Groundwater Flow Modelling Using COMSOL Multiphysics and GMS Software: A Comparison

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Introduction: The groundwater flow modelling of any typical field situation is highly complicated in terms of heterogeneity and anisotropic assumptions. In order to simplify the complexity, this poster gives the grid approach to solve the typical field problem (Kosi Alluvial Fan, Bihar) with simple steps using GMS (MODFLOW) and ArcGIS software. An effort has also been made to simulate the same results using COMSOL Multiphysics and their typical comparisons also mentioned.

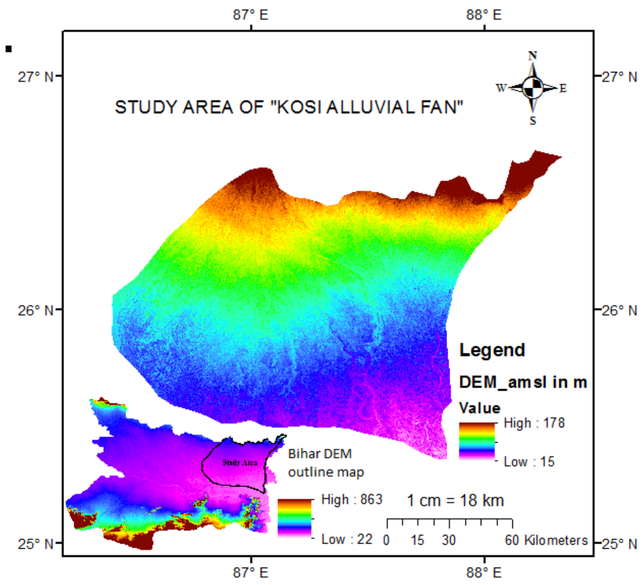

Figure 1. DEM of study area, Kosi Alluvial Fan, Bihar.

Computational Methods: The governing PDE for transient 3D ground water flow in heterogeneous and anisotropic porous medium with source/sink using the principle of mass conservation and Darcy's law,

$$\frac{\partial}{\partial x}(K_{xx})\frac{\partial h}{\partial x}+\frac{\partial}{\partial y}(K_{yy})\frac{\partial h}{\partial y}=S_s\frac{\partial h}{\partial t}+W(x,y,t)$$

The same equation can also be introduced in COMSOL using Darcy's law of physics from porous media and subsurface flow from fluid flow module or Coefficient Form PDE from PDE interfaces of mathematics module,

$$\frac{\partial}{\partial t}(\rho\varepsilon_P)+\nabla\cdot(\rho U)=Q_m$$

$$U=-\frac{k}{\mu}\nabla P$$

Results: The steady state model is performed for the shallow aquifer system having 100 m aquifer thickness. The Fig 2.a shows the comparative results and it is further explained in [1].

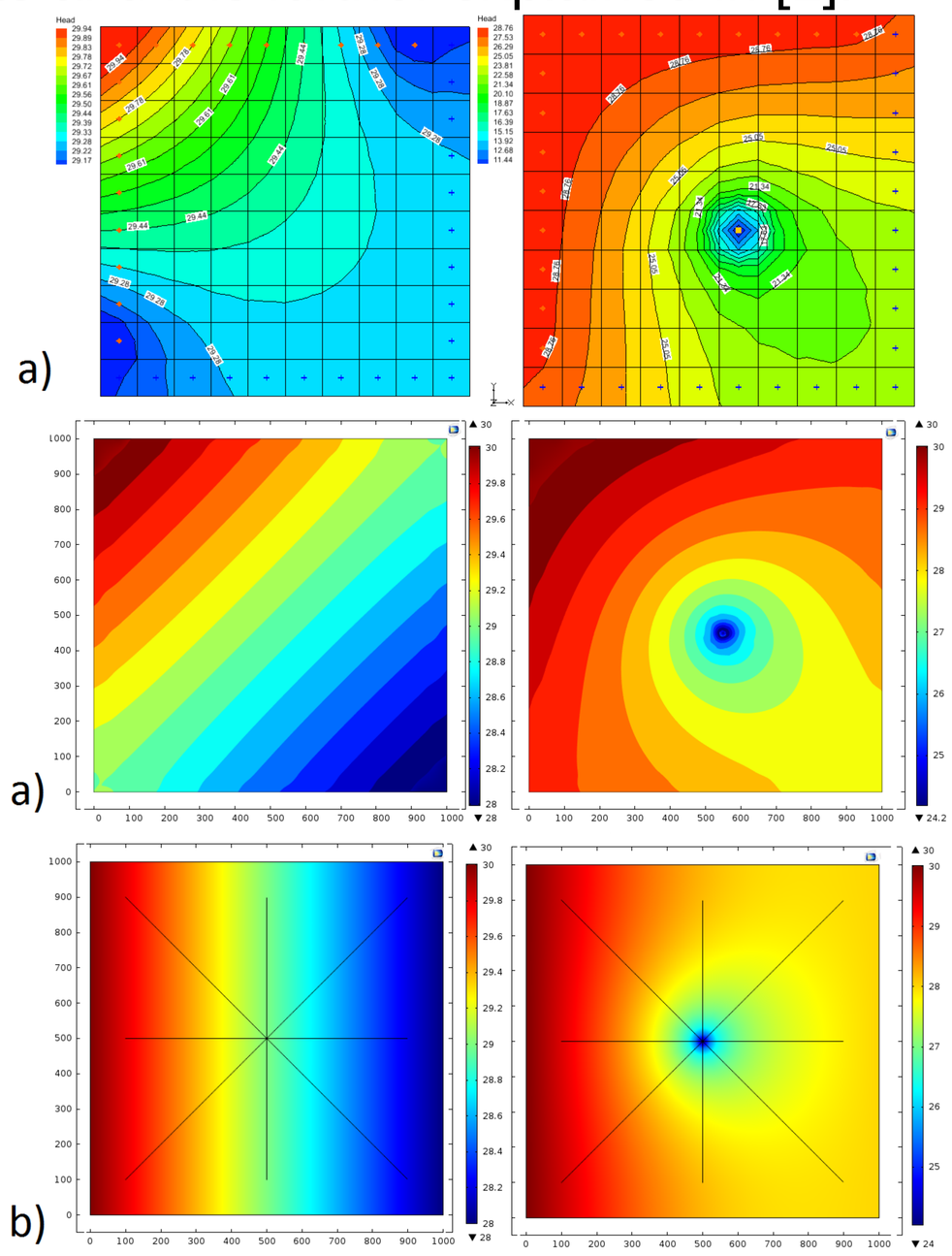

Figure 2. **a)** Comparison of simulation at the confluencing point of two rivers using GMS and COMSOL Multiphysics software. **b)** Multiple fractures in a hypothetical flow domain with/without pumping station in all results.

Conclusions: Thus the Ground water flow modeling of Kosi alluvial fan in Bihar region of India has been studied successfully using MODFLOW 3D GRID approach (GMS) and COMSOL Multiphysics software with available depth to water table data and the aquifer parameters. COMSOL also has other modules like fracture flow, which can be utilised to model flow and contaminant transport through fractured porous media.

References:

1. Dinesh, P., Kartha, S.A., Dutta, S. "Groundwater Flow Modeling of Kosi Alluvial Fan in Bihar State using GMS 3D Grid Approach". National Conference on Water and its Sustainability in Mining and Other Environment. Vision 2050, pp. 289-298, (2014).