3D Hydrogeological Modeling

From a Theoretical 2D Model through a Medium Scale Application up to a Challenge: Simulations at Basin Scale

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Introduction: An alluvial quaternary aquifer system, assumed as a high heterogeneous porous media, has probably conceived as a numerical modeling hell, according to most of hydrogeologists. We will show how we tried to manage the whole subsurface physics

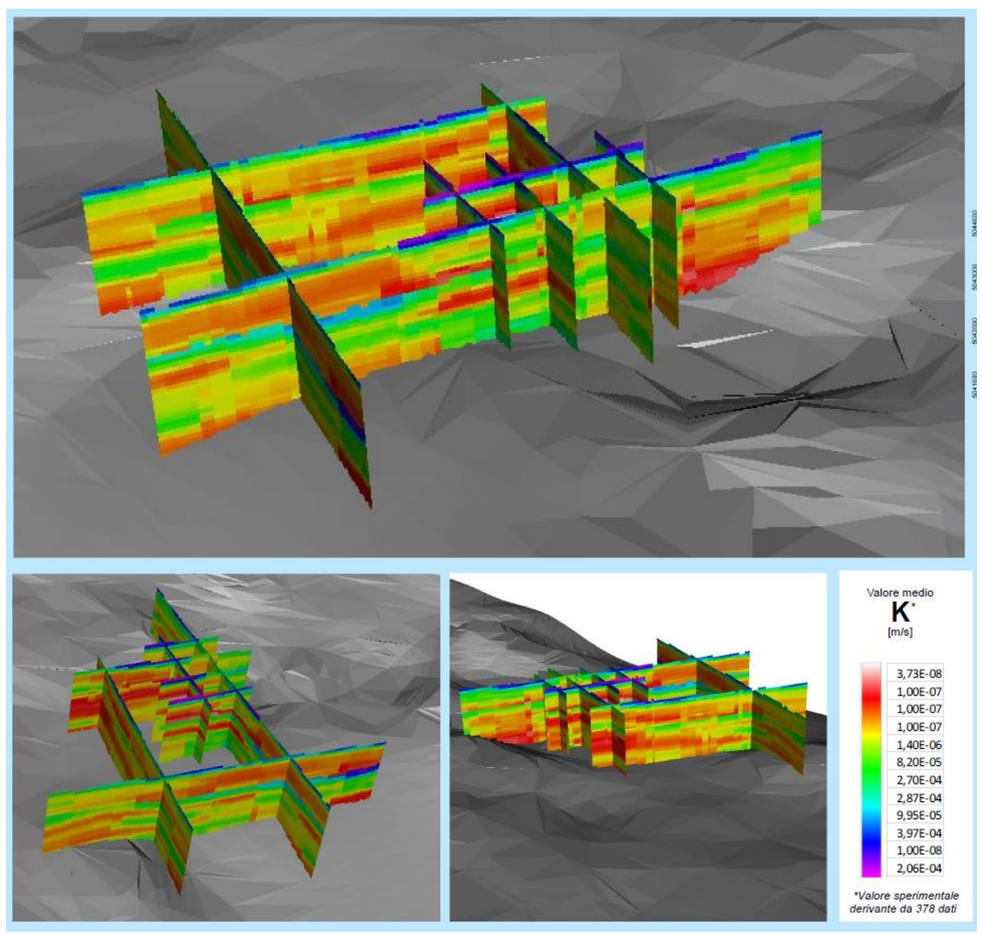

Figure 1. High detailed Aquifer System 3D simulations

Computational Methods: we built a 2D section: **a)** Darcy's law (multylayer and heterogeneus saturated aquifer), **b)** Richards' equation (portion of unsaturated aquifer and), **c)** ALE (aleatory Lagranian-Eulerian) methods to show piezometric surface deformation, **d)** Inlet from surface (recharg according to hydrogeology terms), **e)** soltue transport (flux of mass) and inlet from a surface water (2m incised creek with a generic solute

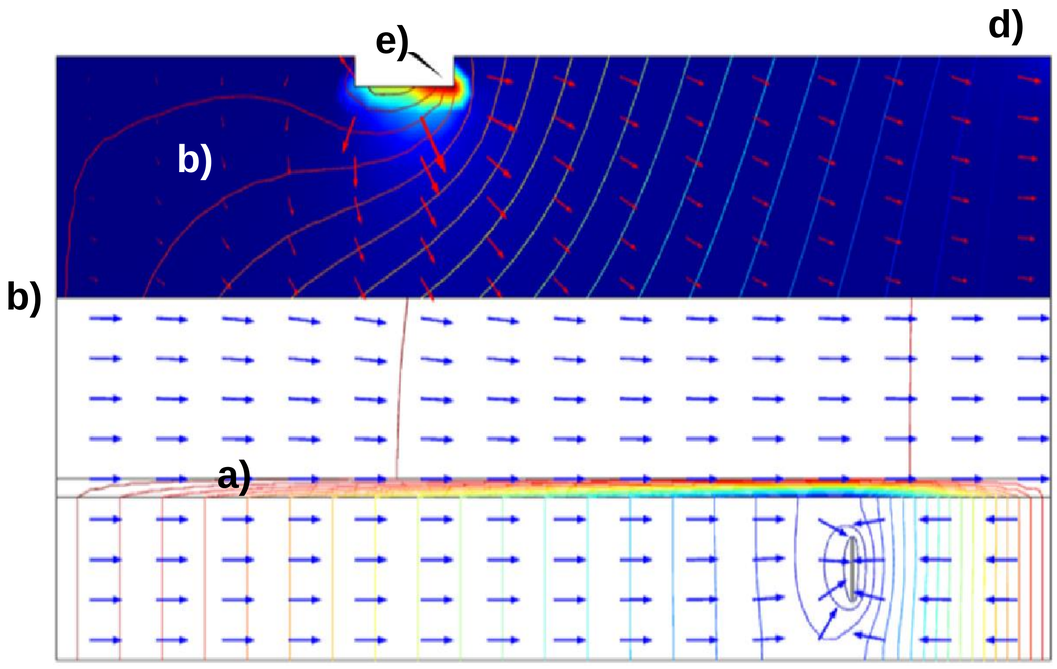

Figure 2. 2D section with 5 different physics simulation.

Results: After this "academic" exercise, we applied this modeling work plan in a very critical pollution site,in order to define a capture zone of nine wells with double screens pumping simultaneously. We exactly used the same configuration of 2D model in a 3D domain

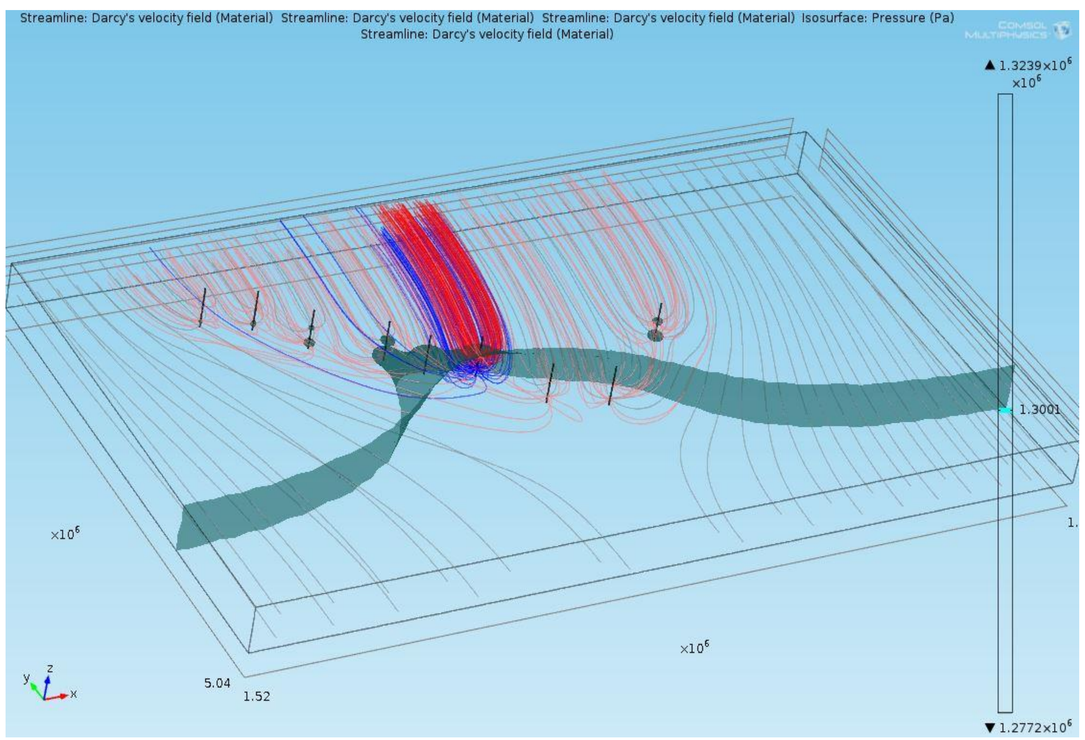

Figure 3. Hydraulic barrier

Conclusions:
Though the domain was increased by 2000% (from a decametric simulation to a kilometric study area) we appreciated how COMSOL multiphysics® runs very well parallelized in our workstation and found very fastly the convergence although faced with a high areal complexity.
Currently, we are developing a very large scale 3D high detailed aquifer model ready to be imported as an interpolation function and to define hydrogeological heterogeneities. We are testing COMSOL Multiphysics® for a very large domain with interesting response. For our test we do not notice a limit (except calculation time) to areal dimension.