Quantifying Subhourly Correction Methodologies

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Introduction

The solar industry has identified a bias in P50 energy estimates resulting from the use of hourly weather data. While the industry has agreed upon the need to account for subhourly impacts, there is not yet a consensus on the specific methodology for this calculation. In this study, we compare subhourly differences using System Advisor Model ("SAM") to a batch process in PVsyst ("Pvsyst_Batch"), PVsyst's built-in method ("PVsyst_Built-in"), and the Allen method.

Methods

Energy Model Parameters

We tested at three locations: Desert Rock, NV; Bondville, IL; and Boulder, CO. These were selected from locations with SURFRAD stations and differing levels of irradiance variability[1].

Two generic solar projects were created in both SAM and PVsyst to be as similar as the two programs allow. These projects varied only in the inverter loading ratio ("ILR") and ILRs of 1.1 and 1.4 were tested. The models used backtracking with a tracking range of 60 degrees.

We used 5-minute interval weather data from NREL NSRDB PSM from 2018-2022 at each site, and 1-minute SURFRAD data from 2021 (for Boulder, CO)

Models

SAM: The SAM method was used as our standard of comparison since SAM can directly model both 60-minute and 5-minute datasets. The two models run with the 5- and 60-minute data sets are then compared, and the resulting difference is the subhourly loss.

PVsyst_Batch: The PVsyst_Batch method operates in a similar way as the SAM method in that it directly compares subhourly outputs with 60-minute outputs. In order to simulate 5-minute data in PVsyst, 12 weather files must be generated for every hour and run through PVsyst as 12 simulations. The 5-minute based results are combined and used to compare to the 60-minute data.

PVsyst_Built-in: The Pvsyst_Built-in method uses 5-minute data as an input. It then runs an internal analysis where it calculates how many minutes in every hour are above the given clipping threshold. The data are then used to develop coefficients which are applied to the entire dataset at clipping and represent subhourly loss [2,3].

Allen: The Allen Method is a feature in SAM. It works by developing a lookup matrix of clipping correction factors that is scaled by output energy[4].

Results

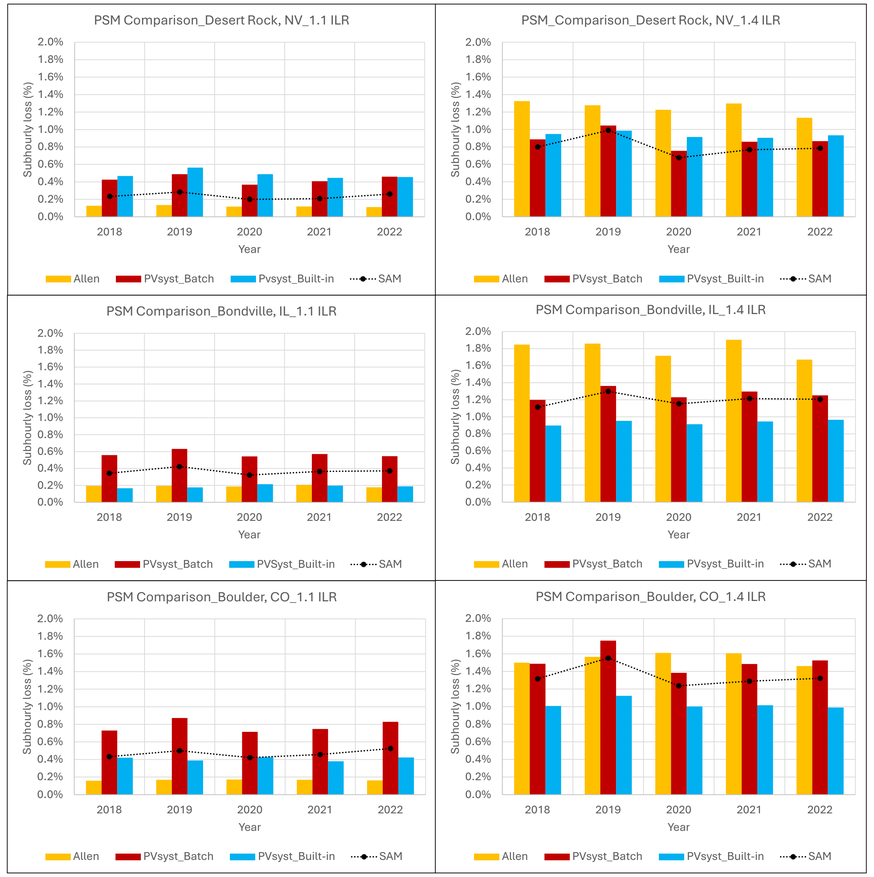


Figure 1: Subhourly calculations by methodology using PSM data

Figure 1 shows the results from each of the calculations. We find that PVsyst_Built-in method generally predicts lower subhourly losses than SAM, however this difference is smaller in low variability regions (NV) and lower ILRs. The Allen method tends to predict lower subhourly losses than SAM at lower ILRs and higher subhourly losses than SAM at higher ILRs in all regions. The PVsyst_Batch method matched SAM's subhourly loss estimates very closely at higher ILRs but predict higher subhourly losses than SAM at lower ILRs. This may be due to differences in irradiance transposition calculations between the two programs.

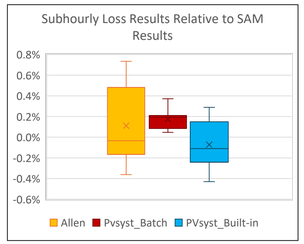


Figure 2: Distribution of loss values relative to SAM calculation

- The Allen method shows the highest range of results relative to the calculation in SAM
- The PVsyst_Batch method showed the lowest range of results relative to SAM
- The PVsyst_Built-in method had the lowest average subhourly loss results relative to the SAM results. The spread of deviation was moderately large.

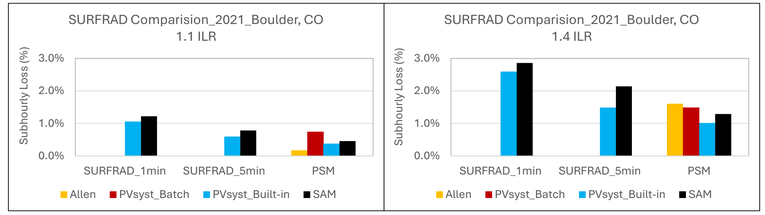


Figure 3: Comparison to SURFRAD measured data

Figure 3 shows that results based on PSM 5-minute data and SURFRAD 5-minute data aligned well for this location and year. Some of the difference between them is likely because SURFRAD is a point source. A single point can show increased variability versus an area and can therefore result in increased subhourly impact. Spatially, a point source would not be as relevant to array-level modeling without additional corrections.

Conclusions

All methods are viable for estimating a subhourly correction. We found the PVsyst_Batch method to predict very similar values to SAM and this method was the least likely to underpredict the subhourly impact. This batch method can be performed by users to calculate project-specific and location-specific subhourly impacts, which can be applied as a correction to a TMY model in post processing.

References

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(2) PVsyst. (n.d.). Sub-hourly clipping correction. Sub-hourly clipping correction - PVsyst documentation. https://www.pvsyst.com/help/physical-models-used/grid-inverter/subhourly-clipping-correction.html#approximation.
(3) Villoz, A., Wittmer, B., Mermoud, A., Oliosi, M., & Bridel-Bertomeu, A. (2024). In *EU PVSEC*. Retrieved 2025, from https://userarea.eupvsec.org/proceedings/WCPEC-8/4EO.2.2/.
(4) Prilliman, M., Keith, J., & Hobbs, W. (2024). Subhourly Clipping Correction Model Comparison. https://www.nrel.gov/docs/fy24osti/89799.pdf.