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Collaboration call nº3
Date 17/08/2023

Collaboration calls

Call for Data on Soiling

Suspect Soiling Issues in Your PV Plant? Engage with European Experts to Find a Solution

Share PV monitoring data for soiling analysis

About SerendiPV

SerendiPV aims to increase PV-generated power penetration in European grids by addressing modeling, diagnostics, & quality control. The project focuses on accurate modeling for new PV technologies, enhancing energy yield assessments. It also innovates in advanced fault diagnosis emphasizing predictive maintenance for PV inverters & batteries. Improved understanding of component failures & aging will enable anticipation. Better quality controls will increase project quality & lifetime, reduce performance uncertainty, & improve bankability.

Soiling: one of the more relevant sources of performance losses

Soiling, the accumulation of dust and other particles on photovoltaic (PV) panels**, is a significant concern in the solar energy industry**, and therefore one of the field of work within SerendiPV. It can drastically reduce the efficiency of PV systems, leading to substantial energy and therefore financial losses. In fact, losses due to soiling have escalated from 4 billion euros in 2018 to an estimated 7 billion euros in 2023. Thus, the continuous measurement and monitoring of soiling levels in a PV plant are critical to maintain optimal energy production.

How to contribute to the project

We invite your organization to join an ambitious European research project dedicated to advancing the field of solar photovoltaic energy. **We are seeking companies/organizations willing to share monitoring data from their photovoltaic plants**. This data will significantly enhance our research efforts, providing additional real-world context to test our developments and innovations.

What's in it for you? What will be offered?

In return for your valuable input, we commit to sharing the results of our analysis: **you will get a soiling ratio analysis from your PV performance data**, you will get results of different methods and a comparison of them. This will offer a unique opportunity for your organization to gain in-depth insights into your own systems.

Call deadline

A first deadline for applying to the call is fixed on the **8th of October**.

Data requirements

- Description of the PV plant (electrical architecture)
- PV module datasheet
- Irradiance in the plane of array measurement
- Location of sensors if numerous
- Module temperature measurement (if not available, ambient temperature)
- DC current measurement at plant, inverter or junction box level; if not available, DC power, otherwise AC power measurement

If you do not match all the criteria, please contact us to **contact@coplasimon.eu** and we could schedule a call to check if you are eligible to join a call.

How to send the data

The data can be sent to the specific partners, detailed in the call, or to **contact@coplasimon.eu**. These data will be shared among the mentioned SerendiPV partner exclusively and will be stored on private folders of the CKAN database of the SerendiPV project.

SerendiPV Innovation on Soiling Detection

Soiling detection out of PV performance data: stochastic Quantifying Soiling Loss (SQSL)

In the literature, among others, two methods can be found to measure soiling: the Fixed Rate Precipitation (FRP) model and the Stochastic Rate and Recovery (SRR) model. The FRP model applies a fixed soiling rate to all dry periods, generating a soiling profile. It requires a performance metric and rainfall pattern as inputs but may fail to detect non-rainfall-related cleanings. On the other hand, the SRR model calculates the soiling rates between each pair of consecutive cleaning events. It generates potential soiling profiles using a Monte Carlo simulation, providing an alternative approach to soiling detection.

SerendiPV project introduces an innovative approach: the **Stochastic Quantifying Soiling Loss (SQSL) method, developed by CEA-INES** since 2022. The SQSL method offers a more sophisticated way to measure soiling. It does not require environmental data or information about artificial cleaning operations. Instead, it **calculates the soiling impact directly from the electrical data measured in solar power plants**. Unlike the SRR approach, SQSL does not look for change points or clean-only days. It considers a performance metrics profile, classifying days into cleaning days, stable periods, and soiling periods based on the performance metrics.

The SQSL method uses the Monte Carlo method to generate many random performance metrics profiles based on the probability distributions of different parameters such as frequency and duration distributions, soiling rate distributions, etc. This allows for the estimation of the most likely average soiling ratio and the uncertainty interval, providing a range of scenarios from the most pessimistic to the most optimistic according to the desired risk level.

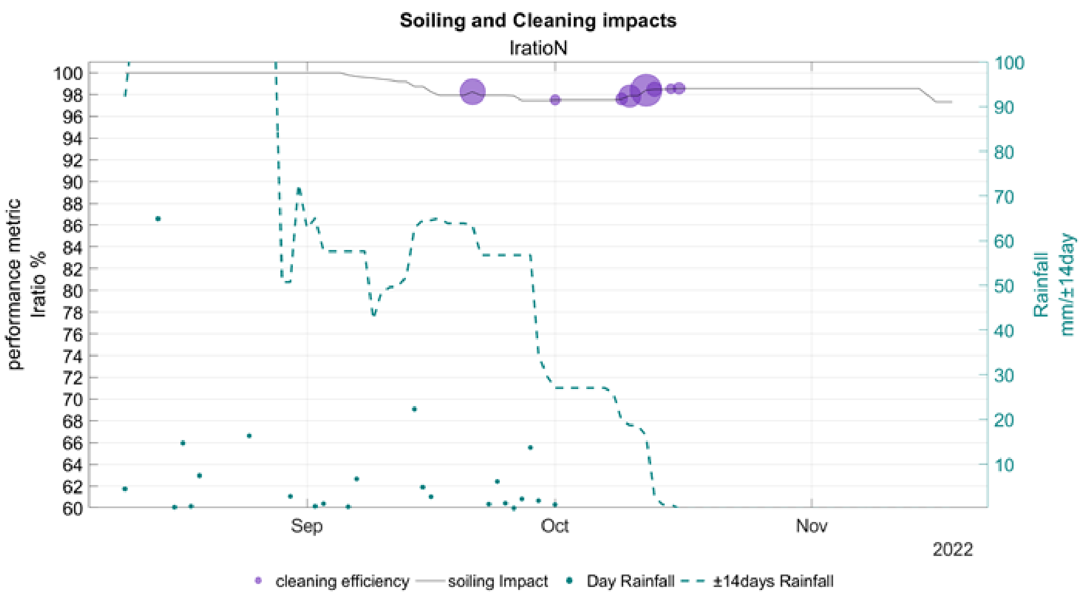

Figure 1. Soiling ratio and rainfall impact (CEA-INES)

Moreover, the SQSL method allows for the generation of future soiling profiles. This predictive capability can help identify the most cost-effective cleaning frequencies and dates in advance, contributing to more efficient maintenance planning and potentially significant cost savings.

Soiling Sensors: Soilratio & E-Dust

Soiling can cause non-homogeneous dust patterns that significantly affect the maximum power point, resulting in higher energy losses than those estimated by traditional soiling sensors. These sensors, which use optical methods or compare the short-circuit current of clean and dusted solar devices, may not accurately reflect the real effective power losses in PV modules due to their inability to account for the impact of uneven soiling distribution.

Automatic soiling sensors, while practical as they can operate without manual intervention, are currently unable to be integrated into real PV arrays. Instead, they are part of an independent static semiportable structure, which may not fully represent dust accumulation patterns, especially when compared to tracking structures. Moreover, manual dry cleaning is often more reliable than automatic wet cleaning of sensors when dust deposition is significant. Therefore, while these sensors provide valuable data, their limitations must be considered when assessing the impact of soiling on PV module performance.

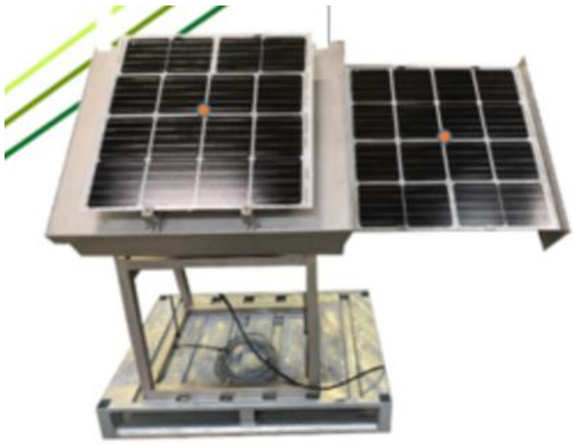

Figure 2. SolRatio (CEA-INES)

The SerendiPV consortium has considered developing soiling sensors to address the effective power affection in PV modules and tackle the challenges mentioned above.

One of innovations introduced is the **SoilRatio sensor, developed by CEA-INES**. The concept consists in protecting one of the two PV sensors with a cover between each measurement, to keep it as clean as possible. In this way, this sensor does not require any cleaning, which guarantees better accuracy and lower operating costs. The latest update of SoilRatio **integrates specific multi-zone panels, each zone being an independent sensor,** thus allowing a more precise identification of the soiling type. The post treatment algorithm collects these multi-zones measurements and extrapolates them to the whole PV plant considering the electrical architecture, in particular the bypass diodes, to calculate the real electrical impact on the whole PV installation.

Figure 3. E-Dust (QPV)

Another innovation presented in the SerendiPV project is the **E-Dust prototype, developed by QPV**. It is **based on the use of two PV modules** (clean and dusted) from the same batches, installed in the same structures and exposed to the same wind and tracking conditions as the rest of PV modules that make up the PV plant. The full I-V curve of both modules is simultaneously and periodically measured. As a **comparative measure is carried out, no specific calibration is needed**, as the system auto calibrates itself when both modules are cleaned.

More information about SerendiPV innovations on soiling can be found in the document: ***SerendiPV Innovations on Soiling Detection***

Participants partners

CEA:

Since 2022, CEA has been developing another approach termed Stochastic Quantifying Soiling Loss (SQSL), which aims to improve the soiling profile extraction. The SQSL method does not require any environmental data, except ambient temperature and plane-of-array irradiance, or any other information like for instance artificial cleaning operation. It calculates the impact of soiling directly from the electrical data measured in solar power plants by considering a performance metrics (PM) profile. The PM is a ratio between relative current (DC current / STC DC current) and relative irradiance (G/ STC G). Statistical analysis of the distribution of the PM profile over several days of operation makes it possible to estimate the most likely average soiling ratio as well as the uncertainty interval. The other strong point of the SQSL method is to allow the generation of future soiling profiles, to identify in advance the cleaning frequencies and dates that are typically more cost effective.

Service provided

CEA:

CEA offers the opportunity to analyze your data with the SQSL method and estimate the soiling ratio of your PV plant. The required information and data are the following ones:

- Description of the PV plant (electrical architecture)
- PV module reference (datasheet)
- Irradiance in the plane of array measurement
- Location of sensors if numerous
- Module temperature measurement (if not available, ambient temperature)
- DC current measurement at plant, inverter or junction box level; if not available, DC power, otherwise AC power measurement
- Dataset length: from 70 up to 100 days

The outcome will be presented in a short report.

Other partners:

Other project partners might provide results using alternative soiling detection methods in order to establish a benchmark.

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