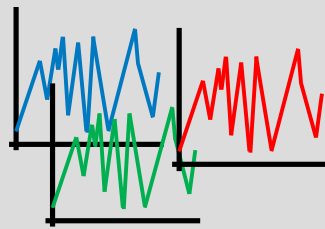
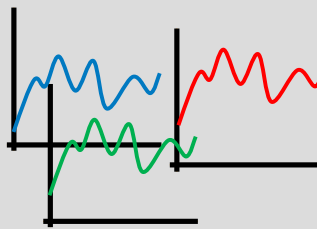


Impact of data resolution on multijunction PV modeling

Rajiv Daxini, Bill E McMahon, Robert Witteck, Ryan M France



High Resolution



Low Resolution



PV Performance modeling?

Introduction

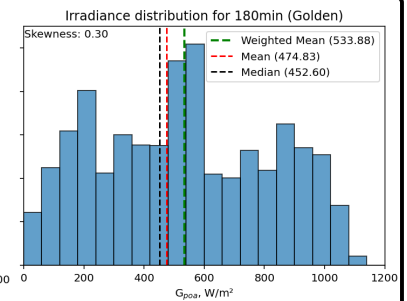
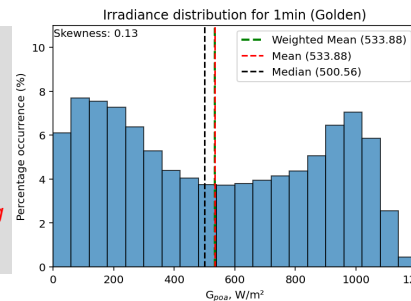
- Popular data sources (NSRDB, TMY...) supply **hourly data**, is this **sufficient for modeling multijunction PV performance**?
- Sub-hourly data is beneficial for single-junction modeling [1]
- Impact on **current matching** in series-connected **multijunction** models has not previously been examined in depth

Methodology

- One year (2024) data from **Golden, CO** [2]
- III-V/Si 2T in **current-matched** condition, PV Circuit simulation [3]
- Resample data → energy yield → Integrate for power
- Temperature-dependent EQE based on measurement
- No data filling, actual duration of power used to compute energy

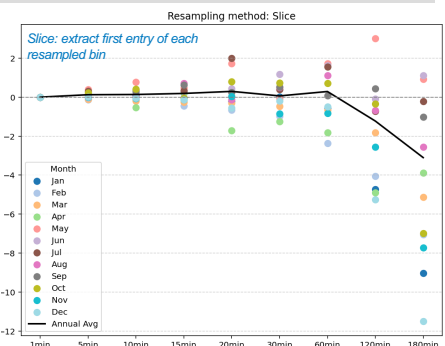
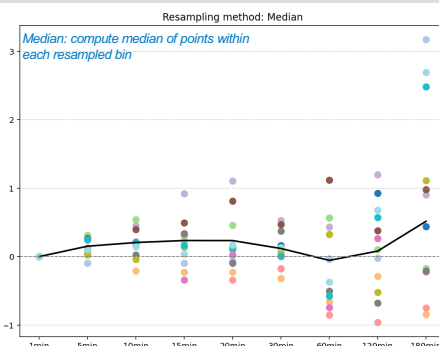
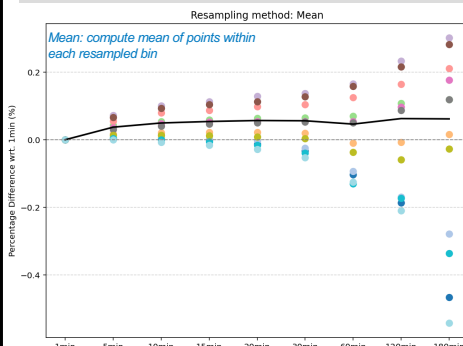
Results: Impact on meteorological data

- Right: irradiance distribution during 2024
- Energy conservation** is important when resampling
- Missing data → **unequal weighting** of each bin
- Median drops**, but **time-weighted mean is constant**
- Bimodal G_{poa} distribution → unimodal
- Spectral shift could **bias modeling current matching** → inaccurate efficiency estimates



Results: Monthly energy difference across resolutions (wrt. 1min) for different resampling methods

- Greatest **drop in accuracy** in the **winter months**
- Monthly **variation** and **prediction error** both **increase** with decreasing resolution
- Impact of **resampling method**: decrease in accuracy when incident energy is **not conserved** (median and slicing)
- Monthly errors generally cancel out on an annual scale for **all** resampling methods, at least up to **60min resolution**
- Low resolution → tendency to **overestimate performance**
- Likely **omission of current mismatch conditions** between junctions when high frequency changes are averaged out



CONCLUSION

- When resampling, incident **energy conservation** is critical
- Annual error can **reach 3%**, but generally **<1%**
- Monthly error can **exceed 10%** → impact for sub-annual performance modeling
- Ongoing work** will investigate different **PV technologies and climates**, and the specific impact of resampling on modeling **current-matching conditions**

References

- [1] Hansen, C.W., et al. "Effect of time scale on analysis of PV system performance." SANDIA Report (2012).
- [2] Andreas, A. and Stoffel, T. "NREL solar radiation research laboratory (SRRL): Baseline measurement system (BMS); Golden, Colorado (Data)." NREL Report No. DA-56488, National Renewable Energy Laboratory, Golden, CO, USA (1981).
- [3] Geisz, J.F., et al. "Generalized optoelectronic model of series-connected multijunction solar cells." IEEE JPV 5.6 (2015): 1827-1839.