



energies



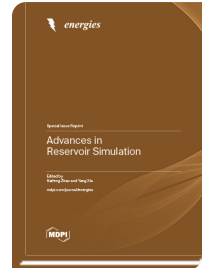
Special Issue Reprint

Advances in Reservoir Simulation

www.mdpi.com/books/reprint/10799

Edited by
Haifeng Zhao
Yang Xia

ISBN 978-3-7258-3816-5 (Hardback)
ISBN 978-3-7258-3815-8 (PDF)



This synthesis highlights innovations addressing reservoir heterogeneity and fracture dynamics through integrated numerical modeling, data assimilation, and multi-physics coupling. Ensemble-based algorithms (e.g., ES-MDA) enhance history matching by assimilating 4D seismic and production data, reducing uncertainties by 15–20%. Hydro-mechanical models optimized with true triaxial experiments guide Discrete Fracture Network (DFN)-driven hydraulic fracturing, boosting shale gas productivity by 40%. Proxy models like INSIM-FT and Physics-Informed Neural Networks (PINNs) enable rapid simulation, cutting computational time from weeks to hours while maintaining >85% accuracy. Machine learning (XGBoost) achieves 92% permeability prediction in carbonates, while dynamic heterogeneity analysis reveals fracture-induced permeability contrasts exceeding 10^3 . Geomechanical frameworks quantify risks in salt cavern storage (0.12% annual creep strain) and fractured reservoirs, extending operational lifespans by 20%. Field applications demonstrate 8% recovery gains in carbonate fields via 4D seismic integration and 60% leakage risk reduction through multi-physics cement design. Emerging trends fuse data-physics models (30–50% efficiency gains) and cross-scale simulations, while challenges persist in proppant transport modeling and sparse 4D data. Future directions prioritize quantum computing for fracture networks, IoT-enabled digital twins, and adapting reservoir engineering to carbon sequestration, positioning the field as pivotal for sustainable energy transition.



Order Your Print Copy
You can order print copies at
www.mdpi.com/books/reprint/10799

MDPI Books offers quality open access book publishing to promote the exchange of ideas and knowledge in a globalized world. MDPI Books encompasses all the benefits of open access – high availability and visibility, as well as wide and rapid dissemination. With MDPI Books, you can complement the digital version of your work with a high quality printed counterpart.



Open Access

Your scholarly work is accessible worldwide without any restrictions. All authors retain the copyright for their work distributed under the terms of the Creative Commons Attribution License.



Author Focus

Authors and editors profit from MDPI's over two decades of experience in open access publishing, our customized personal support throughout the entire publication process, and competitive processing charges as well as unique contributor discounts on book purchases.



High Quality & Rapid Publication

MDPI ensures a thorough review for all published items and provides a fast publication procedure. State-of-the-art research and time-sensitive topics are released with a minimum amount of delay.



High Visibility

Due to our global network and well-known channel partners, we ensure maximum visibility and broad dissemination. Title information of books is sent to international indexing databases and archives, such as the Directory of Open Access Books (DOAB), and the Verzeichnis Lieferbarer Bücher (VLB).



Print on Demand and Multiple Formats

MDPI Books are available for purchase and to read online at any time. Our print-on-demand service offers a sustainable, cost-effective and fast way to publish MDPI Books printed versions.