

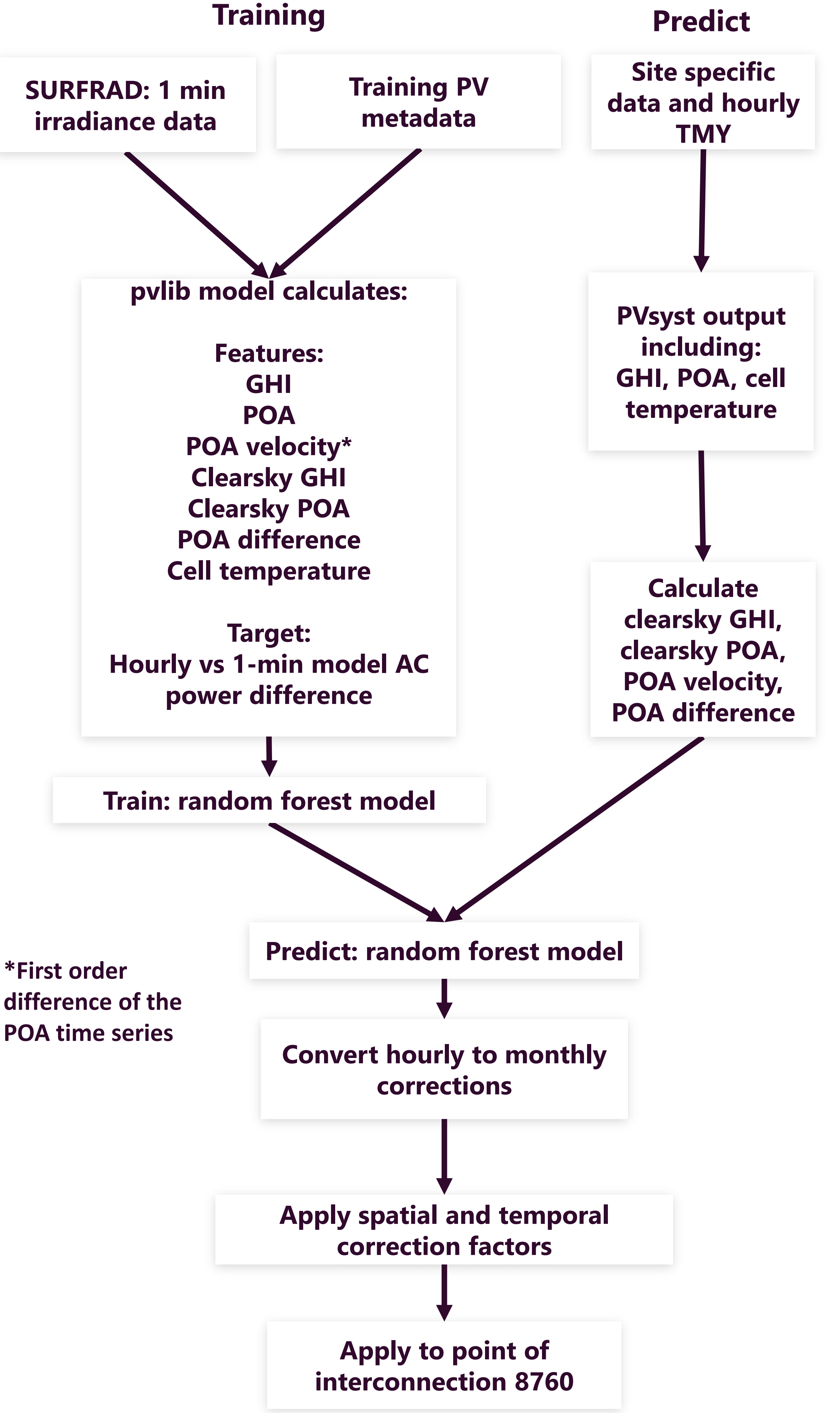
**DNV's machine learning model compensates for errors introduced by hourly PV modeling.**

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## Introduction

Most bankable PV models use hourly irradiance data. In areas that experience intra-hour irradiance variability, the use of this hourly data can over-predict energy yield predominantly due to subhourly DC power above or below inverter rated power, underpredicting inverter clipping losses. DNV implemented a machine learning model to correct for these underpredictions. The hourly modeling correction seen in the US for utility-scale plants is typically around 1.0% and increases with DC:AC ratios above 1.0.

## Methods



- Random forest machine learning model adapted from K. Anderson and K. Perry, 2020
- Times considered are filtered for GHI and POA > 200 W/m<sup>2</sup>
- Spatial factor uses wavelet variability model to account for plant size
- Temporal factor accounts for sampling rate of constituent TMY data

## References

[1] A. Parikh, et al., "Validation of subhourly clipping loss error corrections," in 2021 IEEE 48th Photovoltaic Specialists Conference (PVSC), IEEE, Jun. 2021. [Online].

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[3] R. Kharait, et al., "Energy Yield and Clipping Loss Corrections for Hourly Inputs in Climates with Solar Variability," in 2020 47th IEEE Photovoltaic Specialists Conference (PVSC), 2020, pp. 1330–1334.

[4] J. A. Augustine, et al., "SURFRAD – A national surface radiation budget network for atmospheric research," *Bulletin of the American Meteorological Society*, vol. 81, no. 10, pp. 2341–2357, 2000.

[5] K. Anderson, et al., "The Effect of Inverter Loading Ratio on Energy Estimate Bias," in 2022 IEEE 49th Photovoltaic Specialists Conference (PVSC), IEEE, Jun. 2022.

[6] M. Lave, et al., "A Wavelet-Based Variability Model (WVM) for Solar PV Power Plants," in *IEEE Transactions on Sustainable Energy*, vol. 4, no. 2, pp. 501–509, April 2013.

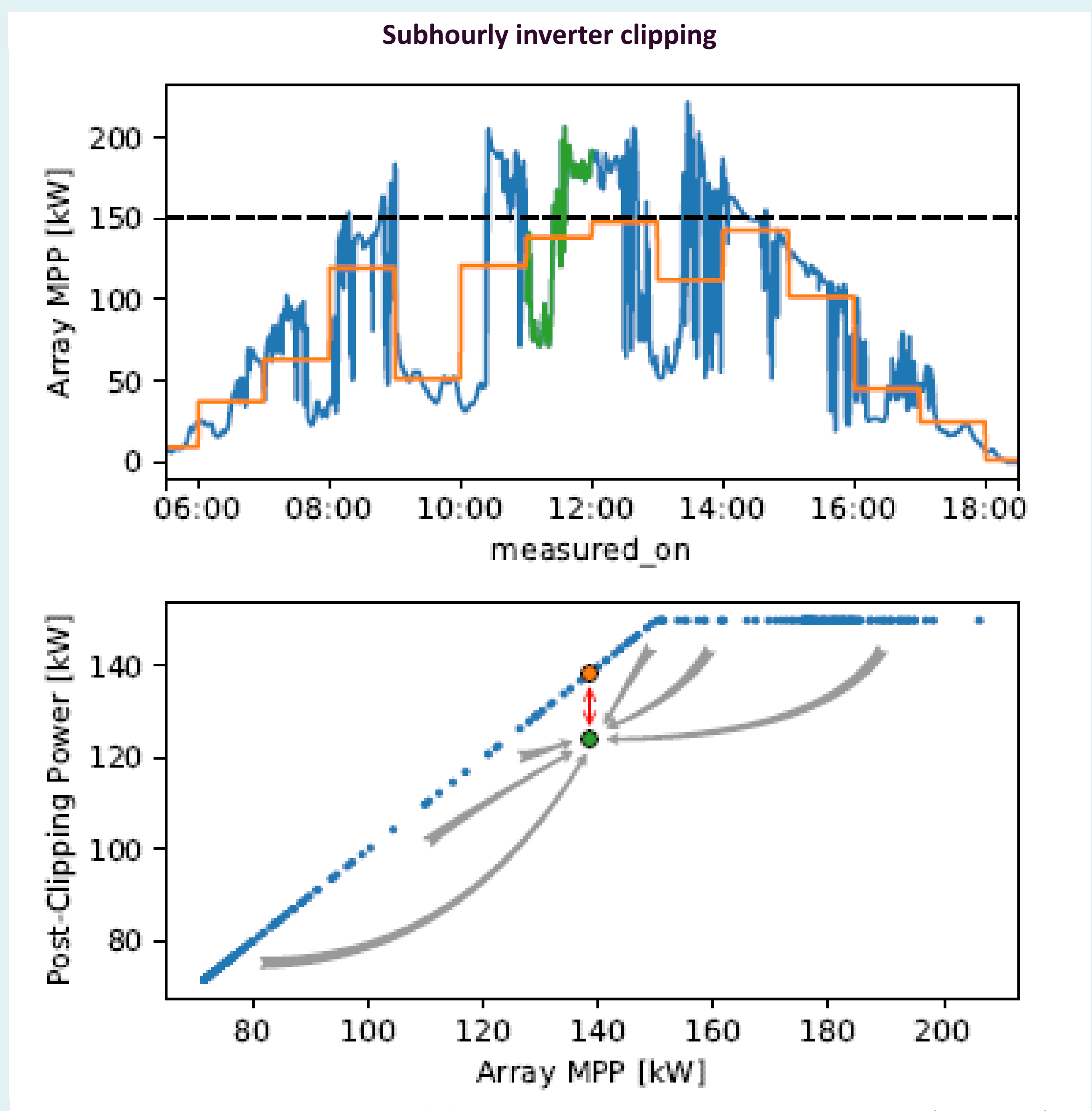


Figure from K. Anderson, et al. in [5]: Upper subplot: 1-min array MPP data (blue line), the corresponding average hourly values (orange line), the particular hourly interval (green line), the hypothetical inverter clipping point (dashed black line). Lower subplot: visualization of the 11:00 – 12:00 interval shown in green on the upper subplot, the 1-min array MPP data (blue dots), the average of the 1-min values (green dot), the average that applies to clipping at hourly scale (orange dot)

