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Resolved Energy Budget of Superstructures in Rayleigh-Bénard Convection MICHAEL WILCZEK, GERRIT GREEN, Max Planck Institute for Dynamics and Self-Organization, Göttingen, Germany, DIMITAR VLAYKOV, Astrophysics Group, College of Engineering, Mathematics and Physical Sciences, University of Exeter, UK, JUAN-PEDRO MELLADO, Department of Physics, Division of Aerospace Engineering, Universitat Politècnica de Catalunya, Barcelona, Spain — Turbulent Rayleigh-Bénard convection shows a complex interaction between coherent large-scale flow patterns, so-called turbulent superstructures, and small-scale fluctuations. Here, we use direct numerical simulations to study the impact of turbulent fluctuations on large-scale patterns. To separate the superstructures and small-scale fluctuations, we employ a filtering approach, which retains the physical space information and therefore complements spectral analysis techniques. Focussing on the resolved energy budget of the superstructures, we characterize the different contributions, such as the resolved power input, direct dissipation and the energy transfer rate between scales. The results show that, as expected, the energy transfer differs significantly between the bulk and close to the wall. At large Rayleigh numbers, the energy input into the superstructures is primarily balanced by a direct energy transfer to smaller scales in the bulk. Here, the energy transfer acts as an effective dissipation for the superstructures. However, close to the wall the energy transfer is more complex and may even drive the superstructures. Besides a characterization, these results can help to develop an effective description of turbulent superstructures in convection.

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