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The Phenomena of Transition and Relaminarization of Convective Boundary Layers in an Enclosed Tall Cavity

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Large-eddy simulations of buoyant-driven flow in a differentially heated tall cavity filled with air have been performed at Ra = 4.6×10^{10}. The dynamic global-coefficient Sub-Grid Scale (SGS) model based on the Vreman formulation has been utilized. Transition phenomenon is investigated through insights into the instantaneous flow of the laminar boundary layers at the hot and cold walls of the tall cavity. The onset of flow transition can be depicted either through the representation of the iso-surfaces of the Q-criterion or large fluctuations of the instantaneous temperature field at the hot and cold walls. Behavioral changes and further understanding of the flow during various phase of transition are explored through identification of distinctive coherent structures and triggering mechanisms. Relaminarization of the instantaneous flow which occurs at the adiabatic walls of the cavity is also investigated in this study.

Keywords: Convective Boundary Layers, Transition, Relaminarization, Large-eddy Simulations