BIFACIAL MODELLING

A comparison of bifacial PV system modelling tools

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Tested models

- PVFactors (https://github.com/SunPower/pvfactors)
- BifacialVF (https://github.com/NREL/bifacialvf)
- PVSyst 6.8.1
- Bifacial_Radiance (https://github.com/NREL/bifacial_radiance)
- INES 3DVF model

We wanted to benchmark our model against available models of different complexities

A Benchmark and Validation of Bifacial PV Irradiance Models

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Test Bed

- INES INCA demonstrator, located @ Bourget du Lac - France (45.6, 5.8)

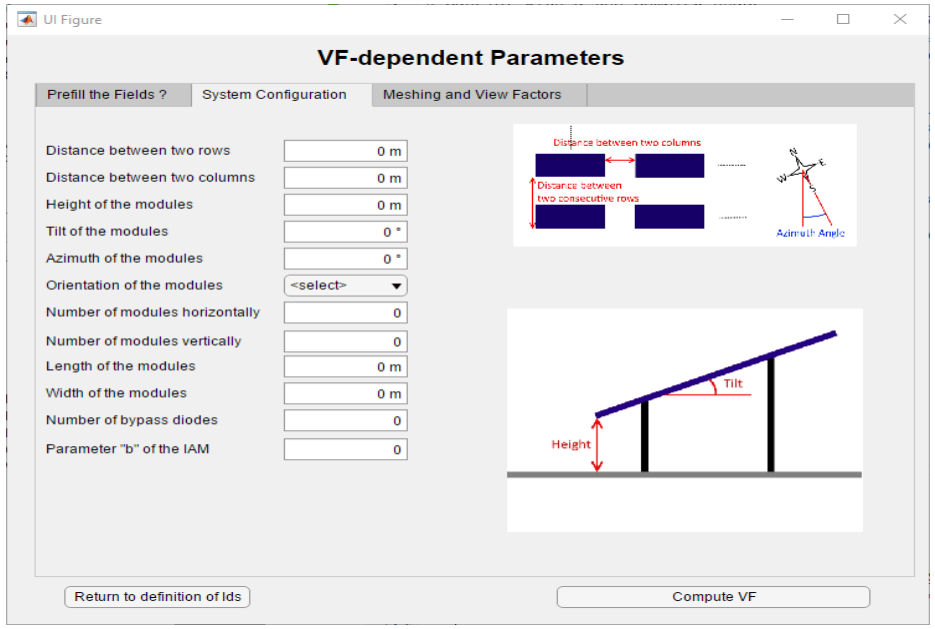
Orientation	Portrait
Inclination	30 °
Azimuth	South
Nb panels (horizontal)	5
Nb panels (vertical)	2
Albedo (white gravel)	0,4
Distance between rows	9,5 m
Ground to module height	0,77m
Module size	1,65 * 0,99 m

- Meteo Data: Pyrheliometer (DNI) and pyrano (GHI, DHI)

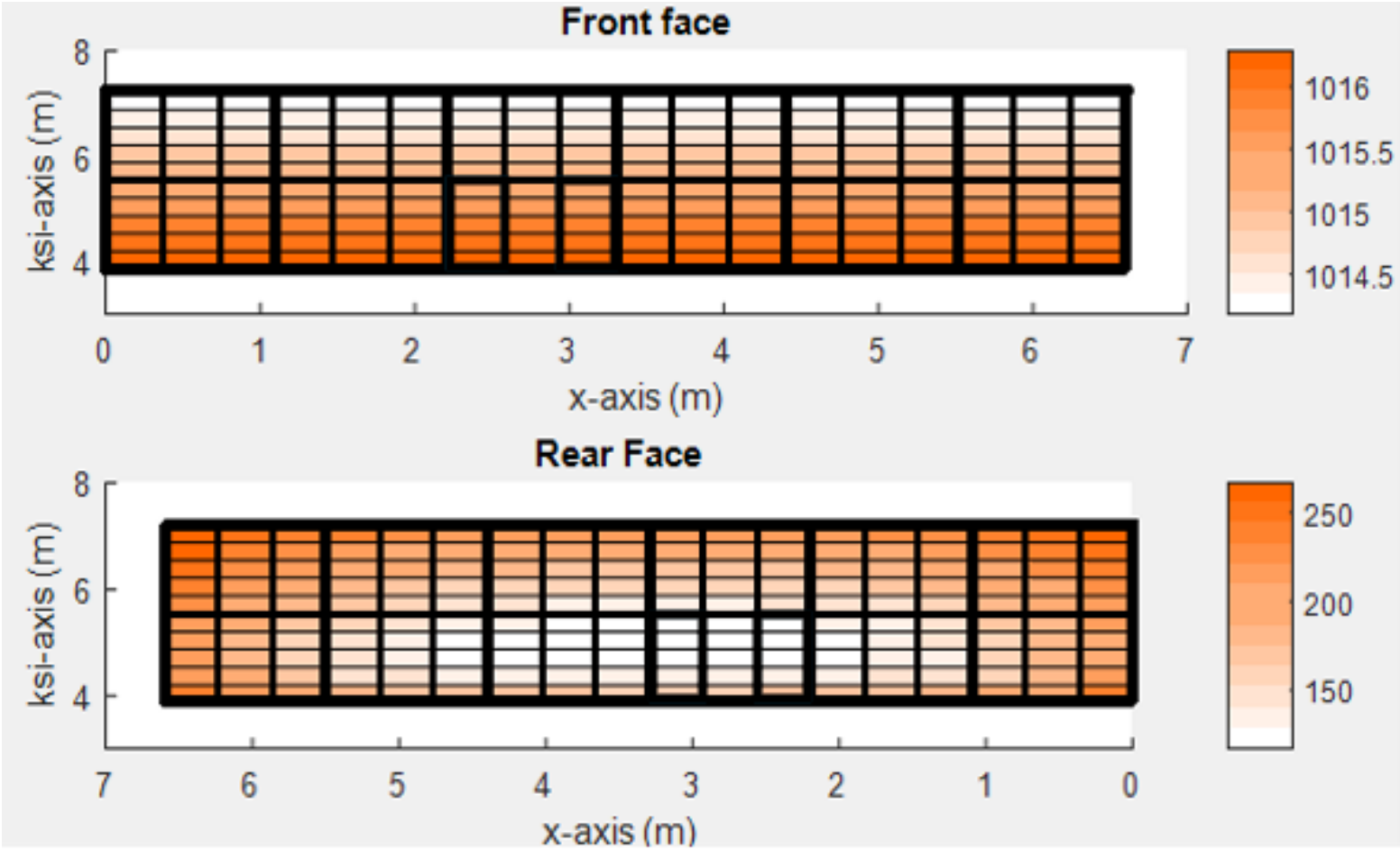
COFFRET METEO 1
BIPPP/CHIC
ALIMENTATION DEPUIS
COFFRET CHAMP PV 1

VF3D: Viewfactors 3D bifacial simulation tool

- IAM losses
- Different meshgrids for modules and ground
- Electrical model
- Tilted and SAT
- Precise shading
- Matlab vectorized code with GUI
- 1h for 1 year (depends on mesh)

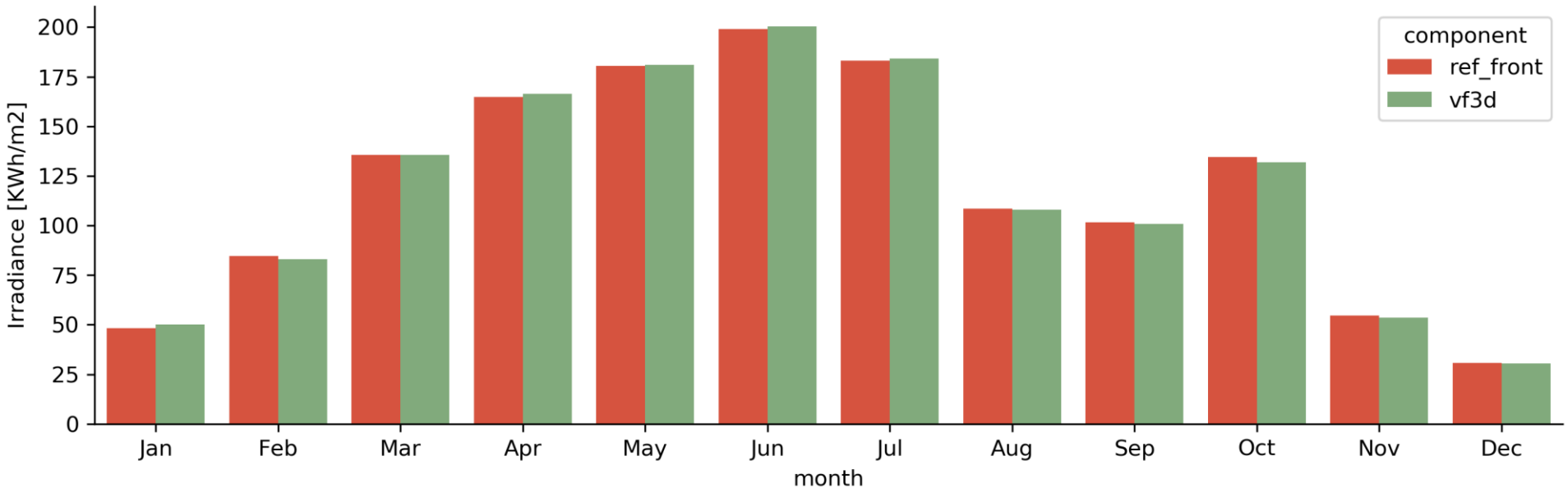


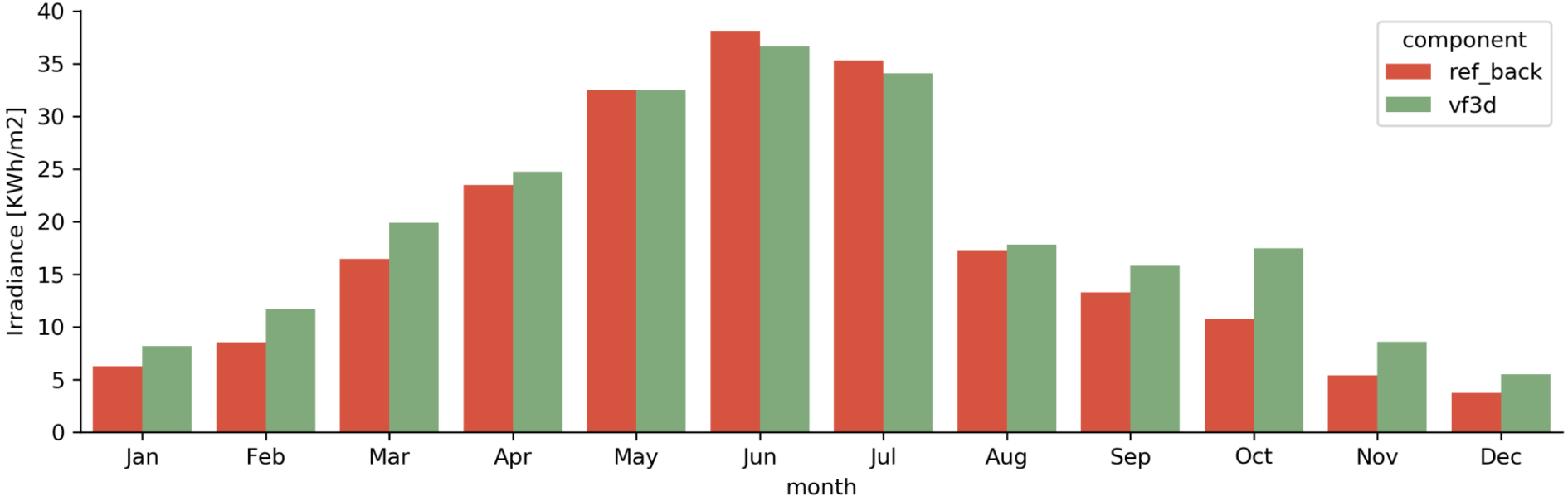
Border conditions are well represented.



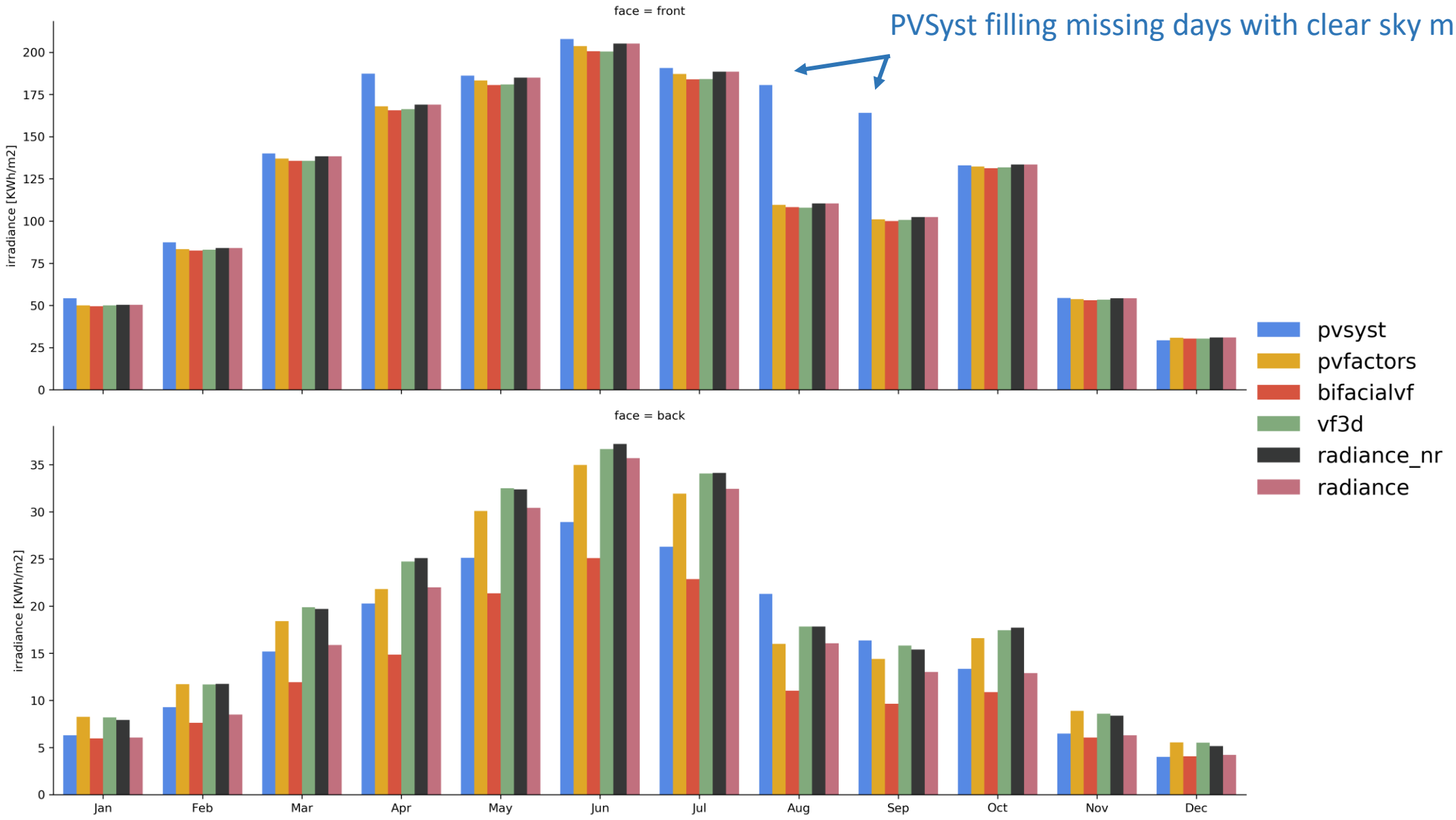
12 modules: landscape configuration, 3 bypass diodes per modules, 5 mesh elements per bypass block

Annual comparison : Measurements - VF3D



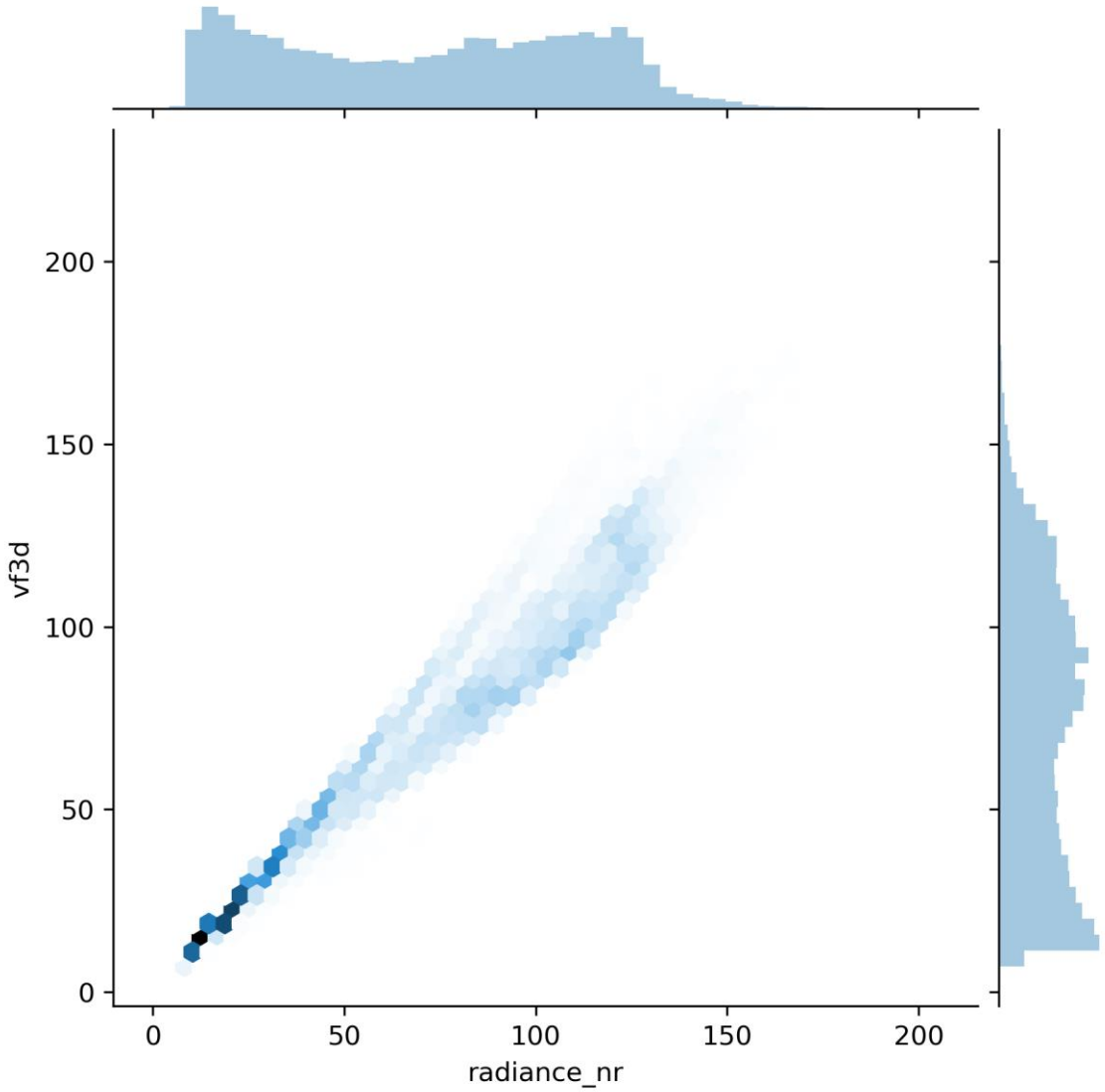


Annual comparison : All simulation tools



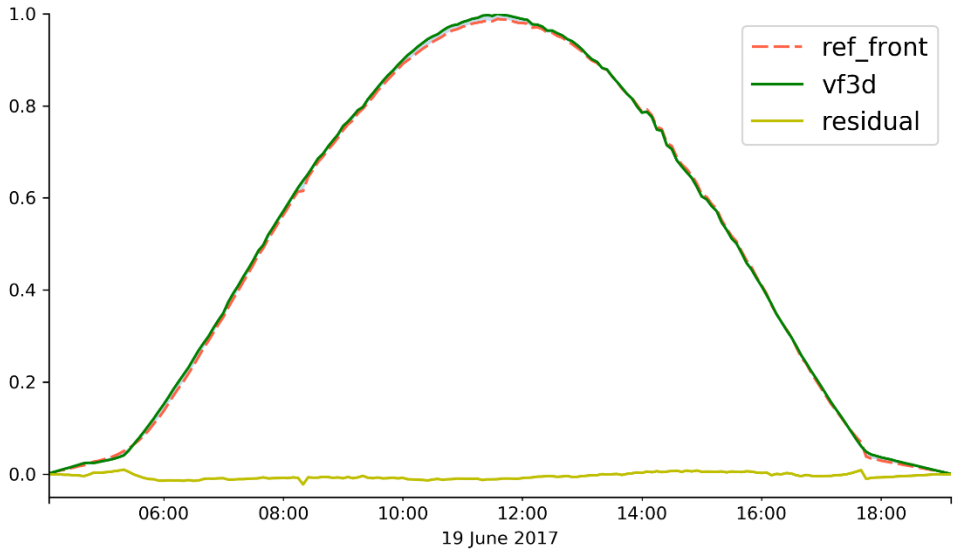
PVSyst filling missing days with clear sky model

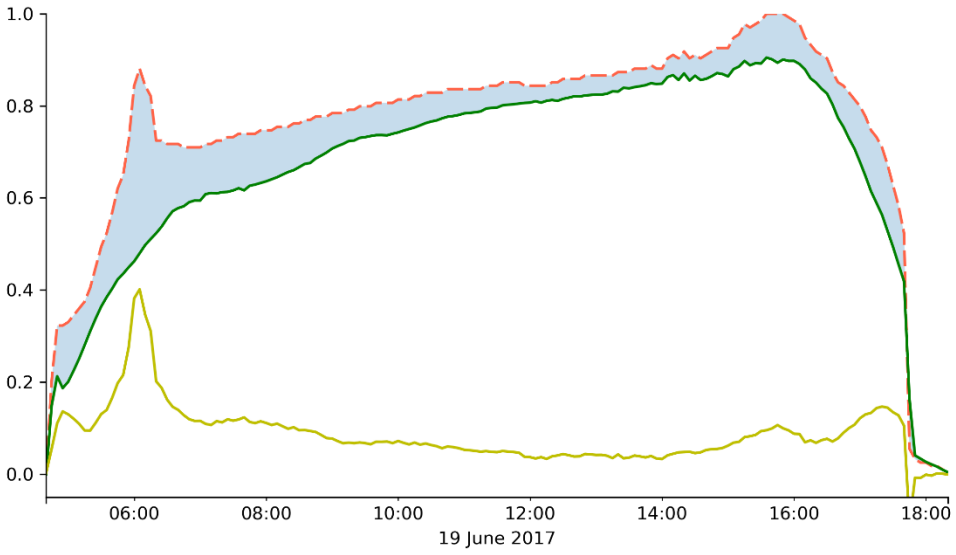
We found useful to compare the INES VF3D model against a radiance simulation with no racking.



BACK Face: Radiance with no racking vs Ines VF3D

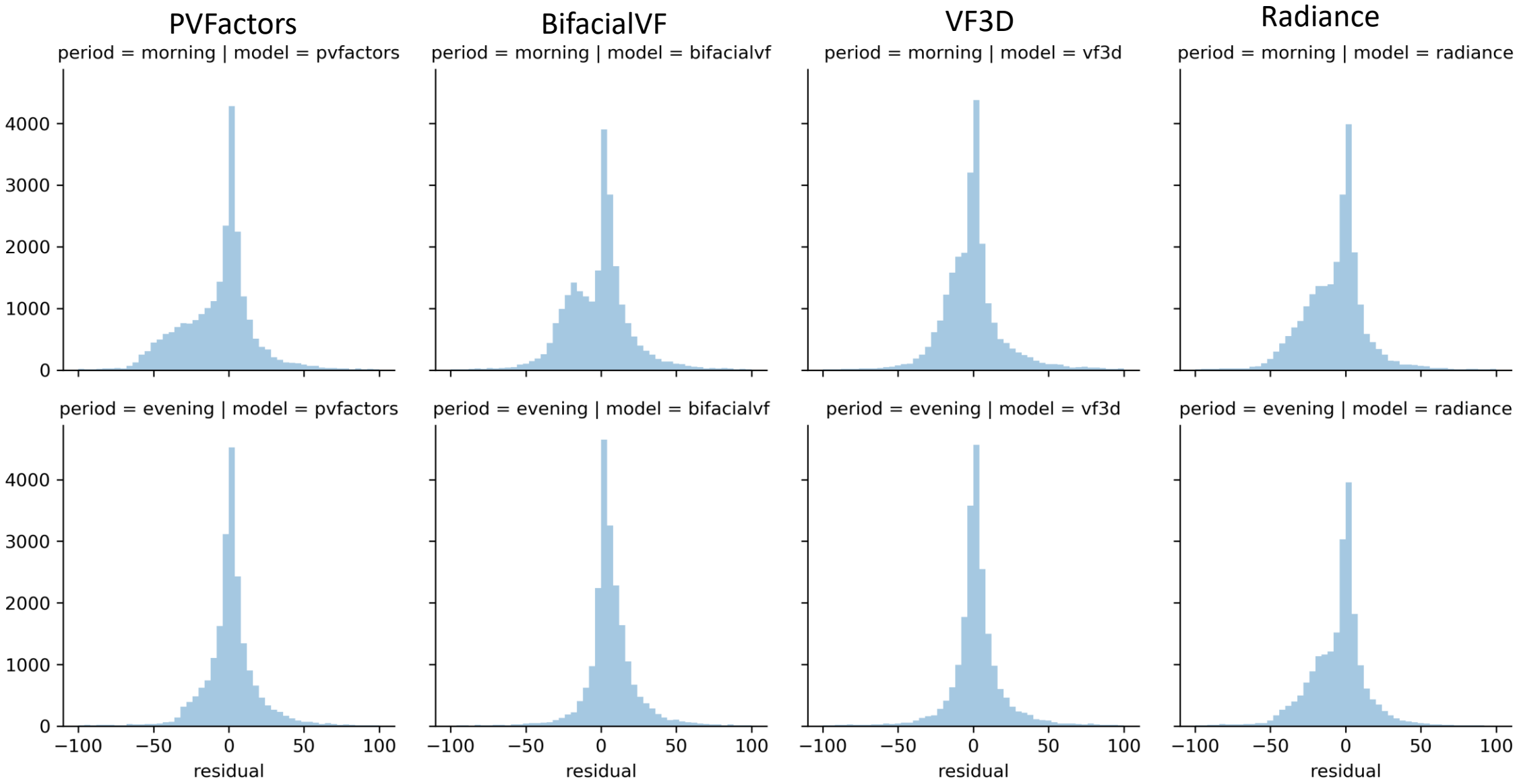
Residuals [target-prediction]



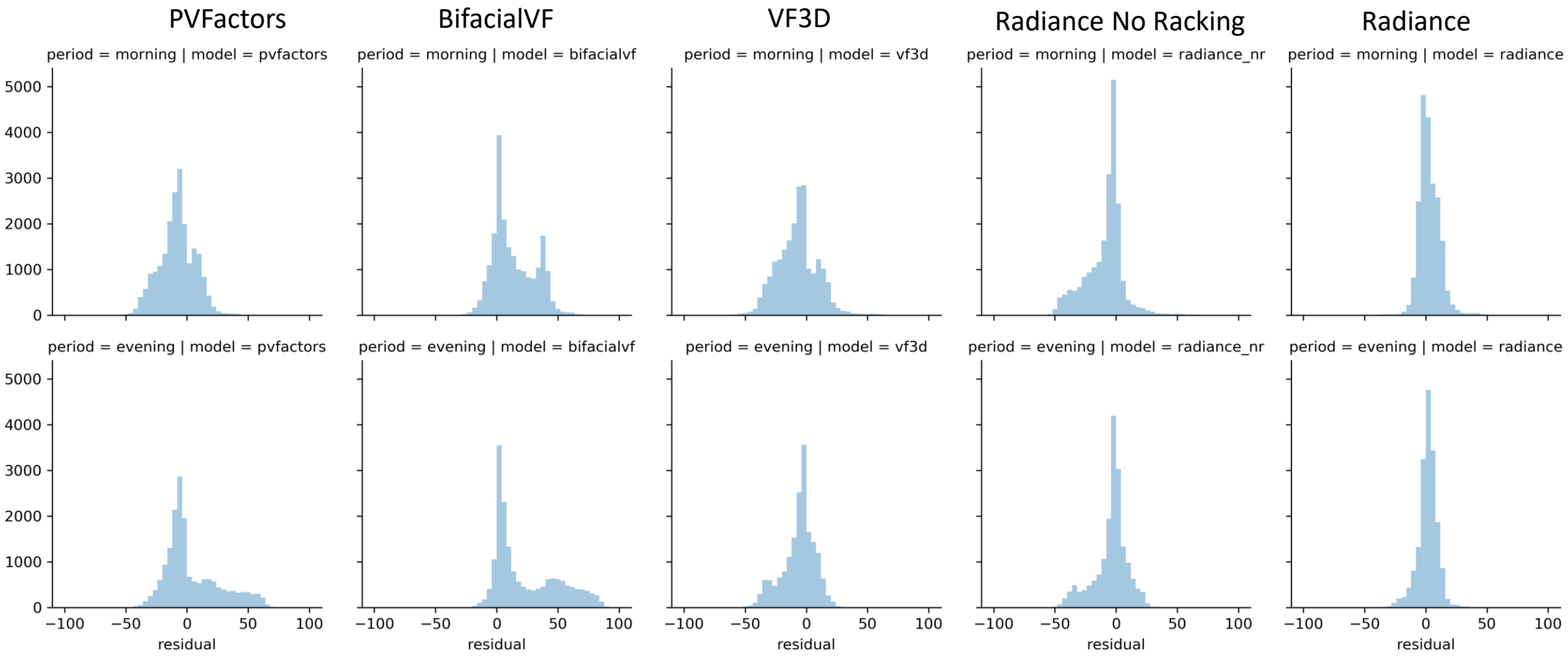


We are interested at the difference between the reference cell and the modeled irradiance.

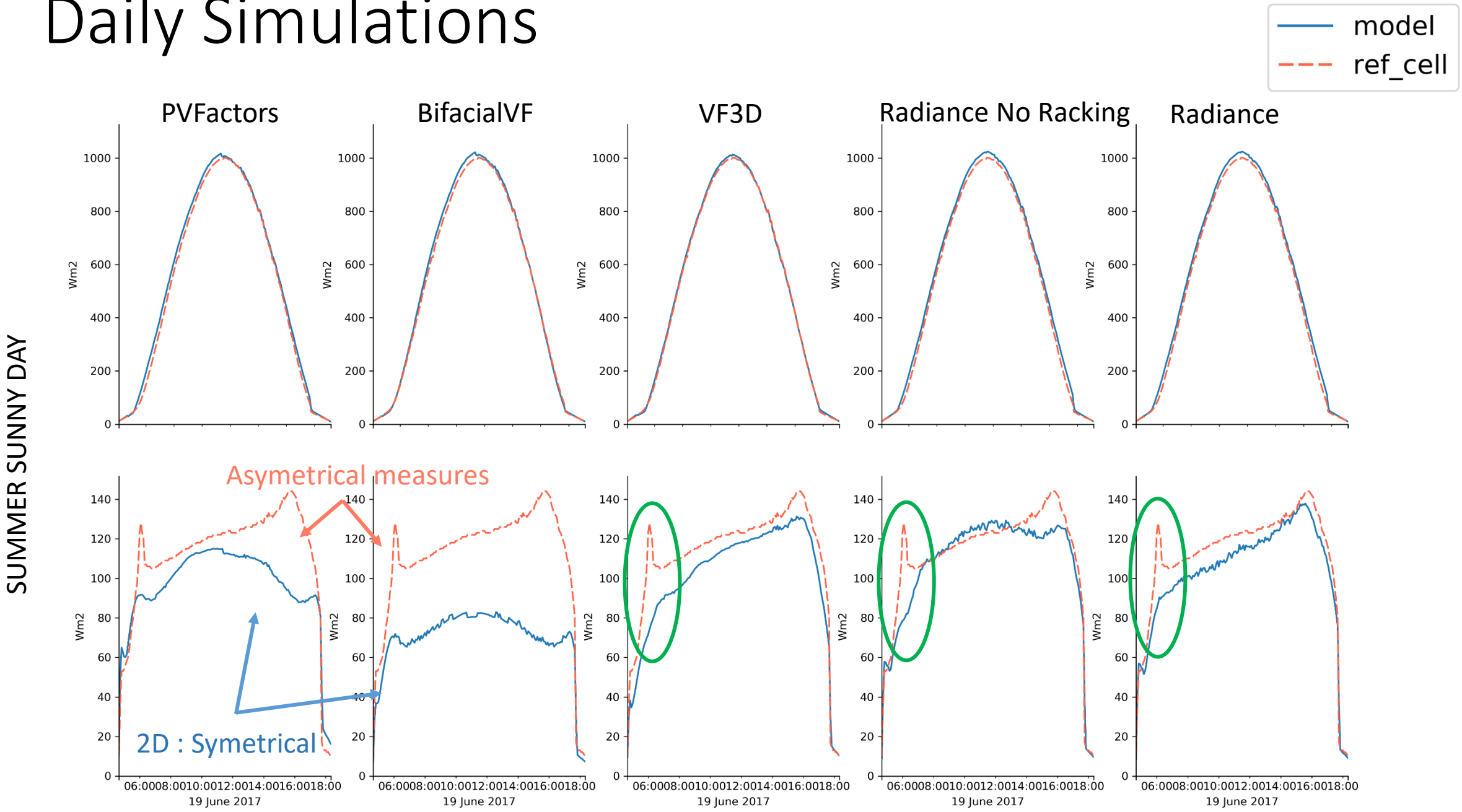
Residuals [target-prediction] - FRONT



Residuals [target-prediction] - BACK



Daily Simulations



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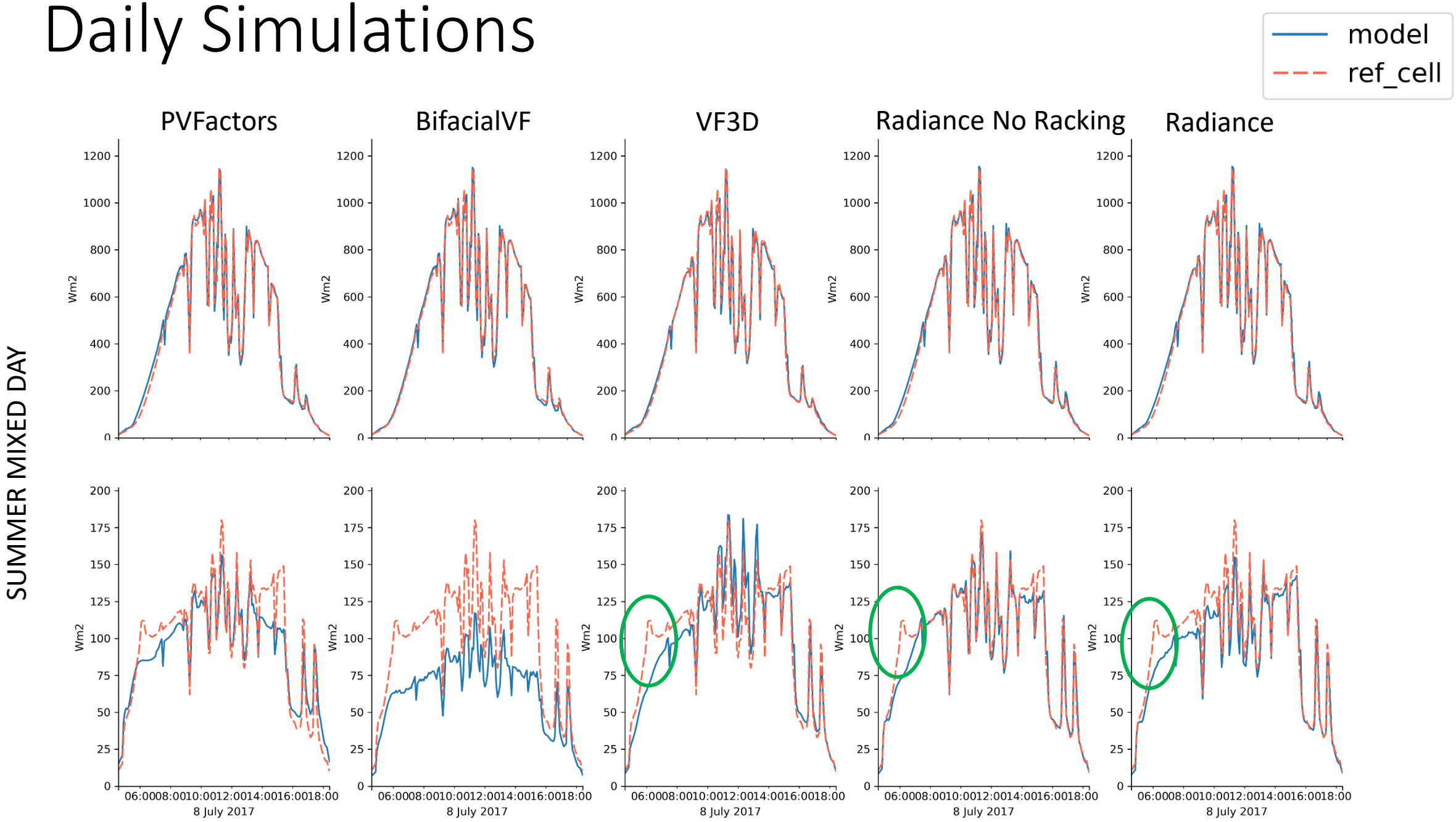

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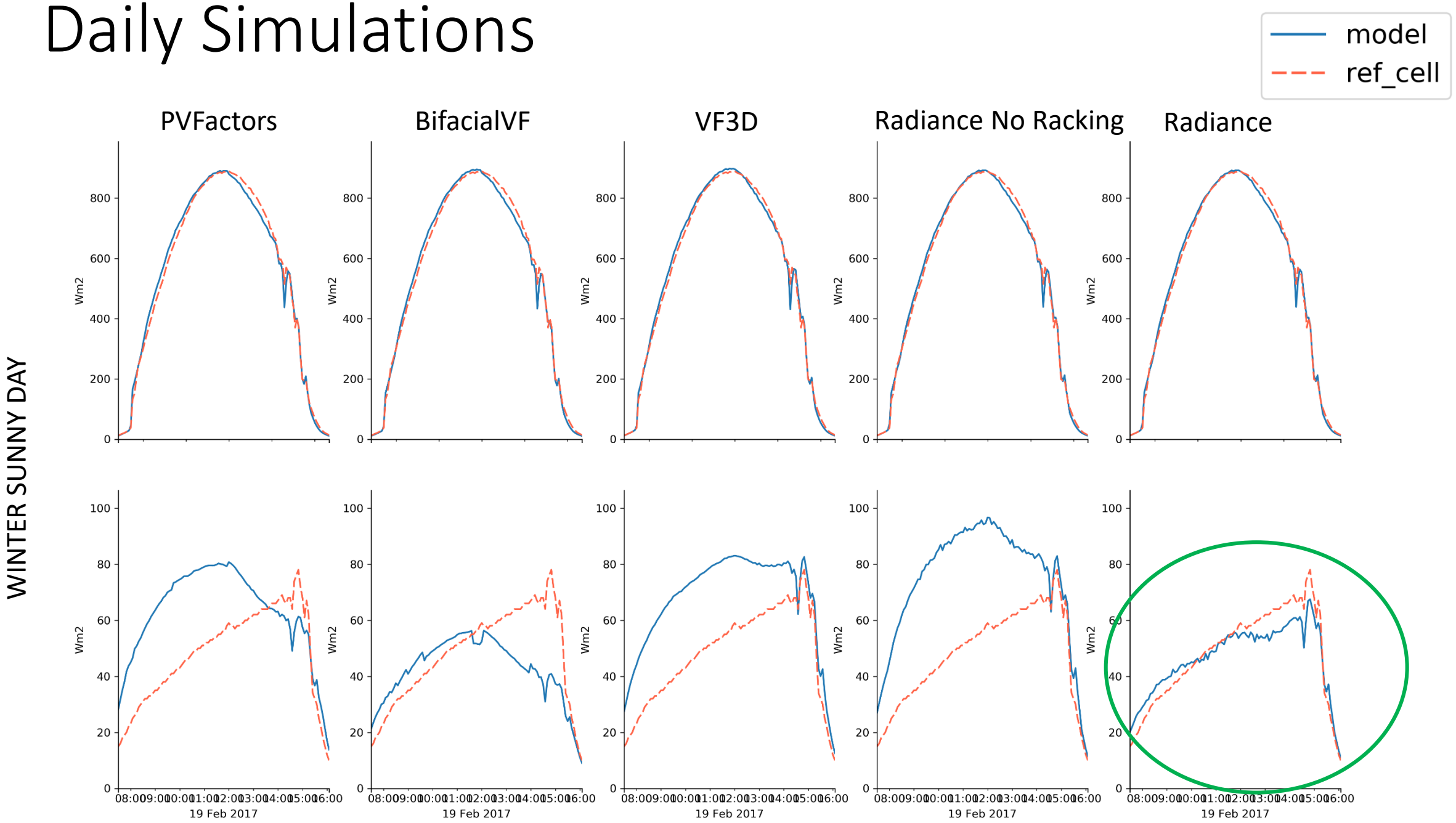

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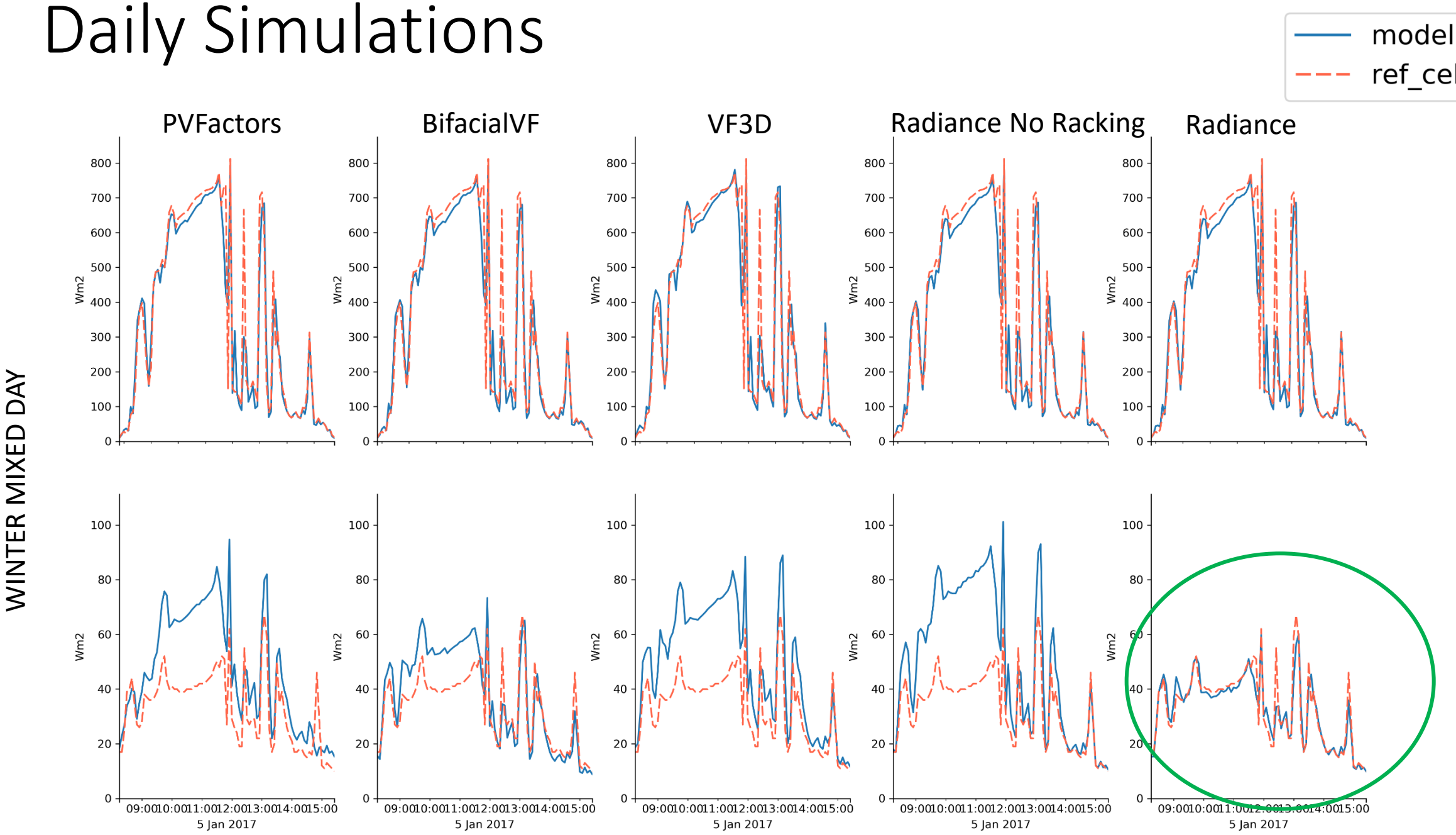
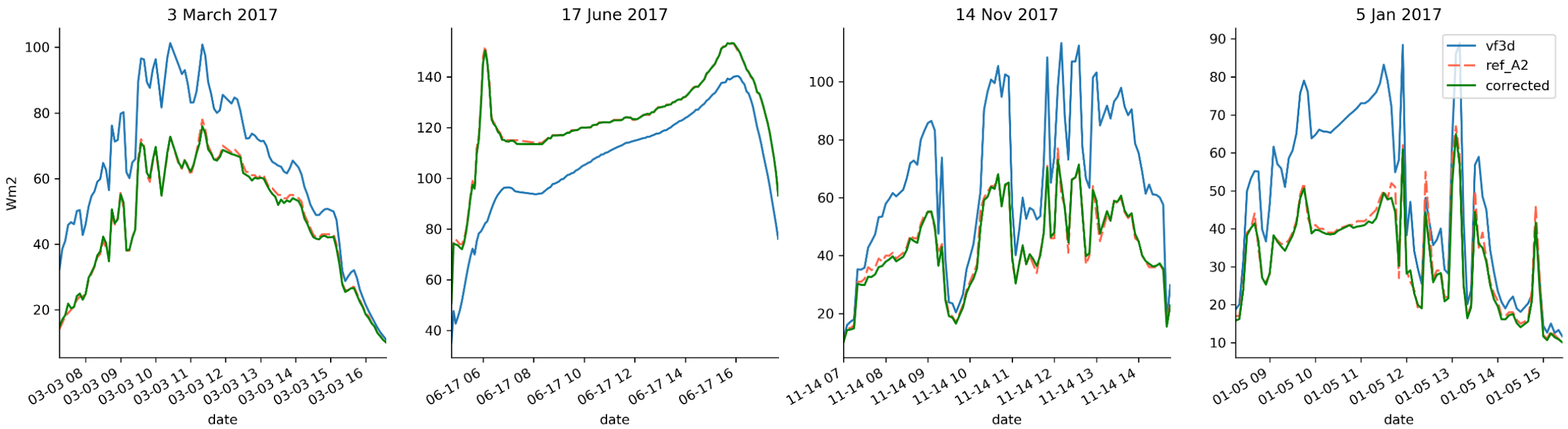


Learning the difference with ML



"If you have monitoring data" you can fit a non Linear regression over meteorological variables to learn the residual.

Conclusions

- Our 3D viewfactors approach outperforms 2D models, and is on pair with RayTracing radiance with no racking.
- For small, non periodic asymmetrical systems, 2D models don't reproduce border effects.
- Diagnostics and forecasting requires high model precision.
- Albedo is mandatory for precise validation/simulation (wet ground model).
- We should share data at different locations with monitored reference cells/pyranos. =)

New data incoming early 2020: AtamosTec project

- Project conceived to supply a **mining company pumping station**.
- First large scale PV Plant **for research purposes**.
- **Belonging** to **Antofagasta University**.

Thanks you. Question?

This work has been financed by ATAMOSTEC.