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Examining departures from the Boussinesq approximation in chaotic Rayleigh-Benard convection using persistent homology[1] BRETT TREGONING, Georgia Institute of Technology, SAIKAT MUKHERJEE, Department of Mechanical Engineering, University of Minnesota, RACHEL LEVANGER, University of Pennsylvania, MU XU, Columbia University, JACEK CYRANKA, University of California San Diego, KONSTANTIN MISCHAIKOW, Rutgers University, MARK PAUL, Virginia Polytechnic Institute and State University, MICHAEL SCHATZ, Georgia Institute of Technology — Persistent homology is a data analysis technique that can be used to quantify the topological information of image data. In the spatio-temporally chaotic flow known as spiral defect chaos in Rayleigh-Benard convection, we explore the connection between convective plumes detected by persistent homology and the extent that the flow deviates from the Boussinesq approximation, a common simplification used to study convective flows. Simulations of the Boussinesq approximation predict that hot and cold plumes occur at roughly equal rates over time scales comparable to the horizontal diffusion time. However, using the same mean values of physical parameters, we demonstrate that rates of hot and cold plume formation differ in simulations and experiments that deviate from the Boussinesq approximation.

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