Accurate determination of PV System’s Performance Loss Rate (PLR) • Critical for assessing PV system operation, maintenance and production

Four main steps in PLR determination

• 0. Data Quality assessment
• 1. Cleaning & Filtering
• 2. Metric Selection
• 3. Feature Corrections
• 4. Statistical Modeling

Exploratory Data Analysis & Dataset Grading

Performance of PLR algorithms, strong function of dataset “missingness”

- Missingness includes Outliers, Missing Datapoints, and Data Gaps

Dataset Grading

- Outliers = Anomalies and Rapid Changes (can be Clouds)
- Missing = 5 or less missing data points
- Gaps = Missing data longer than 5 data points

Interlab PLR Benchmarking: 27 Combinations of Filters, Metrics & Models

- On 19 PV systems + 4 Simulated Digital Power Plant datasets

- These datasets now available as open data, for others to Benchmark

**PLR of the EURAC System**

- By 27 Metric/Statistical Model Approaches
- Ensemble model yields mean $\text{PLR}$ ($\overline{\text{PLR}}$)
  $\overline{\text{PLR}} = -0.85\%/\text{annum}$

**$\overline{\text{PLR}}_i$ determined for 18 PV Systems**

- Using ensemble model (voting) approach
- With 83.4% Confidence Intervals
- Significant Differences among these PV systems
  - At a 5% Significance Level: “Inference by Eye”
Performance Loss Rate Determination

- Task 13 members and other PV researchers completed a benchmarking study of approaches for calculation of the Performance Loss Rates (PLR) of a large number of commercial and research PV power plants in diverse climatic zones, utilizing the PV systems’ power and weather data.

- The combination of 1) data cleaning and filtering, 2) metrics (performance ratio (PR) or predicted power (P) based), temperature corrections, and data aggregation, 3) time series feature corrections, and 4) statistical modeling methods are benchmarked in terms of a) their deviation from the PLR value, and b) their uncertainty, standard error and confidence intervals.

- These results will inform standards development for PLR determination, which was previously attempted with an initial proposal for a new IEC 61724-4 standard. However, the results reported here suggest that proposing a specific standardized method is still premature.