More than a Year: Beyond the "Typical" for Reliable PV Performance Estimates

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Motivation

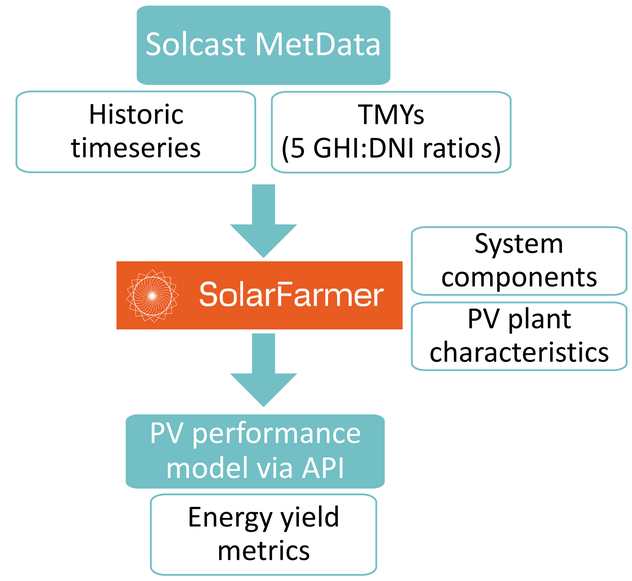
- Solar resource selection is a key stage of energy production assessments. Typical Meteorological Years (TMYs) are often used instead of multi-year historic timeseries due to computational efficiency and ability to represent long-term average conditions in a more manageable dataset.
- Not all TMYs are the same. Practitioners (analysts/engineers/researchers) have a wide range of TMY-family products to choose from, and there is no consensus on an industry-wide standard practice.
- We explored the variance in energy yield of utility-scale PV plants (fixed-tilt and single-axis tracking) between historic timeseries and TMYs with several GHI:DNI ratios.



Illustration of the composition of a Typical Meteorological Year (TMY)

Methodology

- Evaluation of energy yield from **17 years** (2007-2023) of hourly data. +3500 site locations in continental USA.
- Utility-scale PV plant (70MW), bifacial, half-cut cell modules, 1.2 DC/AC ratio.
- Solcast meteorological data, historic timeseries and TMY with **five GHI:DNI ratios**.
- SolarFarmer's performance model. **2D API via Python**.

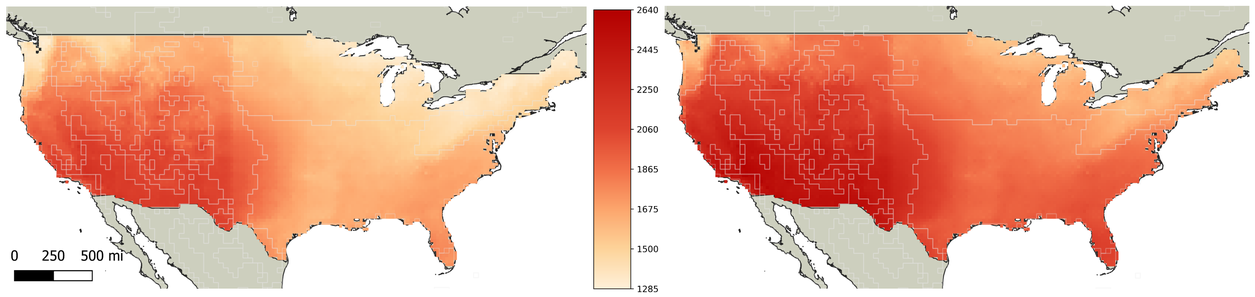


Insights per solar resource and plant type

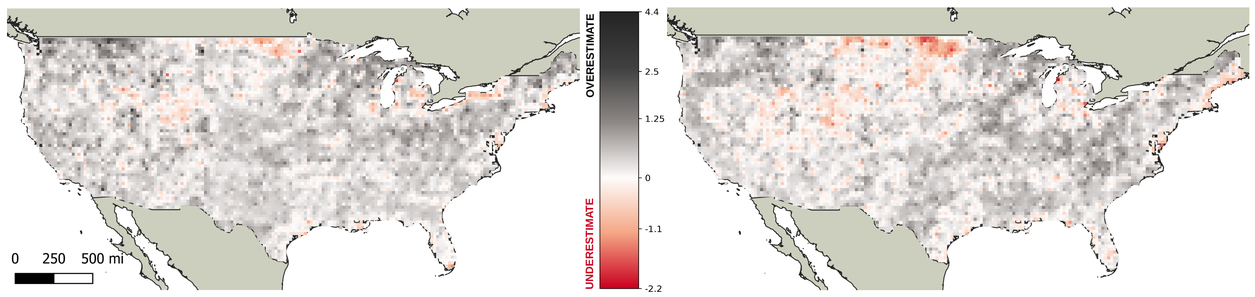
Results

Performance in continental USA

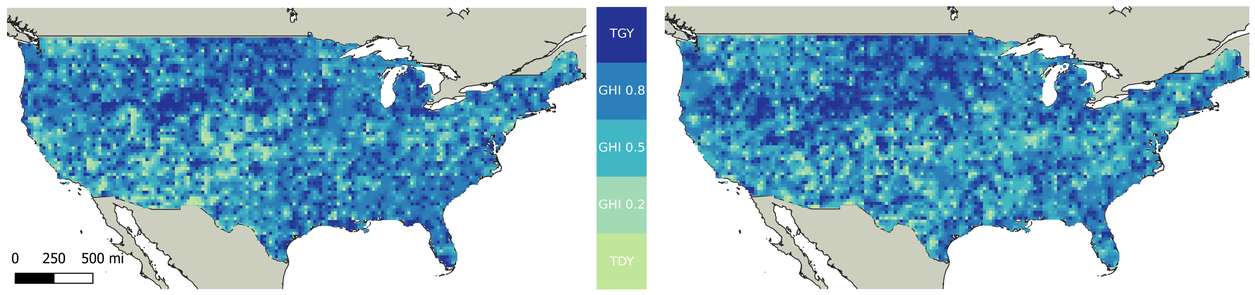
FIXED-TILT PV | SINGLE-AXIS TRACKING PV



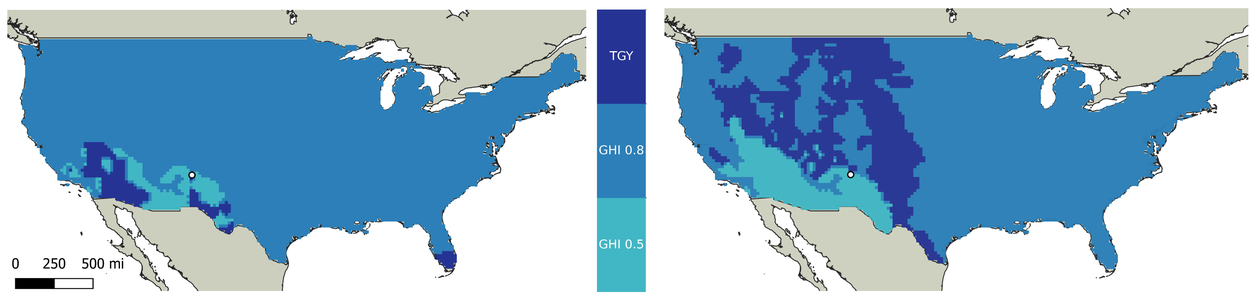
(A) Long-term average (LTA) energy yield (kWh/kWp) with KGPV climate zones overlaid



(B) Distribution of errors (%) of TGYs (GHI-only TMYs) compared to LTA energy yield



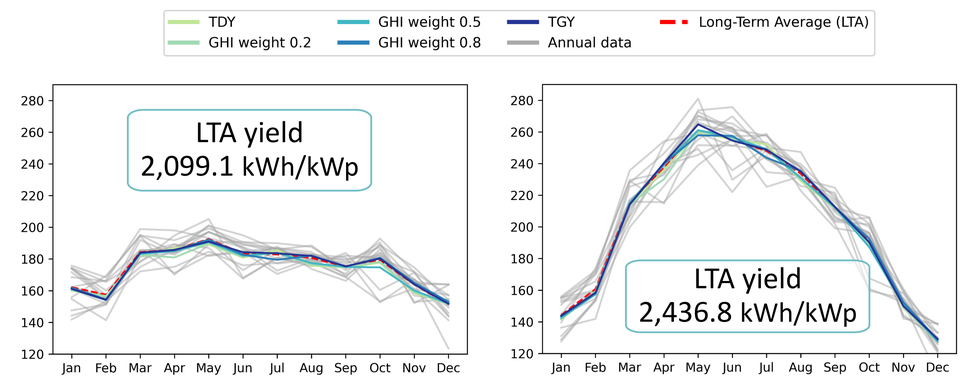
(C) What GHI:DNI ratio produces the most accurate TMY compared to LTA energy yield?



(D) What GHI:DNI ratio could be best when aggregated by KGPV climate area?

Energy yield variability: case of Albuquerque, NM

FIXED-TILT PV | SINGLE-AXIS TRACKING PV



TDY	GHI 0.2	GHI 0.5	GHI 0.8	TGY
-0.93%	-1.11%	-0.96%	-0.14%	**-0.09%**

TDY	GHI 0.2	GHI 0.5	GHI 0.8	TGY
-0.55%	-0.73%	-0.28%	**-0.04%**	0.21%

Conclusions

- Multi-year energy assessments may provide the distribution of energy production to take informed decisions on prospective PV assets.
- TMY simplifications may deviate from historic LTAs: TGYs (GHI-only TMYs) tend to overestimate production +4.4/-2.2% (Map B).
- Ideal GHI:DNI ratios in TMYs vary geographically. However, an approximation could be done using KGPV climate zones (Map C and D).
- There are bankable industry products (like Solcast and SolarFarmer) to help you produce multi-year and sub-hourly energy assessment today.

Survey

What type of solar resource are you using?

HISTORIC TIMESERIES	TMY (off the shelf)	TGY (GHI-only TMY)	CUSTOM TMY (GHI:DNI ratios)	TMY3/TMY2	FIELD DATA

Add an X to your choice

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