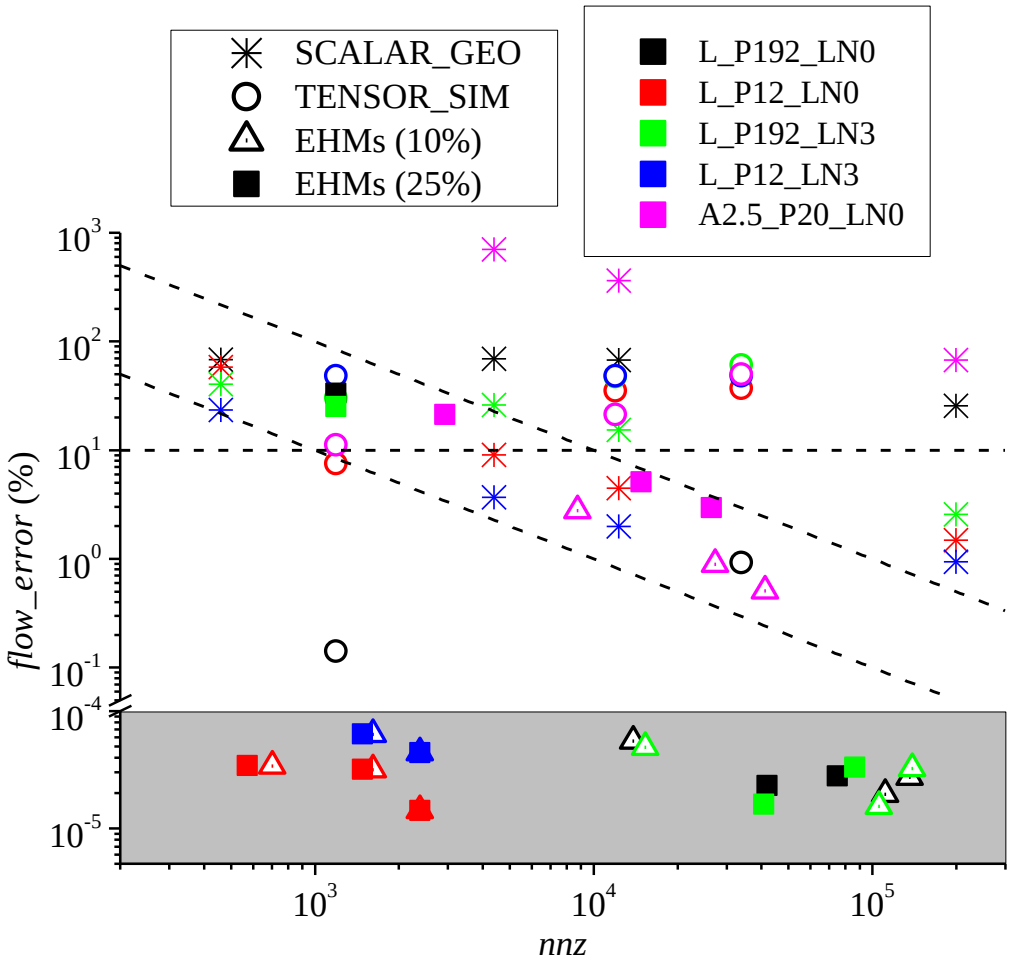
3. The Equivalent Hydraulic Matrices method

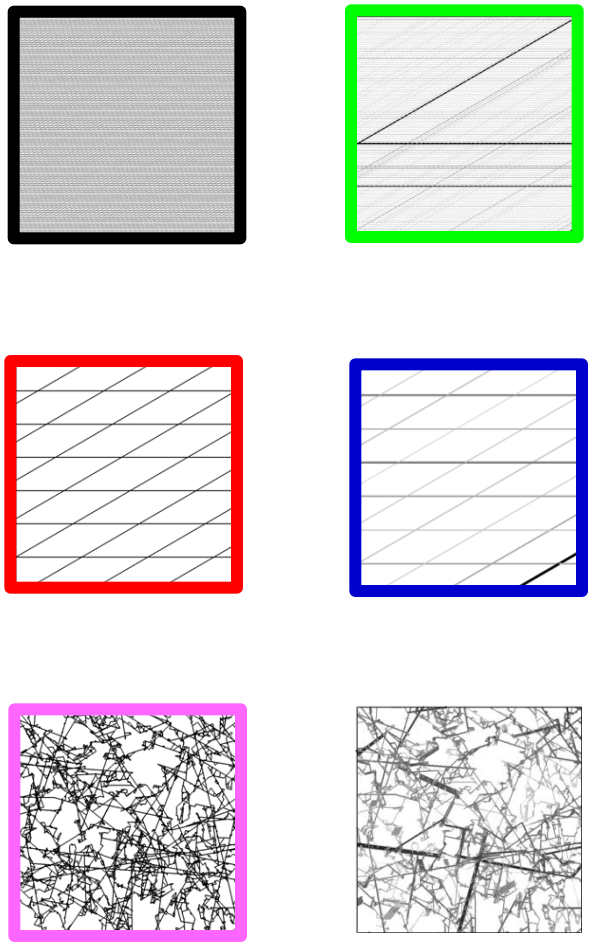
$$q_k = \sum_{l=1}^{p} A(k,l).\frac{\partial h_k}{\partial x_{kl}} \rightarrow \begin{pmatrix} q_1 \\ \vdots \\ q_p \end{pmatrix} = A_{EHM}.\begin{pmatrix} h_1 \\ \vdots \\ h_p \end{pmatrix}$$

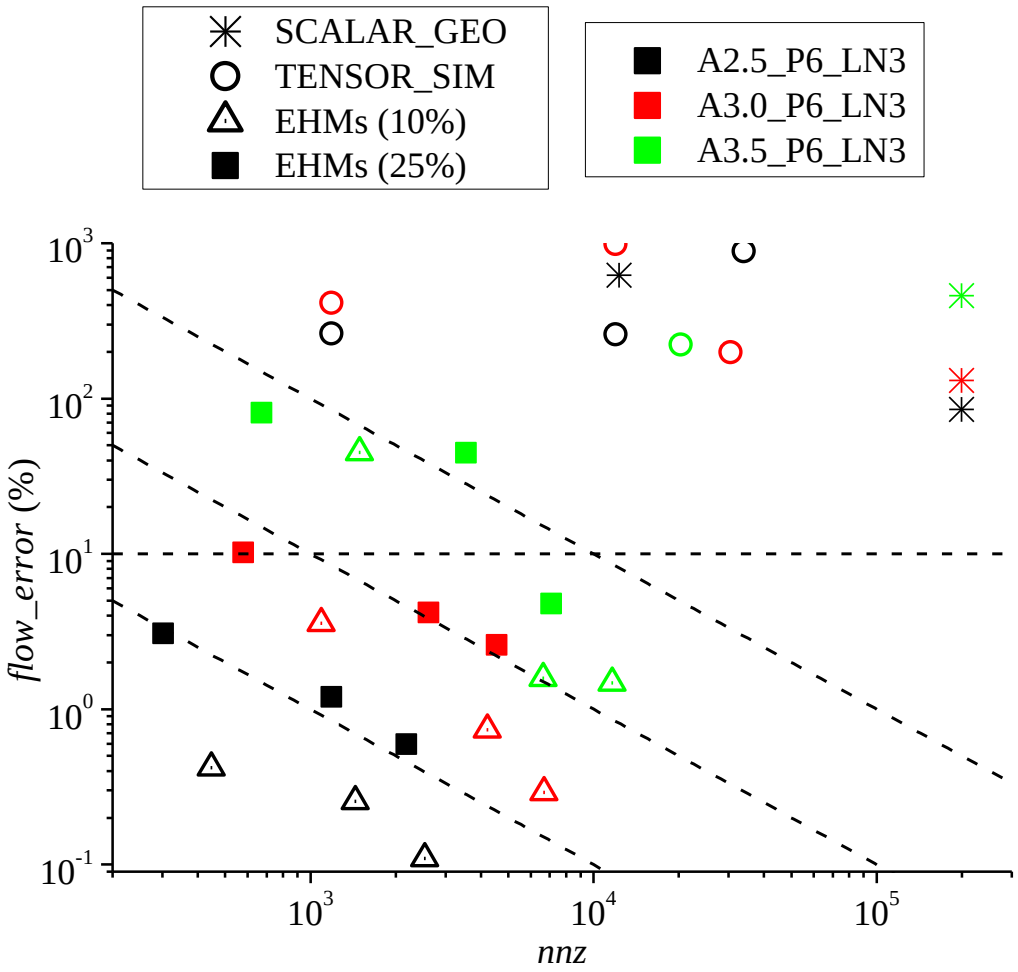


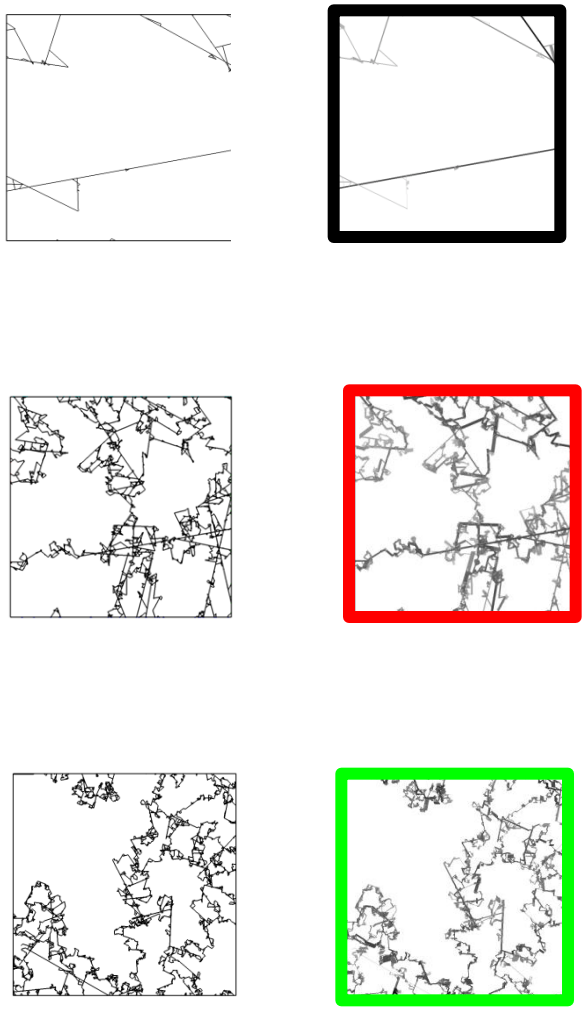


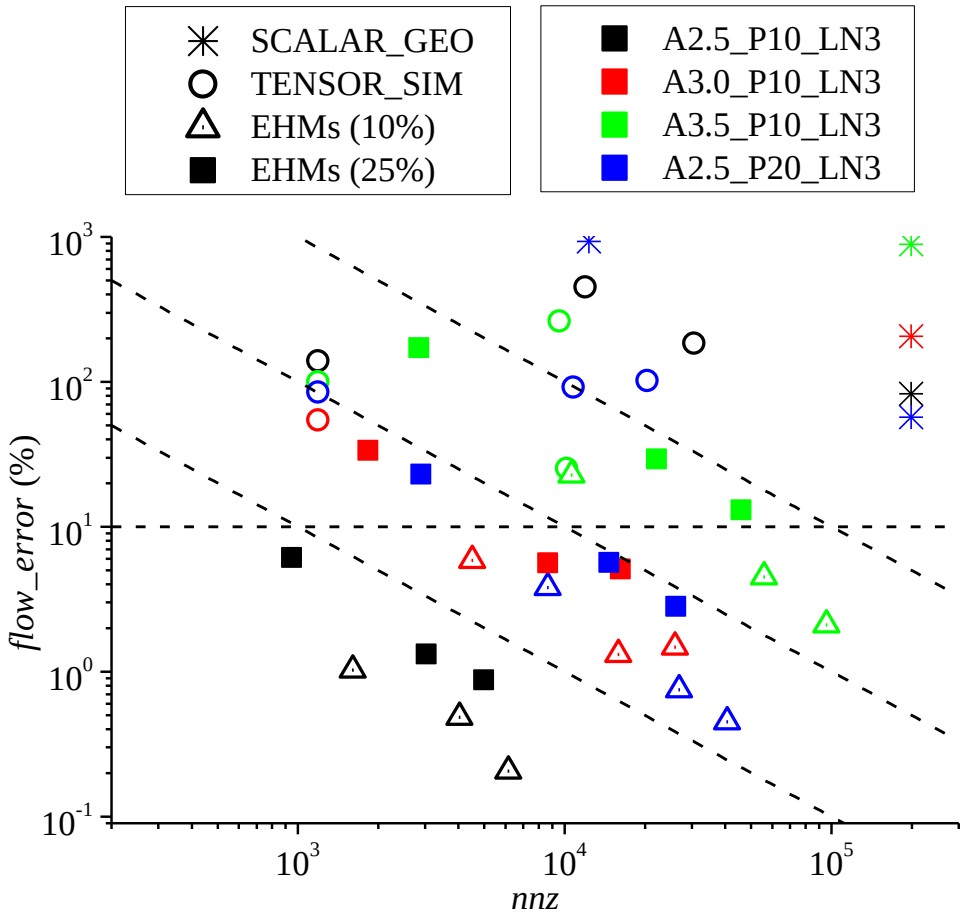
EHMs assessment for fractured media

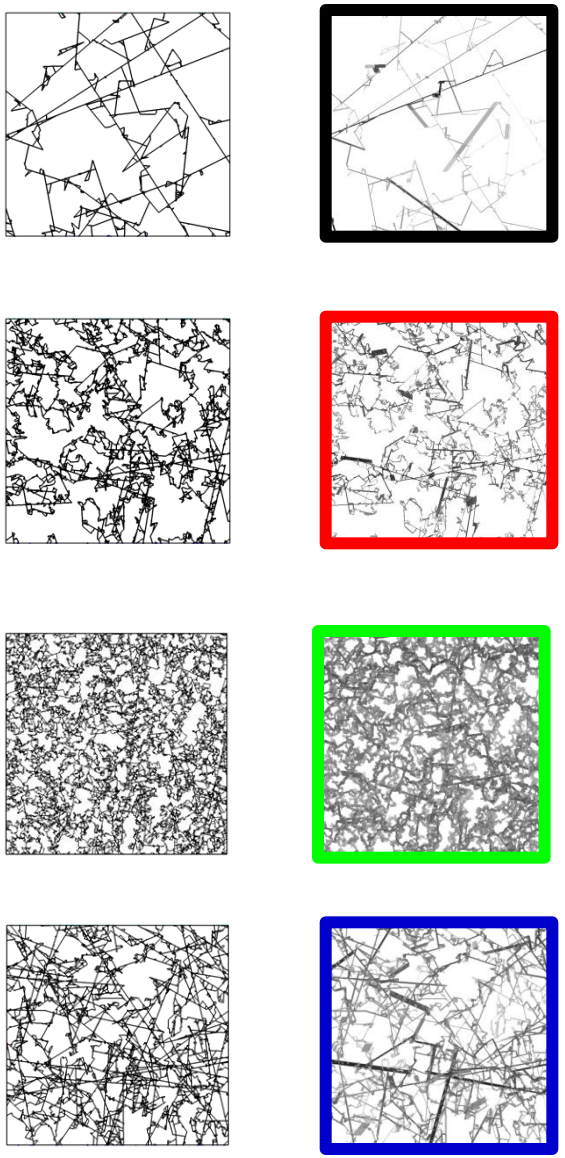





SCALAR_GEO
TENSOR_SIM
EHMs (10%)
EHMs (25%)
A2.5_P6_LN3
A3.0_P6_LN3
A3.5_P6_LN3
flow_error (%)
nnz
10^3
10^2
10^1
10^0
10^-1
10^3
10^4
10^5




SCALAR_GEO
TENSOR_SIM
EHMs (10%)
EHMs (25%)
A2.5_P10_LN3
A3.0_P10_LN3
A3.5_P10_LN3
A2.5_P20_LN3
flow_error (%)
nnz
10^3
10^2
10^1
10^0
10^-1
10^3
10^4
10^5



Future work

1. *Extension of the EHMs method*

- Assessment of EHMs method for porous media
- Transient
- 3D
- Particle tracking

2. *The discrete dual-porosity model*

- Fracture-matrix exchange : flow and transport
- Comparison model results/field datas (^{222}Rn)

- Fracture/matrix exchange: $Q_{mf} = \alpha.(h_m - h_f)$
- C_{Rn} = f(rock/fracture surface,flow velocity)