

Materials for 5th Int. Conference on Applications of Porous Media

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Title: Thermal instability of a plane porous layer with an inclined temperature gradient: recent results (by A. Barletta)

Abstract:

The Hadley circulation is named after George Hadley, an eighteenth century meteorologist, who proposed an explanation for the distribution of trade winds in the atmosphere. Nowadays, the term Hadley flow is used in a more general sense to describe buoyant flows driven by an externally-imposed temperature gradient inclined to the vertical. The thermal instability of the Hadley flow in a fluid-saturated horizontal porous layer has been widely studied in the literature during the past three decades. Recently, further results have been obtained on this subject, by investigating the effects of the boundary conditions, the heterogeneity of the porous medium, and the inclination of the layer to the horizontal. The main numerical and analytical results obtained will be surveyed and discussed. Other studies have been carried out on the closely related problem of a horizontal porous layer subject to a horizontal through-flow and to a net wall heating or cooling. These conditions imply that non-vanishing heat flux components in the vertical direction as well as in the horizontal direction are built up. The shape and the position of the neutral stability curves are strongly influenced by the Péclet number relative to the basic mass flow rate. The onset bound for the linear thermo-convective instability has been obtained under conditions of local thermal equilibrium between the phases, and extended also to the regime of local thermal non-equilibrium.