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Lagrangian Coherent Sets as transport barriers in convection¹

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The analysis of the turbulent heat transfer in thermal convection flow is mostly done in the Eulerian frame of reference. Here, we use an ensemble of more than half a million individual Lagrangian tracer trajectories, which are advected together with the evolving turbulent flow, to identify subsets that contribute least to the heat transfer. These trajectories probe Lagrangian Coherent Sets sets that remain spatially connected for a finite time and evolve in time. The analysis is based on three-dimensional direct numerical simulations at three different Prandtl numbers. Our Lagrangian analysis results provide a complementary view on the transport and are found to be consistent with the standard Eulerian results.

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