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Computations of flow in an anchored Solar Vortex[1] DAHHEA MIN, PAUL F. FISCHER, ARNE J. PEARLSTEIN, University of Illinois at Urbana-Champaign — In regions with high solar insolation, there is a potential to extract mechanical energy from the gravitationally unstable ground-heated air layer, using the substantial axial and azimuthal momentum of an anchored buoyancy-induced columnar vortex to drive a vertical-axis turbine. The seasonal and diurnal availability (which extends well into the late afternoon and even past sunset, due to utilization of the thermal capacity of the ground to heat the air, rather than direct use of photons) is well-matched to air-conditioning loads in the southwestern US. Critical issues in the design of such systems are the geometry of the enclosure that serves to anchor the dust devil-like vortex and prevent it from being blown away by ambient wind, as well as the geometry of the stationary vanes used both to enhance entrainment of ground-heated air into the vortex from a collection area much larger than that of the enclosure, and to utilize any ambient wind to enhance the vortex. Here, we report computations (using the spectral-element code Nek5000) of heated and unheated flows in several geometries of interest. The results are discussed in the context of field experiments.

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