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Passive and active transport in a chaotic flow field CHRISTOPHER MEHRVARZI, MARK PAUL, Virginia Tech — The transport of a scalar species in a complex flow field is important in many areas of current interest such as the combustion of premixed gases, the dynamics of particles in the atmosphere and oceans, and the reaction of chemicals in a mixture. There has been significant progress in understanding transport in steady periodic flows such as a ring of vortices. In addition, transport in turbulent flow has an extensive literature. However, in this work, we focus upon the transport of a scalar species in a three-dimensional time-dependent flow field given by the spiral defect chaos state of Rayleigh-Benard convection (the buoyant convection that results when a shallow fluid layer is heated from below). We take advantage of the significant theoretical and numerical progress in recent years that provides a physical understanding of this chaotic flow field. We study the transport using a highly efficient and parallel spectral element approach to simultaneously evolve the Boussinesq and reaction-advection-diffusion equations in large cylindrical domains with experimentally relevant boundary conditions. For active transport we include a reaction term with relevance to the combustion of premixed gases that are undergoing chaotic convection. We develop and use diagnostic tools to quantify the transport over a wide range of parameters in order to gain new physical insights.

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