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Transient effects of sudden changes of heat load in a naturally ventilated room C.P. CAULFIELD, BP Institute, University of Cambridge, D.J. BOWER, S. FITZGERALD, A.W. WOODS — Using reduced numerical models and small-scale laboratory experiments, we investigate the transient effects of changing isolated heat loads discontinuously within a large, ventilated space. We consider the emptying filling box (with high and low openings) driven by a single isolated source of buoyancy. The original steady state consists of a buoyant layer, whose depth (for the simplest case of a point source plume) is determined by the geometric properties of the room alone. When the buoyancy flux of the source is increased, a new layer 'fills' the room from the top with a more buoyant layer. The original layer disappears due to entrainment by the rising plume. The behaviour is qualitatively different when the source buoyancy flux is decreased. In this case, the rising plume fluid is now relatively dense, and so it inevitably collapses back to 'intrude' below the original layer. In this case, the original layer disappears due to both draining through the upper opening, and penetrative entrainment by the dense plume. We compare the predictions of three numerical models using different penetrative entrainment parametrizations to a sequence of laboratory experiments. This entrainment reduces the density of the intruding layer, and so the rising plume eventually stalls, and no longer reaches the (draining) original layer. We demonstrate that it is necessary to consider the transient effects of penetrative entrainment when the reduction in source buoyancy flux is sufficiently small.

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