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Numerical Aspects of Petroleum Systems Modeling—How Fast Can We Go?

In recent years considerable progress was made in the understanding and numerical simulation of geological processes. This encompasses such improvements as modeling petroleum generation, advanced PVT-calculation for product prediction, sophisticated (multidimensional, multiphase, n-component) 3-D-migration analysis and structural tectonic modeling.

One of the main challenges today is the integration of these models into the overall framework of Petroleum Systems Modeling. Limitations in computer resources and performance make it necessary to search for fast algorithms and more effective implementations.

In our presentation we discuss separately the modeling performance for structural analysis, temperature, compaction and pressure simulation, petroleum generation, migration and accumulation. We confirm that due to the complex structure of the differential equations the migration model is the bottleneck. We propose the following measures to improve performance: A separation of the PVT - flash calculations from flow equations and an adaptive hybrid migration algorithm. This results in a performance improvement and lowering of computing time by orders of magnitude. Furthermore we discuss the improvements of parallelization of the solution of the remaining differential equations. We conclude with considerations concerning the practical use of Petroleum Systems Modeling in exploration and field development.