

Benchmarking tailored formulations of multiphase flow in porous media

Alvaro Sainz-García ^(1,2) (alvaro.sainz@amphos21.com), Elena Abarca ⁽¹⁾, Albert Nardi ⁽¹⁾, Fidel Grandia ⁽¹⁾

⁽¹⁾ Amphos 21 Consulting S.L., ⁽²⁾ Université Toulouse III - Paul Sabatier, Toulouse

Introduction

Nowadays, gas and nuclear waste storage, shale gas and EOR exploitation rise the need to understand and predict the fate of multiphase flows in the underground.

Various formulations for multiphase flow arise from different linear combinations of governing equations and choice of associated unknowns (CHEN et al., 2006; Helmig et al., 1997). Each formulation has its own benefits and drawbacks; and the optimal may vary depending on the **conceptualization of the problem**.

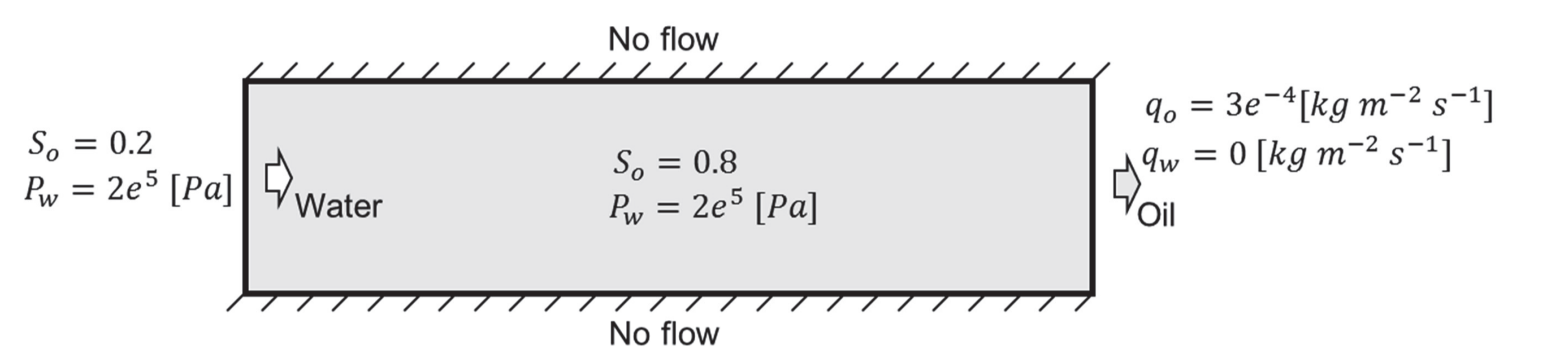
Modeling approach

A set of formulations, available for the selection of the user, have been implemented in COMSOL. The formulations are able to model two-phase, variable density, miscible and immiscible fluid flows in any dimensions.

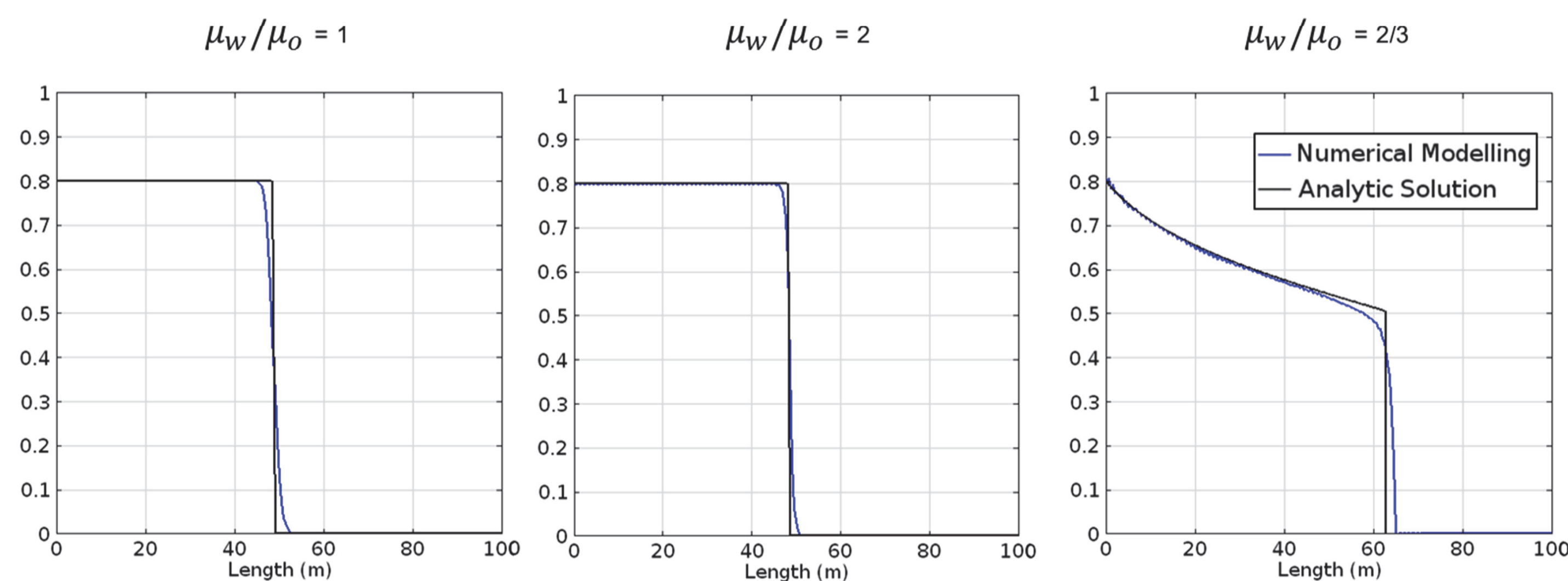
Currently, the equations of state of oil, water, brine and supercritical CO₂ have been implemented although they can be easily extended to any other fluid. These formulations open a wide spectrum of possible applications for multiphase processes that can be combined with other physics to create multiphase multiphysics applications.

Benchmarking

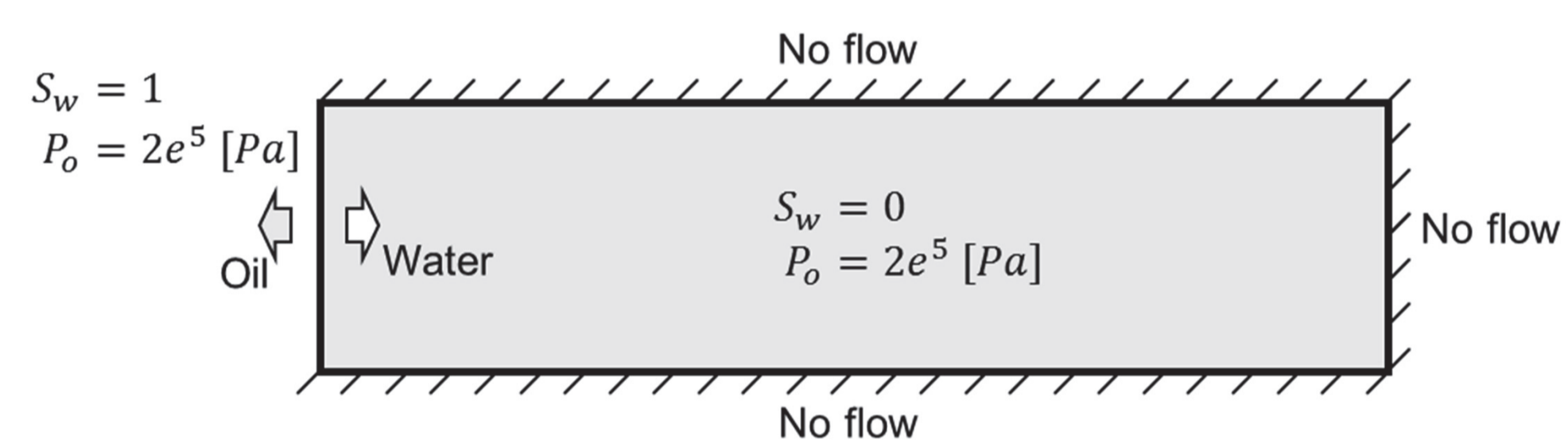
Buckley & Leverett, 1942



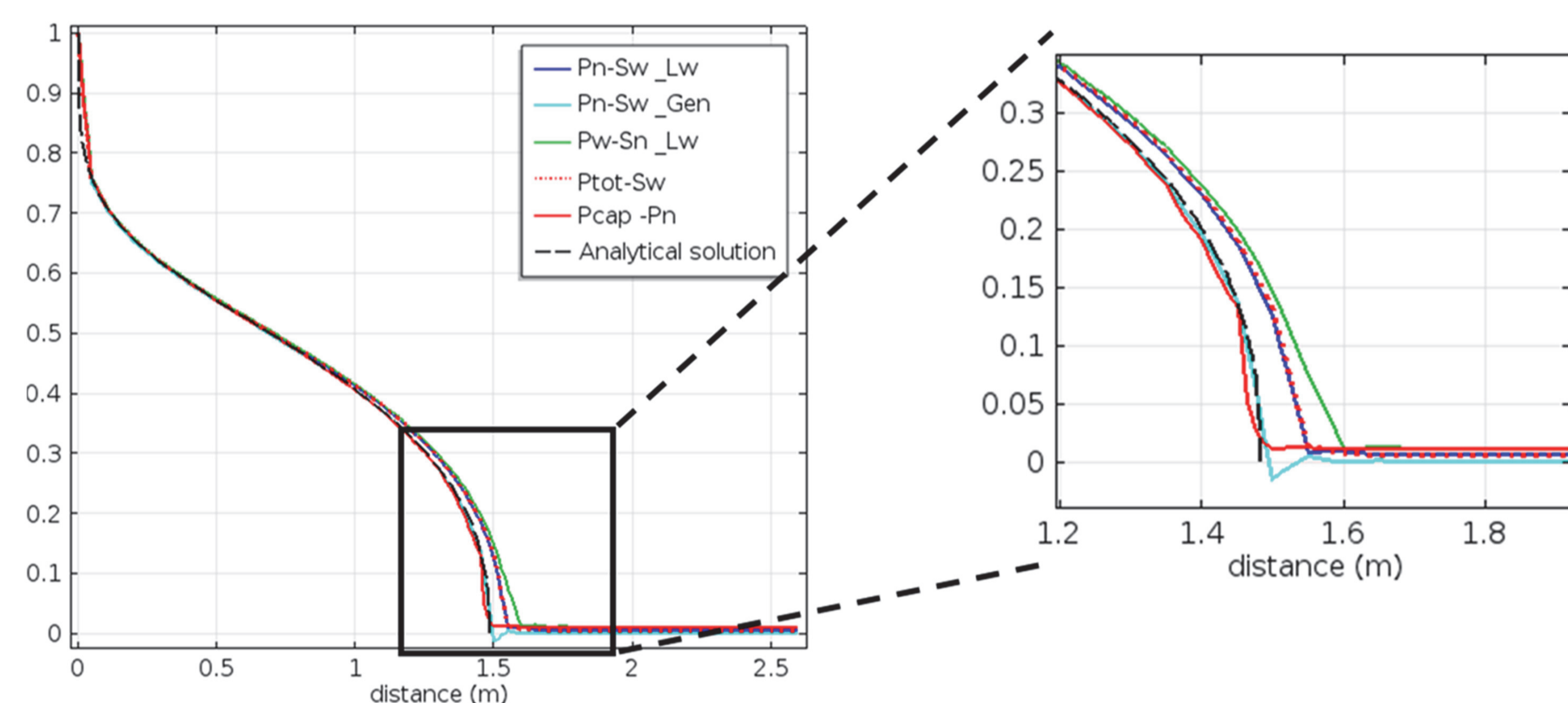
Water Saturation after 300 days



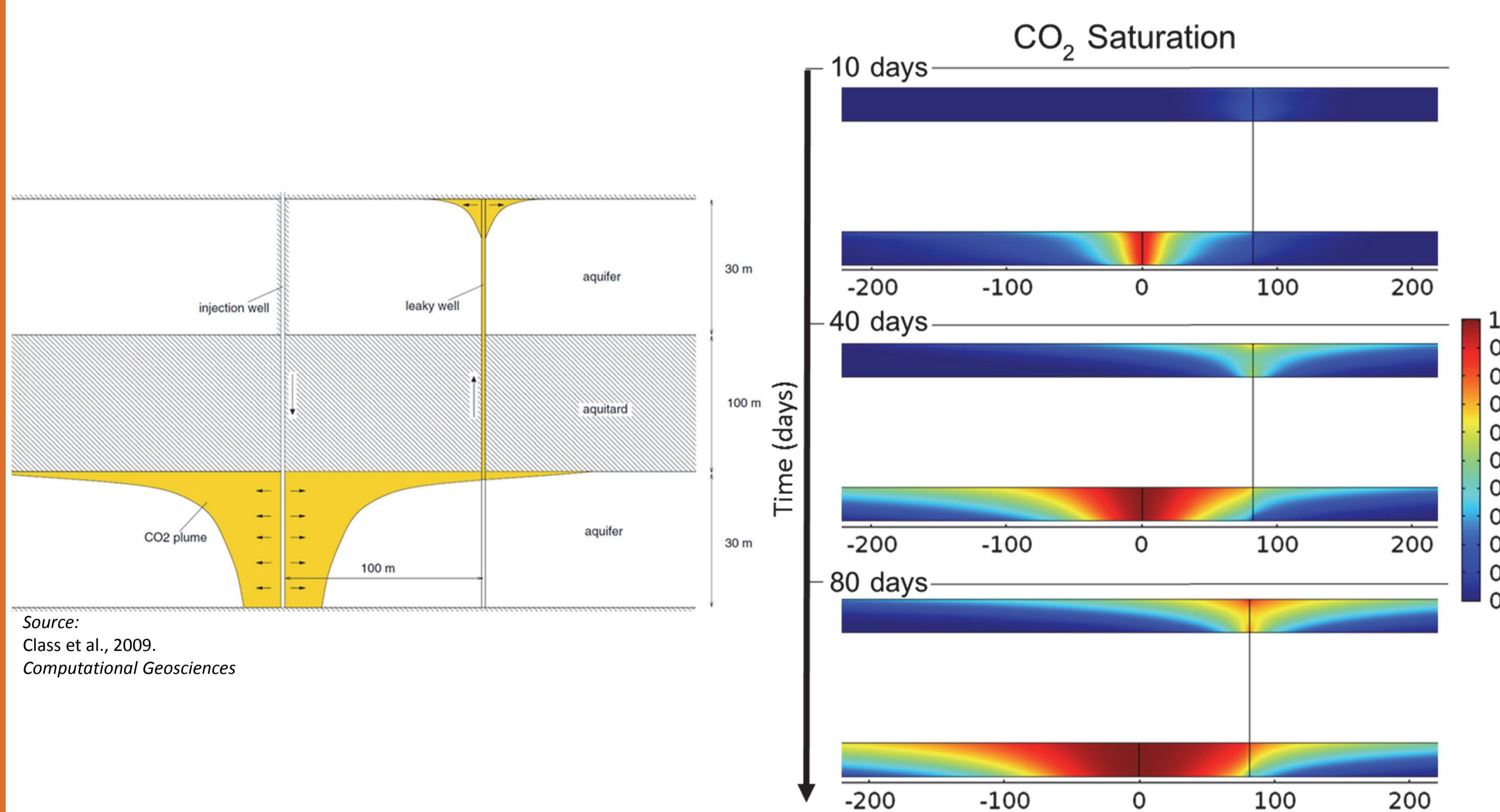
McWhorter & Sunada, 1990



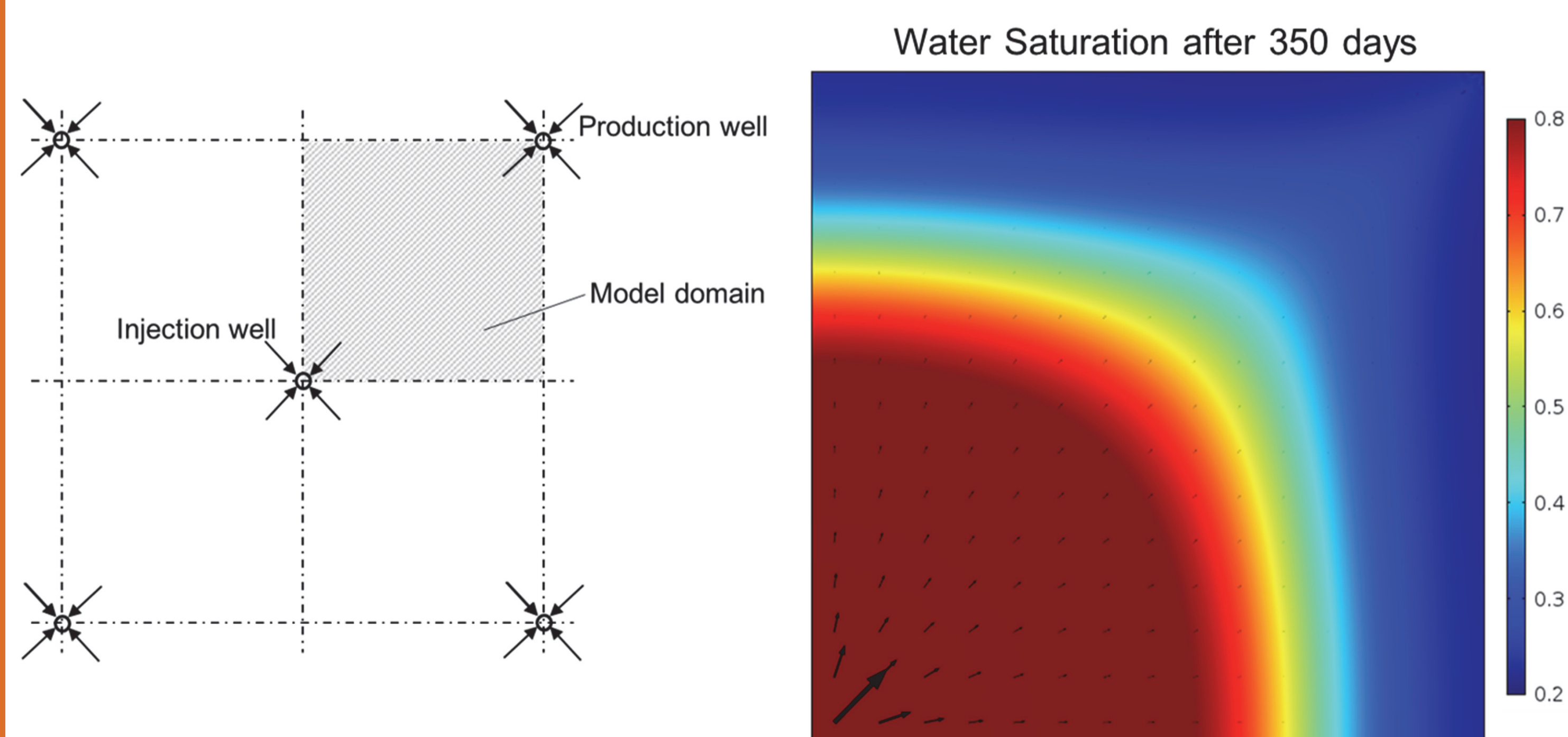
Water Saturation after 2.78 hours



Leakage well (Ebigbo et al., 2007)



Five-spot (Chen, et al., 2006)



References

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