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The influence of streamwise row spacing on convective heat transfer in solar photovoltaic arrays[1] BROOKE STANISLAWSKI, TODD HARMAN, University of Utah, RAUL BAYOAN CAL, Portland State University, MARC CALAF, University of Utah — When the temperature of solar photovoltaic (PV) modules exceeds 25°C, efficiency drops and module degradation accelerates. Thus, the PV community aims to reduce module operating temperatures. However, existing cooling systems require additional power or assembly, which precludes their adoption in utility-scale PV plants. Previous studies of solar farms have illustrated that incoming flow characteristics and geometric parameters can substantially impact the convective heat transfer coefficient, h. However, the impact of row spacing within realistic, three-dimensional solar farms on convective cooling has not yet been studied. Here, six solar farm arrangements are developed with varying streamwise row spacing. The spatial heterogeneity of these cases is characterized by a novel application of lacunarity. To represent the fluid-structure interaction and heat transfer, high-resolution large-eddy simulations are performed with the Uintah platform. A control volume analysis is used to compute h and study the influence of row spacing on the convective heat transfer. Row-specific h values are calculated to explore the spatial variation of cooling and the relationship with the velocity and thermal boundary layers generated by the solar farm.

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