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Buoyancy-Induced Columnar Vortices[1] MARK SIMPSON, ARI GLEZER, Georgia Institute of Technology — The formation of anchored, buoyancy-driven columnar vortices driven by the instability of a thermally stratified air layer, and sustained by entrainment of ground-heated air is investigated in a meter-scale laboratory facility. In hot-climate regions, buoyancy-driven columnar vortices ("dust devils") spontaneously occur with core diameter of 1-50 m at the surface and heights up to one km, with considerable angular and axial momentum. Such vortices convert low-grade heat in an air layer overlying a warm surface into a flow with significant kinetic energy. The considerable kinetic energy of the vortex column cannot be explained by buoyancy alone and is a result of the production, concentration, and tilting of the horizontal vorticity produced in the air layer over the heated ground plane. The present investigation focuses on the fundamental mechanisms of the formation, evolution, and dynamics of the columnar vortex using stereo-PIV with emphasis on scaling and assessment of the available kinetic energy. It is shown that the strength and scaling of these vortices can be significantly altered through adjustments of the flow vanes and the global sensible heat absorbed by the air flow.

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