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High Precision Saline Intrusion Modelling in Heterogeneous Aquifers using Dynamic Mesh Optimisation

Wednesday, 1 June 2022 09:20 (1h 10m)

Saline intrusion (SI) in coastal aquifers is a global problem with the potential to contaminate groundwater used by over a billion people. The problem is becoming more widespread due to increased groundwater abstraction in response to urbanization combined with natural phenomena such rising sea levels due to climate change or storm surges. Accurate modelling and prediction of SI in coastal aquifers is vital for aquifer management, development of regulatory frameworks and risk assessment. However, numerical modelling of SI is very challenging because the mixing zone at the saline front is often highly anisotropic, or order meters perpendicular to the front, but extending laterally over the order of km. Moreover, the aquifer may be highly heterogeneous, further complicating the movement and geometry of the front. Here, we present a parallel computational framework (using the memory distributed approach) with dynamic mesh optimization (DMO) for contaminant transport in density-dependent groundwater flow modelling. The use of DMO guarantees that precision is placed where and when necessary to ensure accurate solutions and is especially effective when having to span many length scales without compromising the computational cost. The approach uses a double-control-volume-finite element method and is implemented in IC-FERST (the open-source Imperial College Finite Element Reservoir SimulaTor). We first validate the approach and study the precision and efficiency/speed up of DMO for SI modelling with the classic "Henry"problem. Next, we apply the framework to a realistic 3D case study simulating saline intrusion in a heterogeneous chalk aquifer. We study the efficiency and precision of DMO both in serial and in parallel, obtaining with the combination of the two a simulation speed-up of 120x.

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Time Block Preference

Time Block B (14:00-17:00 CET)

Participation

In person

Primary authors: SALINAS, Pablo; Dr BAHLALI, Meissam (Imperial College London); Dr JACQUEMYN, Carl (Imperial College London); Prof. PAIN, Christopher C. (Imperial College London); Dr BUTLER, Adrian P. (Imperial College London); Prof. JACKSON, Matthew D. (Imperial College London)

Presenter: SALINAS, Pablo

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