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Buoyancy-Induced Columnar Vortices MARK W. SIMPSON, ARI GLEZER, Georgia Institute of Technology — Large-scale inherent instability of a thermally stratified air layer that is heated from below by a thermal ground plane in a meter-scale laboratory facility is exploited for the deliberate formation of intense columnar vortices. In nature, such buoyancy-driven vortices ("dust devils") occur spontaneously, with core diameters of 1-50 m at the surface, heights up to one kilometer, and with induced air flow of considerable angular and linear momentum. The laboratory experiments have demonstrated the nucleation and sustainment of strong, buoyancy-driven vortices that are anchored and stabilized using an azimuthal array of flow vanes while the temperature of the thermal ground plane is maintained using a resistive heater and a controllable power source. The present investigation focuses on the fundamental mechanisms of the formation, evolution, and dynamics of the columnar vortex using stereo-PIV. It is also shown that the strength and scaling of theses vortices can be significantly altered by adjustment of the flow vanes and the amount of global sensible heat absorbed by the air flow, or the "buoyancy flux". The characteristics of the anchored vortices can also be altered by small modifications of the thermal ground plane that affect the flux and distribution of the ground plane vorticity that forms the core of the vortex.

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