

# 30+ years of operation – a comprehensive review of the long-term performance of the Mont-Soleil PV power plant

Hugo Quest<sup>1,2\*</sup>, Christof Bucher<sup>3</sup>, Matthias Burri<sup>3</sup>, Christophe Ballif<sup>1,4</sup>, Alessandro Virtuani<sup>4</sup>

1 – EPFL, Institute of Electrical and Micro Engineering (IEM), Photovoltaics and Thin-Film Electronics Laboratory (PV-LAB), CH-2002 Neuchâtel

2 – 3S Swiss Solar Solutions AG, CH-3645 Thun

3 – Bern University of Applied Sciences (BFH), CH-3400 Burgdorf

4 – CSEM, Sustainable Energy Centre, CH-2002 Neuchâtel

EPFL :: csem

3S Swiss Solar Solutions

BFH

PV Tagung 2024 (Lausanne)

\* hugo.quest@epfl.ch

## 1 Context and goals

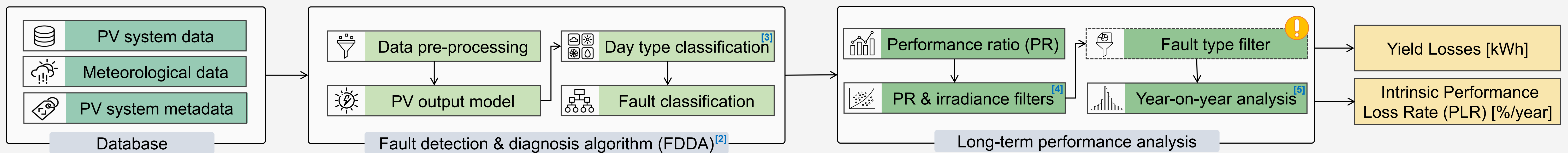
- Europe's oldest grid-connected +500 kWp PV system (Feb. 1992).<sup>[1]</sup>
- Combining fault detection & long-term performance analysis pipelines.

20+ years of monitoring data    Fault Detection & Diagnosis    Long-term performance analysis

Total DC capacity	554.592 kWp
Tilt angle	52°
Orientation	20° East / 35° East
Altitude	1270 m a.s.l.
Inverter type	ABB central inverter
Module type	Siemens SM55 55 Wp



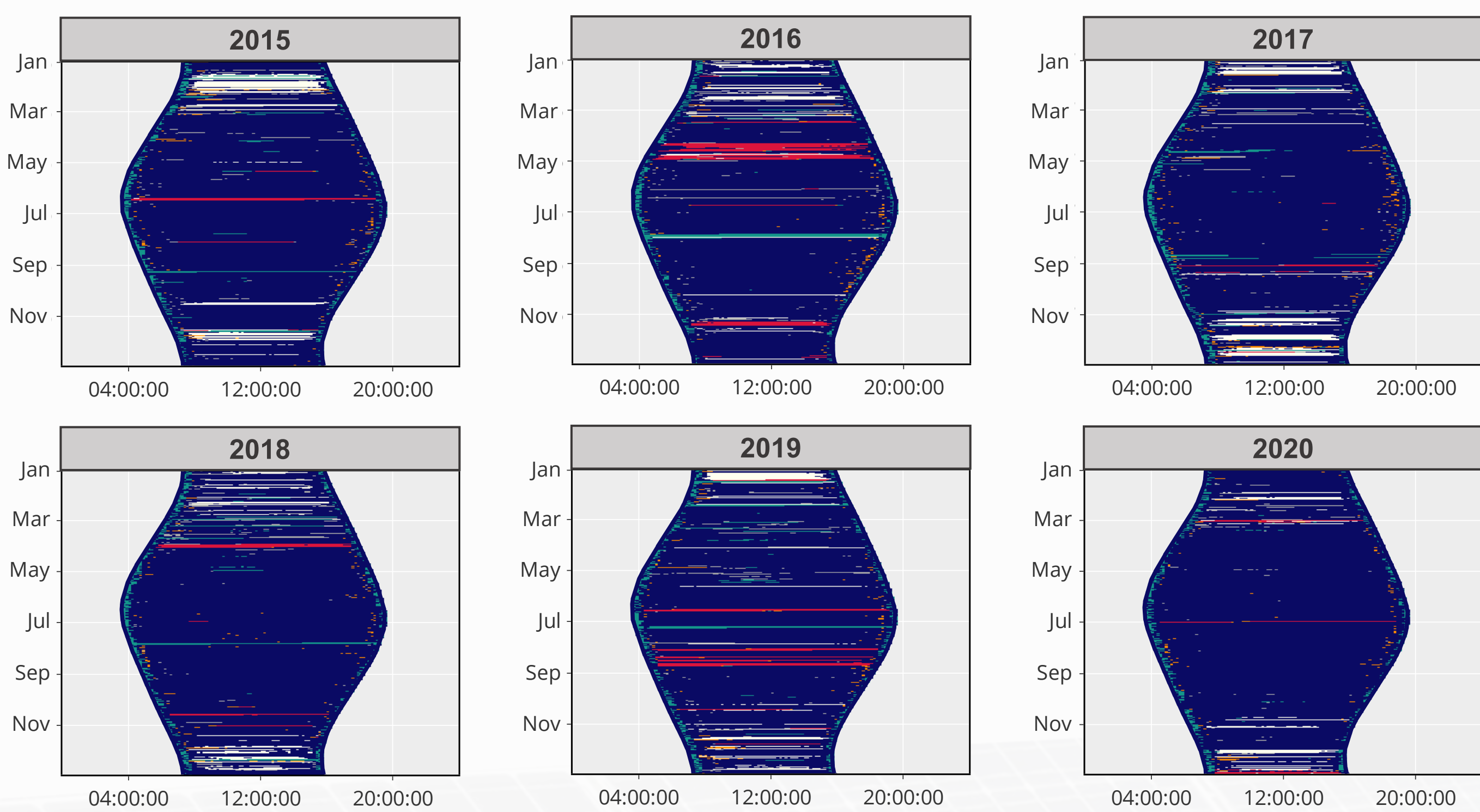
## 2 Methodology



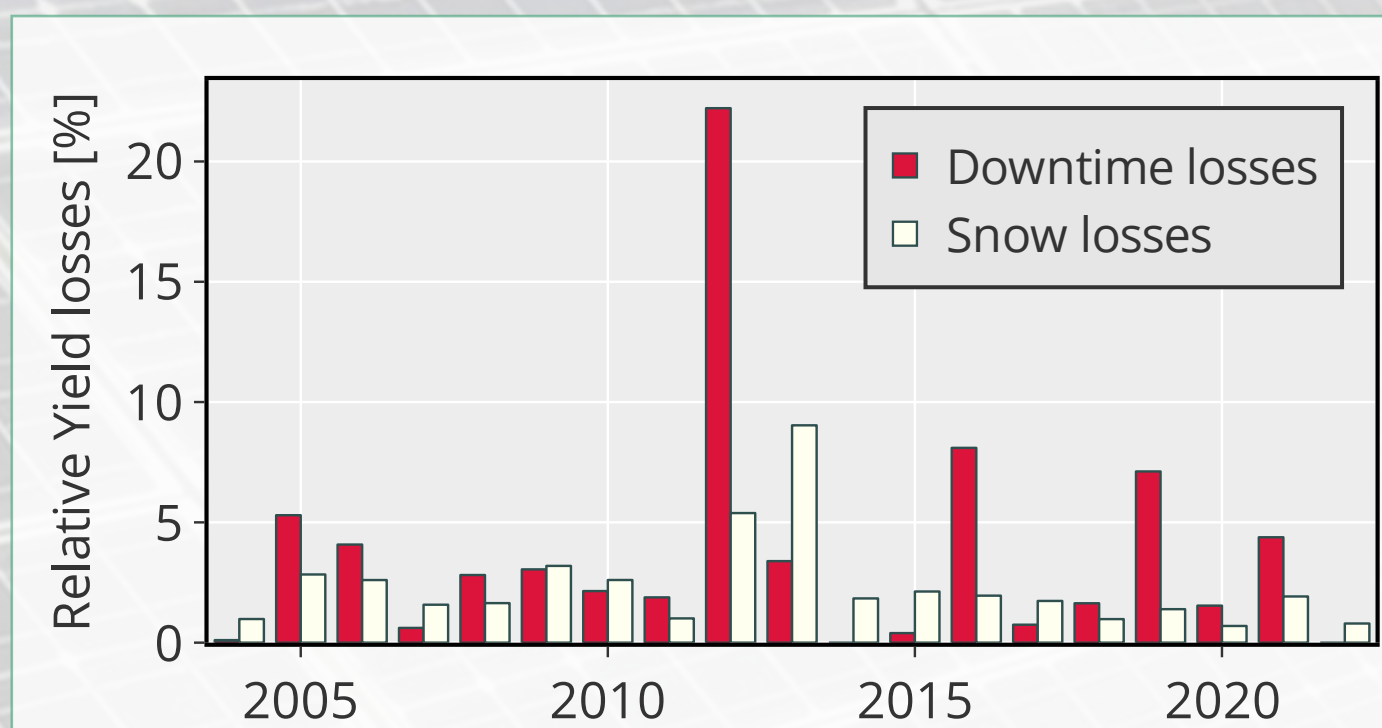
## 3 Results

### Fault Detection algorithm

Fault Types		
Normal	Snow	Cloudy
Shading (BPD)	Shading (MPPT)	Downtime

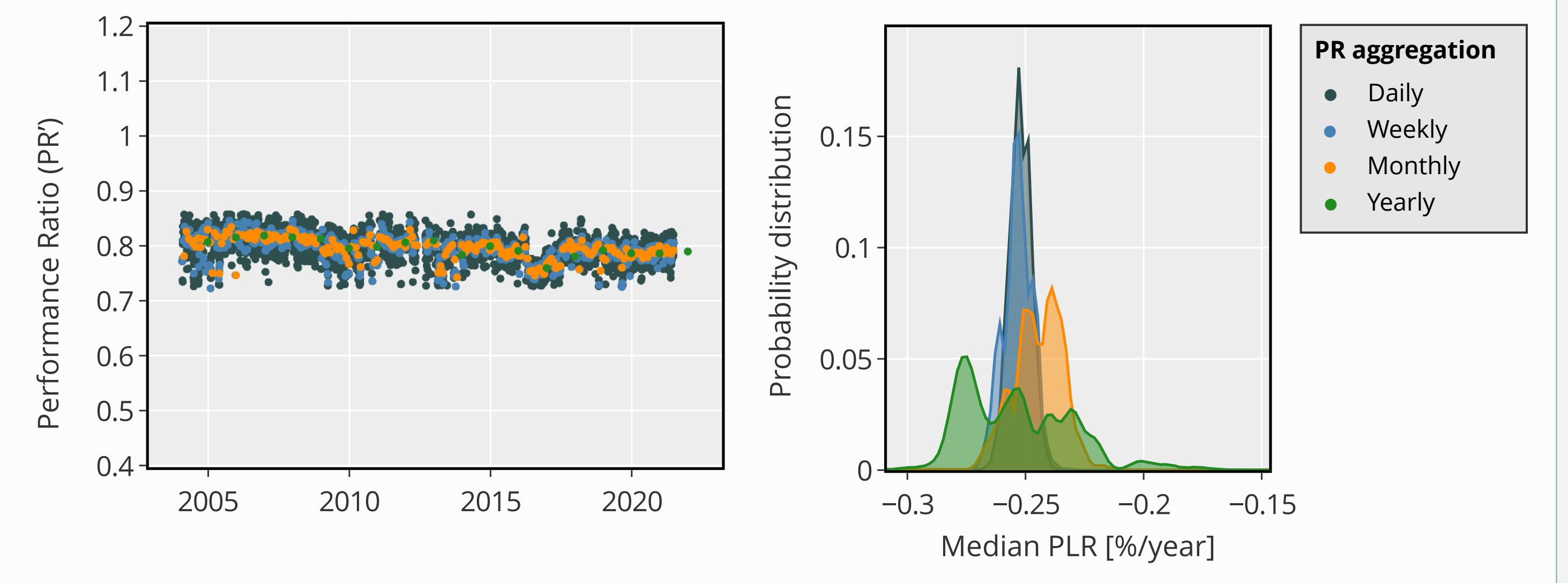


- Fault detection and diagnosis algorithm applied to each year w/ all data (2004-2021).
- Fault heatmaps show patterns in fault occurrences.



- Main detected fault types: snow and downtime. Estimated losses up to 20% of yearly yield.
- Between 2004 and 2021, an estimated ~370 MWh and ~230 MWh are lost to downtime and snow losses, respectively. This amounts to almost a full year of average production for the power plant.

### Long-term performance analysis



- Faults are filtered out based on the fault detection algorithm results (e.g., snow & downtime).
- Standard and multi-annual year-on-year (multi-YoY) pipelines applied to extract system performance loss rates (PLR). Multi-YoY offers lower uncertainties<sup>[5]</sup>.
- Overall, the Mont-Soleil power plant is found to have a PLR of approximately **-0.25 %/year**.



Aggregation	Intrinsic PLR [%/year]	
	Standard YoY	Multi-YoY
daily	-0.321	-0.252
weekly	-0.291	-0.253
monthly	-0.299	-0.245
yearly	0.356	-0.256

## 4 Conclusion

Fault detection algorithm shows mainly downtime and snow faults, with ~600 MWh estimated yield losses (2004 – 2021).

Robust long-term performance analysis pipeline with fault pre-processing shows a system PLR of **-0.25 %/year**.

On-site analysis and indoor measurements will further correlate detected degradation to system components.

Two peer systems with same module type will be added to the analysis: Jungfrauoch (Swiss Alps) and Tiergarten (Bern).

### Acknowledgements

PV-lab IEM NEUCHÂTEL



SWISSOLAR



Schweizerische Eidgenossenschaft  
Confédération suisse  
Confederazione Svizzera  
Confederaziun svizra



openicus  
Atmosphere Monitoring Service

### References

- El Boujdaini et al. (2022), 'Analysis of non-linear long-term degradation of PV systems', WCPEC-8
- Fairbrother et al. (2021), doi: 10.1002/solr.202100583
- Quest et al. (2023), doi: 10.13140/RG.2.2.12033.12644
- Özkalay et al. (2021), doi: 10.4229/EUPVSEC20212021-5DO.2.1
- Quest et al. (2023), doi: 10.4229/EUPVSEC2023/4CV.1.14

21st – 22nd March 2024

