Performance Loss Rates of PV systems of Task 13 database

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INTRODUCTION

The awareness of a PV systems performance evolution is crucial to evaluate if a system is operating within the boundaries of the initial long term yield assessment as well as cost efficient. In order to be able to judge a systems performance, one has to ensure that the performance loss (PL) is calculated accurately, which is not a straightforward task. Data availability, accuracy and resolution have to be taken into account when choosing and carrying out the necessary steps to calculate PL values. In this work, we present an overview of the performance evolution of PV systems from several locations in the U.S. and in Europe. The data are collected within the IEA PVPS Task 13 performance database. The performance loss rate is calculated based on the performance ratio by using two different methodologies, namely seasonal and trend decomposition using LOESS and the year-on-year approach. A study of performance losses depending on prevailing climatic conditions and technologies has been carried out.

PV SYSTEMS

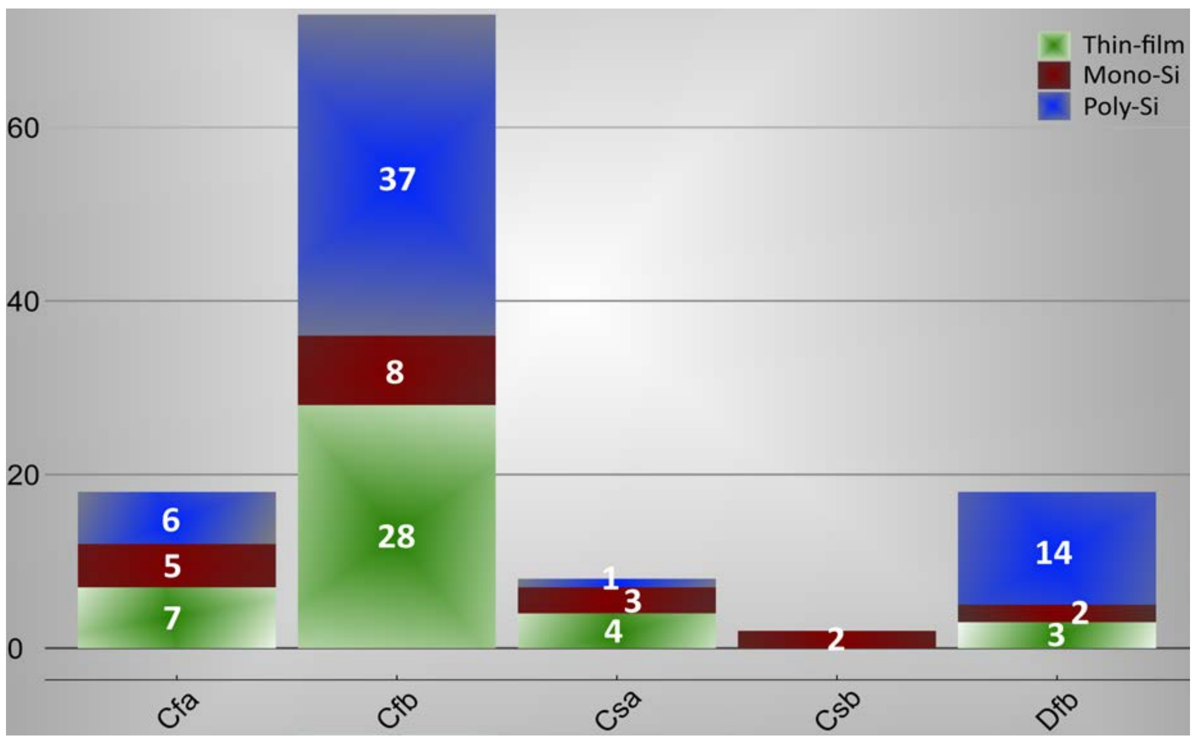

Fig. 1. PV systems of IEA PVPS Task 13 database, divided in climate zone & technology

Table 1. Köppen-Geiger classification

C	Warm temperature climates	
Cfa	Fully humid	Hot summer
Cfb	Fully humid	Warm summer
Csa	With dry summer	Hot summer
Csb	With dry summer	Warm summer
D	Snow Climates	
Dfb	Fully humid	Warm summer

PERFORMANCE LOSS CALCULATION

Data input	• Monthly PR values
Outlier filtering	• Monthly PR mode: ±2σ • Filling with 6 month rolling mean
PL calculation methodologies	• STL[1] • YoY[2]

STL – Seasonal & Trend Decomposition using Loess
YoY – Year-on-Year approach

REFERENCES

[1] R. B. Cleveland et al., "STL: A Seasonal-Trend Decomposition Procedure Based on LOESS," *Journal of Official Statistics*, vol. 6, no. 1, pp. 3-33 1990.
[2] D. Jordan et al., "Robust PV Degradation Methodology and Application," *IEEE Journal of Photovoltaics*, vol. 8, no. 2, pp. 525-531, 2017.

RESULTS

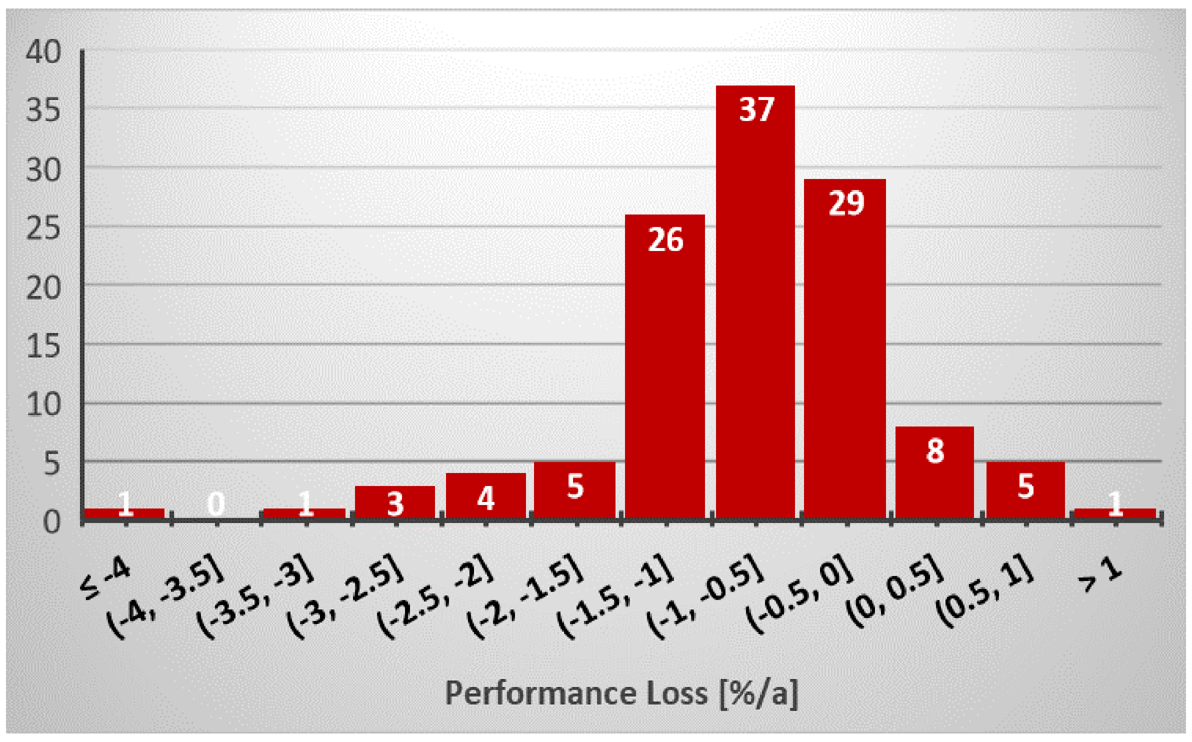

Fig. 2. PL distribution of datase using STL approach

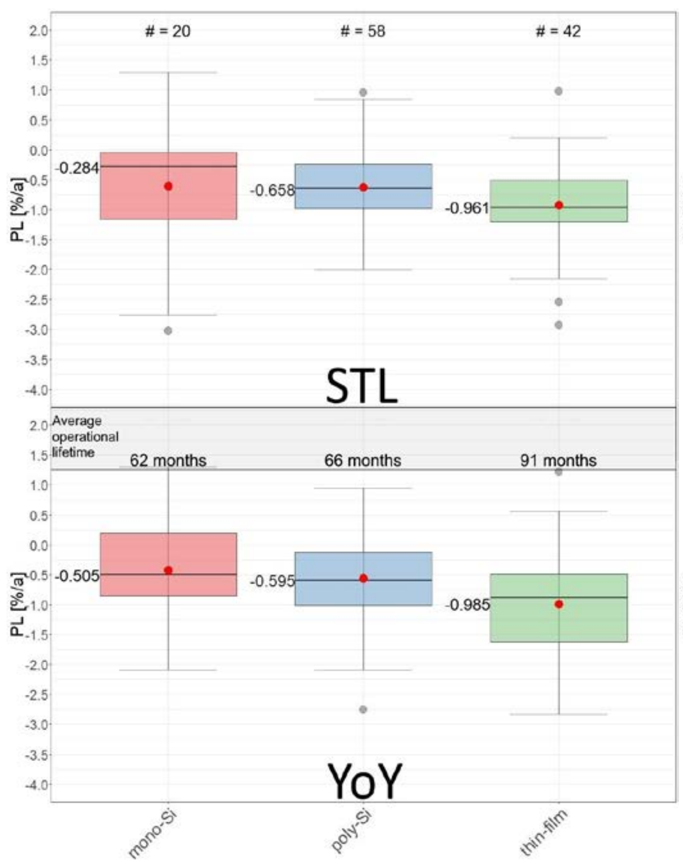

Fig. 3. PL divided by technology & methodology

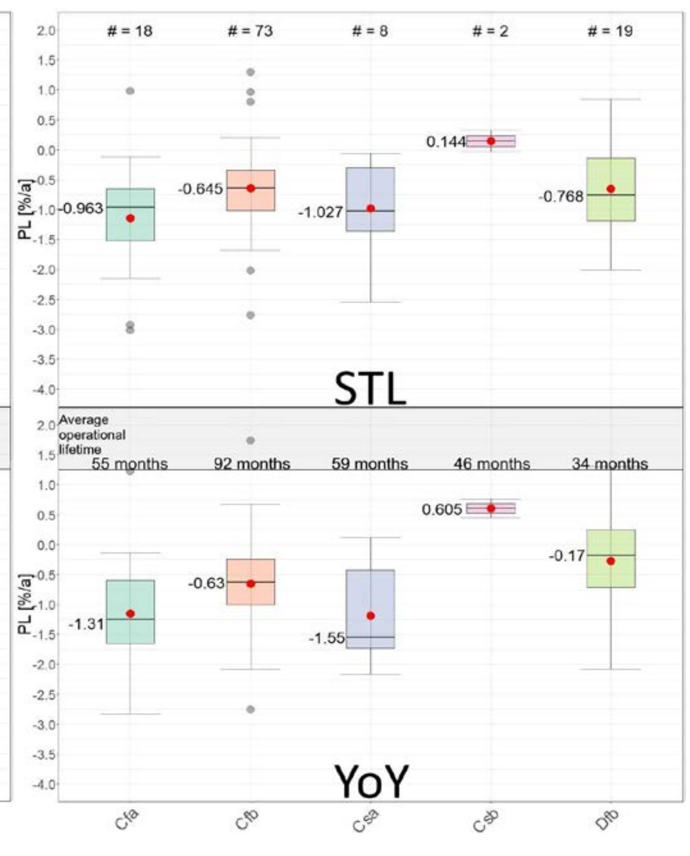

Fig. 4. PL divided by Köppen-Geiger classification & methodology

- Systems experience performance losses with a peak within the bin of -1.0 to -0.5%/a and the distribution is approximately Gaussian
  $\widetilde{PL_{STL}} \rightarrow -0.71\%/a \qquad \widetilde{PL_{YoY}} \rightarrow -0.63\%/a$
- Division by technologies: $PL_{mono} < PL_{poly} < PL_{thin-film}$
  - Average operational lifetime might affect this results
  - Differences between methodologies are small
- Division by climate classification: hot climates (Cfa, Csa) seem to affect the performance loss to the greatest extent
  - Sample size is too small to draw concrete conclusions

SUMMARY & OUTLOOK

- Creation of clear and structured dataset classification by data quality (resolution; data availability – both PV and meteo side)
- Increase sample size to divide not just by technology or climate but by technology AND climate AND possibly operational lifetime to study interaction between investigated factors

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