An autonomous system for chaotic convection in a porous medium using a thermal non-equilibrium model

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Abstract

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Thermal convection in a fluid-saturated porous medium was analyzed using a thermal non-equilibrium model to
take account of the interphase heat transfer between the fluid and the solid. An autonomous system with five differential
equations was deduced by applying the truncated Galerkin expansion to the momentum and heat transfer equations.
The effects of the porosity-modified conductivity ratio, k, and interphase heat transfer, H, on the routes to chaos for
convection in a porous medium were analyzed and discussed. The stability analysis revealed that the interphase heat
transfer tends to stabilize the steady convection. The results show that with weak interphase heat transfer, a transition
occurs from steady convection to chaos by a period-doubling sequence. However, an abrupt transition to chaos is predicted
when interphase heat transfer is moderate and the porosity is small or moderate. As the product of k and H
approaches infinity, the present system is reduced to Vadasz' s system which employs a thermal equilibrium model.

Keyword：autonomous system
thermal non-equilibrium model