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Reduced-order transport models for energy and the environment
ZHONG ZHENG, Tsinghua-Sichuan Energy Research Institute — We present recent developments on reduced-order modelling and its applications to energy and environmental processes, such as geological CO_2 sequestration and hydraulic fracturing, which is related to the application of energy resource recovery, such as shale gas recovery. In particular, we introduce a series of gravity current models, which describe the spreading and draining dynamics of supercritical CO_2 that is injected into a saline aquifer, for example. In many situations we consider here, self-similar solutions are available to describe some of the interesting dynamics, considering the effects of buoyancy, surface tension, and heterogeneity, for example. We next introduce a series of experimental work that is related to the dynamics of hydraulic fracturing. Model viscous fluids and elastic solids have been employed for the laboratory-scale experiments, and scaling argument has been performed to describe the spatial and temporal evolution of the hydraulic fractures and some of the parametric dependence. We also point out several future research directions and hopefully bring in more interests on this topic.

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