CAMS Radiation Service use cases for solar energy and beyond

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TRANSVALOR S.A.

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

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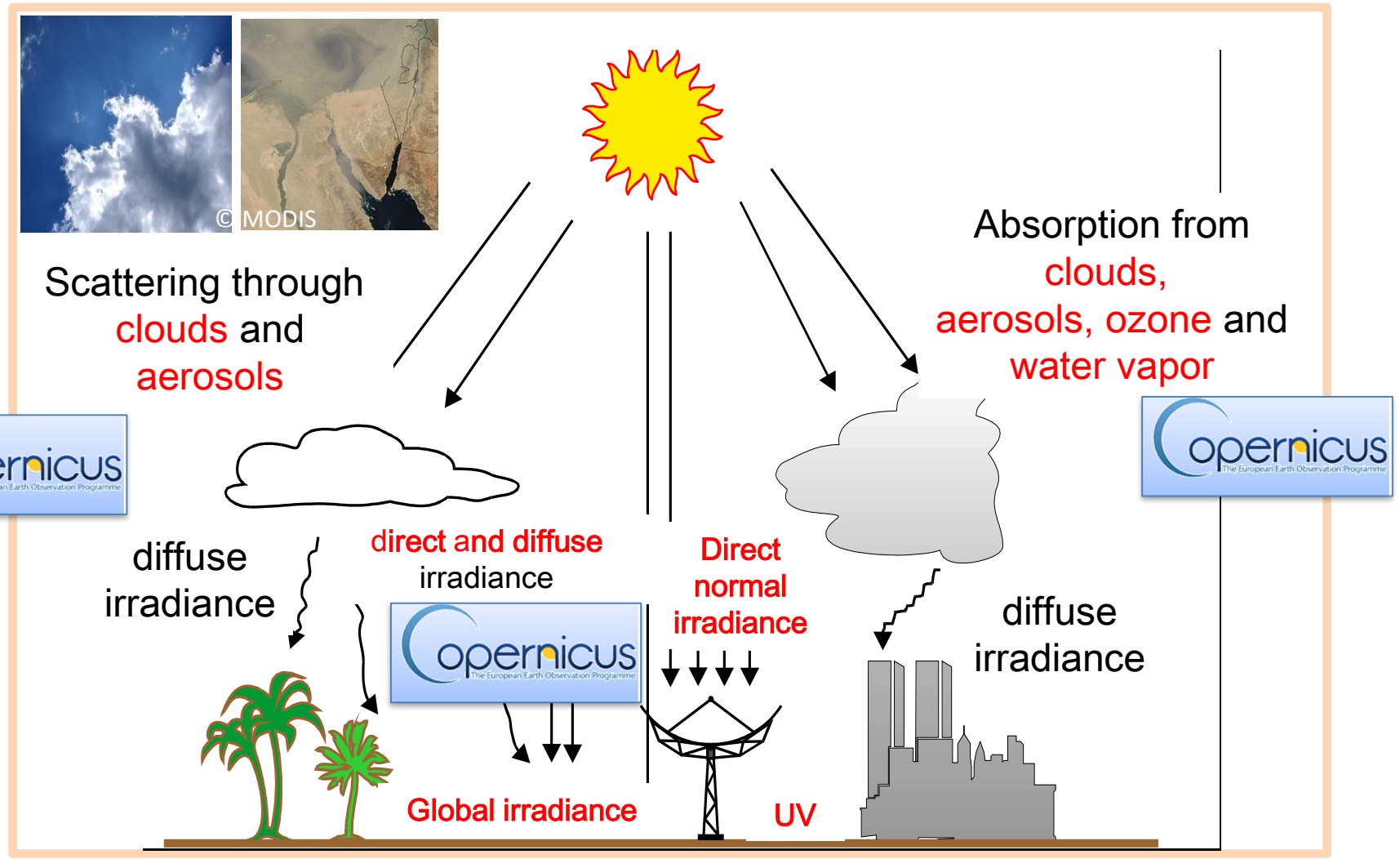
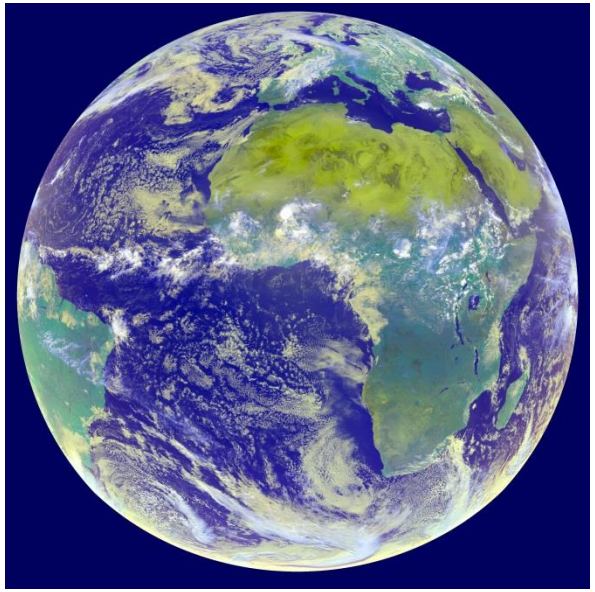
Outline

- 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



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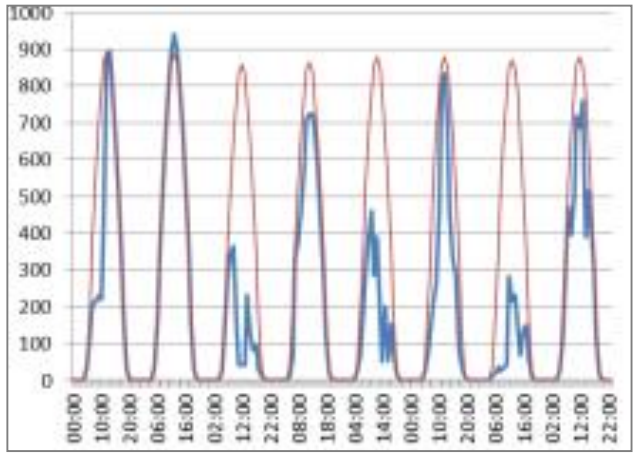
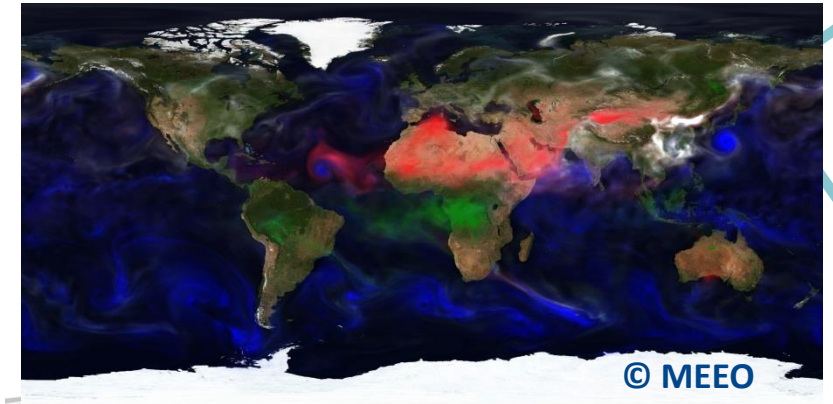
clouds from satellite

Heliosat-4 and McClear physical approaches, fast radiative transfer



irradiance,

cloud free irradiance



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aerosol
H2O, O3
from model

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

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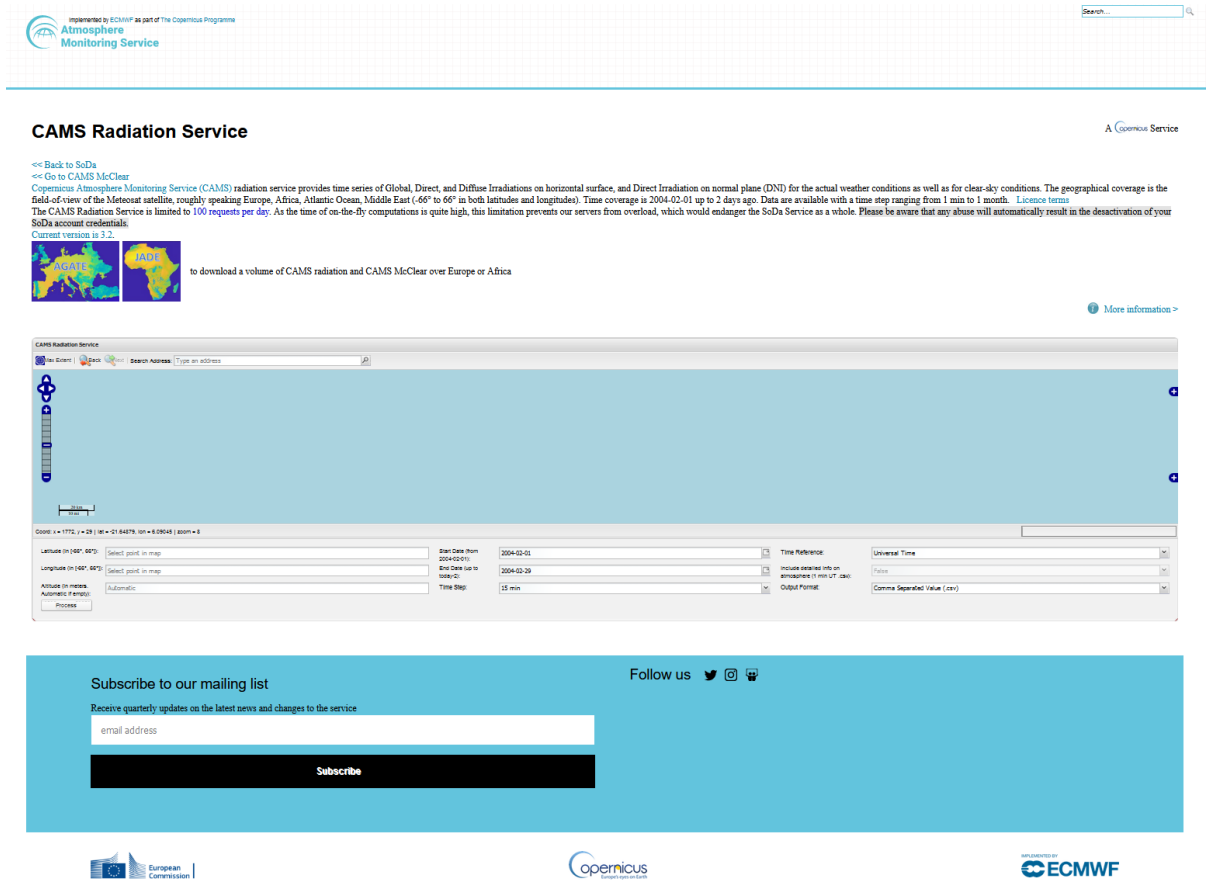
Users request time series at their location of interest



- **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

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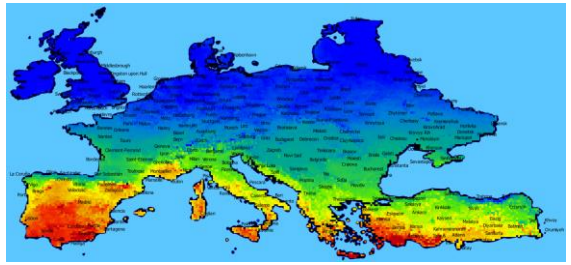
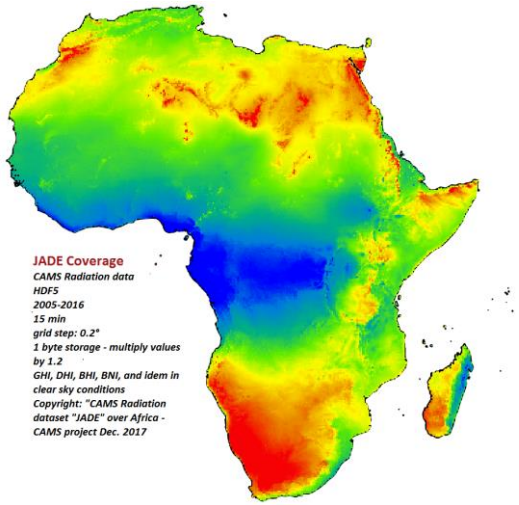
Generic use cases for solar energy

- 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)

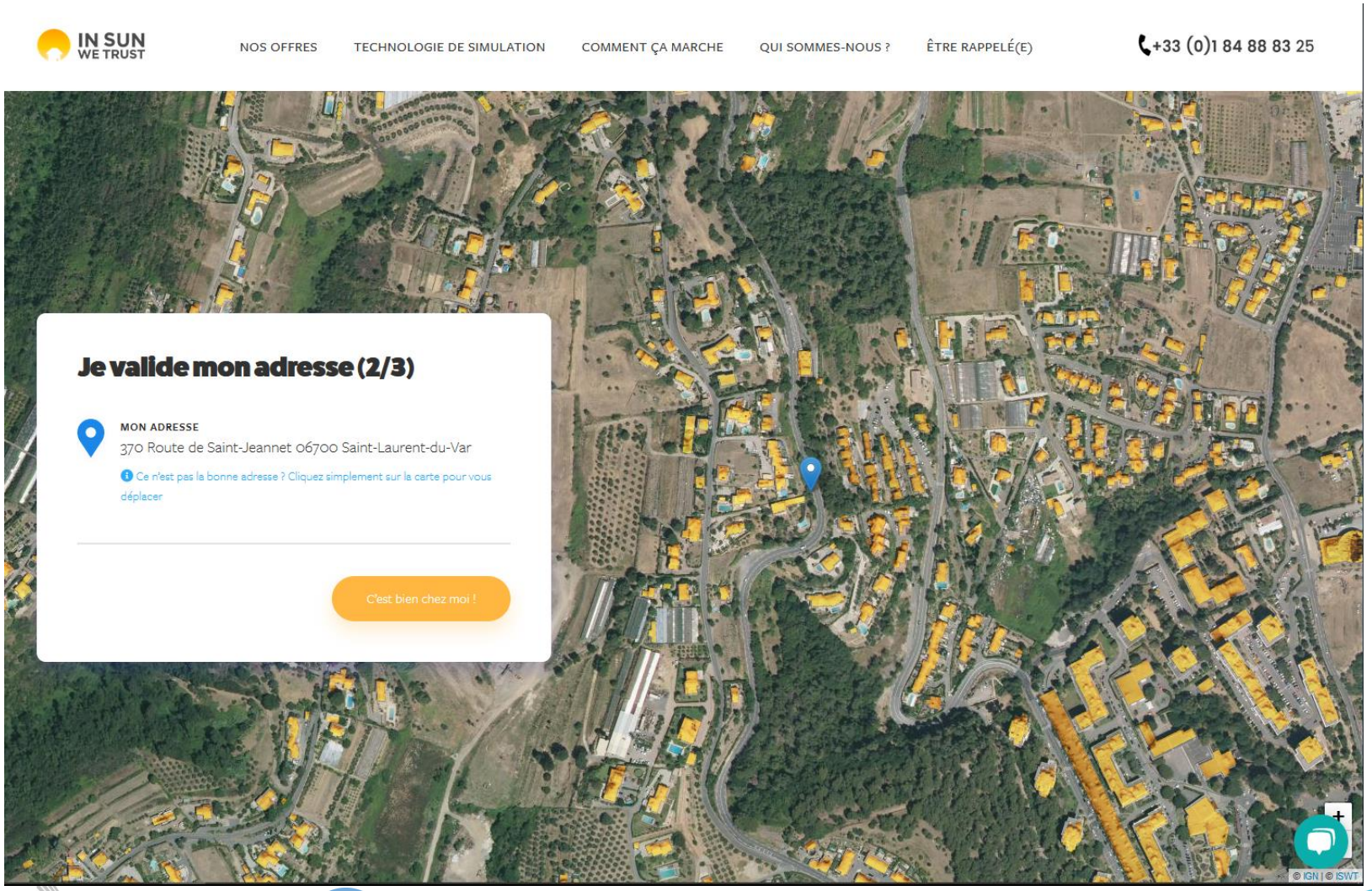
Generic use cases for solar energy

- **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



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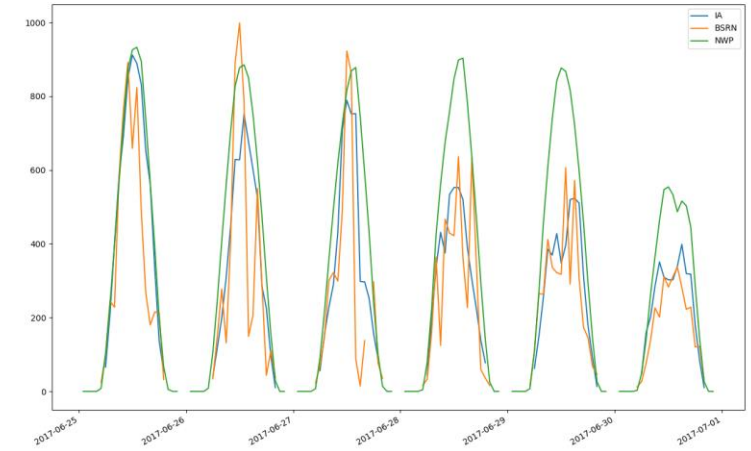
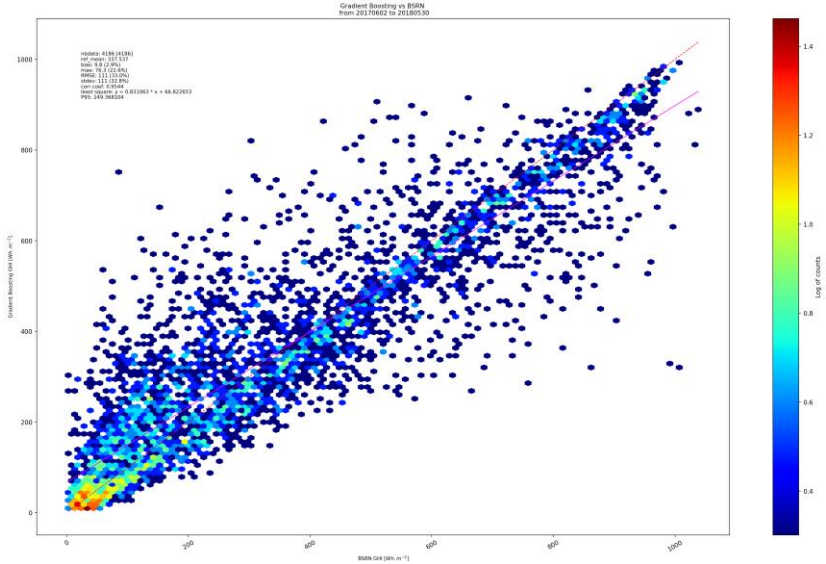
CAMS downstream solar radiation forecast for D and D+1

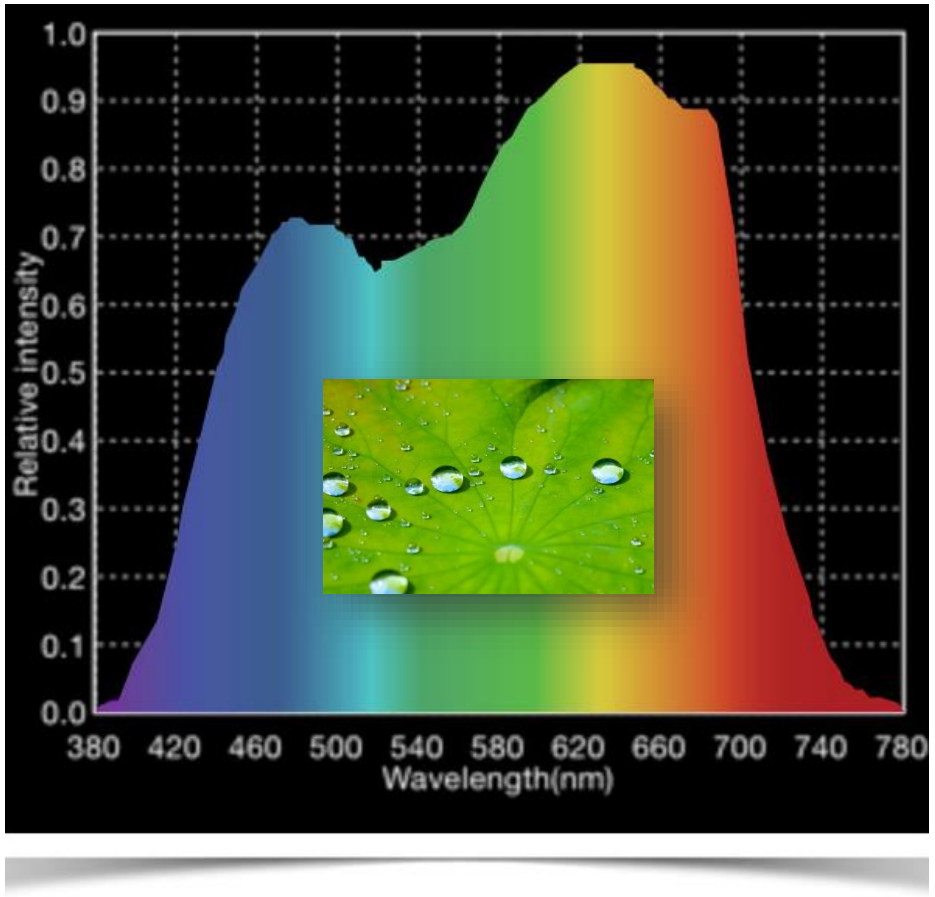
- **Recent Transvalor customers request:**
  - Selling day ahead PV production to an aggregator at “market” price
  - Need to know the irradiation at an hourly time step
  - Questions about the feasibility and quality of the forecast
- **Answer:**
  - Several IA machine learning methods tested and trained 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