

WHITE PAPER

COMBINED THERMOGRAPHY & SOILING DETECTION USING AUTOMIZED DRONES

by Dr.-Ing. Fabian Wolfertstetter,
PV Lead Volateq GmbH Germany



Volateq Web App: From time-consuming manual inspection to automated drone inspections

In the fast-paced realm of solar energy, the quest for maximizing efficiency and ensuring the longevity of photovoltaic (PV) systems is paramount. Traditional manual inspection methods, often labor-intensive and time-consuming, struggle to keep up with the rapid advancements and growing scale of solar installations. This white paper introduces how Volateq, a trailblazer in the solar industry, leverages the power of automated drones for a new combination of thermography and soiling detection with one and the same flight.

The Innovation of Volateq: AI-supported Web App for holistic PV inspection data in no time

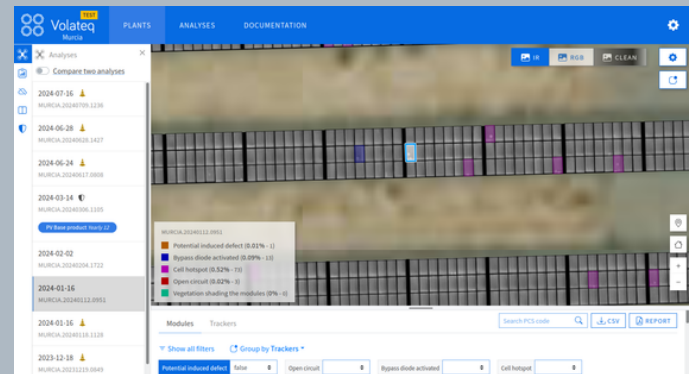
Founded in 2020 as a spin-off from the German Aerospace Center (DLR), Volateq has swiftly emerged as a leader in drone inspections for concentrated solar power (CSP) plants. The company's rapid ascent is a testament to its pioneering efforts in digitizing inspection processes and establishing drone-based inspections as the gold standard in the CSP industry. For the photovoltaic (PV) sector, it offers a cutting-edge, AI-backed Software-as-a-Service (SaaS) solution that seamlessly integrates thermography with the world's first aerial soiling detection.

It is designed to address the critical need for accurate, efficient, and comprehensive inspections of large PV fields.

Volateq's approach is compatible with most drone models and employs top-notch image analysis.

Volateq delivers the detailed insights that enable proactive maintenance and cleaning optimization.

Fig. 1:
See exactly what is happening and where in the interactive Web App: Volateq's analysis based on a digital twin of the respective solar field.



VOLATEQ'S SOLAR FIELD INSPECTION:

UP TO **75%**

COST SAVINGS

as compared to
standard thermography.

Effective optimizations of PV Plants by automation

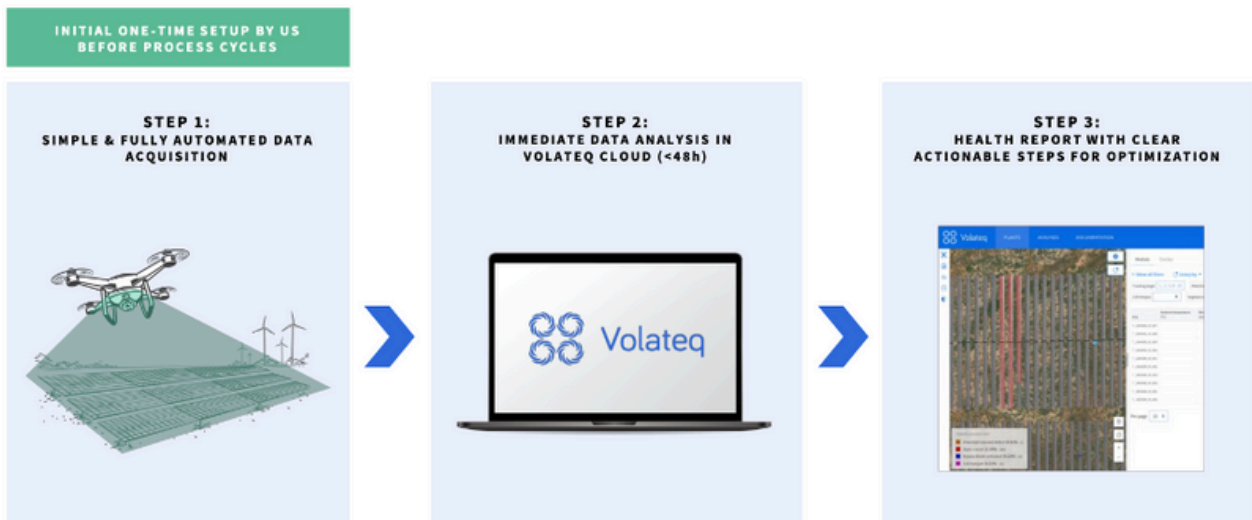
Volateq's digital solution makes the drone a simple-to-operate tool for any solar field staff. It ensures that even the most complex PV inspection tasks are handled with ease and precision.

The process begins with the automated data acquisition using off-the-shelf drones. Volateq provides preprogrammed, time-efficient flight routes directly to the drone controller. This allows staff members to collect high-quality data with minimal preparation and supervision, simply by pushing a button. With the recommended drone hardware, drones are ready to fly within minutes.

Once the data is collected, it is uploaded to the Volateq Web App, where it undergoes immediate analysis. Within 48 hours, the data is processed, and detailed evaluation results are provided in Volateq's interactive Web App. This short processing time ensures that operators can quickly address any issues, optimizing system performance and minimizing downtime.

The results provide actionable insights into the condition of the PV system, including precise measurements of soiling loss and inefficiencies such as hot-spots, bypass diode activation, offline-modules, vegetation and many more. Customized PDF reports are generated with ease in the Web App.

The third step is an evaluation of the impacts of the detected defects that facilitate a prioritization of maintenance and replacement tasks, ensuring that the PV system continues to operate at peak efficiency.



Groundbreaking World Novelty: Aerial Soiling Detection

While thermography is a known inspection standard in modern PV plants, Volateq's aerial soiling detection is a world first, developed in collaboration with the German Aerospace Center.

Soiling, which refers to the accumulation of dirt and dust on solar panels, can significantly reduce the efficiency of PV systems. Unfortunately, the degree of soiling cannot be accurately derived from performance data analysis.

Traditional methods of detecting soiling are often labor-intensive and imprecise, as they rely on visual impressions or stationary sensors that can miss localized issues.

The soiling on the small surface analysed in stationary soiling sensors can divert significantly from that accumulated on the actual module surfaces. Furthermore, inhomogeneous soiling distributions can lead to significant mismatch losses within a module or string of modules. The mismatch can be as high as 50 % of the total soiling-induced production losses. Mismatch effects are reported in our technology thanks to the information on the distribution of soiling and its coupling to a proven electro-optical performance model.

At the same time, soiling-induced energy loss is a serious issue in many regions worldwide. Studies make soiling-induced losses responsible for a reduction of global PV production by 4 - 7 %.

Volateq's algorithm allows for the precise quantification of soiling-induced optical loss on a cell level across entire solar fields. The algorithm is based on RGB images where it separates the light scattered by the dust particles from the background brightness of a PV-cell and analyses it over more than 10 images taken from different viewing angles that are covered during a passage of the drone. This rich image database makes the method less susceptible to the influence of differing dust properties (as often observed in other stationary scattering-based sensors).

To better understand the measurement principle, imagine a dirty car wind shield in the sun. You can recognize the dirt differently, depending on from where you look at it and from where the sun hits the window.



“Soiling can reduce efficiency of PV plants by up to 7 %.”

Dr.-Ing. Fabian Wolfertstetter

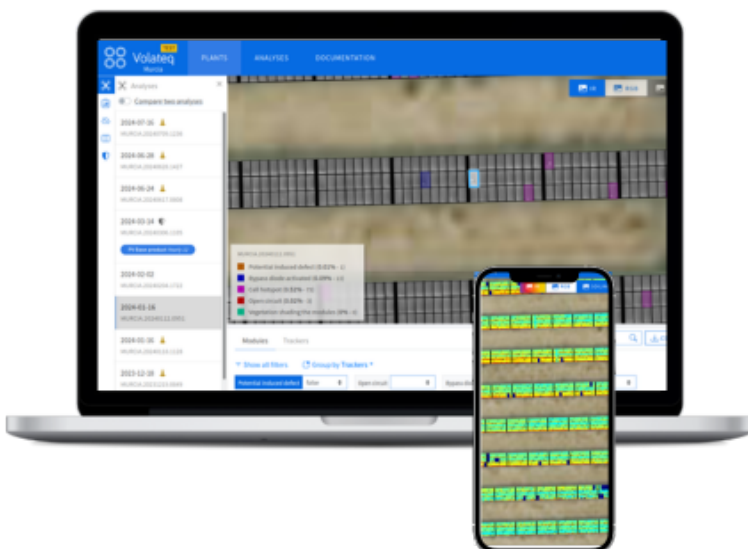


Fig. 2:
Volateq's Web App displays the desired performance indicators for thermography and/or soiling down to the single cell

Dual-functionality for maximum efficiency gains

By combining soiling and thermography detection in a single drone flight, Volateq offers a unique, efficient, and comprehensive inspection method. This dual-functionality not only improves the accuracy of thermal inspections but also saves money. The gathered data inform about effective soiling mitigation strategies, transforming soiling from an unknown variable into a quantifiable input for performance models extending the lifespan of the solar plant.

As flying the drone is made extremely easy, maximum flexibility and autonomy to PV plant operators is provided: Inspections can be done whenever needed, without the constraints of traditional methods. Operators are no longer dependent on external pilots but can fly the drones whenever necessary, using simple, intuitive controls to initiate and manage flights. Drone pilots on the other hand can offer full-service thermography and soiling analysis to end users with the Volateq Web App. ■

Comparison of different soiling measurement methods

	Stationary Soiling Sensor	String Production before and after Cleaning	Visual Inspection	VOLATEQ drone-based Inspection
Surface Area Coverage	< 100 cm ²	One string, approx. 25 – 50 m ²	Depending on staff and displacement in the field	Entire solar field
Reported Value	Optical loss	Electric loss, including mismatch	Depends strongly on staff member	Optical loss on cell level, Electric loss incl mismatch on all levels
Time for Measurement	Continuous measurement	> 1 hour for 2 technicians	Depending on tasks of that staff member	1 hour for ~10MWp. Same flight as thermography
Main Source of Uncertainty	High: Small measurement area, dust properties	High: depends on irradiance conditions, measurement devices, cleaning quality	Very high: Individual experience of field staff	Medium-low: only exotic soiling types (soot, algae, etc.) can lead to elevated uncertainty
Dust Distribution over Solar Field	Few points in a solar field, e.g. only 2 devices in a 50 MWp field	Possible to take multiple measurements, but with a high effort	Depends on other solar field technical tasks	100 % coverage of solar field

WHEN WILL YOU TAKE OFF WITH US?

We are happy to answer all your questions or provide an online demo.

For EMEA:

Volateq GmbH

Dr.-Ing. Fabian Wolfertstetter

m. [+49 157 5464 7859](tel:+4915754647859)

fabian.wolfertstetter@volateq.de



[Schedule a meeting with Fabian](#)

For North America:

Volateq GmbH

Christopher Kabat

m. [+1 858 336 9799](tel:+18583369799)

christopher.kabat@volateq.de



[Schedule a meeting with Christopher](#)

About Volateq

Volateq GmbH, founded in 2020 as a spin-off from the German Aerospace Center, has rapidly established itself as a leader in drone-based inspections for the solar industry. With a presence on four continents, Volateq has digitized the inspection process for CSP plants and is now bringing its innovative solutions to the PV sector.

The company's mission is to enhance the efficiency and sustainability of solar energy systems through cutting-edge technology and automated solutions. Volateq's commitment to innovation, quality, and customer satisfaction has positioned it as a trusted partner for solar operators worldwide.



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