Abstract Submitted
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Boundary layer precursors of extreme events in the bulk of turbulent Rayleigh-Bénard convection VALENTINA VALORI, JRG SCHUMACHER, TU Ilmenau — We study the connection between extreme events of thermal and kinetic dissipation rates in the bulk of three-dimensional Rayleigh-Bénard convection and the wall-shear-stress at the top and the bottom boundary layers of the cell. Local minima in the vicinity of zero points of the wall shear-stress vector field are connected to the smallest magnitudes of the vertical temperature derivative in the boundary layer, and identify the locations where thermal plumes rise from the boundary layers [Schumacher and Scheel, 2016]. Our direct numerical simulations (DNS) at Rayleigh number of $Ra = 5 \times 10^5$ and $Ra = 1.5 \times 10^4$, and Prandtl number $Pr = 1$ in a Cartesian domain of aspect ratio $\Gamma = 8$ cell show that local maxima of the vertical temperature derivative which appear simultaneously at similar horizontal positions in both boundary layers can be considered as a precursor for an extreme event of thermal and kinetic energy dissipation in the bulk of the cell. We show from DNS and stereo PIV measurements that a typical example of extreme event of energy dissipation in the bulk is a front that forms between two colliding thermal plumes. Such collision can be predicted by the boundary layer dynamics up to a few free fall times in advance.

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