

The data presented here are for a bifacial PV system at Sandia National Laboratories Photovoltaic Systems Evaluation Lab (PSEL) in Albuquerque, NM.

The reported findings of high front and rear irradiance are shown here with explanations that may aid the understanding of the data. It is perhaps difficult to believe that 3-hour averages of the sum of front and rear irradiance can exceed 1500 W/m^2 , and we will attempt to provide more context to these events.

The irradiances shown here are from a south-facing, 15-degree-tilt, bifacial PV system. EETS RC01 reference cells were mounted in the same plane as PV modules in both the front-facing and rear-facing directions, and the data reported here are the sum of these front and rear reference cells. Measurements of these reference cells occurred every 5 seconds, and the 5-second measurements were averaged and recorded every minute. The ground underneath the PV system was covered in white rock with albedo of 0.6, and the ballast blocks were also painted white with an unknown (but relatively high) albedo. There were no rows of PV modules immediately in front or behind the system. The reference cells were mounted between two PV modules in the middle of the row, with no gap between the mounting plate and the neighboring modules. The total dataset consists of 3,774,892 minutely averages spanning February 2016 through June 2023 with a data loss in that time of approximately 2%, mostly due to planned system outages.

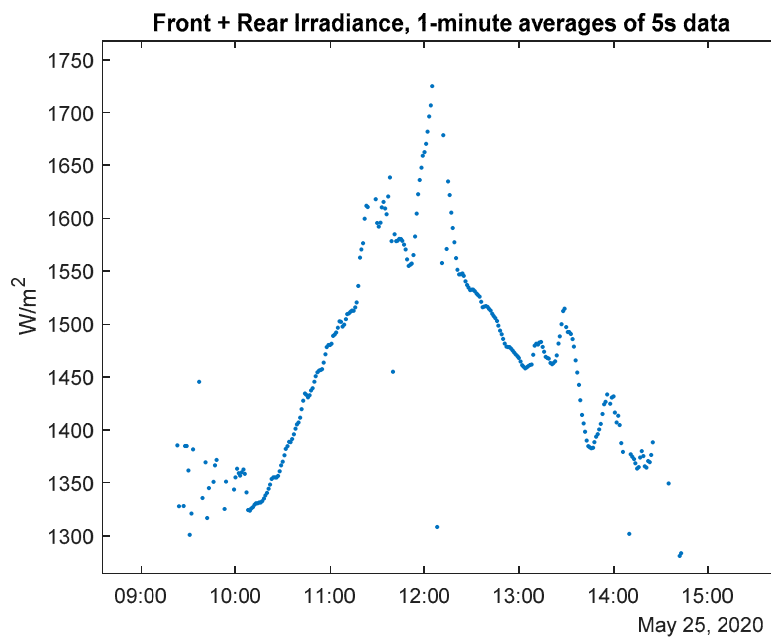
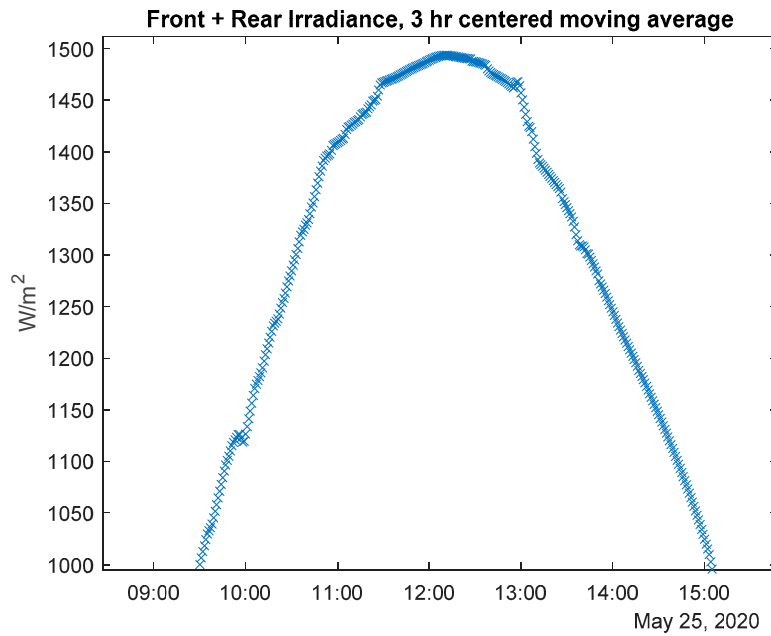
There are several factors that cause these high-irradiance conditions. System mounting configurations mentioned earlier such as the high albedo surface and the lack of rows surrounding the PV row under study cause a high rear-side irradiance. The Albuquerque site is located at an altitude of approximately 1660 meters and thus has a high ratio of direct to total radiation with relatively little atmospheric scattering. The time of year is also a factor, as the highest total (front plus rear) irradiance is typically observed in the summer when solar incident angles (and subsequent cosine losses) are low. Finally, the highest recorded irradiances occur when there are clouds “near” the sun, but not obscuring the sun. This creates a “cloud lens” effect, which directs additional light to the site.

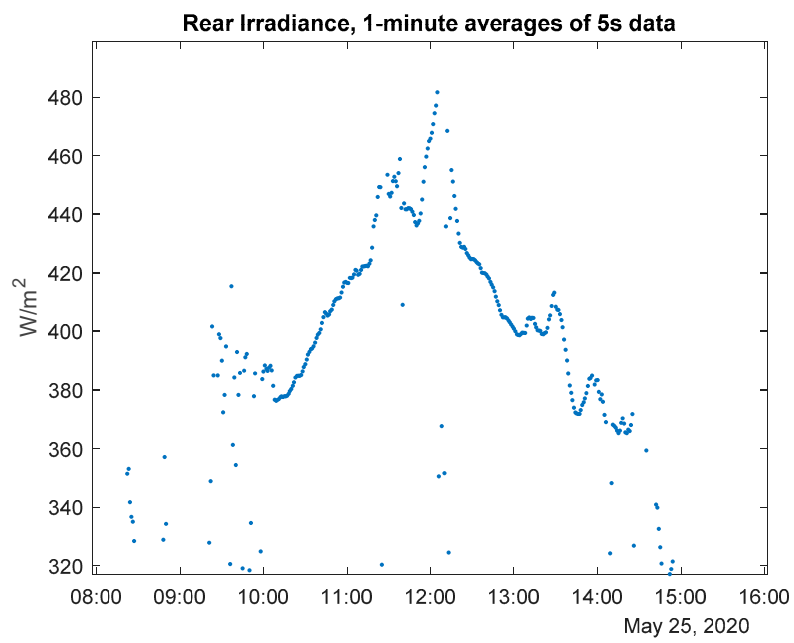
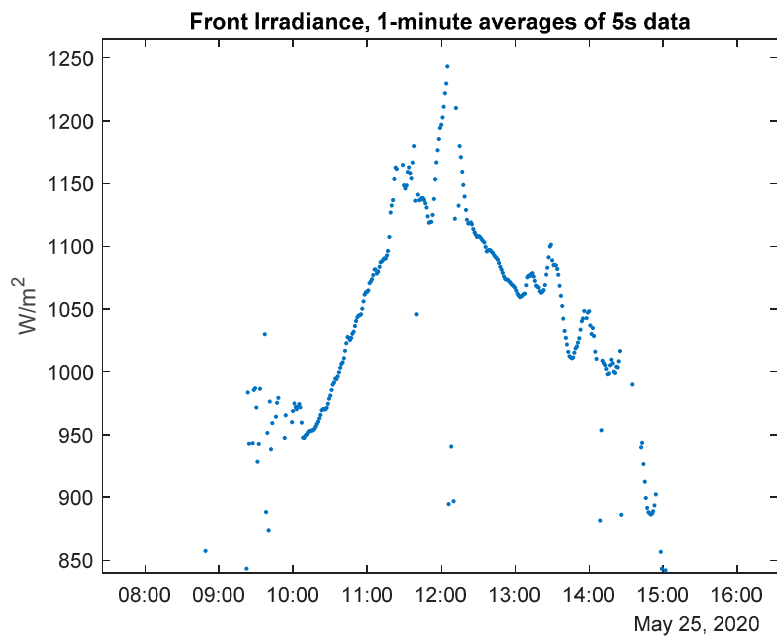
We show here the data from May 25, 2020, as an example. In some cases we present the minutely data, and in other cases we present a three-hour average of the minutely data centered at the time specified. A sky image is presented from that day to show an example of cloud lensing.

We also show a pseudo cumulative distribution function (CDF) for the 3-hour averaged total (front plus rear) irradiance. The pseudo CDF shows that 1% of the minutely 3-hour moving averages exceed 1397 W/m^2 , and 0.1% of the minutely 3-hour moving averages have a total irradiance exceeding 1447 W/m^2 . Only 0.01% of the minutely 3-hour moving averages have a total irradiance greater than 1474 W/m^2 . So, 3-hour averages of total irradiance exceeding 1500 W/m^2 are very rare, occurring in only 0.0006% of our measurements.

However, keep in mind that 3-hour averages will always be less than the maximum value within the average window. We have also provided a pseudo CDF of the 1-minute average total

irradiance to show that on a 1-minute time scale, the total irradiance exceeded 1470 W/m^2 in 1% of our measurements.





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