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Onset of density-driven convection in heterogeneous porous media: Non-modal stability analysis SAIKIRAN RAPAKA, Johns Hopkins University, RAJESH PAWAR, PHILIP STAUFFER, Los Alamos National Laboratory, DONGXIAO ZHANG, University of Southern California, SHIYI CHEN, Johns Hopkins University and Peking University — When carbon dioxide (CO_2) is injected into saline aquifers, it slowly dissolves into the brine resulting in a gravitationally unstable state. Under suitable conditions, this instability manifests itself in the form of "fingers" of CO_2-rich brine penetrating into the system resulting in a significant enhancement of the rate of dissolution of CO_2 into the system. Recently, we applied the idea of non-modal growth of perturbations to compute the length and time scales characteristic of the onset of convection in a homogeneous porous medium. Non-modal stability theory is a theoretically rigorous extension of the traditional eigenvalue approach to non-normal and non-autonomous operators. In this work, we extend this approach to horizontally layered porous media generated with a Gaussian covariance model. We use a Monte-Carlo approach to analyze the effects of correlation length and the variance of the log-permeability field on the critical time for the onset of convection. We present the probability density function for the critical time and show that its variance increases with both the variance of the permeability field and its correlation length.

Saikiran Rapaka
Johns Hopkins University

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