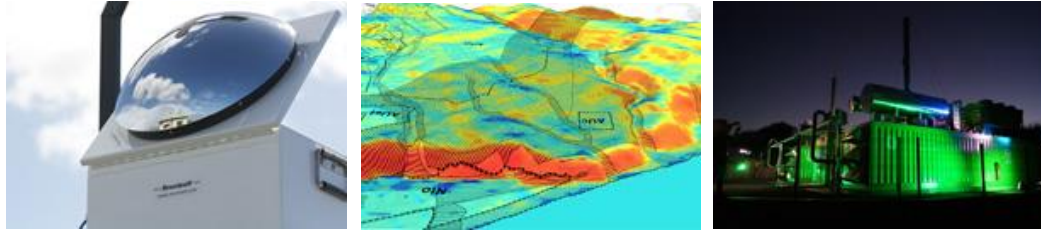


# — Reuniwatt —



## Improving PV system monitoring using big data analytics and remote sensing

Dr. Nicolas Sébastien, CTO, Reuniwatt

*PV System Performance and Reliability – Quo Vadis?*



# Reuniwatt

“ *Weather and Big data in the service of the Energy sector* ”

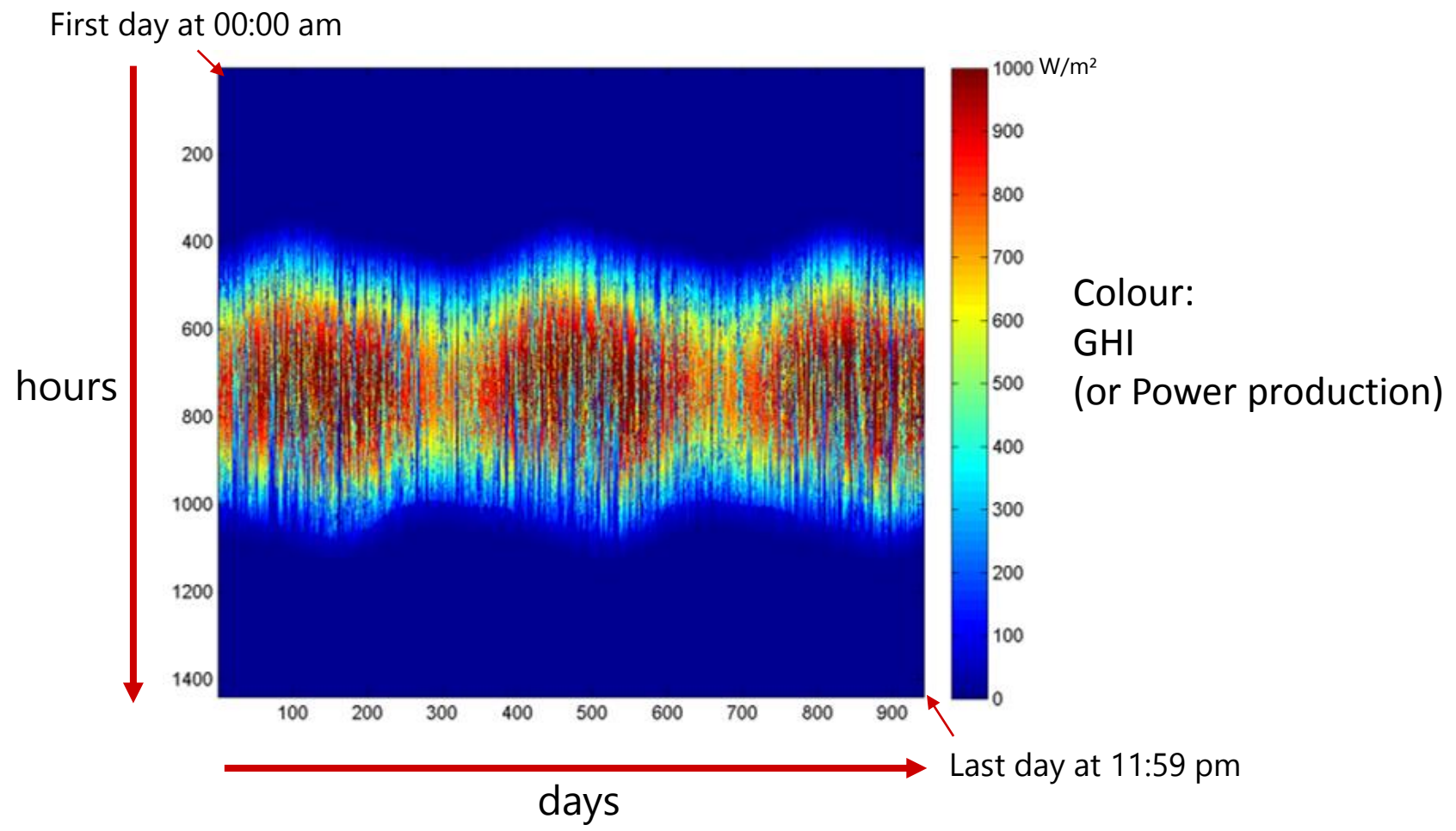
- A team of 16 engineers and doctors with complementary skills
- Services available world-wide – Offices in Paris & La Réunion
- Soleka, solar forecasting tool + solar/weather expertise services





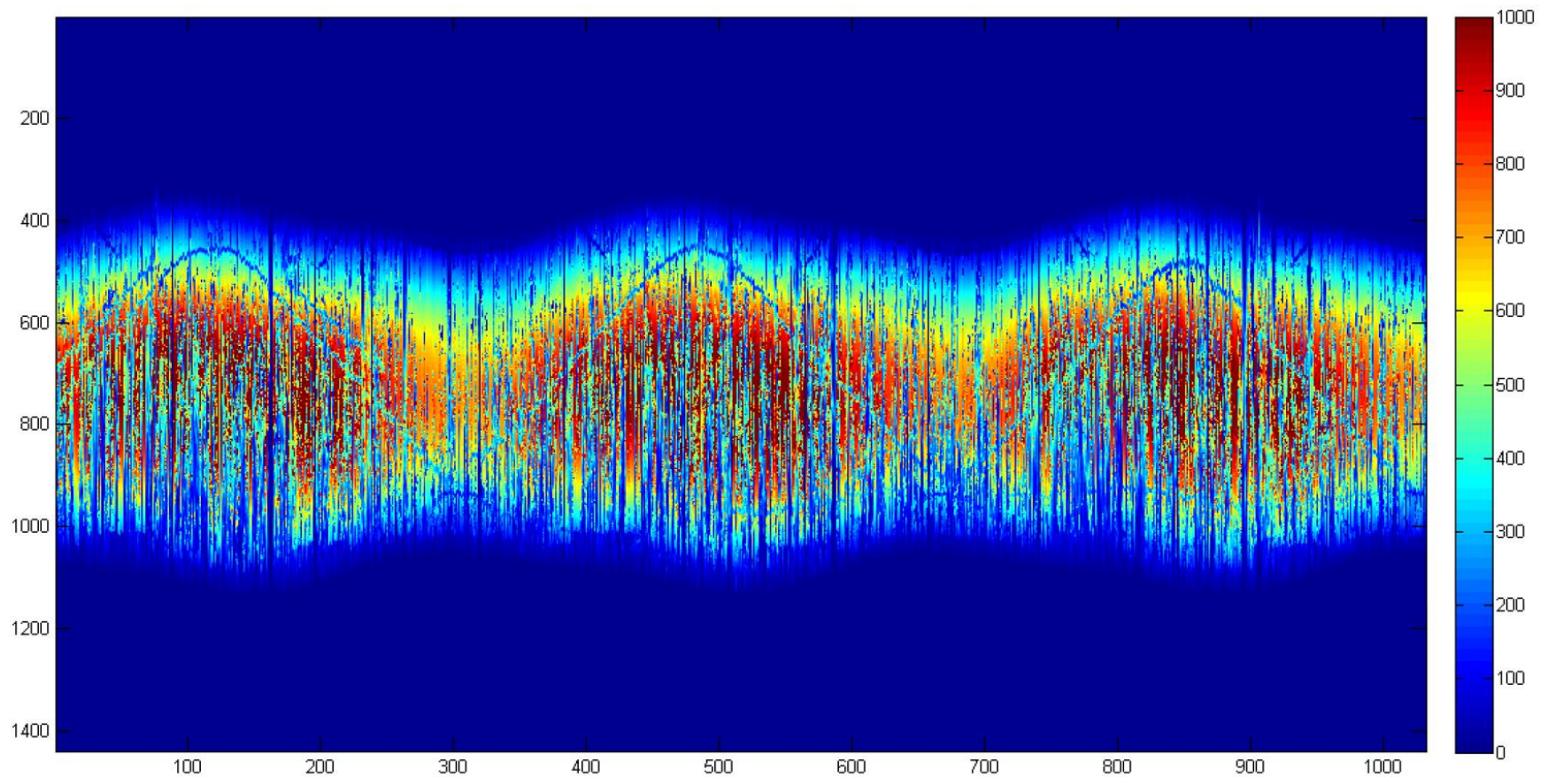
# Datamining and visualisation tools for long-term analysis of a plant's performance

# Time-series datagram



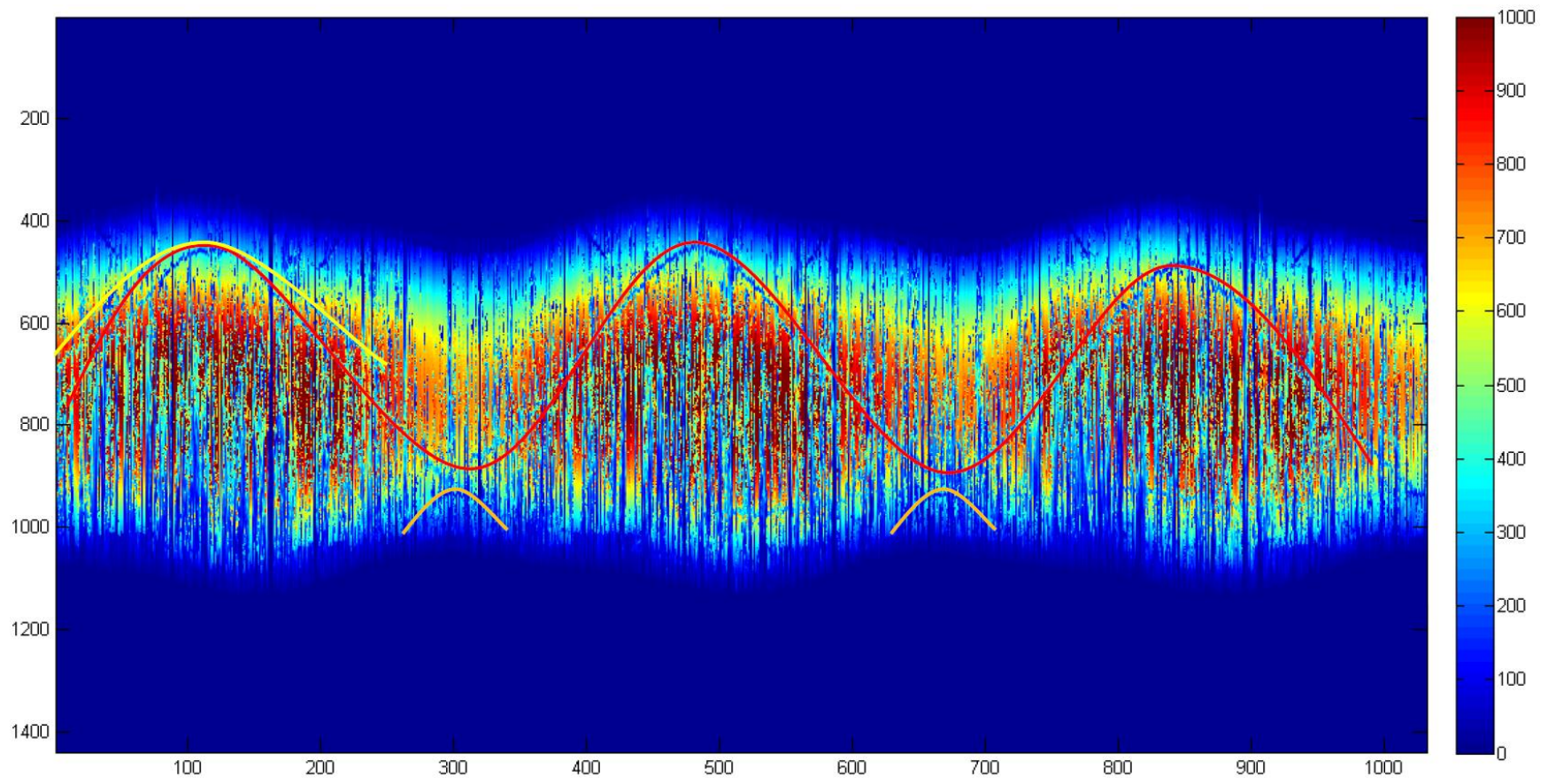


# Shadowing detection



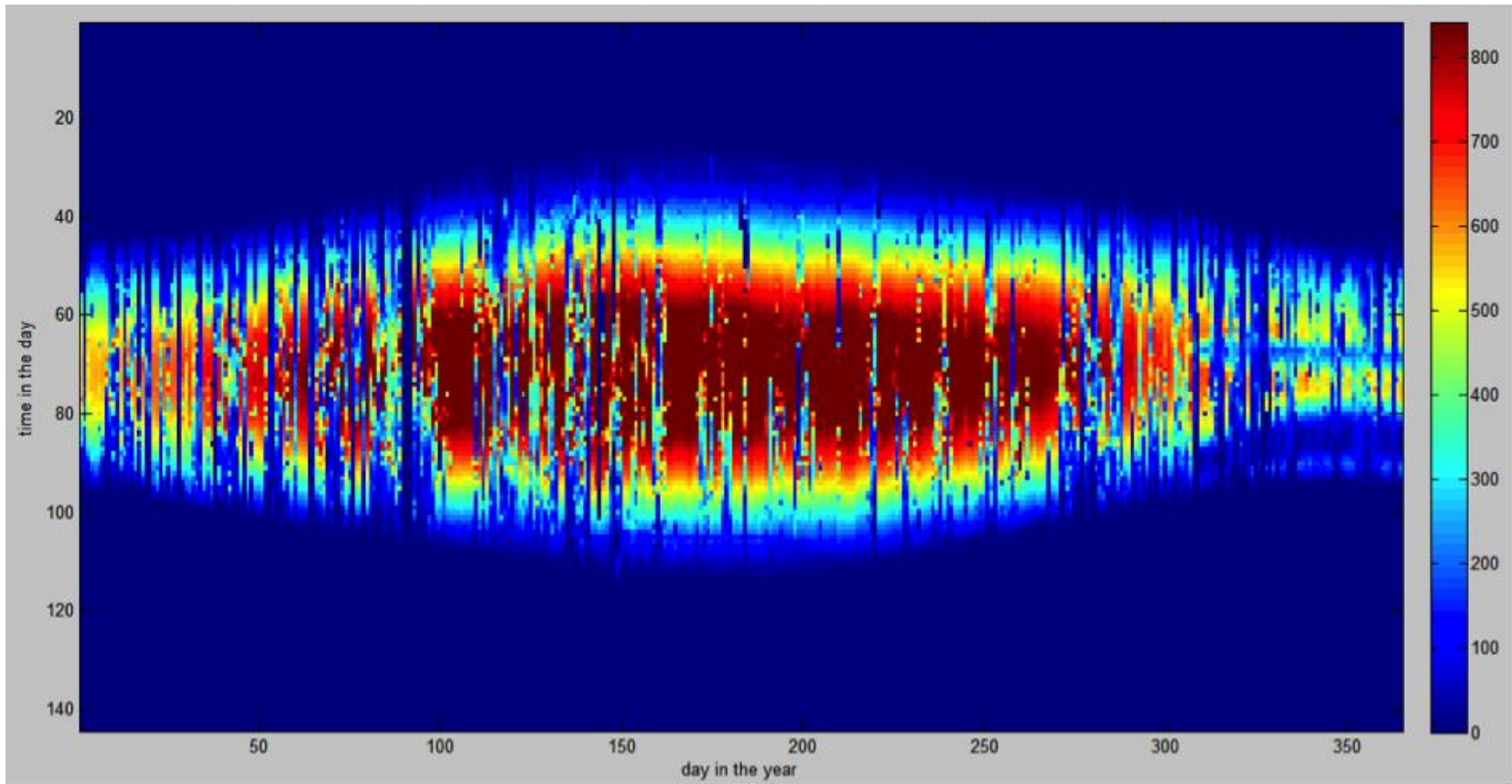
Cables detection

# Shadowing detection



Cables detection

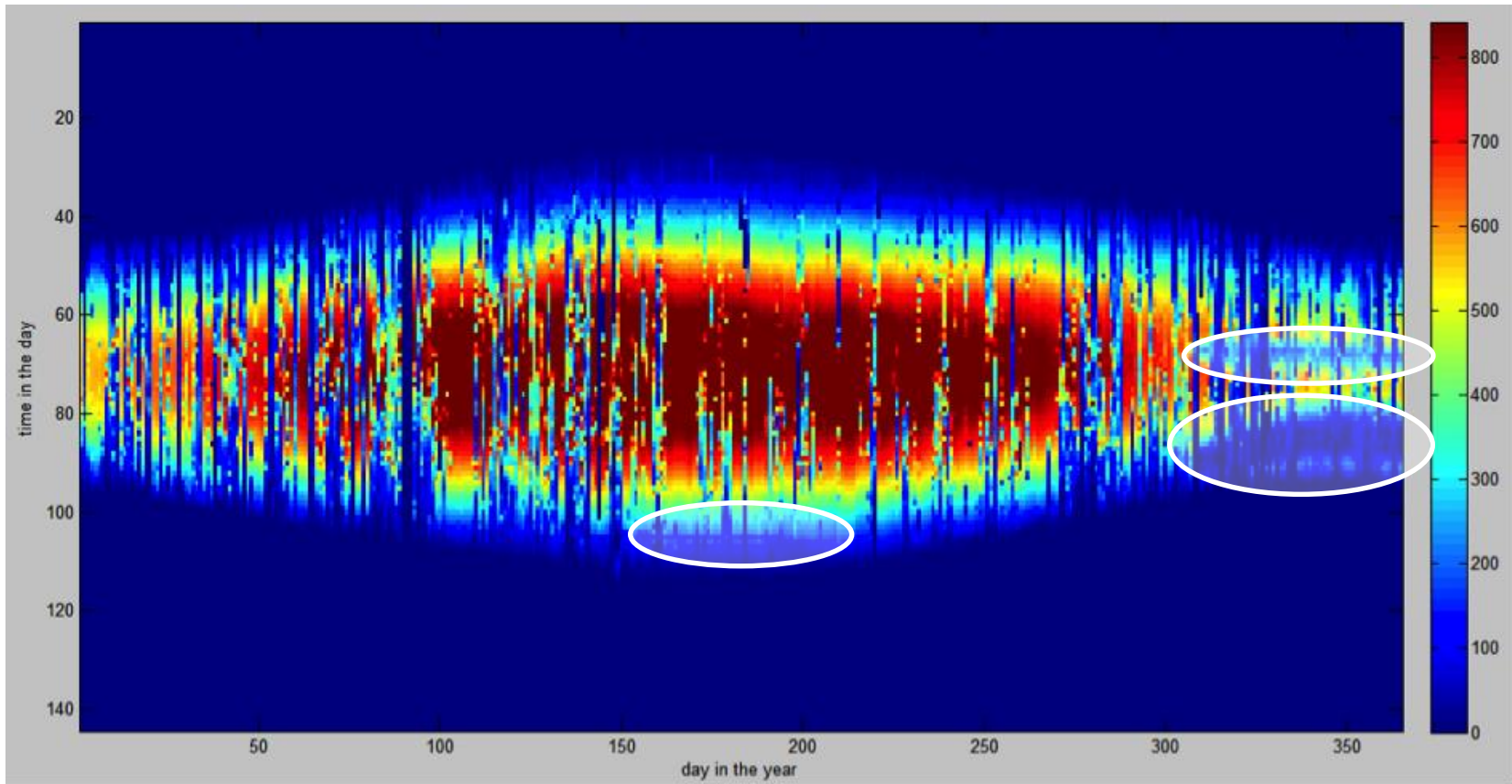
# Shadowing detection



Trees/antennas detections



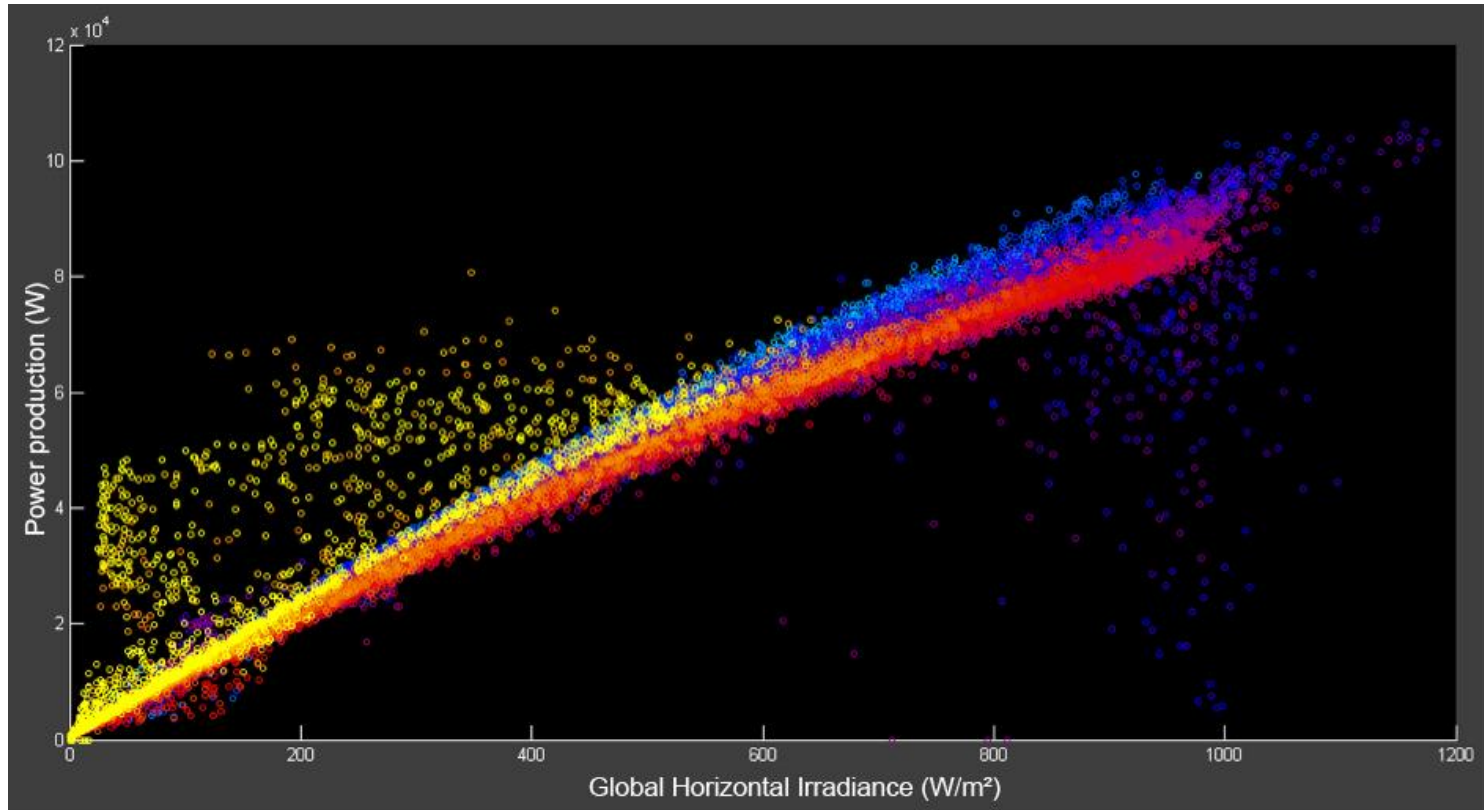
# Shadowing detection



Trees/antennas detections

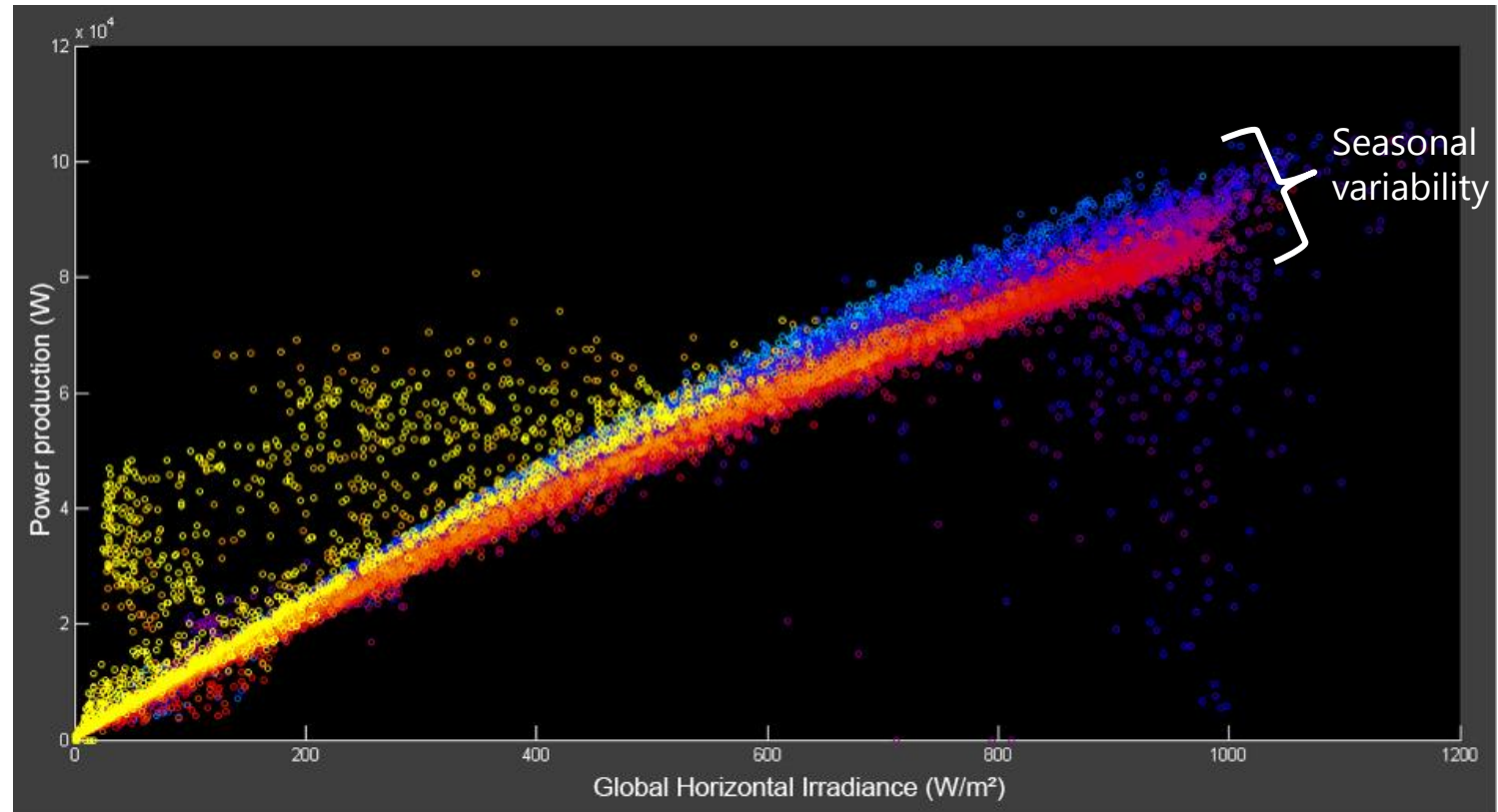


# GHI/Power prod correlation



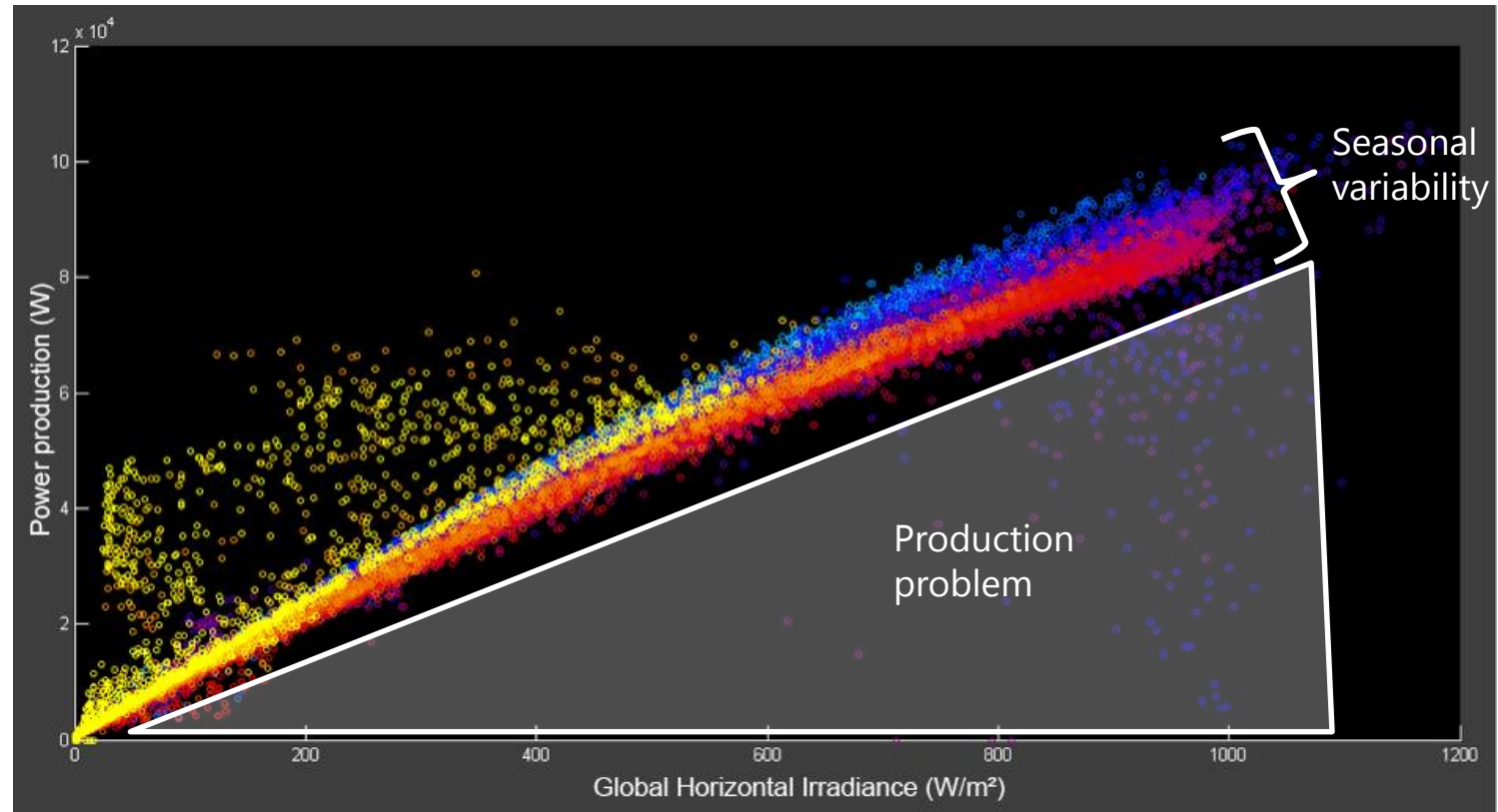
Time is color-coded: from blue (beginning of dataset) to yellow (end of dataset)

# GHI/Power prod correlation



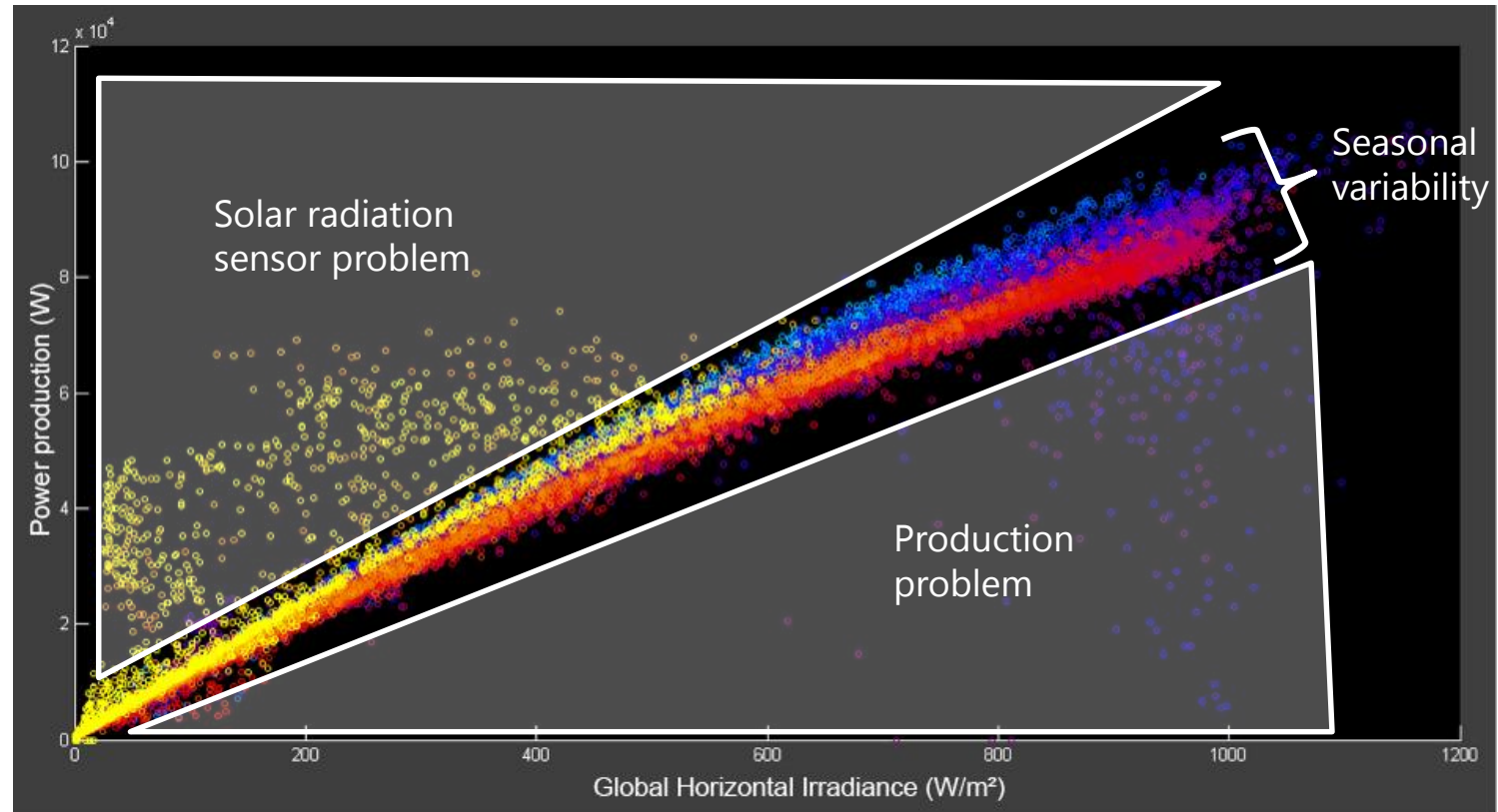
Time is color-coded: from blue (beginning of dataset) to yellow (end of dataset)

# GHI/Power prod correlation



Time is color-coded: from blue (beginning of dataset) to yellow (end of dataset)

# GHI/Power prod correlation



Time is color-coded: from blue (beginning of dataset) to yellow (end of dataset)

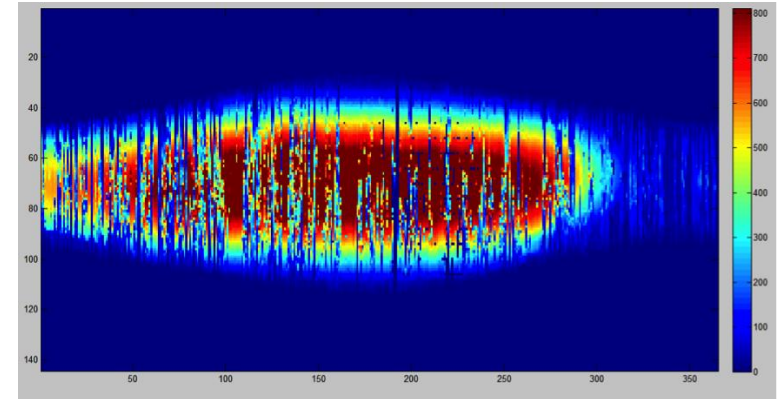




## Reliable calculation of a PV plant's performance using satellite images

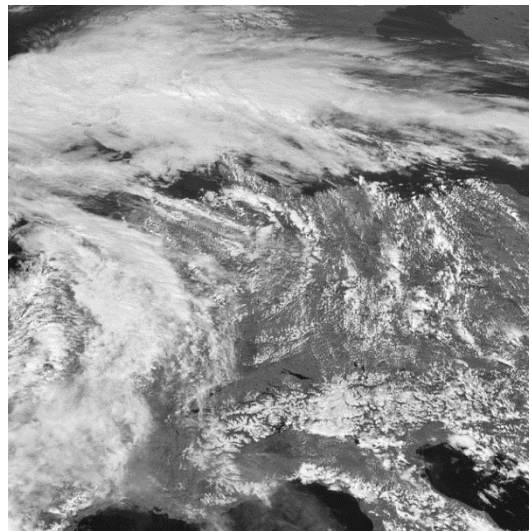
# Limits of ground sensors

- Sensor failures
- "Measurement error " caused by the sensor's environment
- Measurement drift over time (long-term)

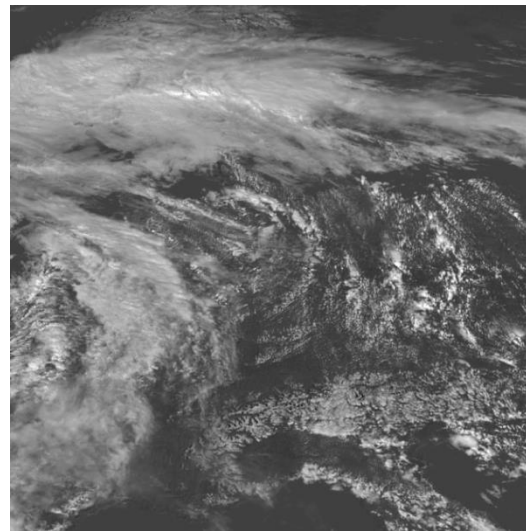


# Estimation of the solar irradiance using satellite images

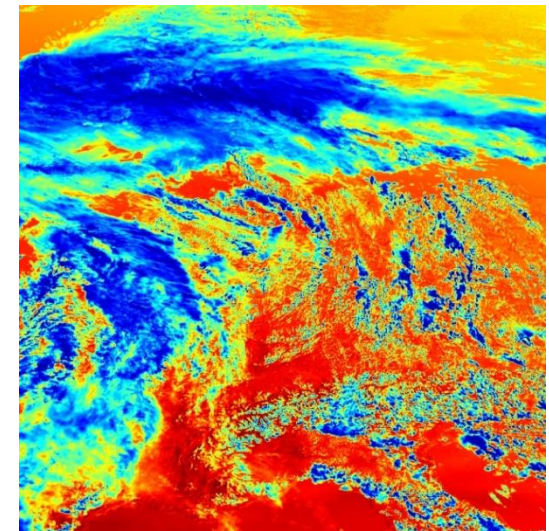
- Reuniwatt's method is based on the Heliosat-2 method, co-developed in 2004 by CSO Dr. Sylvain Cros



**Meteosat-10 raw image**



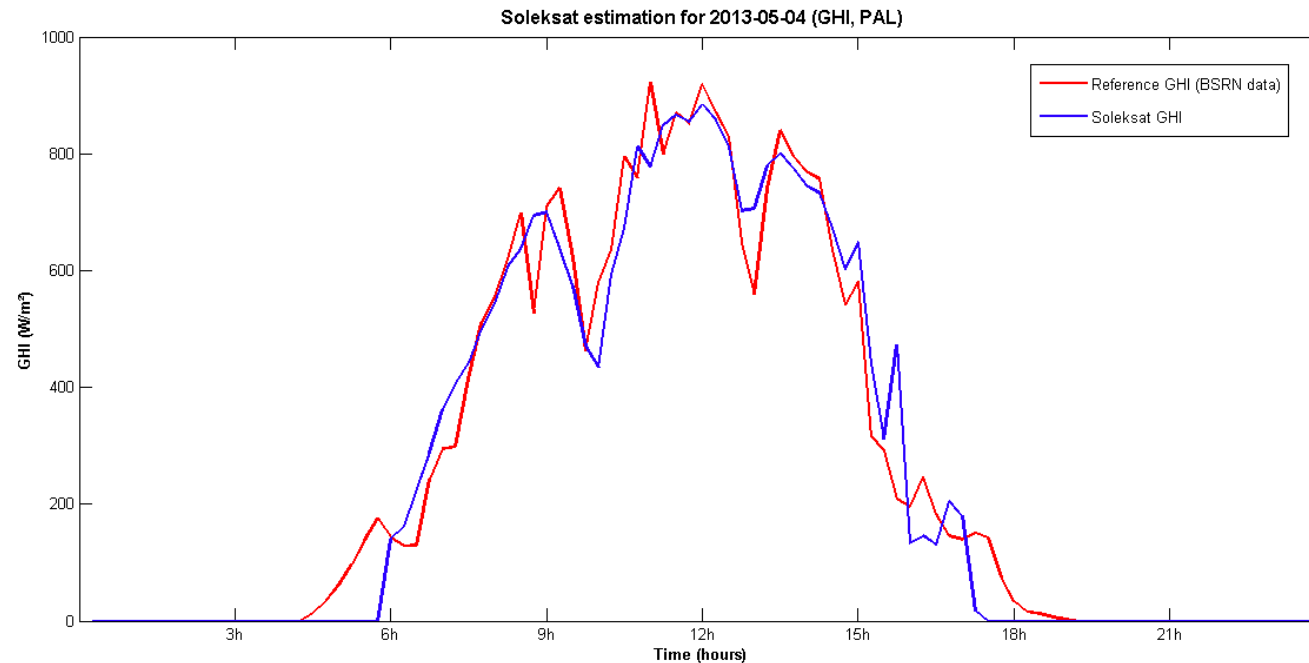
**Cloud index:** comparison between actual and clear sky for each pixel



**GHI:** global horizontal irradiation at ground level

*Mines Paristech, Oldenburg University  
Rigollier et al. (2004), Cros et al., (2004)*

# Performance of solar assessment using satellite images

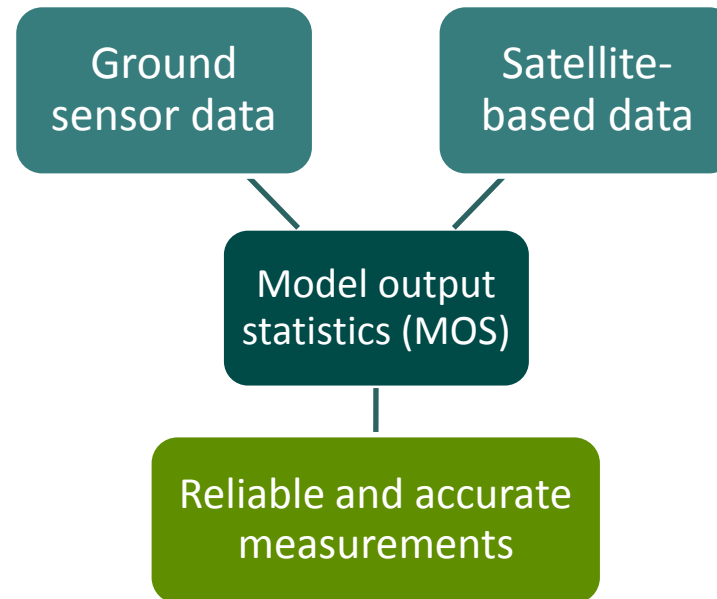


- Estimation error: 19% NMAE
- Great stability (no deviation), great availability (10+ years history)



# Towards an optimal PV performance monitoring system

- Hybridization method:



- Combines satellite's stability and sensor's accuracy
- Performance ratio only depends on plant's reliability, no more on sensor's reliability
- Enables to monitor on-site weather stations and to detect failures

# Conclusions

- Analysing **huge datasets** permits to identify **drifts over time**, which are hardly noticeable on daily monitoring analysis.
- Drops of the plant's performance ratio might appear, as well as **drifts from the irradiance sensors**.
- To avoid such issues, a method based on **hybridization of satellite and ground-measurement data** is recommended.

# — Reuniwatt —

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Thank you for your attention.