

New spatio-temporal instability scenarios in non-Boussinesq mixed convection

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Abstract

Mixed convection flows in a tall vertical channel with differentially heated walls subject to large cross-channel temperature gradients are shown to exhibit enormous variety of instability scenarios which have two physically distinct origins: the shear and the buoyancy of the flow. In order to visualize the most typical spatio-temporal patterns and complement previous analytical stability studies the Fourier integrals representing linearised disturbances arising from an initially localised source are evaluated numerically. The disturbance fields are obtained for strongly non-Boussinesq high-temperature convection of air. They are contrasted to their counterparts in the Boussinesq limits of small temperature gradients. A drastic difference in disturbance evolution scenarios is found. In particular, it is shown that non-Boussinesq natural convection is convectively unstable while mixed convection flows can be absolutely unstable. These scenarios are opposite to the ones detected in the classical Boussinesq convection in the same geometry.