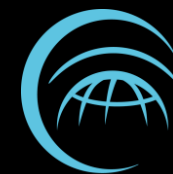


CAMS Radiation Service use cases for solar energy and beyond

Etienne Wey
TRANSVALOR S.A.

InDust: Development of dust climate services for solar energy –
May 11, 2021

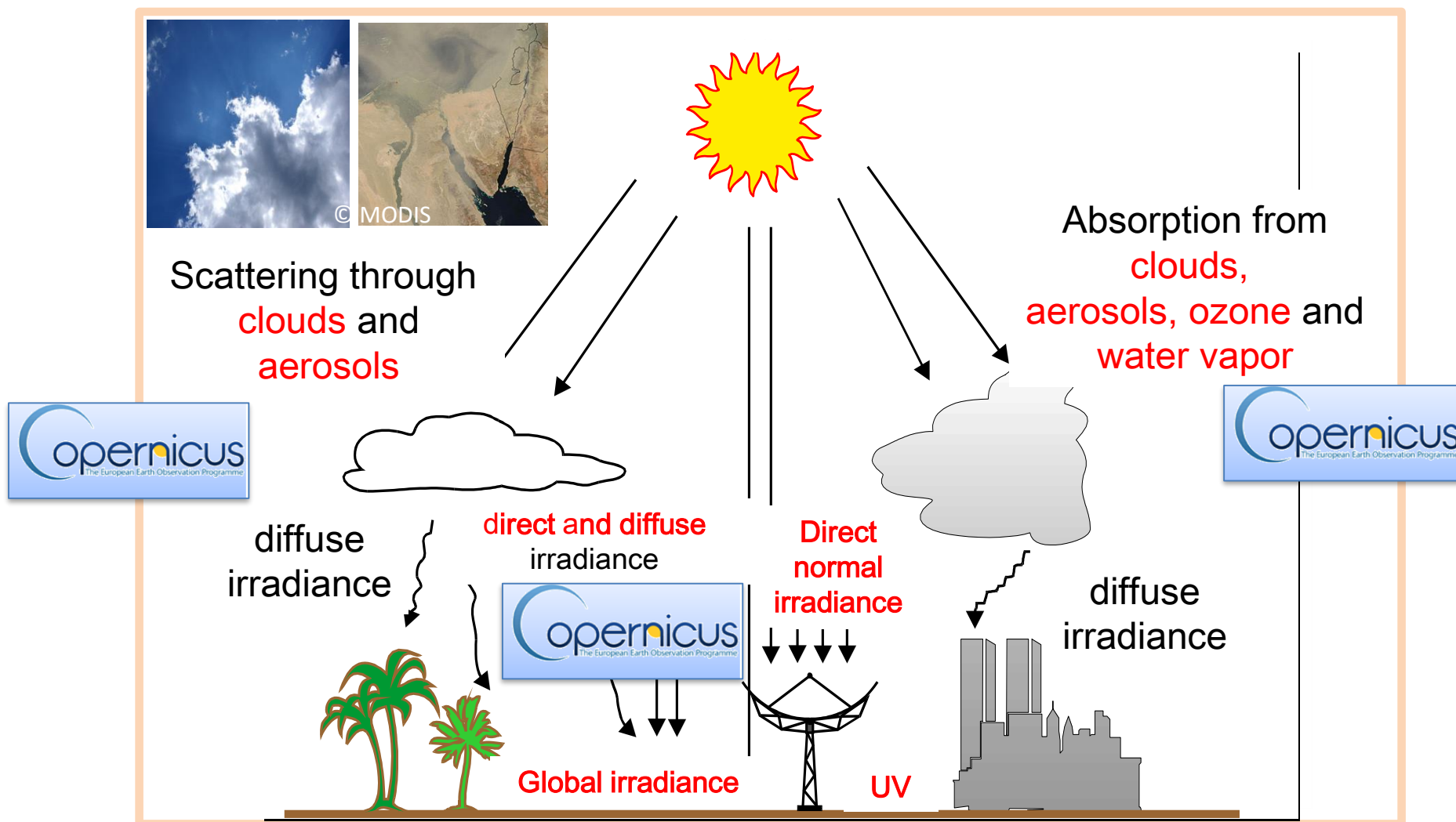


Outline

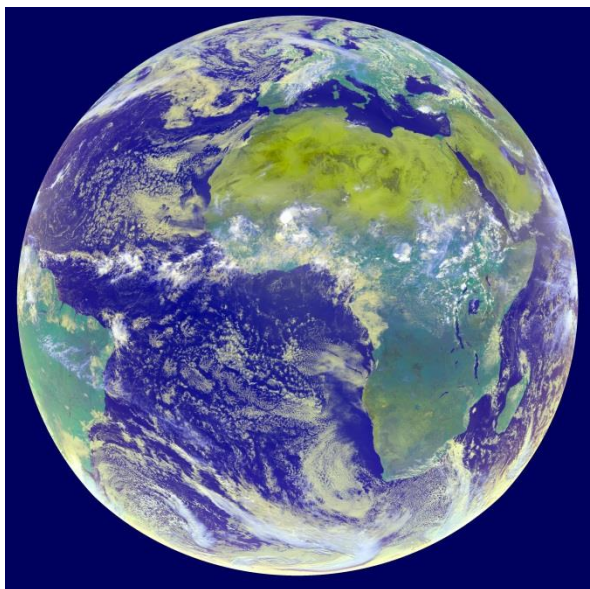
- CAMS Solar Radiation Services description
- Generic use cases for solar energy
- CAMS downstream solar radiation for Solar Cadasters
- R&D example of CAMS based PV power forecast for up to D+6
- CAMS downstream solar radiation forecast for D and D+1
- Solar radiation use case beyond solar energy



The CAMS McClear and CAMS Radiation services



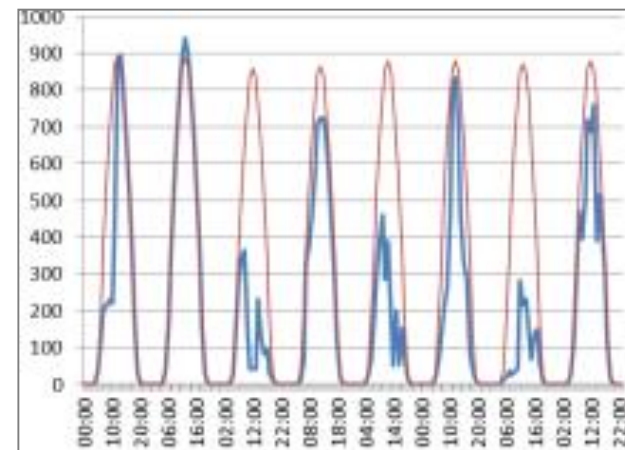
Satellite imagery & numerical model output



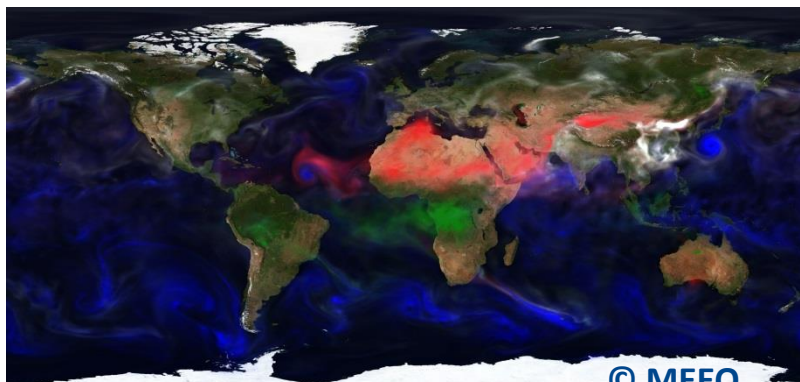
© EUMETSAT/DLR

clouds
from
satellite

Heliosat-4
and McClear
physical
approaches,
fast radiative
transfer



irradiance,
cloud free irradiance



© MEE0

aerosol
H2O, O3
from model

method paper
Qu et al., MetZet, 2017
Lefèvre et al., AMT, 2013

Users request time series at their location of interest

Implemented by ECMWF as part of The Copernicus Programme
Atmosphere
Monitoring Service

Search...

CAMS Radiation Service

« Back to SoDa
« Go to CAMS McClear

Copernicus Atmosphere Monitoring Service (CAMS) radiation service provides time series of Global, Direct, and Diffuse Irradiations on horizontal surface, and Direct Irradiation on normal plane (DNI) for the actual weather conditions as well as for clear-sky conditions. The geographical coverage is the field-of-view of the Meteosat satellite, roughly speaking Europe, Africa, Atlantic Ocean, Middle East (46° to 66° in both latitudes and longitudes). Time coverage is 2004-02-01 up to 2 days ago. Data are available with a time step ranging from 1 min to 1 month. [Licence terms](#)

The CAMS Radiation Service is limited to 100 requests per day. As the time of on-the-fly computations is quite high, this limitation prevents our servers from overload, which would endanger the SoDa Service as a whole. Please be aware that any abuse will automatically result in the deactivation of your SoDa account credentials.

Current version is 3.3.

to download a volume of CAMS radiation and CAMS McClear over Europe or Africa

More information >

CAMS Radiation Service

Search Address: Type an address

Coordinates: 1772.1, 28.1, 21.84478, 101.8, 0.05648, 100m, 0

Latitude (in 100°, 00°): Select point in map

Longitude (in 100°, 00°): Select point in map

Altitude (in meters): Automatic

Start Date from: 2004-02-01

End Date up to: 2004-02-29

Time Step: 15 min

Time Reference: Universal Time

Include detailed info on atmosphere (1 min UTC, 000): ☐

Output Format: Common Separated Value (CSV)

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European Commission

Copernicus
Europe's eyes on Earth

IMPLEMENTED BY
ECMWF

- **start in 2004**
- **Available up to D-2**
- **global, diffuse, direct and direct normal irradiation**
- **time series**
- **1 min, 15 min, 1 hour, 1 day, 1 month temporal resolution**
- **interactive and OGC script access possible**

Access via <http://www.soda-pro.com/web-services/radiation/cams-radiation-service>

And via the Copernicus Atmosphere Data Store <https://atmosphere.copernicus.eu/data>



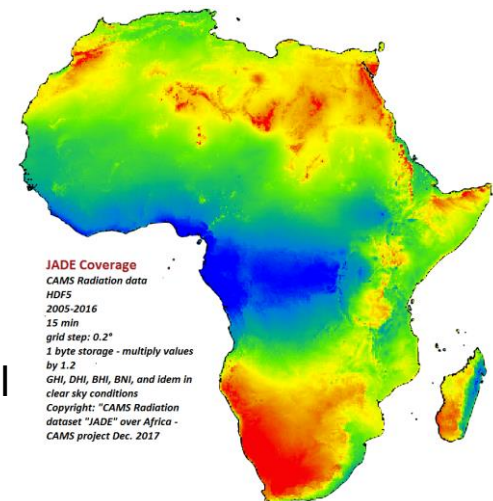
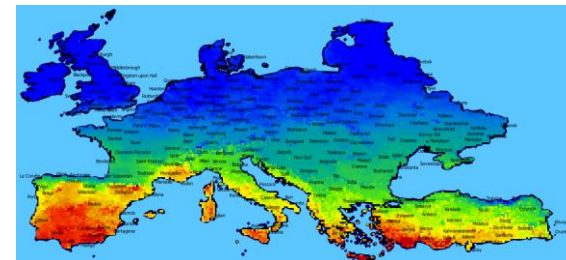
Generic use cases for solar energy

- CAMS Radiation users in 2020:
 - ~400 active users from 50 countries for 220,000 requests done
 - Over 30 documented downloads of the CAMS Europe or Africa datasets (<http://www.soda-pro.com/about-us/testimonies>) for multiple uses
- Main use of CAMS in 2020 is via the HelioClim-3v5 downstream service provided by Transvalor with the SoDa portal:
 - More than 6 Millions requests to HelioClim-3v5 which is based on CAMS McClear – growing sharply
 - Identified users from 49 countries – 98% of requests from companies
- Used for bankable reports by many companies and production monitoring (QOS Energy, S4E, MyLight, EDF, Enercast, LRC Servizi)

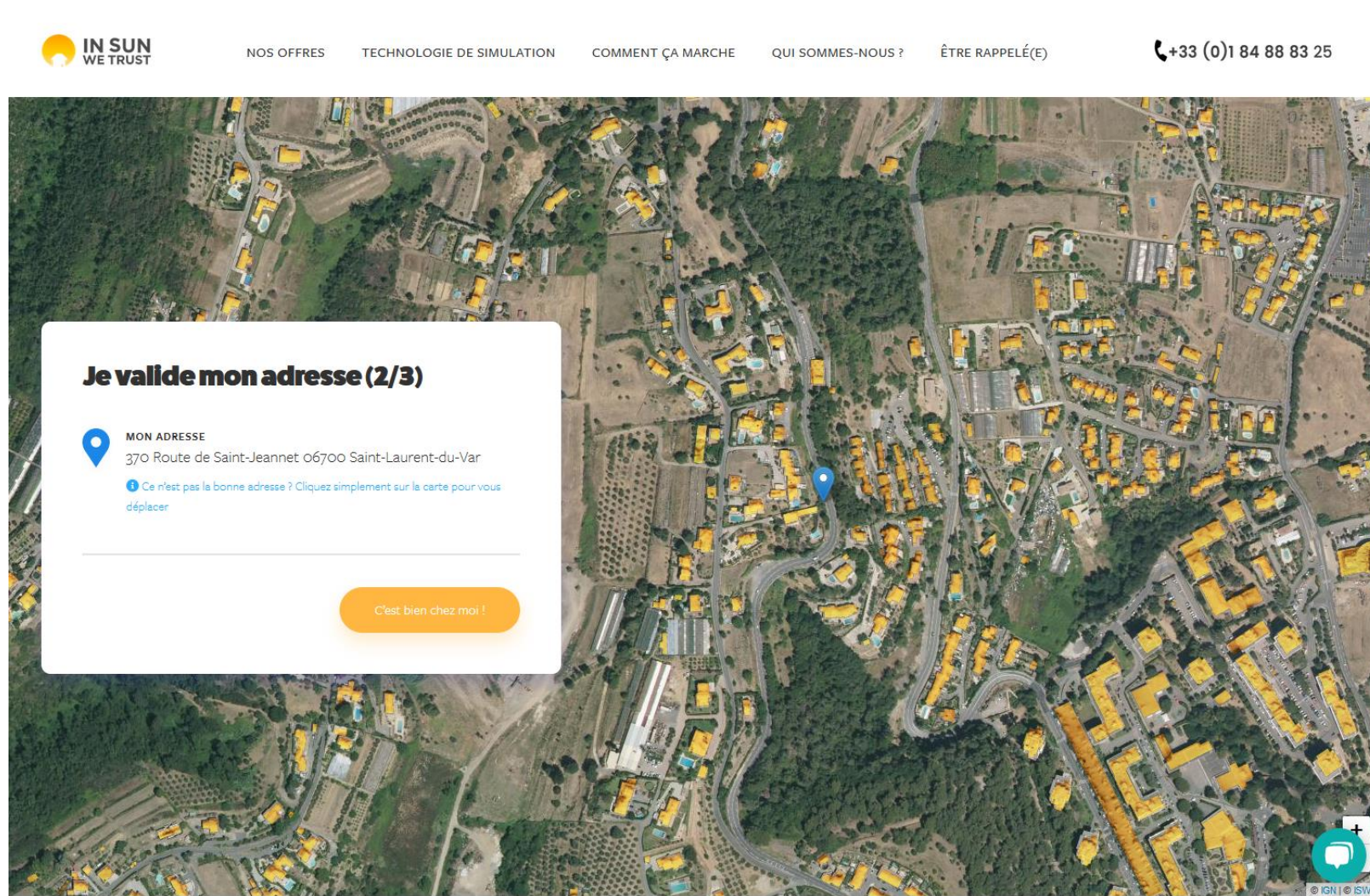


Generic use cases for solar energy

- **Some CAMS Europe and Africa datasets recent use cases :**
 - Energy transition in **Africa** with renewable **micro grids** for rural electrification
 - **Calibrate NWP** outcomes for the purpose of **solar** power production **forecasting**
 - Solar-mediated **disinfection** of **waters** in **Africa**
 - Analysis of the **impacts** of surface **solar radiation** on **leaf turnover** for **tropical tree** species
 - **Water pumping** with solar energy in **Africa**
 - Modeling of **solar** powered **cooking**
 - Model past water demand based on past solar irradiance
 - **Agroforestry** applications
 - Analysis of **optimal times** to perform **aerial thermal PV scans** throughout a typical year in Europe
 - Statistical analysis to **improve farm yields** in **Eastern Africa**
 - Investigating the **potential of urban solar farms** using EO and GIS



CAMS downstream solar radiation for Solar Cadasters



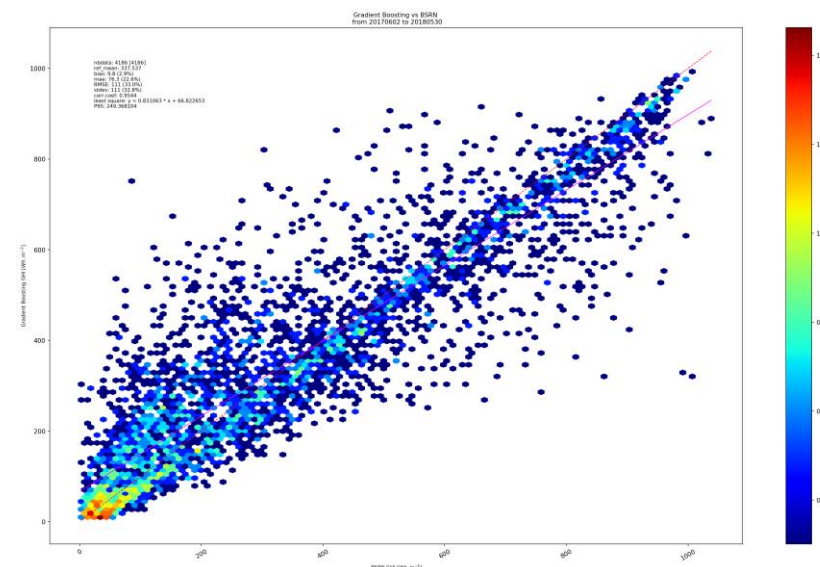
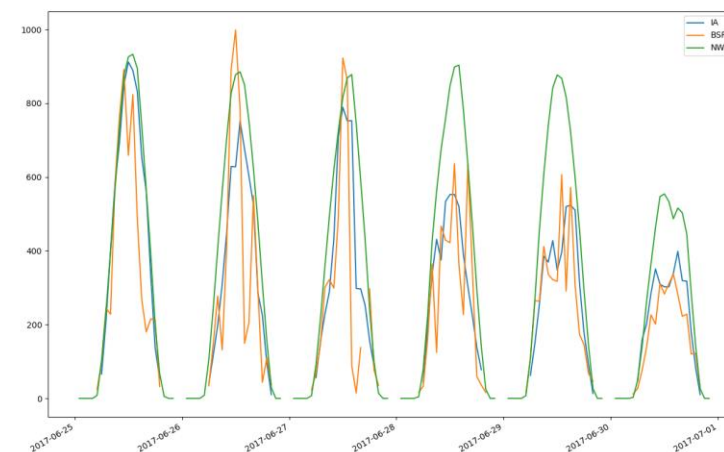
CAMS downstream solar radiation forecast for D and D+1

- **Recent Transvalor customers request:**

- Selling day ahead PV production to an aggregator at “market” price
- Need to know the irradiation at an hourly time step
- Questions about the feasibility and quality of the forecast

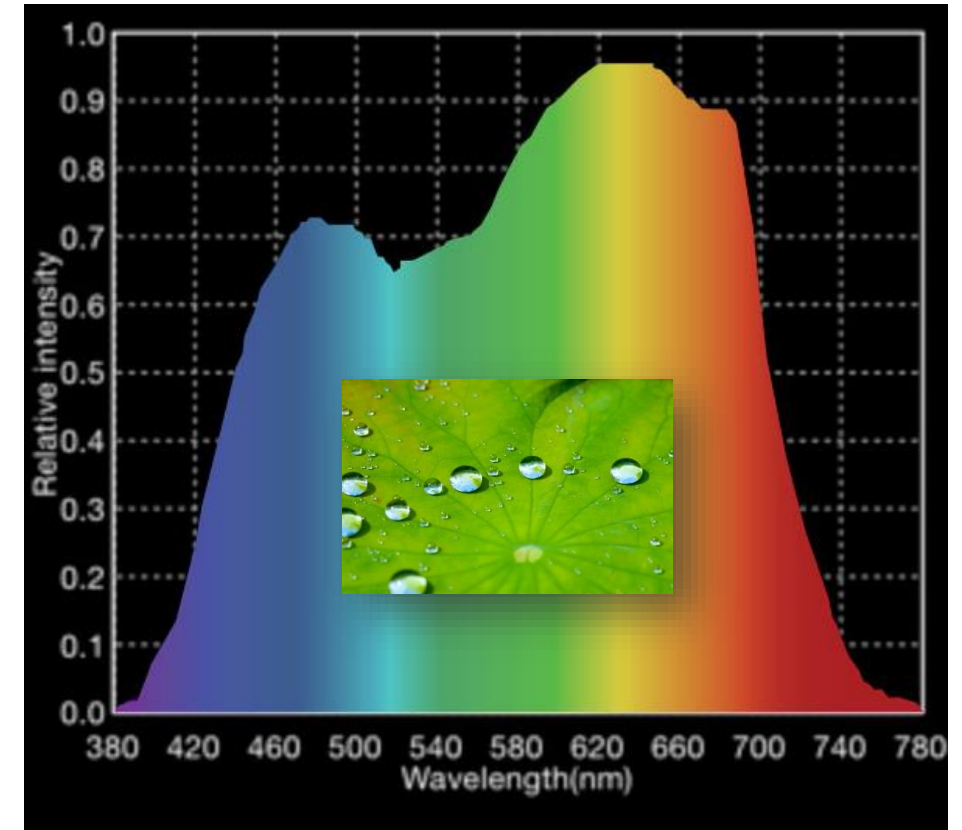
- **Answer:**

- Several IA machine learning methods tested and trained with a HelioClim-3v5 (based on CAMS McClear) historical dataset and a Numerical Weather Program hindcast historical dataset
- Tested against all covered BSRN station high quality irradiation measurements at hourly time step for a full year
- Best results with Gradient Boosting, deep learning LSTM is being tested
- The HelioClim-3v5 bias is maintained and the RMSE is only slightly degraded
- Test ongoing for several customer sites; commercial service is now available



CAMS solar radiation: beyond solar energy

- Light is one of the most important factors that trigger a response in plants, and specifically the portion of the solar spectrum responsible for **photosynthesis processes**, in the range **400 – 700 nm**



PAR = Photosynthetically Active Radiation

CAMS solar radiation: beyond solar energy



www.soda-pro.com

- Approx. 5000 emails every year about accessing solar radiation data and related products.

- Among these requests:



CAMS solar radiation: beyond solar energy

- A solution to control the ripening is:



Need perfect knowledge of PAR, in the past and in real time



A new spectral resolved radiation service is now available on the SoDa web site



Conclusion

The CAMS Radiation Service and downstream services provide solar irradiation

- At the point of interest or as spatio-temporal datasets
- As time series in the requested temporal resolution
- Either interactively in a web browser or automatically via an API
- Traceable data generation, open information on quality control

Usage includes

- Standard questions like optimum location, costs, and investment security
- Standard questions like security of electricity supply in grid operations or solar plant monitoring
- But also detailed questions on storage planning, ground observation selection, engineering details, high resolution solar cadasters for urban solar energy production,...
- New usages with the spectrally resolved irradiation for agriculture or health and the day ahead forecasting for decision making in electricity trading

