PVcheck: A free software to check your PV system performance

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What do you do …

After you bought a **photovoltaic system**?

How do you find out:

Does the PV system perform as expected?

Image source:
https://www.habo.se/bygga-bo-och-miljo/energi-och-uppvarmning/solenergi.html

https://pvcheck.hotell.kau.se/

How do you check your PV system?

Typical solution

Wait a year counting the energy yield

Compare the yield with the prediction

Problem: Result depends on

- **Sun hours**
- **Air temperature**
- **Periods of shading**

  (trees, buildings, etc.)

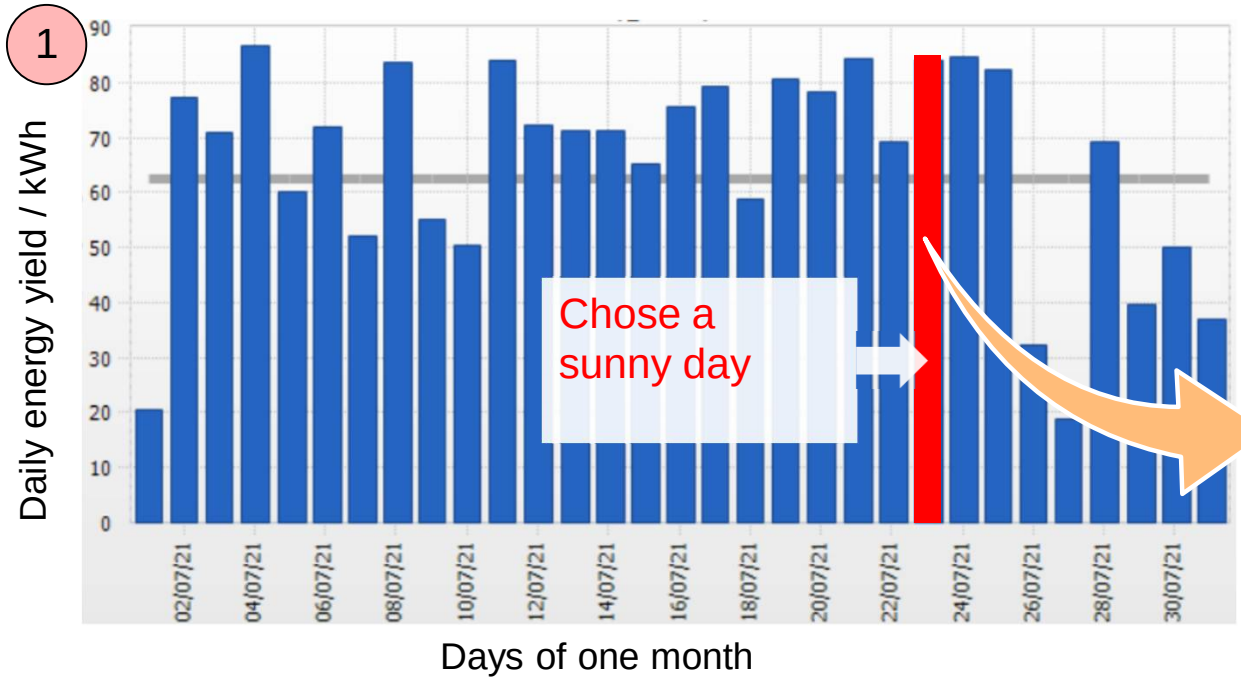
Our solution

Wait some days

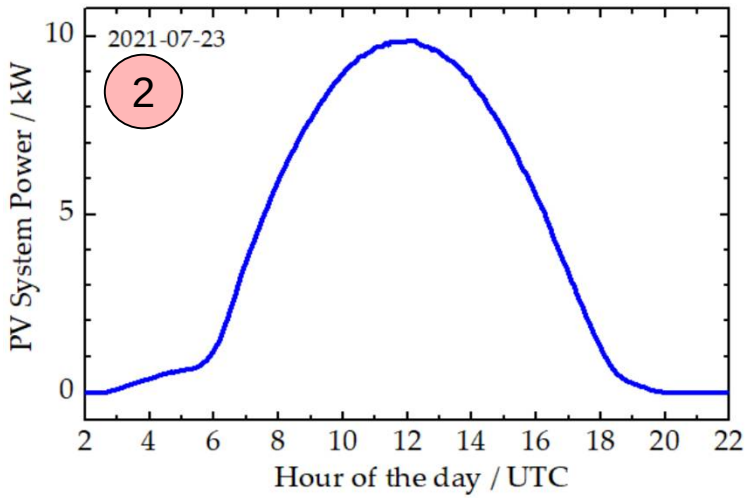
Compare
measured power curve of one sunny day
to a
simulation

Then these effects can be eliminated!

„Measuring“ the peak power of the PV system



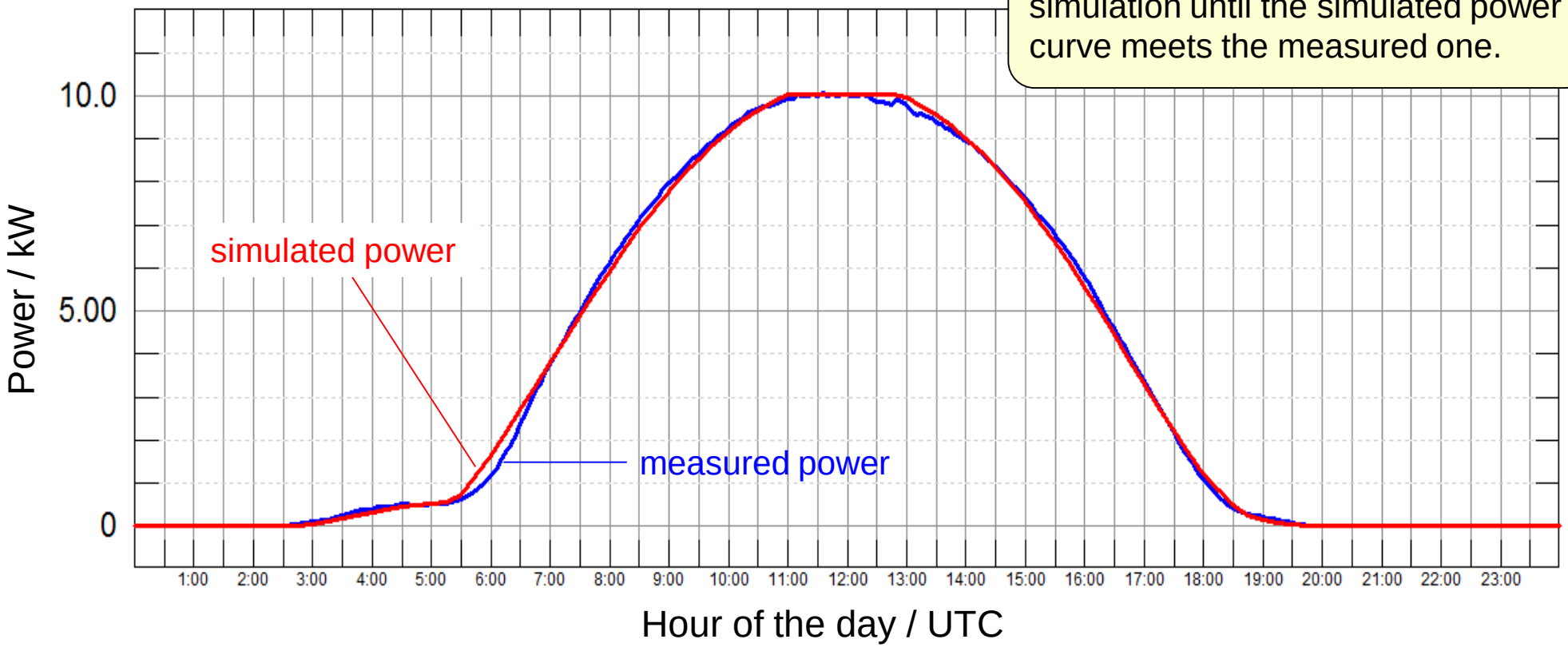
Download a power curve of this day from your inverter



3 Simulate this curve with the **peak power** as fit parameter.

Fitting of simulated power curve

Modify the peak power of the simulation until the simulated power curve meets the measured one.



Simulation of a power curve
for each point in time

For the PV system, you provide:

- Tilt and azimuth
- GPS coordinates
- Air temperature
- Wind speed

Can be downloaded from nearby weather stations

Produced power curve of a sunny day from inverter

date, time – power
... – ...

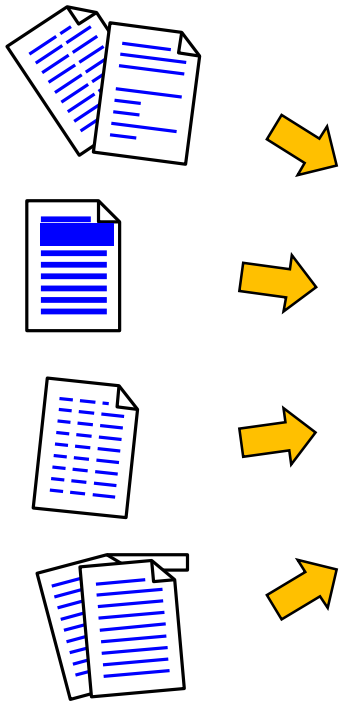
The software then **simulates this power curve** with the systems **peak power** **as fit parameter**:

This is what you get!

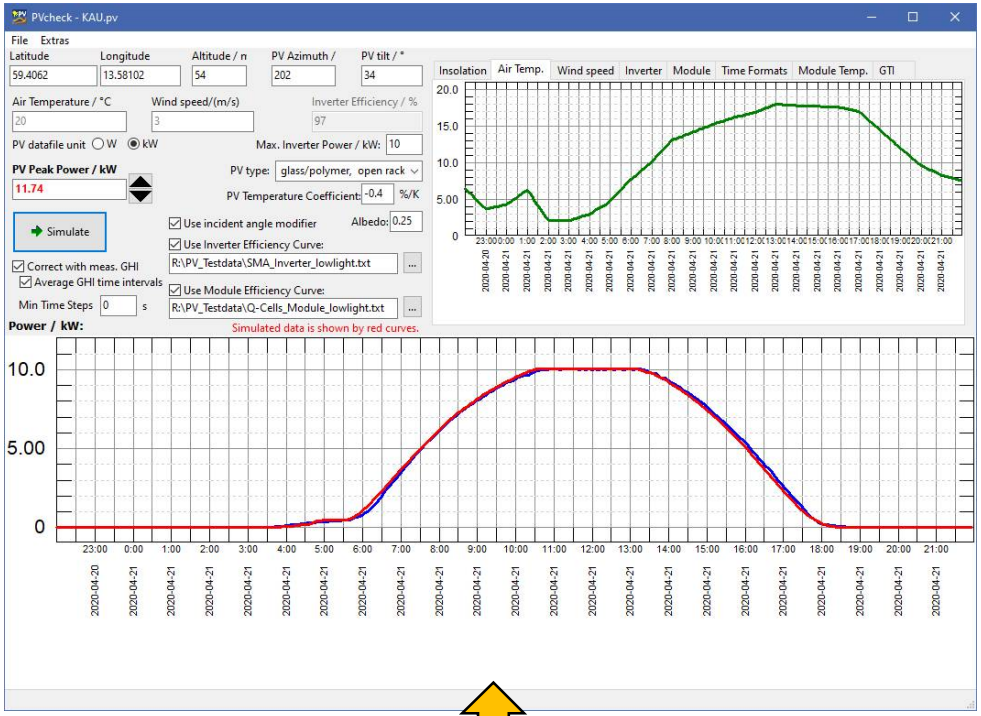
Internally, it calculates for every time:

- Sun position in the sky
- Air mass in the line of sun rays
- Air turbidity using a database
- Irradiance components (direct, diffuse, in-plane of modules)
- Module temperature
- Produced power

The software



All kinds of measurement data file formats



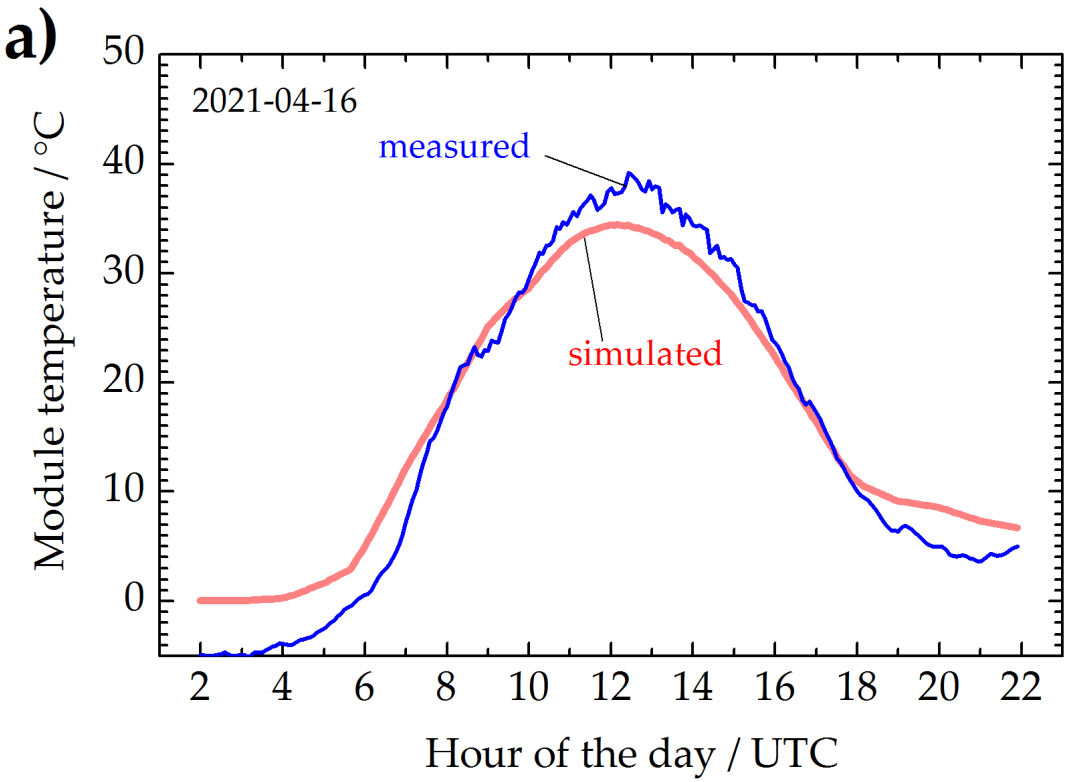
The graphical user interface

PVlib python

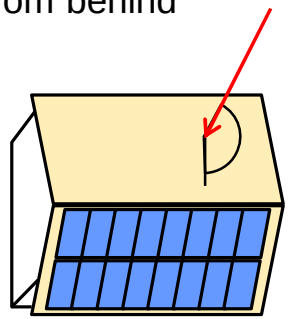
Simulation library

Output:
PV system peak performance

Results – Module temperature simulation
for a single house



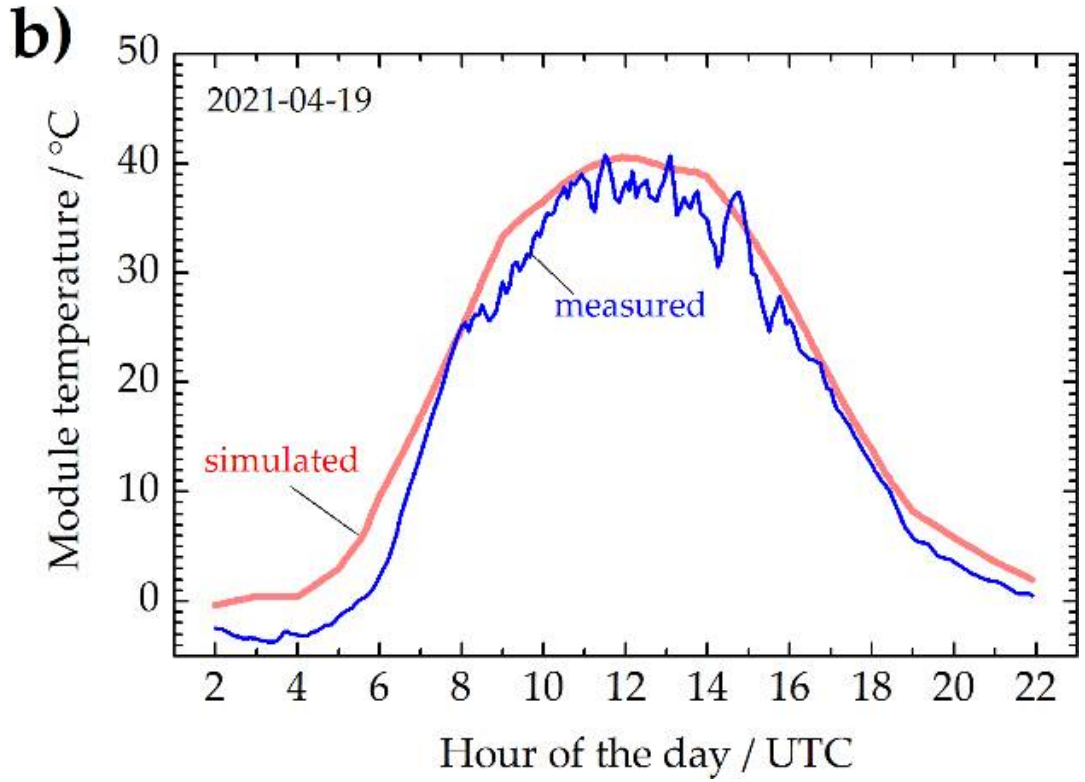
Wind direction
from behind



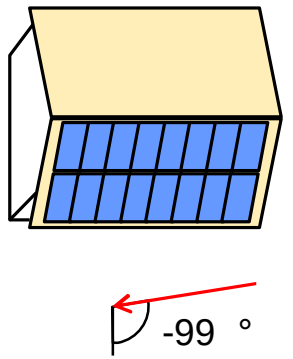
PV system in
wind shadow

Temperature deviation about 5 ºC
⟹ 2-3 % peak power inaccuracy

Results – Module temperature simulation
for a single house

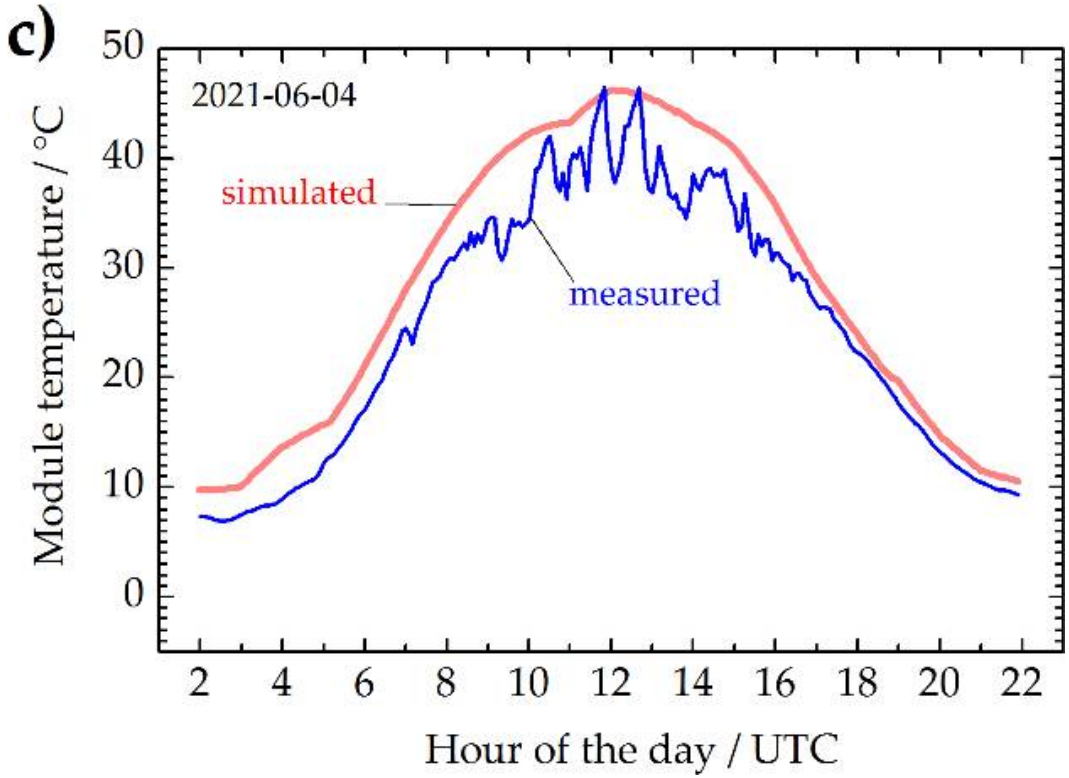


Wind direction nearly parallel to modules

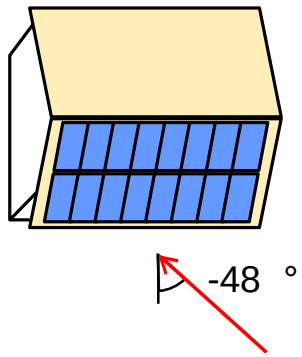


Good accuracy!

Results – Module temperature simulation
for a single house



Wind direction
diagonal from front



Temperature deviation about 5 ºC
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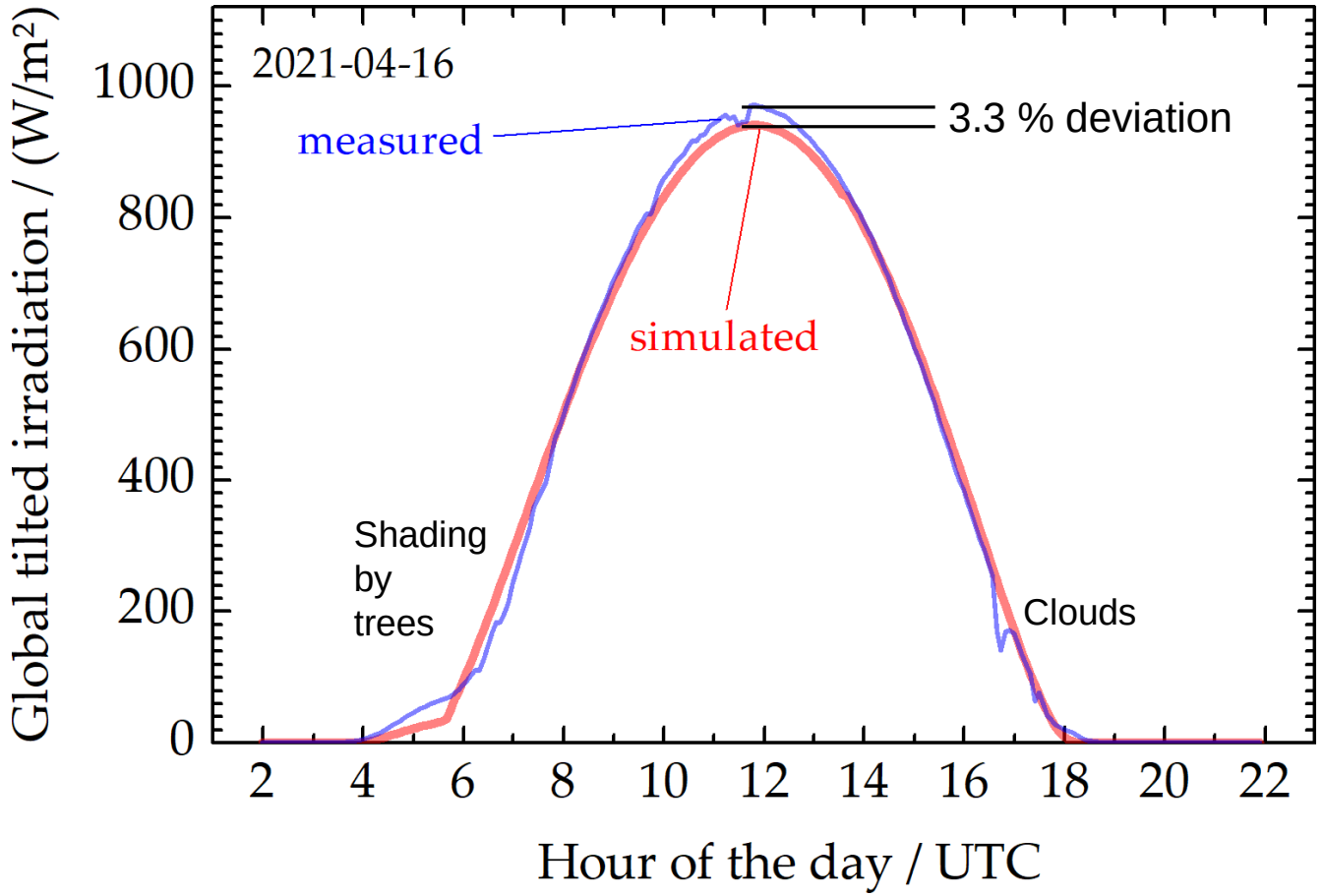
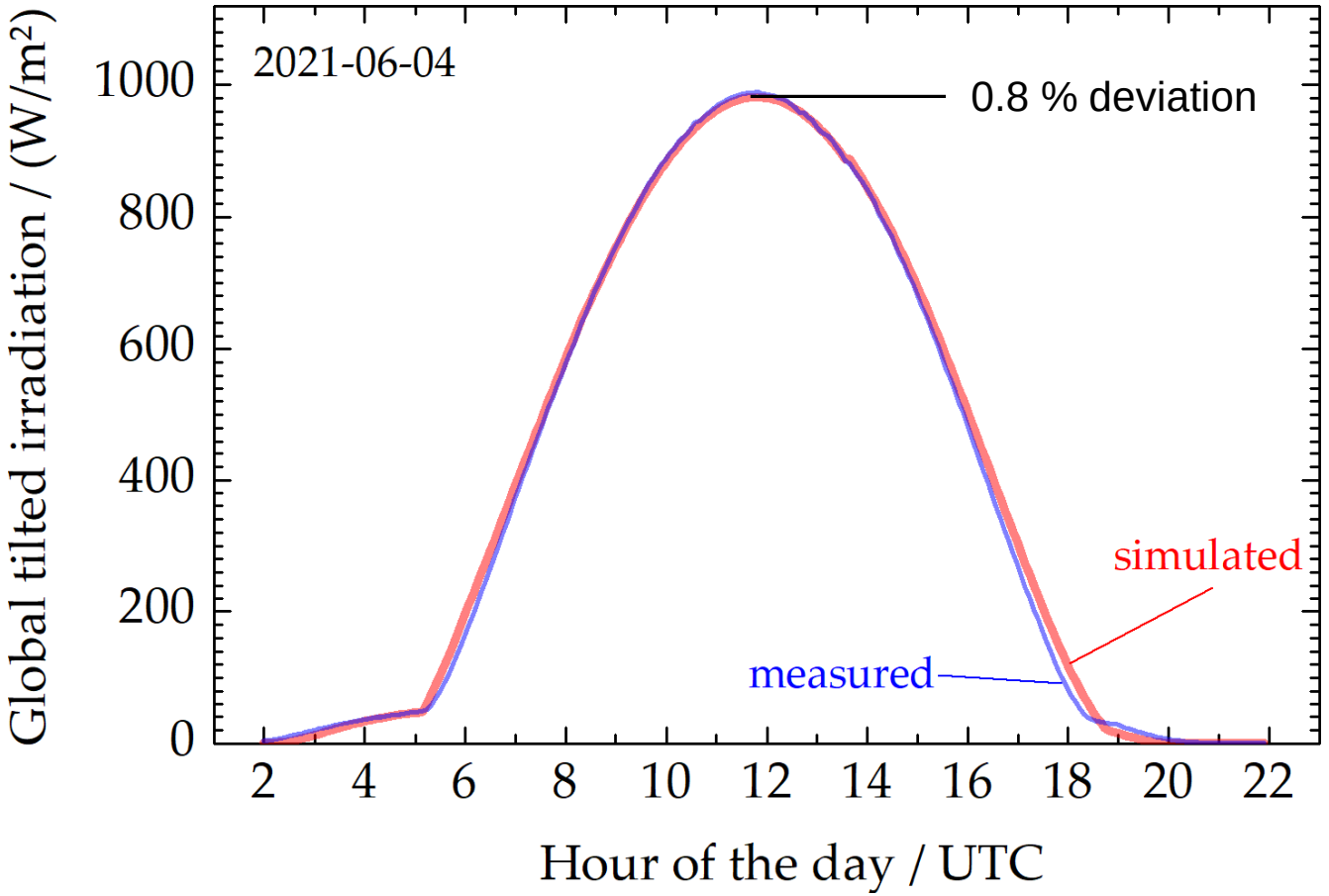
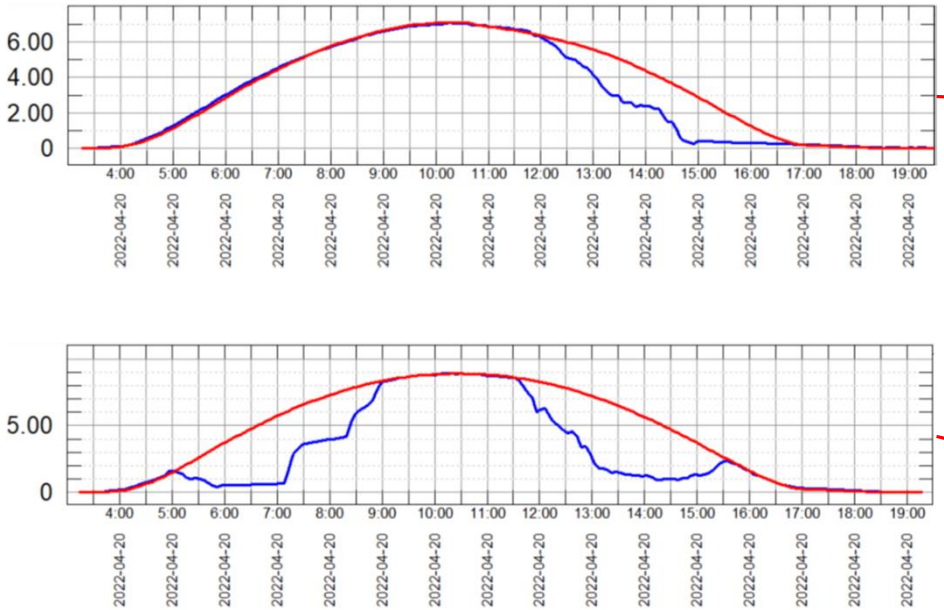
Results – Module temperature simulation
for a single house

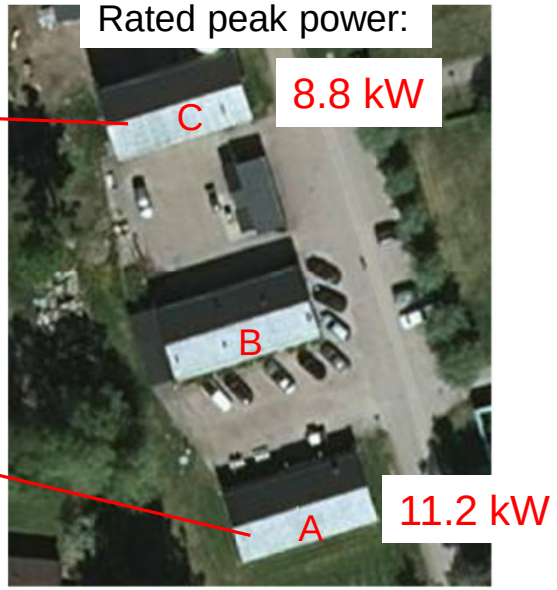


Results – Irradiation calculation with ClearSky model
for a single house



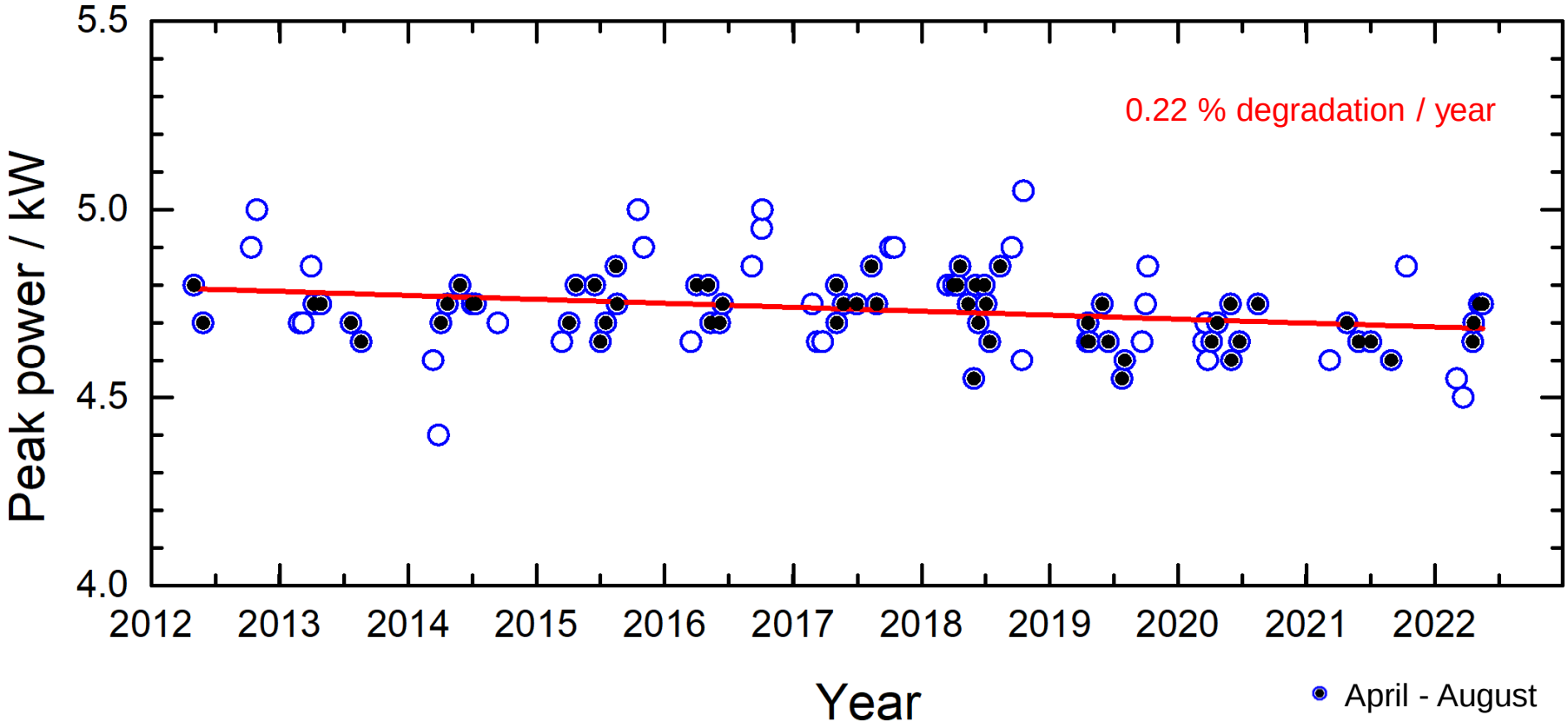
Evaluation of newly installed systems with strong shading





System	Peak power / rated peak power using simulated module temperature	Peak power / rated peak power using measured module temperature
C	97 %	100 %
A	97 %	98 %

Degradation of a PV system
at Glava Energy Center



Summary

- **Pvcheck** is a fast tool to measure the peak power of a PV system
- The **temperature simulation** matched the measurement within about 5 ºC
- An analysis of a test system showed promising **0.22 % degradation / year**
- An measured peak power lower than 90 % of the rated peak power is likely to **indicate a problem**, which then could fastly be handled.

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Thanks to **Region Värmland, Tillväxtverket**, and **Energimyndigheten** who partly funded this work via the project „Solar Värmland“ and „SOLVE“ as well as to **Glava Energy Center** and the **Church of Sweden** for providing data.