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Re-orientations of the large scale flow in turbulent convection with cubic confinement NAJMEH FOROOZANI, JOSEPH NIEMELA, The Abdus Salam ICTP, VINCENZO ARMENIO, University of Trieste, KATEPALLI SREENIVASAN, New York University — Large-eddy simulations (LES) of turbulent Rayleigh-Bénard convection were conducted with a fluid of Prandtl number $Pr = 0.7$ in a fully three dimensional cubic confinement of characteristic width-to-height aspect ratio unity for $Ra = 10^6$ and 10^8. The model solves the unsteady Navier-Stokes equations under the Boussinesq approximation, using a dynamic Smagorinsky model with a Lagrangian averaging technique for the subgrid scale terms. Under fully developed conditions the flow topology is characterized by a large scale circulation (LSC) or mean wind developing in a plane containing one of the diagonals of the cell, while two counter-rotating vortices develop in the other diagonal plane, resulting in inflow at the midplane. This flow structure is not stable in time, undergoing non-periodic re-orientation or switching between the two diagonal planes. The time-interval over which the flow maintains a particular orientation is not constant. We contrast the three-dimensional time-averaged flow structures with single point measurements (time-series) to shed light on the dynamics of the re-orientations. We observe that as Ra increases the LSC becomes more robust and attains a more squarish-like shape.

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