

Ecovoltaic solar energy development creates novel microclimate, temperature, and soil moisture patterns under solar panels in a warm desert

Juan Pinos^{1*}, Seth M. Munson², Claire C. Karban², Matthew D. Petrie¹

¹ School of Life Sciences, University of Nevada Las Vegas, Las Vegas, NV, USA

² U.S. Geological Survey, Southwest Biological Science Center, Flagstaff, Arizona, USA

*Corresponding author: juanandres.pinos@unlv.edu (J. Pinos)

Disclaimer statement: Any use of trade, firm, or product names is for descriptive purposes only and does not imply endorsement by the U.S. Government.

Appendix S1

Vapor pressure deficit (VPD) calculation

Vapor pressure deficit was calculated to assess potential evaporation rates using the following equation (Allen et al., 1998):

$$VPD = 0.6108 \cdot e^{\left(\frac{17.27 \cdot T_a}{T_a + 237.3}\right)} \cdot \left(1 - \frac{RH}{100\%}\right)$$

where VPD is vapor pressure deficit (kPa), RH is relative humidity (%), and Ta is air temperature (°C).

Solar radiation estimation

Solar radiation was measured using a ClimaVue 50 Compact Digital Weather Sensor (Campbell Scientific, Logan, UT, USA) at 1 m above the ground surface at stations located in the panel interspace inside the facility and in the undisturbed open desert outside the facility. A strong correlation was observed between solar radiation (R_s , MJ m⁻²) and photosynthetic active radiation (PAR, μmol m⁻² s⁻¹) at these stations (Figure A1). This relationship was utilized to convert PAR data from all stations into estimated solar radiation values.

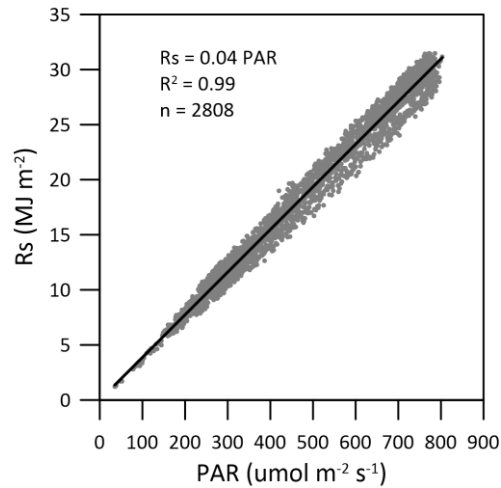


Figure S1. Linear relationship between solar radiation (R_s) and photosynthetic active radiation (PAR) based on daily data, combining datasets from shallow and deep soil stations (inside, $n = 2$) and outside ($n = 2$) the facility.

Reference evapotranspiration (E_{To}) calculation

E_{To} was computed using the Penman-Monteith FAO 56 equation (Allen et al., 1998). Wind speed was assumed to be 2 m s^{-1} across all microsites.

References

Allen, R. G., Pereira, L. S., Raes, D., & Smith, M. (1998). Crop evapotranspiration - Guidelines for computing crop water requirements. FAO Irrigation and drainage paper 56. FAO, Rome.