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Quantifying near-wall coherent structures in turbulent convection G.S. GUNASEGARANE, BABURAJ A PUTHENVEETTIL, IIT Madras, YOGESH K AGRAWAL, NIT Durgapur, India, DANIEL SCHMELING, JOHANNES BOSBACH, Institute of Aerodynamics and Flow Technology, German Aerospace Center (DLR), JAYWANT H. ARAKERI, IISc Bangalore, IIT MADRAS- DLR - IISC COLLABORATION — We present planforms of line plumes formed on horizontal surfaces in turbulent convection, along with the length of near- wall line plumes measured from these planforms, in a six decade range of Rayleigh numbers ($10^5 < Ra < 10^{11}$) and at three Prandtl numbers ($Pr = 0.7, 6, 602$). Using geometric constraints on the relations for the mean plume spacings, we obtain expressions for the total length of these near-wall plumes in turbulent convection. The plume length per unit area (L_p/A), made dimensionless by the near-wall length scale in turbulent convection (Z_w) remains a constant for a given fluid. The Nusselt number is shown to be directly proportional to L_pH/A for a given fluid layer of height H. Increase in Pr has a weak influence in decreasing L_p/A. These expressions match the measurements, thereby showing that the assumption of laminar natural convection boundary layers in turbulent convection is consistent with the observed total length of line plumes. We then show that similar relationships are obtained based on the assumption that the line plumes are the outcome of the instability of laminar natural convection boundary layers on the horizontal surfaces.

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