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Turbulent plumes of unequal strength in a ventilated filling-box - thermal overshoots and bulk overturning AJAY SHRINIVAS, Imperial College London, GARY HUNT, University of Cambridge — The activation of two non-interacting turbulent plumes of constant buoyancy fluxes B_1 and $B_2 > B_1$ in a ventilated box typically gives rise to a three-layer stratification comprised of two buoyant layers and a lower region at ambient density. A theoretical model is developed to predict the time evolution of this density stratification and the displacement flow driven by the two buoyant layers through openings, at the top and base, that connect the box to a quiescent stationary ambient of uniform density. When the top layer provides the dominant forcing, we show that the mean layer buoyancies evolve on two characteristically different timescales, thus inducing a time lag. As a result, the mean buoyancy of the intermediate (i.e. middle) layer exceeds its steady value for a significant duration, giving rise to a "thermal overshoot." This phenomenon can have key practical implications in ventilated rooms as occupants would experience "localised overheating." Furthermore, we find that the two plumes can induce a bulk overturning of the buoyant layers. We show that, for a given source strength ratio $\psi = B_1/B_2$, thermal overshoots are realised for dimensionless opening areas $A < A_{oh}$ and overturning for $A < A_{ot}$.

Ajay Shrinivas
Imperial College London

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