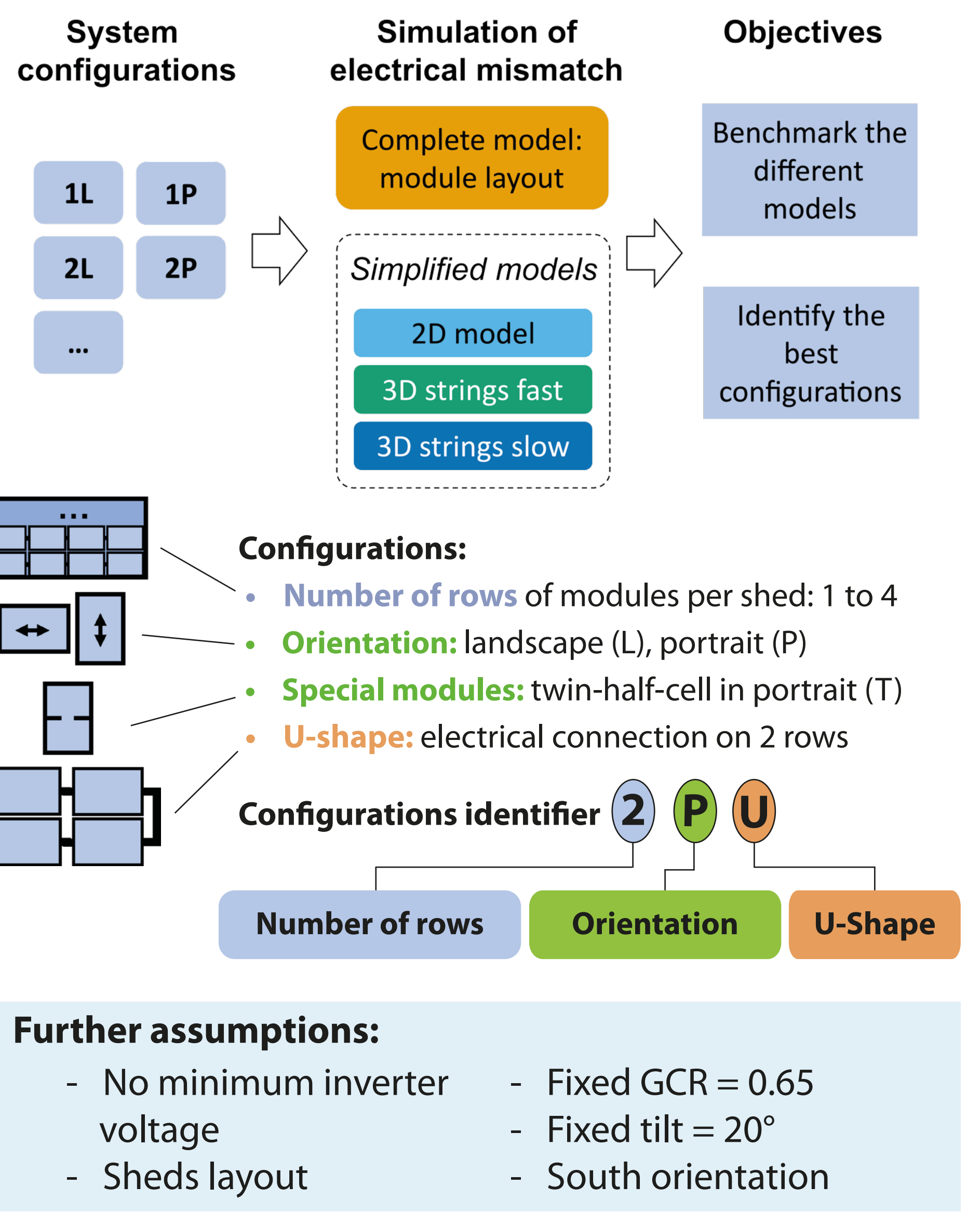


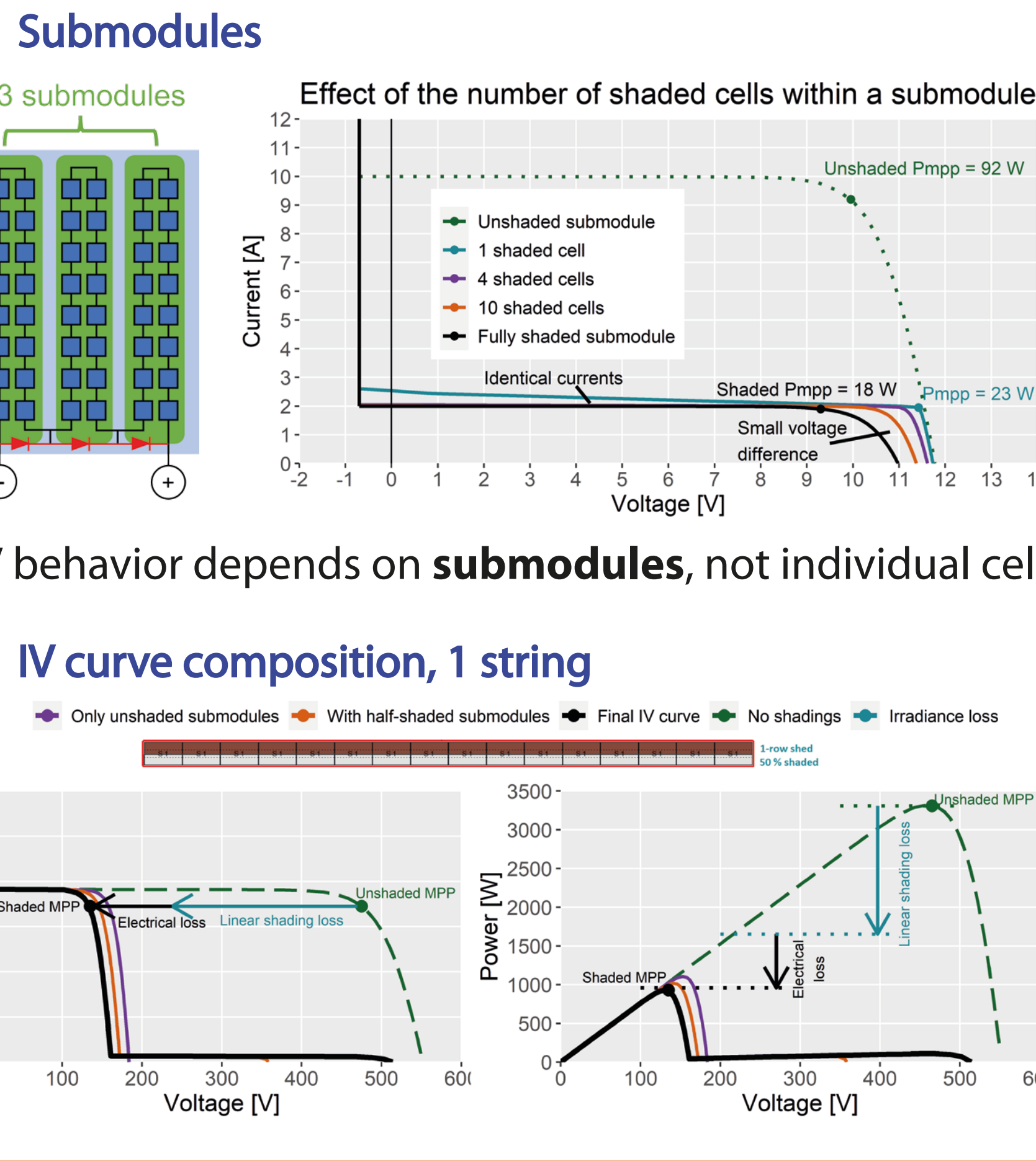
Abstract

In a PV system, partial shading leads to extra mismatch losses due to shaded PV cells limiting the current of a string. We investigate these so-called electrical shading losses, with two models available in PVsyst: a complete IV-curve-based model, and a simplified model. These are applied to PV shed systems with different string layouts and PV module types. Common configurations are shown to be compatible with the simplified model, after adapting the number of string partitions. We also derive some general strategies for minimizing electrical shading losses.

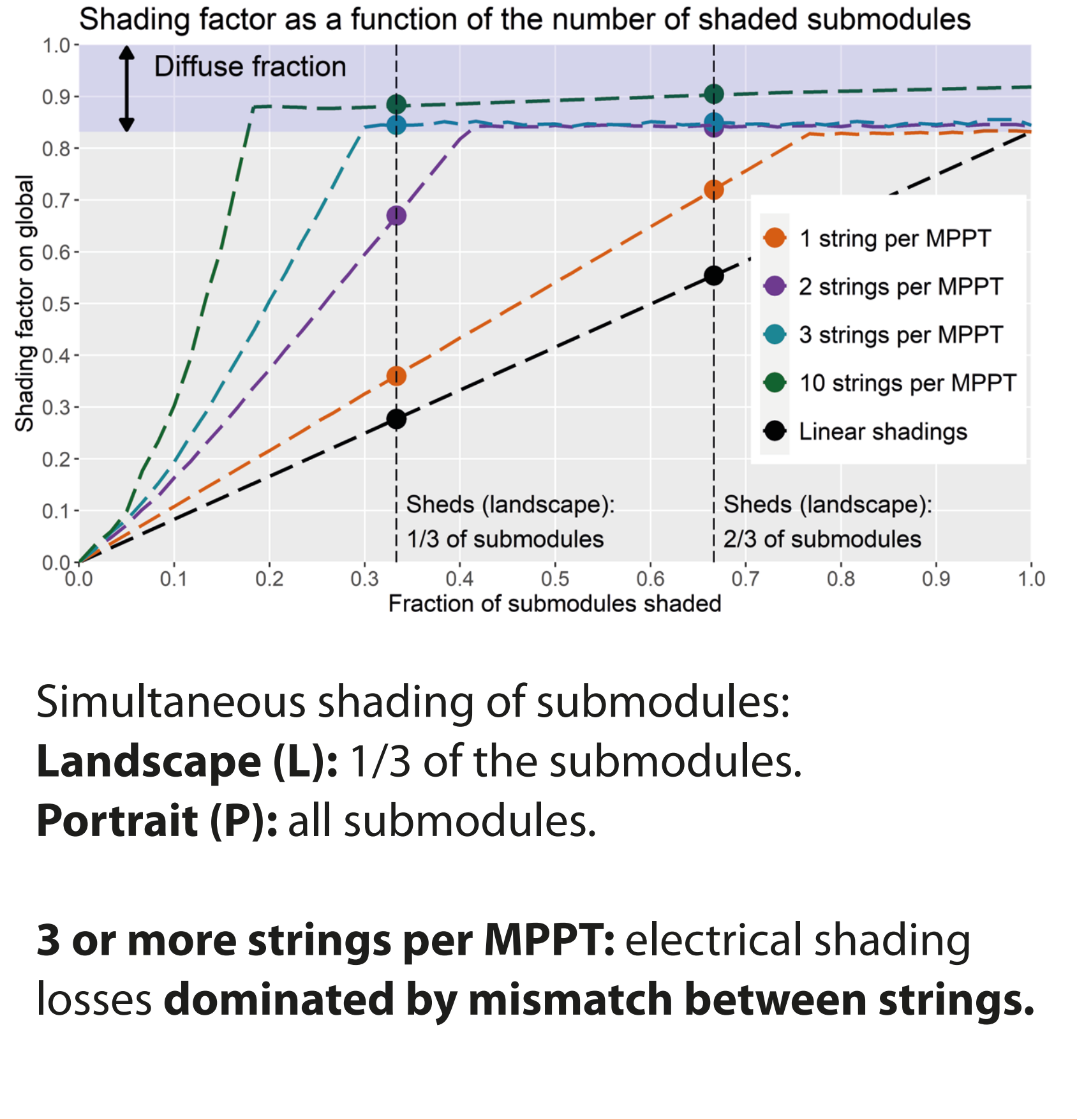
Methodology



Reference model: module layout



Behaviour for sheds (rows)



Effect on irradiance components

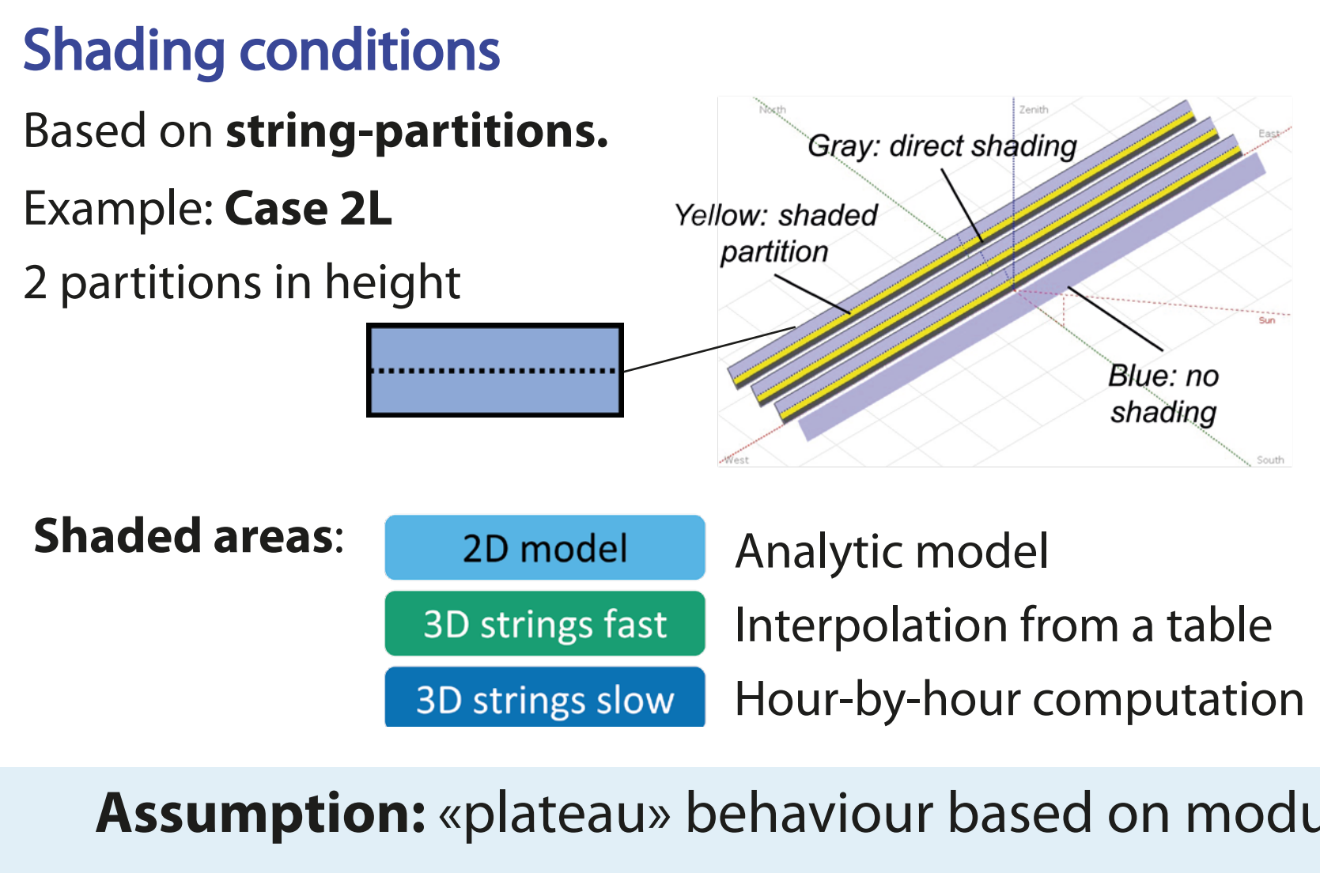
Beam:

- Linear: shaded area ratio
- Electrical: according to models

Diffuse and albedo: integral of view factor

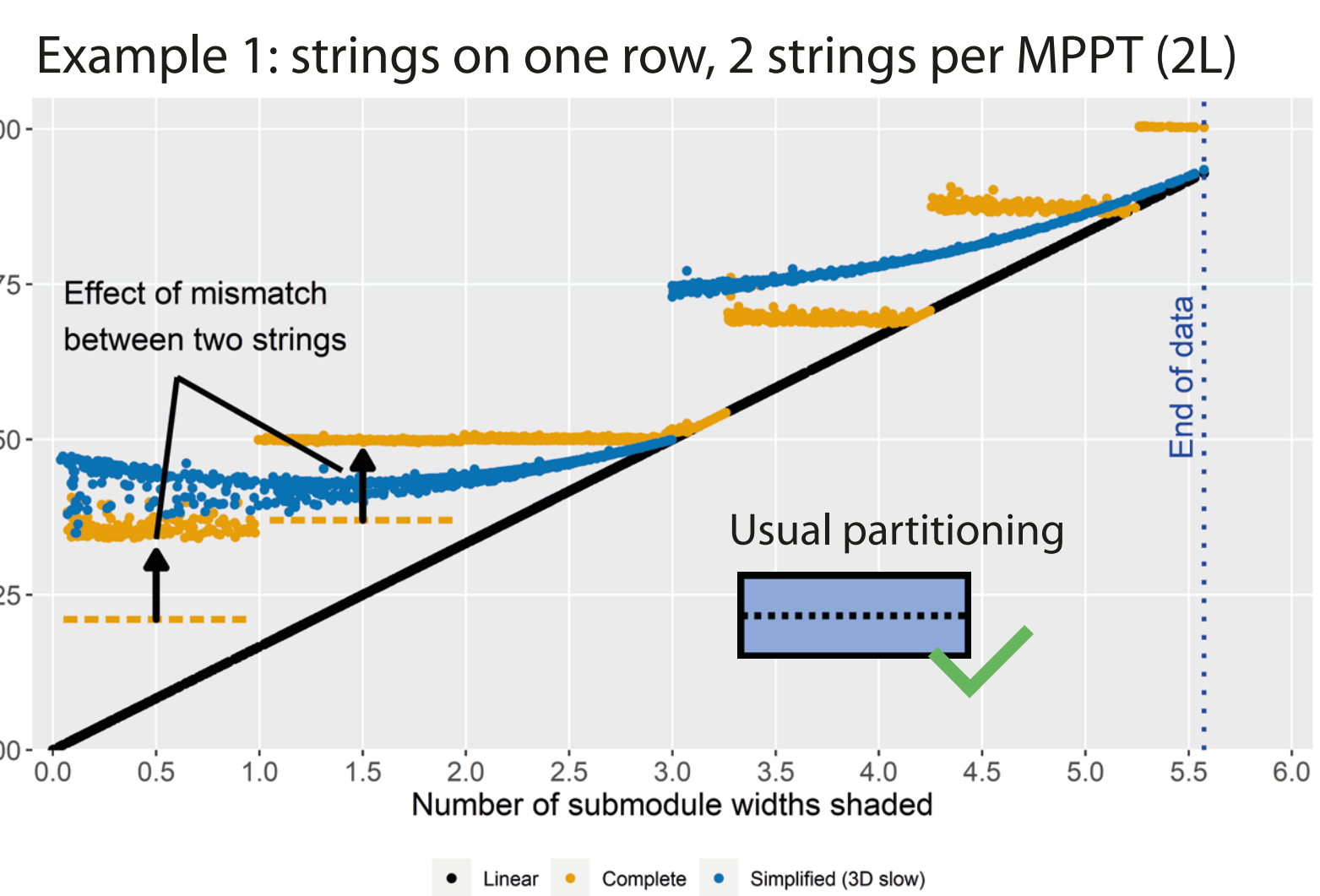
The circumsolar component is included in the diffuse.

Simplified model for sheds (rows)

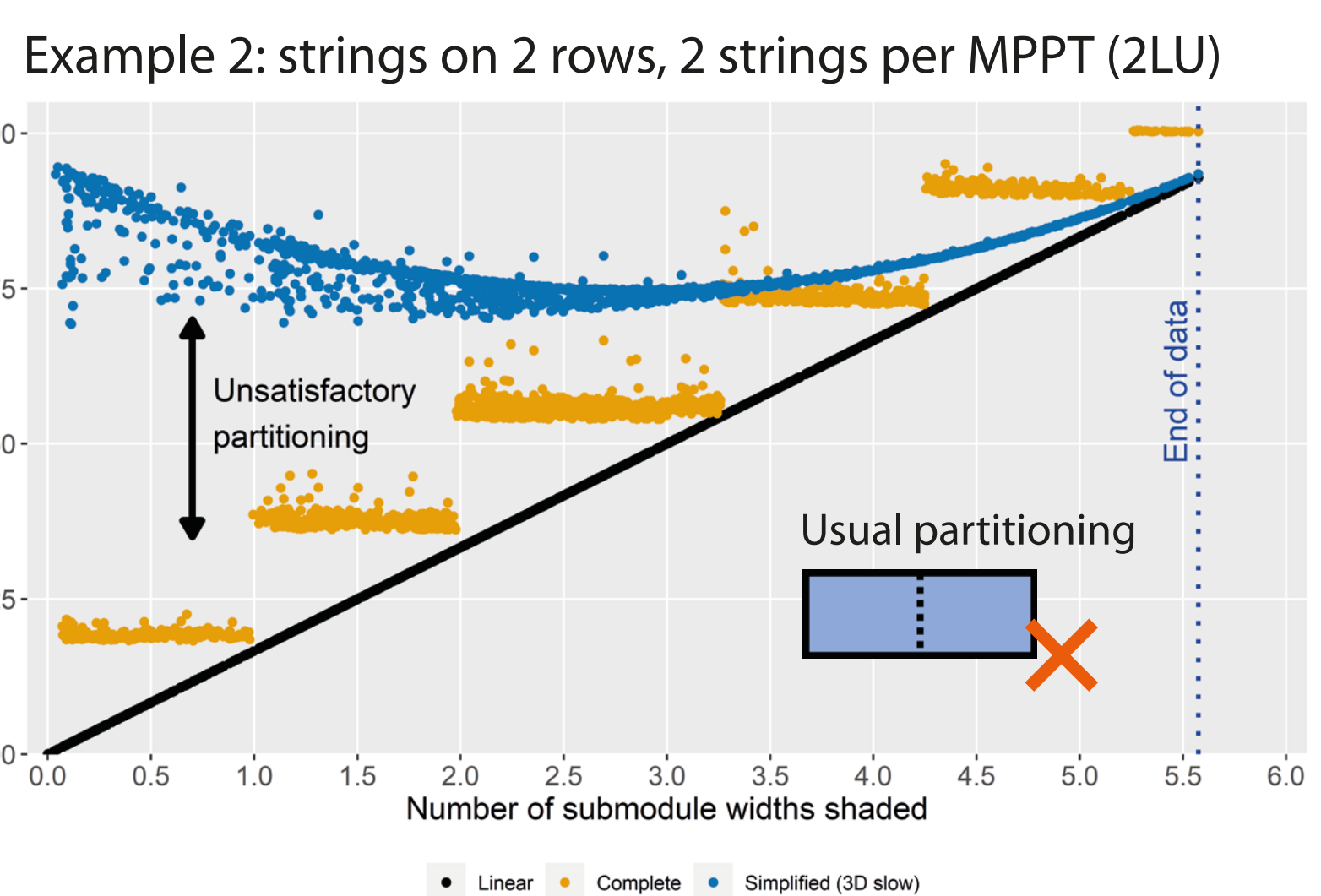


Detailed hourly results

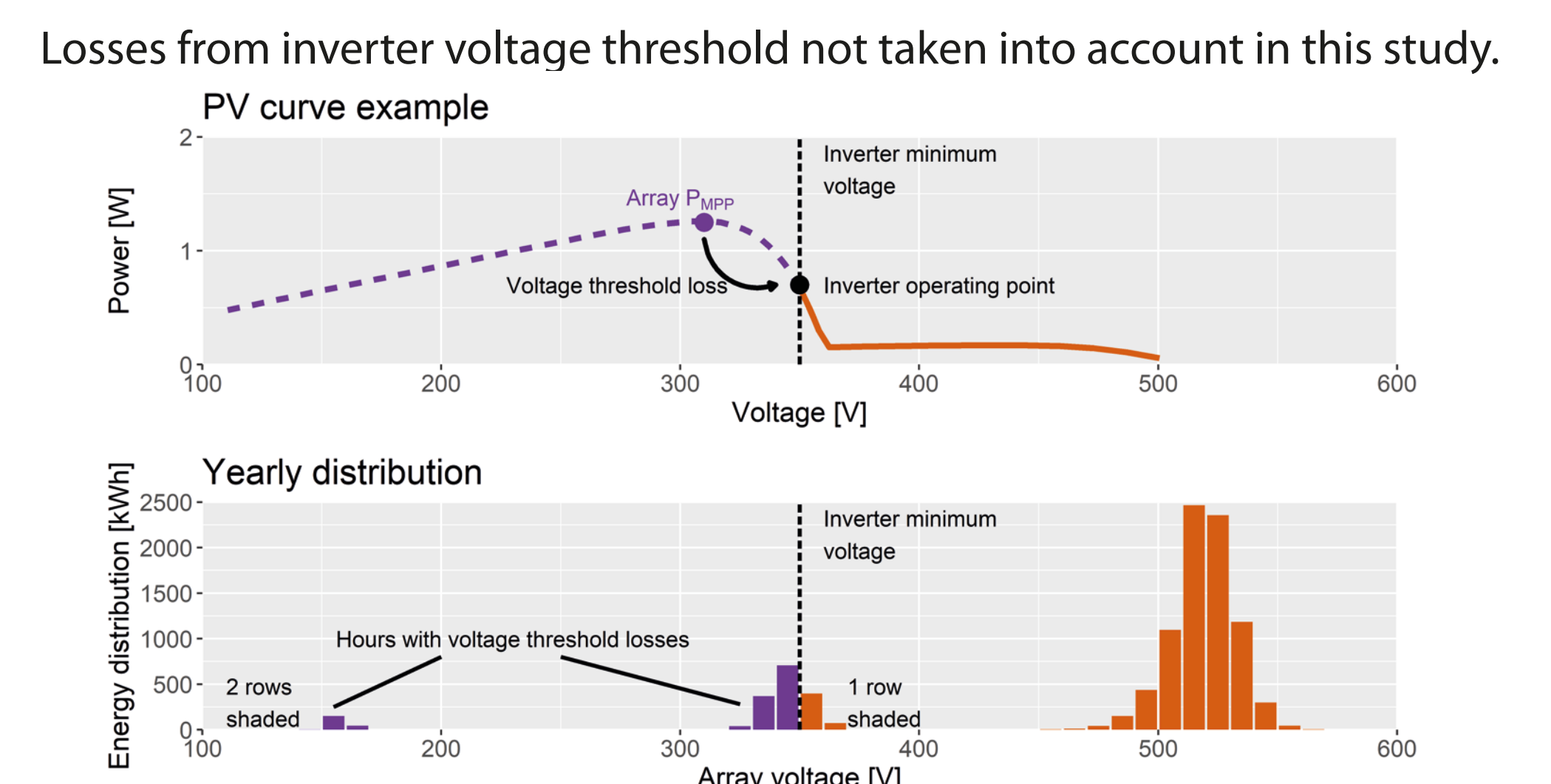
Satisfactory partitioning



Unsatisfactory partitioning



Impact of inverter minimum voltage



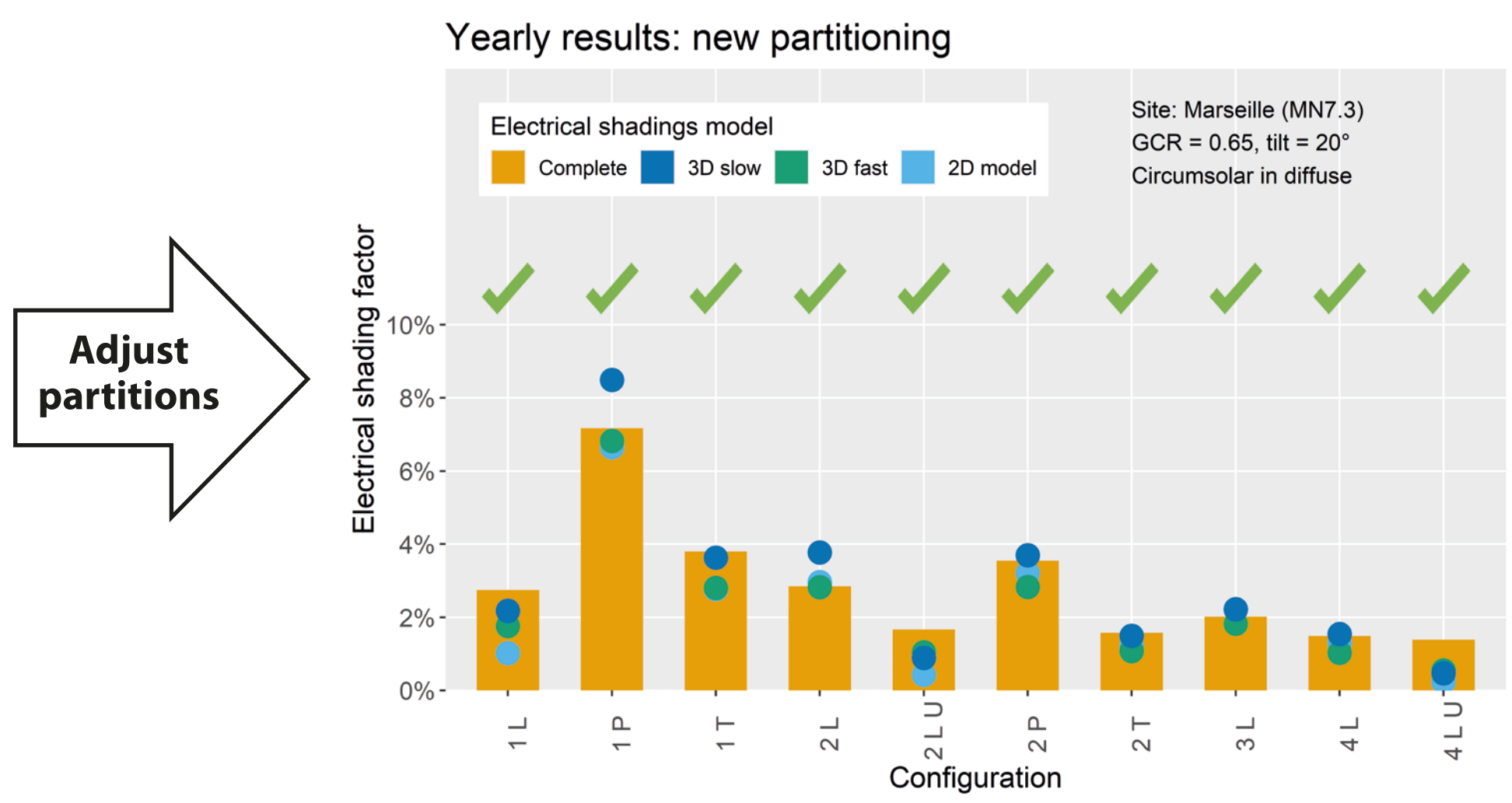
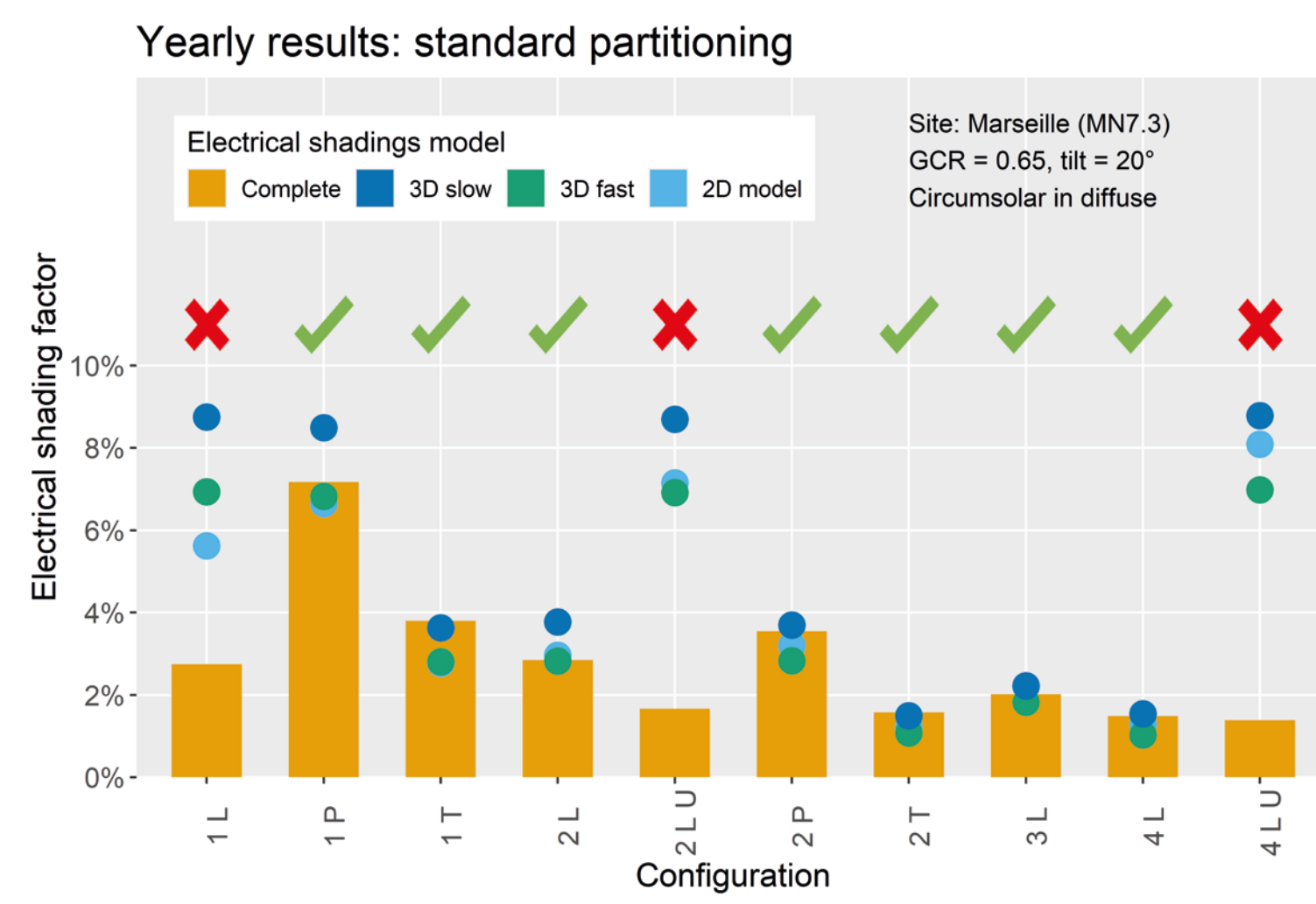
Model yearly results

Yearly results are used to benchmark the simplified and reference models.

Main conclusions:

- More rows → fewer electrical losses.
- Twin half-cells and landscape are similar
- Adjusted partitioning for some cases

NB: One string per MPPT (string inverter): like case 1L



Adjusted partitioning for the simplified model:

- 1L: 2 partitions in height.
- xL: x partitions in height.
- xLU: 3x partitions in height.
- xP: x partitions in height.
- xT: 2x partitions in height.

Summary and Outlook

Configurations with low electrical losses (without inverter voltage threshold):

- Fewer strings on each MPPT: decreases the mismatch between strings.
- Higher number of rows → fewer electrical losses.
- Normal modules should be positioned in landscape.
- Twin half-cells in portrait: similar behavior to normal modules in landscape.
- U-shape may be acceptable for landscape configuration only.

The simplified model needs a well-chosen partitioning to match the reference model.

Improvements in future PVsyst versions:

- Improve accuracy of simplified model, refine step definition.
- Module layout calculation on part of the system, extrapolated to full system.

This study was based on PVsyst 7.2.5.