Applications of the HelioClim Solar Radiation Databases

The HelioClim (HC) Databases contain radiation values at ground level obtained from the processing of the images taken by Meteosat satellites. These databases are disseminated by the SoDa website.

Forecasting
Long Term
T0 +15 years
T0 +1 day
Short Term
T0 + 2 hours
T0
Nowcasting
Monitoring
T0 -15 min
T0 -1 day
Long Term Analysis
Archive

Forecasting

In the Pipe:
Atmospheric parameters retrieved from satellite images (as solar irradiance, water vapor or aerosols) have the advantage to give information on the actual atmospheric state. As a consequence, they can enhance the accuracy of both meteorological and statistical forecasting models, from few minutes to hours.
Satellite images provides spatio-temporal information for large areas and a fine time resolution (15 min).

Usage:
Typical applications requiring intra-day forecast information are:
- Solar PV power generation
- Solar thermal power plants
- Load management (according to market timelines).

Monitoring

Companies monitoring solar installations need a theoretical value of the electrical production of the past day against which they compare the actual value. For this purpose, HC3 irradiation values are provided everynight to these companies which use them for computing the theoretical production.

Customers:
Meteotest, Poyry, Photowatt, Rtone, 3E...

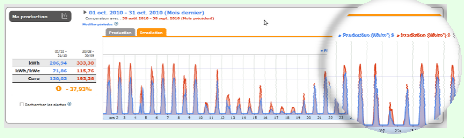
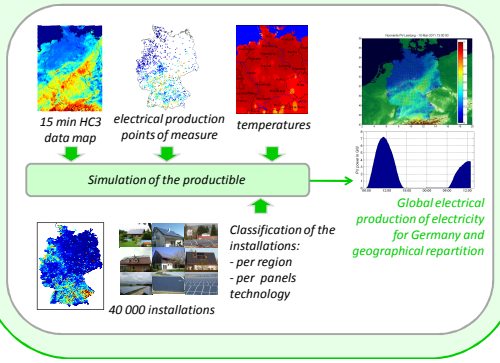


Illustration of the on-line tool developed by the company RTONE

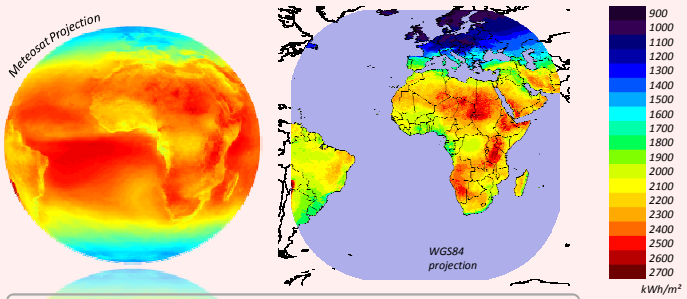
Nowcasting

Definition:
We define the nowcasting as the immediate delivery of irradiation values or maps to the Customer, as soon as the satellite images are received and processed (« real time »).

Example: the Customer is Micromata
Project purpose: get the electrical production for the whole Germany in real time.



Mapping Service



Yearly Global Irradiation on Horizontal Plane (GHI) for the year 2010 – Copyright Transvalor S.A. Produced in March 2011, Source: Database HelioClim3 – MINES ParisTech

Possible data types: GHI, Direct Irradiation on Normal plane (DNI)...
Possible time aggregations: yearly for a given year or averaged over several years, monthly...

Quality Assessment of HC

Solys 2 – copyright Kipp & Zonnen

Meteosat – Eumetsat

The **Quality Assessment of the HC databases** consists of the **benchmark** of the HC values with the corresponding ground station measurements. It follows the protocol SHC#36 of the International Energy Agency.

Example: Stellenbosch University, South Africa.
Measurements time period: 2010-06-03 – 2011-01-25

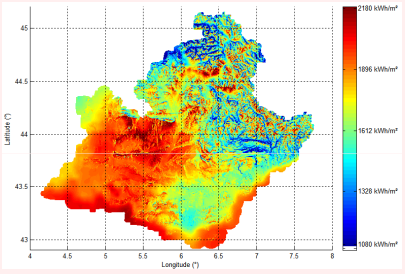
Equipments:
- 1 Kipp&Zonnen Solys 2 Tracker and shading call assembly
- 1 Kipp&Zonnen CH1 Pyrheliometer
- 1 Kipp&Zonnen CMP6 Pyranometer

Results:

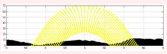
Data Type	GHI		DHI		DNI	
Time Step	hour	day	hour	day	hour	day
Number of Data	2612	211	2612	211	2612	211
Mean of the Ground Station data (Wh/m²)	468	5594	125	1509	533	6379
Bias (%)	-2.79	-2.71	12.50	12.30	-8.49	-8.47
Standard dev (%)	13.91	8.86	54.21	37.54	30.03	23.11
Correlation coefficient	0.9808	0.9895	0.7862	0.7672	0.9101	0.9652

Solar Atlas (atlas-solaire.org)

What is this? The Solar Atlas for the region of Provence in France is a series of high spatial resolution (approx. 200 m) yearly and monthly irradiation maps, created with the help of ADEME-PACA and Conseil Général 06.



How to increase the spatial resolution of HC3?
- Exploit the Digital Elevation Model SRTM to modulate the irradiation values according the optical thickness of the atmosphere, as well as due to the shadowing effect of the far horizon.



Horizon and sun position

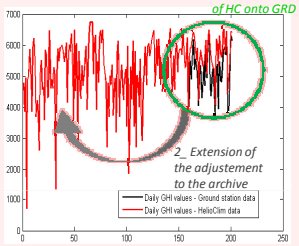
- Use irradiation values measured at 32 ground stations to perform a local calibration of the HC3 data.

Applications: better discrimination of locations for the solar plant sitting, enhanced profitability calculation, more accurate installation sizing, energy policy planning...
Further enhancement is taking place in the EC-funded ENDORSE project (Grant Agreement no. 262892).

Synergy between HC and ground station measurements

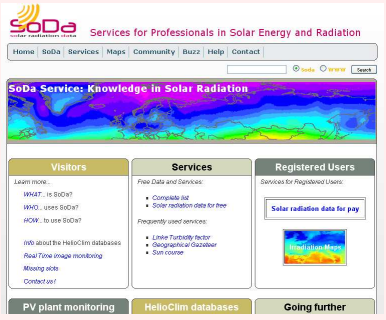
Principle:
Combine the advantages of the local and precise ground station (GRD) measurements and the long-term satellite data.

Results:
A long-term time series of irradiation values calibrated for a given site.



Usage:
Besides direct use for simulation of energy production, such high quality long-term time series are used to derive several useful quantities. For instance, banks require statistics of several climatic parameters to decide on an investment, such as P50 (median scenario), P90 (worst scenario) and Typical Meteorological Year.
Further enhancement is taking place in the EC-funded ENDORSE project (no. 262892).

SoDa website / services (soda-is.com)



Non-exhaustive list of Customers: 3E, CENER, Concentrix, Dii, DLR, EDF-EN, EDF R&D, Enerqos, EoleRes, Fraunhofer IWES Kassel, Ineo GDF-Suez, Lahmeyer, Meteotest, NurEnergie, Photon GmbH, Photowatt, PVSYST, RAE Greece, Rtone, Statkraft, Stellenbosch Univ., TEI Crete, Total, Univ. Politec Madrid, WinchEnergy...

SoDa is a broker to a list of webservices:

Astronomy:	Sun / Earth geometry
	Extraterrestrial and top of atmosphere radiation
Climate:	Climatic average for Materials, PVC, Paints, Coating, Ageing
	Climatic average over 15 and 30 years
	Climatic normals: radiation, temperature, UV
	Degree-days, Frequency of type of skies, Linke turbidity factor
Energy:	Optimal panel orientation
	Performance of a solar water heater
Building:	Daylighting
Environment:	Photosynthesis in the ocean
Geography:	Coordinates (lat, lon) of a city, and height
Meteorology:	Weather forecasts (Europe, World)
	UV and spectral distribution (Europe, Africa)
Solar radiation data:	HelioClim-1 (HC1): 1985-2005, Meteosat 1st Gen, 20 x 20 km² cell
	HelioClim-3 (HC3): from Feb. 2004, Meteosat 2nd Gen, 3 x 3 km² cell
	NASA-SSE: July 1983 to Dec. 2003, world cover, 1° by 1° cell
	NASA-SSE + HC: meeting the best of the two databases

SoDa website:
www.soda-is.com

The HelioClim databases are processed by **MINES ParisTech – ARMINES**[1]. **TRANSVALOR**[2] has been created by ARMINES to transfer and promote the results of the research centers of ARMINES. TRANSVALOR manages the SoDa website.
Authors: Claire Thomas[2], Bella Espinar[2], Etienne Wey[2], Philippe Blanc[1], Lucien Wald[1]