

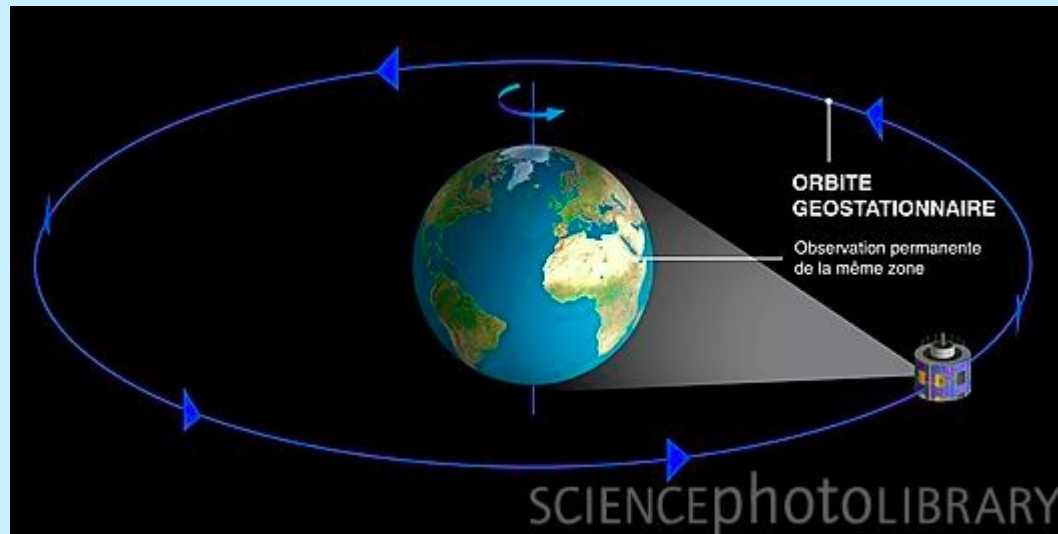
Applications of CM SAF SIS data for solar energy applications

R.W. Mueller & CM SAF Radiation Team
German Weather Service

D. Lee
University of Marburg

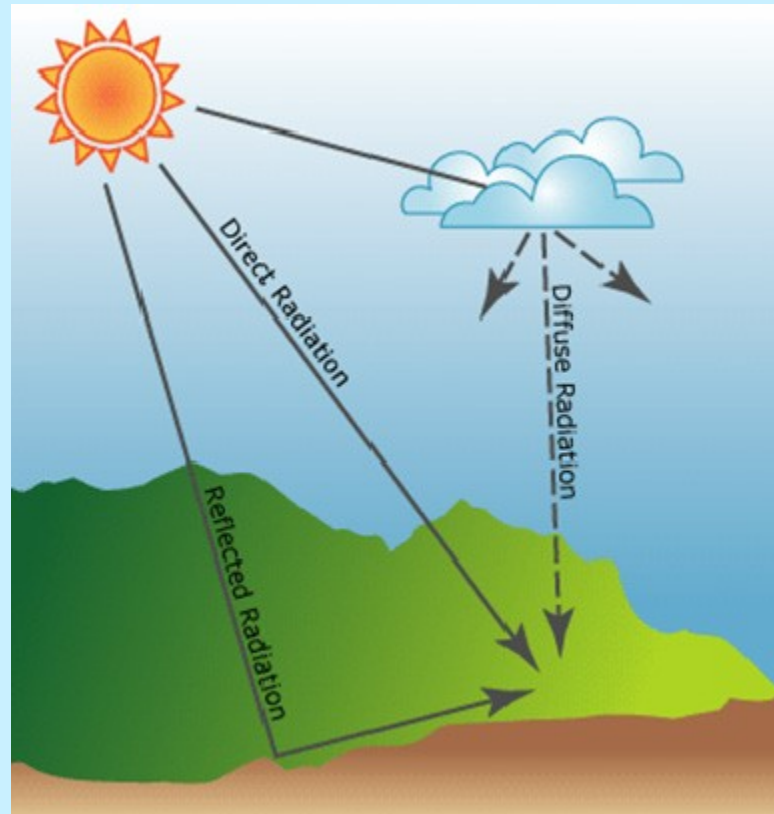


Basics: Geosynchronous satellites

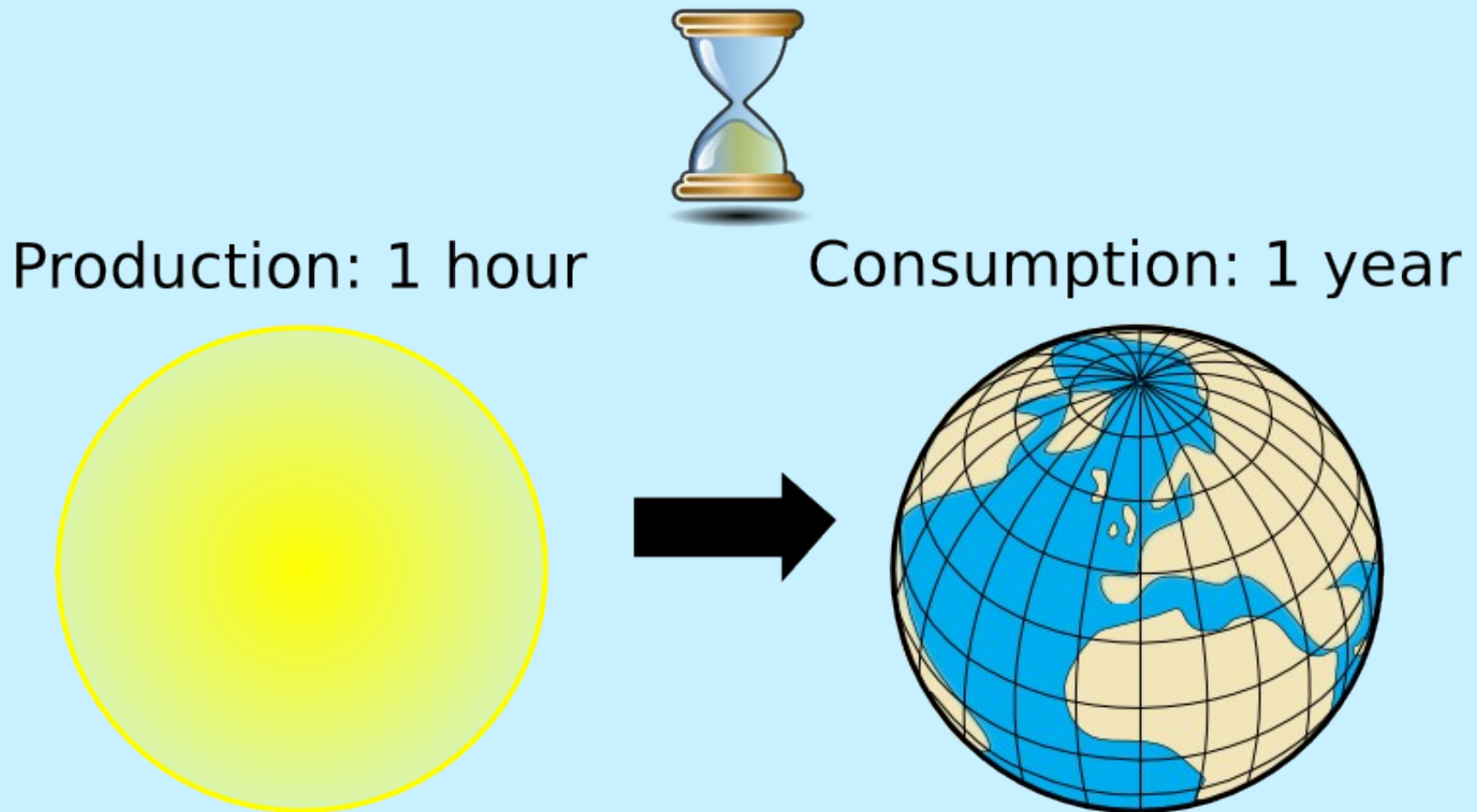


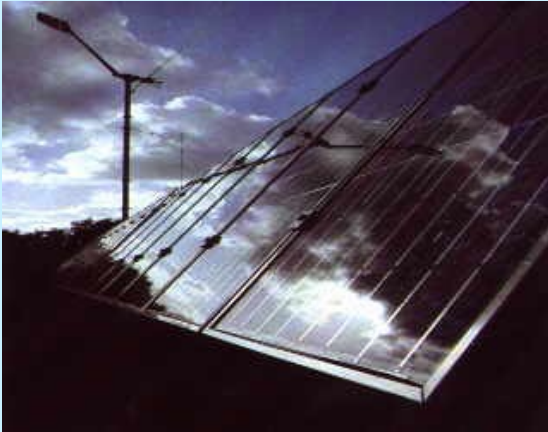
Source: Ducros 2012

Basics: Global vs. direct radiation



Source: State Government of Victoria 2012

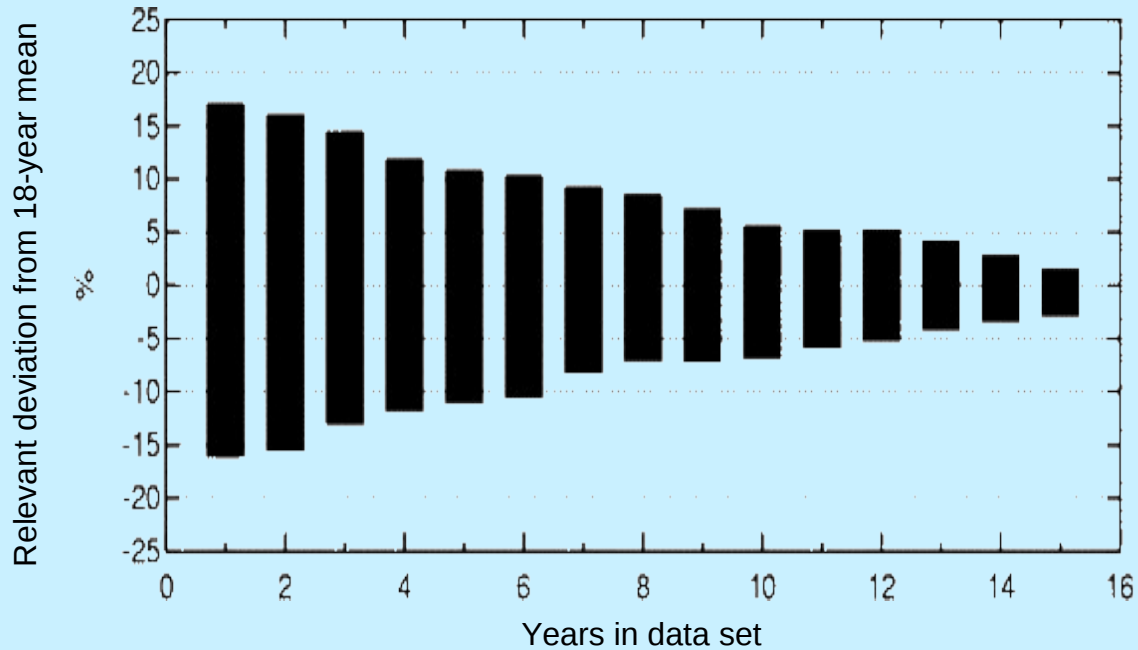




Global radiation:
Primarily for photovoltaics

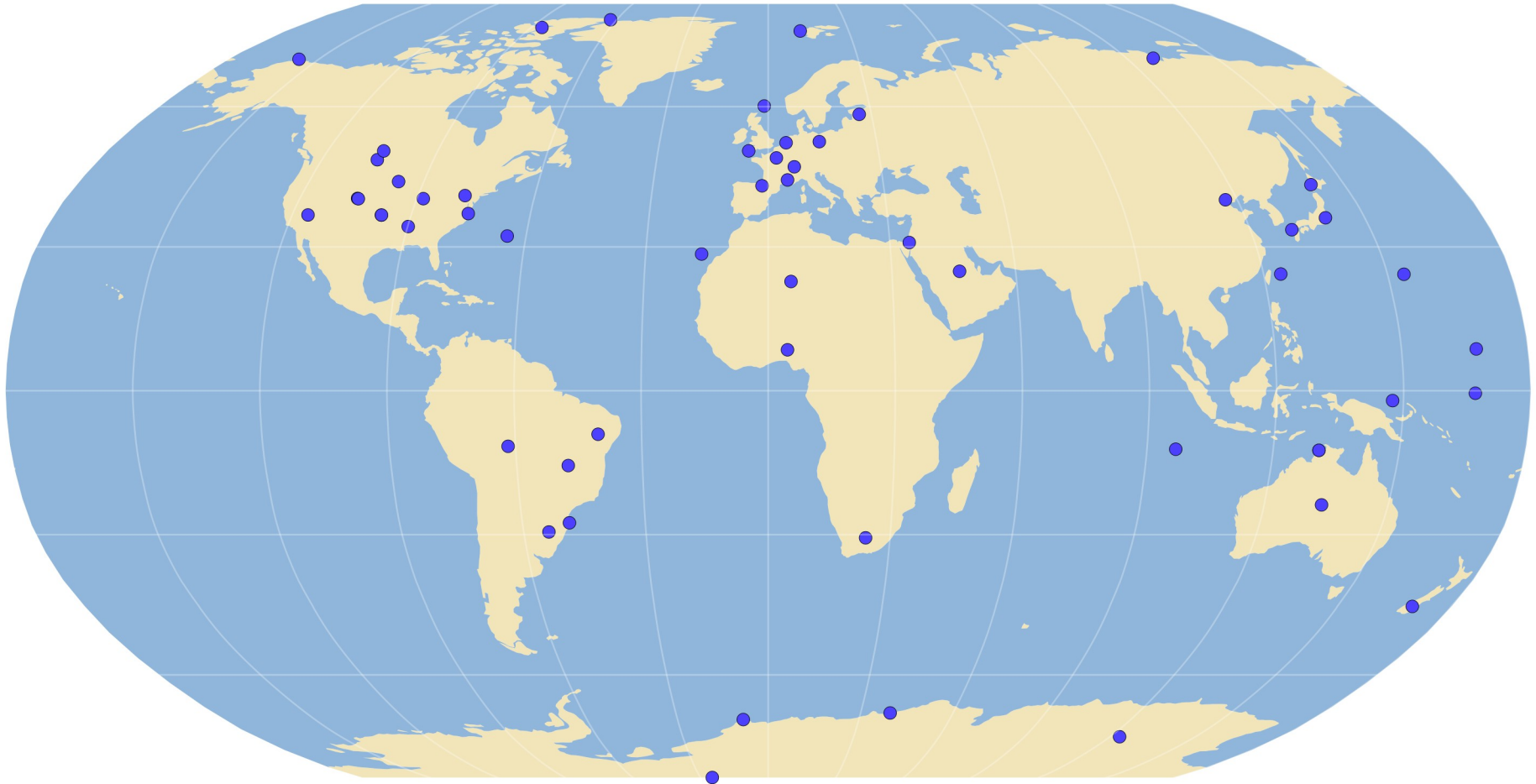


Direct radiation:
Can be concentrated

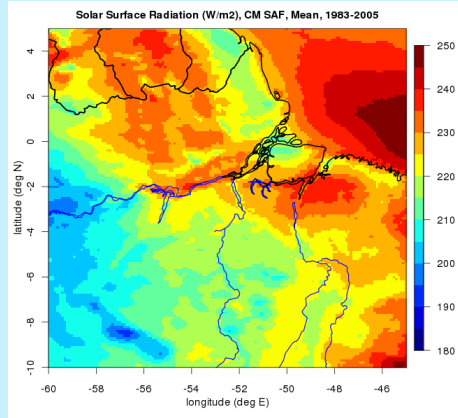


Source: Lohmann et al., DLR 2006

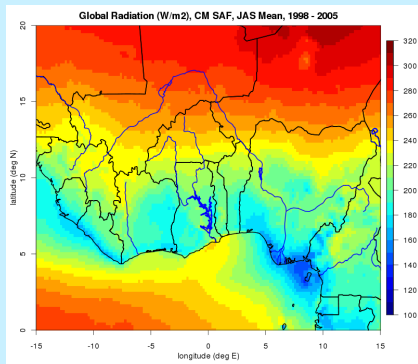
Advantage: Continuous spatial coverage



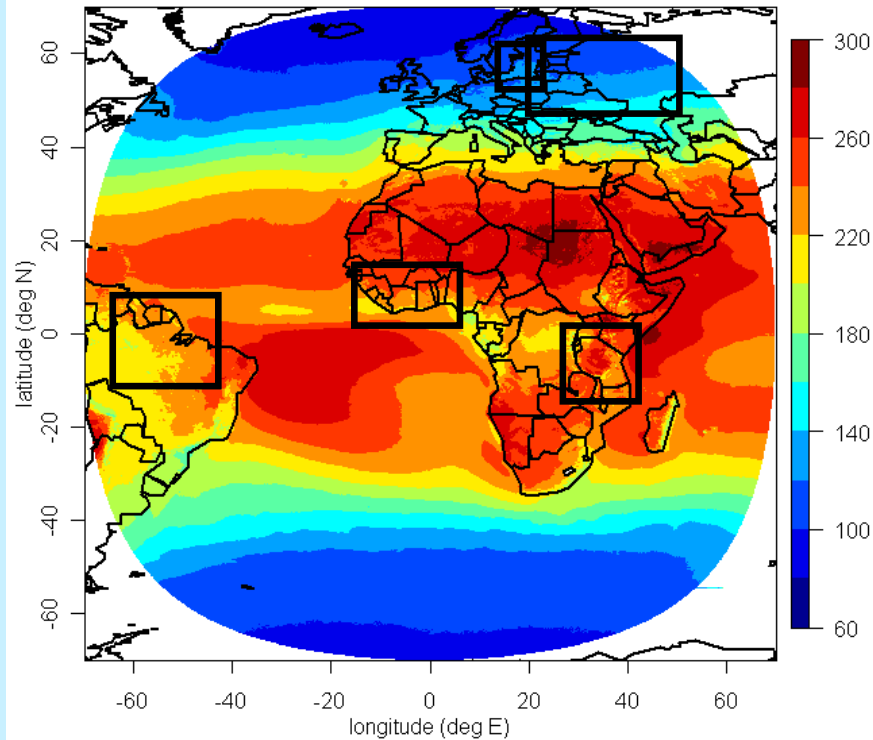
Amazon



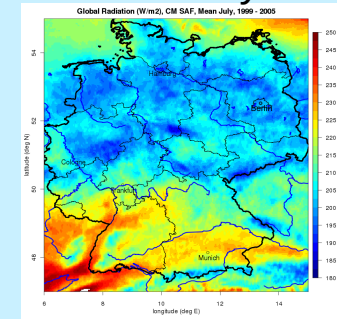
West Africa



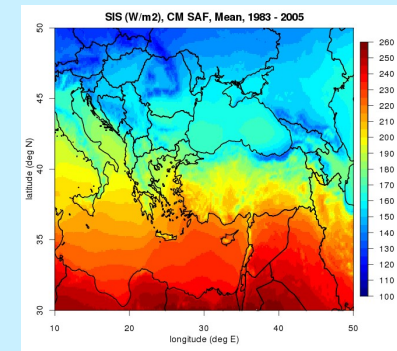
SIS, CM-SAF (1988-2005), W/m²



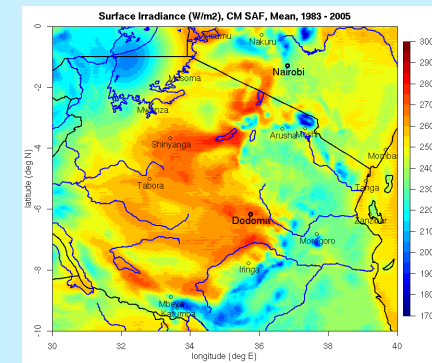
Germany



Mediterranean



High resolution:
0.03° spatial
Daily/hourly temporal



Tanzania

Accuracy targets compared to ground measurements

	Global radiation (W/m ²)			Direct radiation (W/m ²)		
	Threshold	Target	Optimum	Threshold	Target	Optimum
Monthly	15	10	8	20	15	12
Daily	25	20	15	30	25	20

Source: Posselt et al 2012

Accuracy targets compared to ground measurements

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	Threshold	Target	Optimum	Threshold	Target	Optimum
Monthly	15	10	8	20	15	12
Daily	25	20	15	30	25	20

Source: Posselt et al 2012

Validation against BSRN stations

Data source	Bias (W/m ²)	Mean absolute difference (W/m ²)	Standard deviance (W/m ²)	Anomaly correlation (%)	Fraction of time steps above validation target values
CM SAF	4.24	7.76	8.23	0.89	10.71
ERAinterim	5.48	10.41	12.15	0.8	24.6
GEWEX	-2.42	12.03	11.03	0.82	31.89
ISCCP	-0.02	11.56	11.25	0.78	29.16

Source: Posselt et al 2011



The EUMETSAT
Network of
Satellite Application
Facilities



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Motivation: GEO satellites

001000110010110
010011011001001
001000110010110
010011011001001



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Here you are able to finish your order. For this we need your preferred product format and way of data transfer.

Please take notice of the fact that continuous orders will always be delivered by ftp (no matter what you've chosen below).

Submit your order.

Please choose your preferred type of data transfer:

(please consider that the total Byte amount of your order is **0 Bytes**)

- ☐ Mail - Delivery of data via a Email attachment.
- ☐ CD - Delivery of data via CD or DVD.
- ☒ FTP - Delivery of data via a temporary FTP-Account.

[Place an order](#)

Id	Description	From	To	Size	
11444	300, CFC - Fractional cloud cover, CFC from MSG1, Daily, Mean, MSG full disk (includes Europe, Afrika, Atlantic Ocean)	03.12.2007	10.12.2007	?	
14064	300, CFC - Fractional cloud cover, CFC from MSG2, Daily, Mean, MSG full disk (includes Europe, Afrika, Atlantic Ocean)	01.05.2007	30.04.2008	?	
15651	310, CFC - Fractional cloud cover, CFC from MSG1, Daily, Mean, MSG full disk (includes Europe, Afrika, Atlantic Ocean)	01.12.2008	08.12.2008	?	
15684	310, CFC - Fractional cloud cover, CFC from MSG2, Daily, Mean, MSG full disk (includes Europe, Afrika, Atlantic Ocean)	01.05.2008	31.12.2008	?	
16610	320, CFC - Fractional cloud cover, CFC from MSG2, Daily, Mean, MSG full disk (includes Europe, Afrika, Atlantic Ocean)	01.01.2009	18.07.2010	?	

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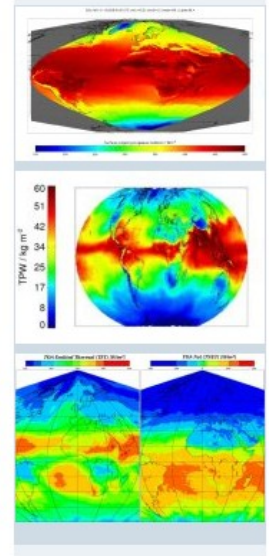
Welcome
Joe Bloggs

[Logout](#)

Your order cart: 5

[To order cart](#)

Example products



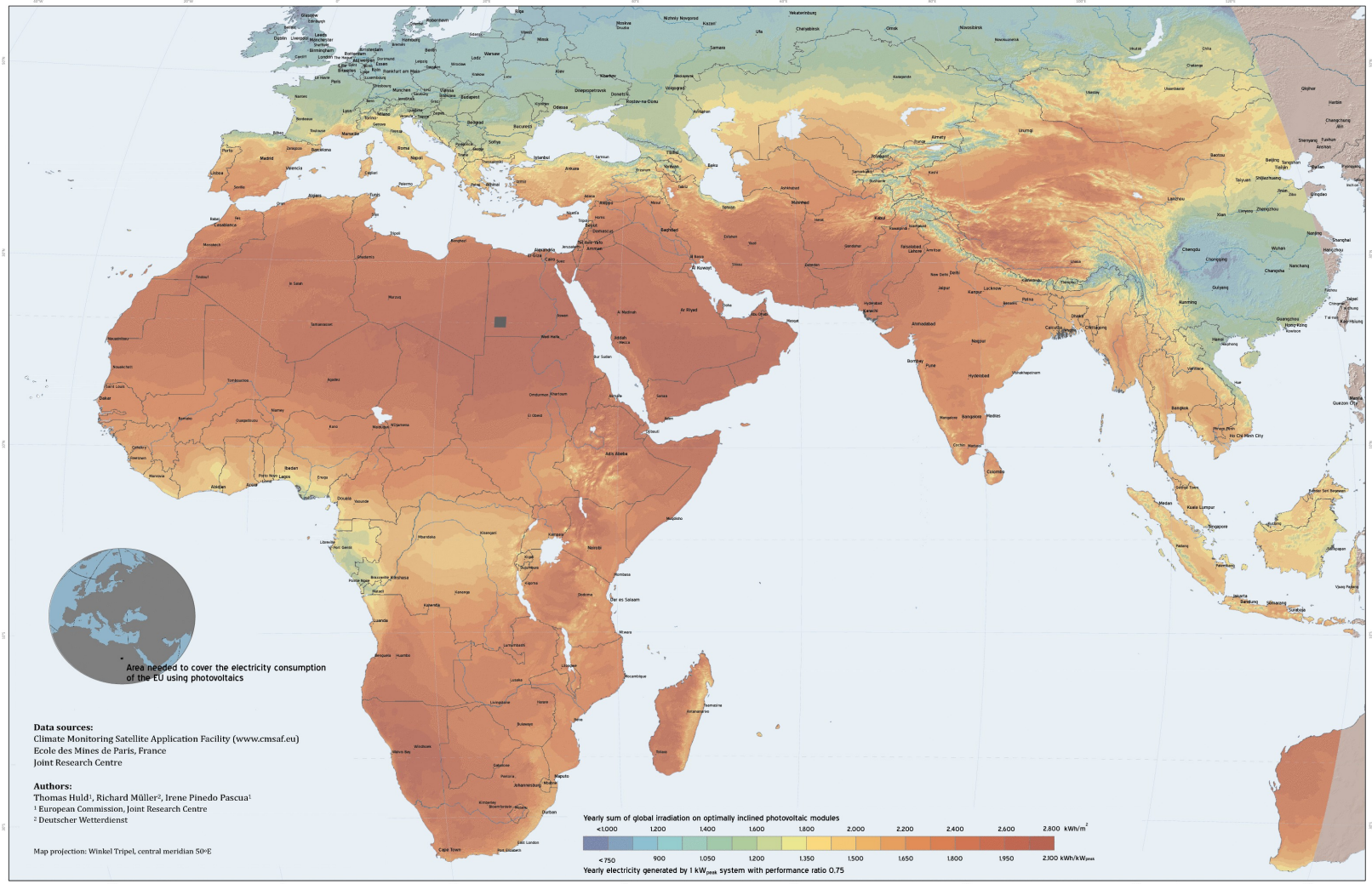
- user-friendly data access via the Web User Interface: wui.cmsaf.eu
- all data is freely available in netcdf format & Toolkit (example data + scripts) available: www.cmsaf.eu/tools

Photovoltaic Solar Electricity Potential in Europe, Africa and Asia

JRC
EUROPEAN COMMISSION

ie
Institute for Energy

CM SAF
Climate Monitoring



PV potential estimation utility - Mozilla Firefox

File Edit View History Bookmarks Tools Help

http://re.jrc.ec.europa.eu/pvgis/apps4/pvest.php#

openSUSE Getting Started Latest Headlines

JRC CM SAF Photovoltaic Geographical Information System - Interactive Maps

EUROPA > EC > JRC > IE > RE > SOLAREC > PVGIS > Interactive maps > europe

Contact Important legal notice

Europe Africa

e.g., "Ispra, Italy" or "45.256N, 16.9589E"

Search

cursor position: 33.138, 20.742
selected position: 35.174, 4.746

PV Estimation Monthly radiation Daily radiation

Performance of Grid-connected PV

Radiation database: Climate-SAF PVGIS [What is this?]

PV technology: Crystalline silicon

Installed peak PV power 1 kWp

Estimated system losses [0;100] 14 %

Fixed mounting options:

Mounting position: Free-standing

Slope [0;90] 35 ° ☐ Optimize slope

Azimuth 0 ° ☐ Also optimize azimuth

(Azimuth angle from -180 to 180, East=-90, South=0)

Tracking options:

☐ Vertical axis Slope [0;90] ° ☐ Optimize

☐ Inclined axis Slope [0;90] ° ☐ Optimize

☐ 2-axis tracking

Horizon file Browse...

Output options

☐ Show graphs ☐ Show horizon

☒ Web page ☐ Text file ☐ PDF

Calculate [help]

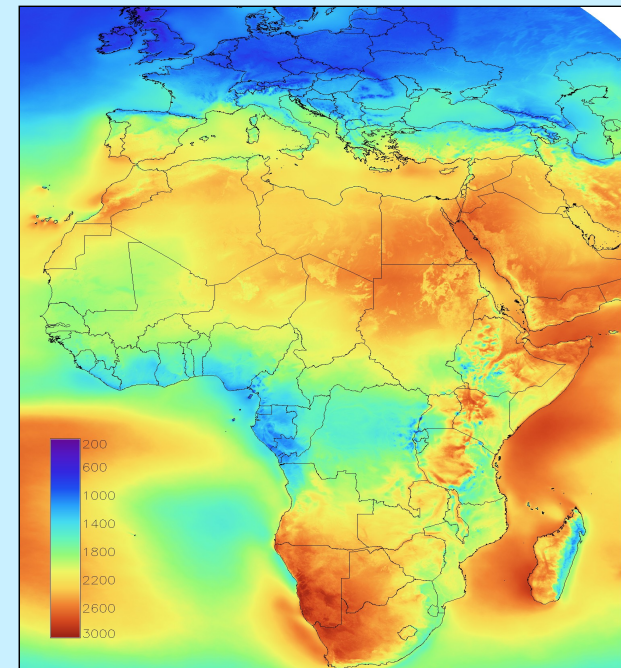
Solar radiation Temperature Other maps

200 650 1100 1550 2000 [kWh/m²]

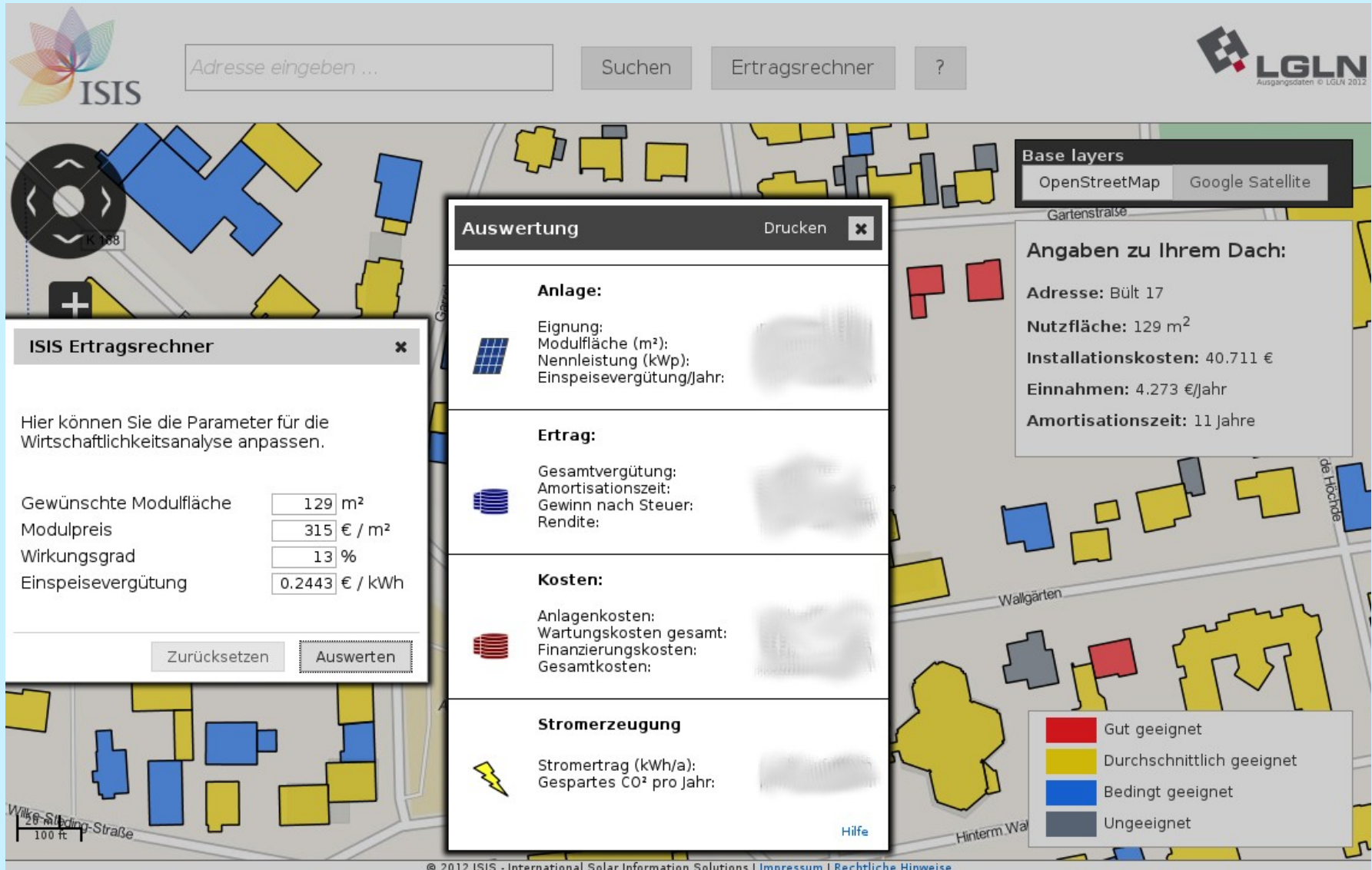
Done

Interactive online tool

Raw geodata



Source: JRC 2012



ISIS
Adresse eingeben ... Suchen Ertragsrechner ?

Base layers
OpenStreetMap Google Satellite

Angaben zu Ihrem Dach:
Adresse: Bült 17
Nutzfläche: 129 m²
Installationskosten: 40.711 €
Einnahmen: 4.273 €/Jahr
Amortisationszeit: 11 Jahre

ISIS Ertragsrechner

Hier können Sie die Parameter für die Wirtschaftlichkeitsanalyse anpassen.

Gewünschte Modulfläche: 129 m²
Modulpreis: 315 €/m²
Wirkungsgrad: 13 %
Einspeisevergütung: 0.2443 €/kWh

Zurücksetzen Auswerten

Auswertung Drucken

Anlage:
Eignung:
Modulfläche (m²):
Nennleistung (kWp):
Einspeisevergütung/Jahr:

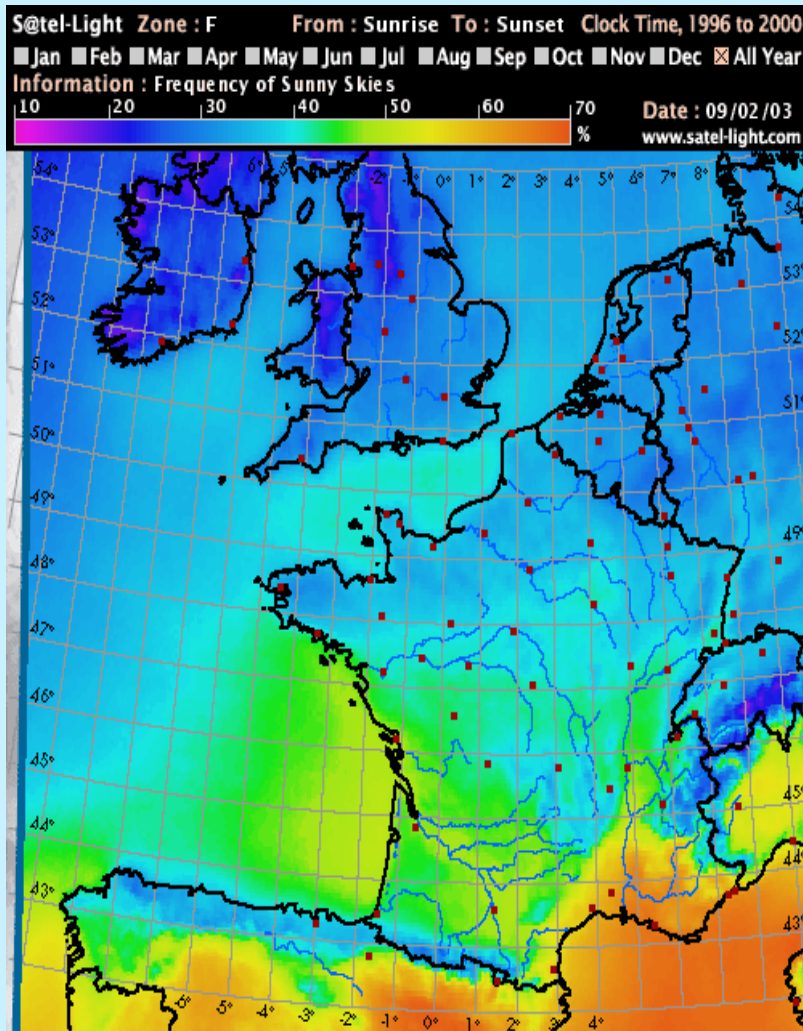
Ertrag:
Gesamtvergütung:
Amortisationszeit:
Gewinn nach Steuer:
Rendite:

Kosten:
Anlagenkosten:
Wartungskosten gesamt:
Finanzierungskosten:
Gesamtkosten:

Stromerzeugung
Stromertrag (kWh/a):
Gespartes CO₂ pro Jahr:

Legende:
Gut geeignet
Durchschnittlich geeignet
Bedingt geeignet
Ungeeignet

© 2012 ISIS - International Solar Information Solutions | Impressum | Rechtliche Hinweise



- ## Architectural planning
- Window size
 - Window positioning
 - Tint grade

Source: Satel-Light 2004

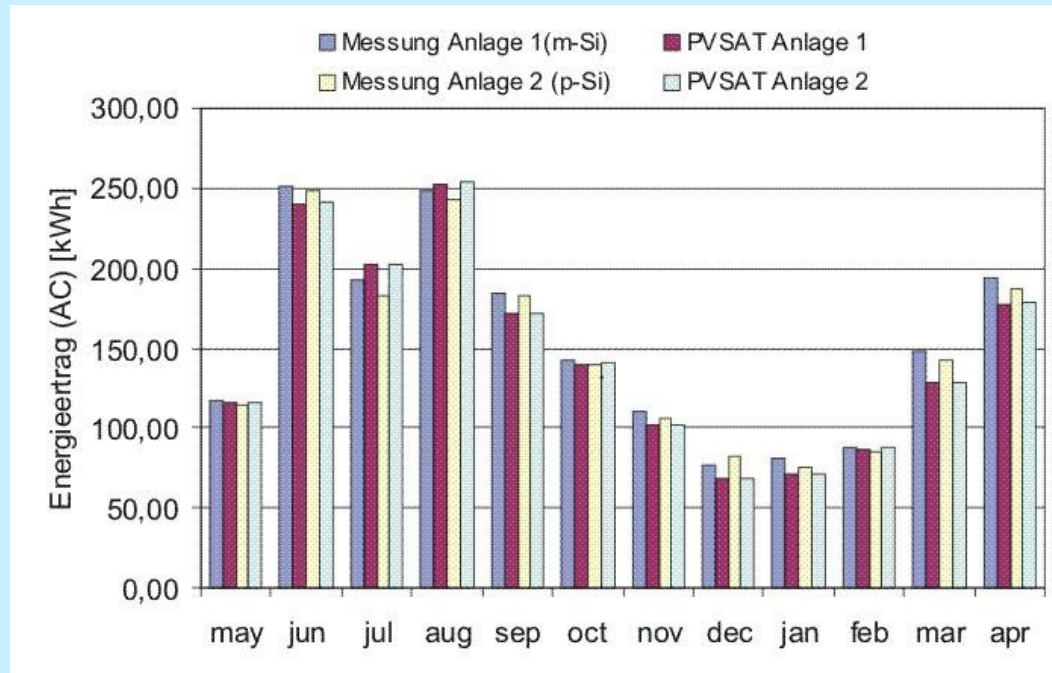


Source: Schott Solar 2007

- Architectural planning
- Transparent thin film solar cells

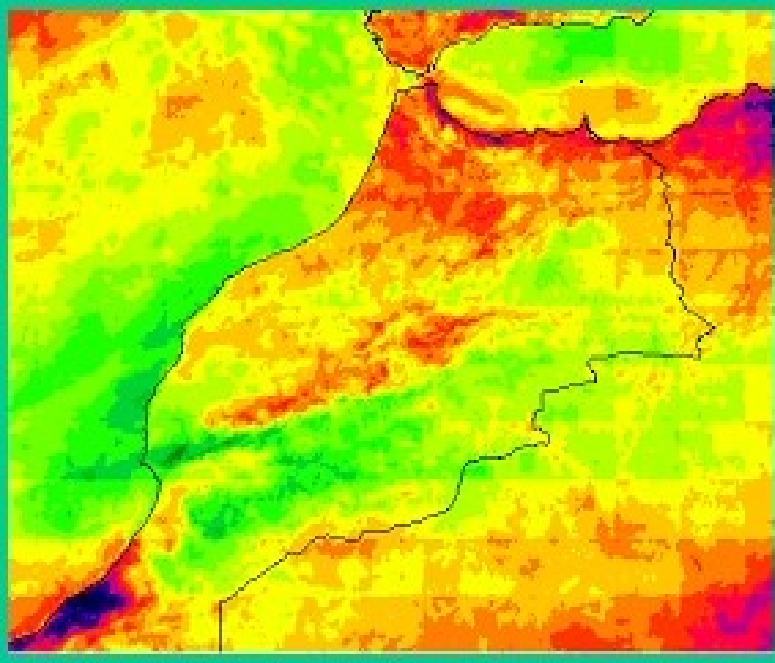
Applications:

Near-real time production monitoring



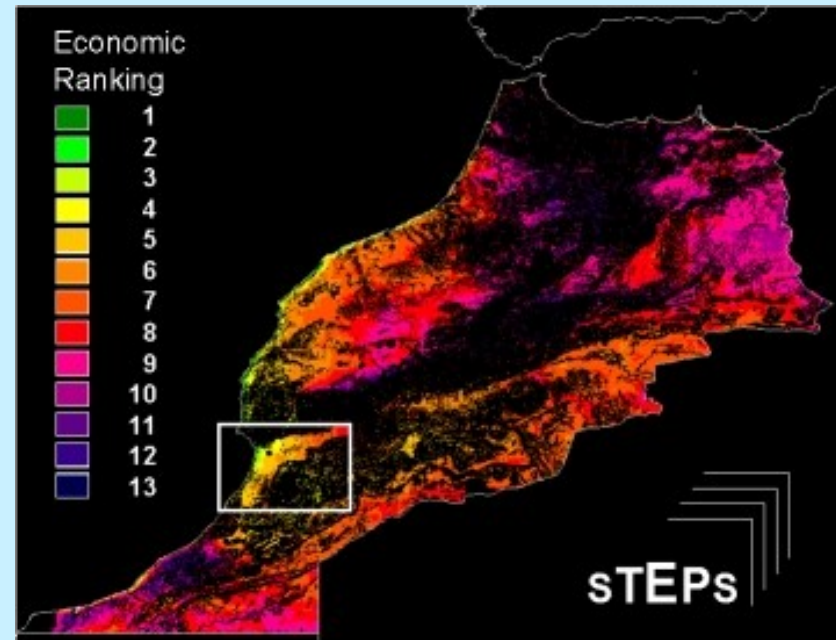
Source: PVSAT, University of Magdeburg 2012

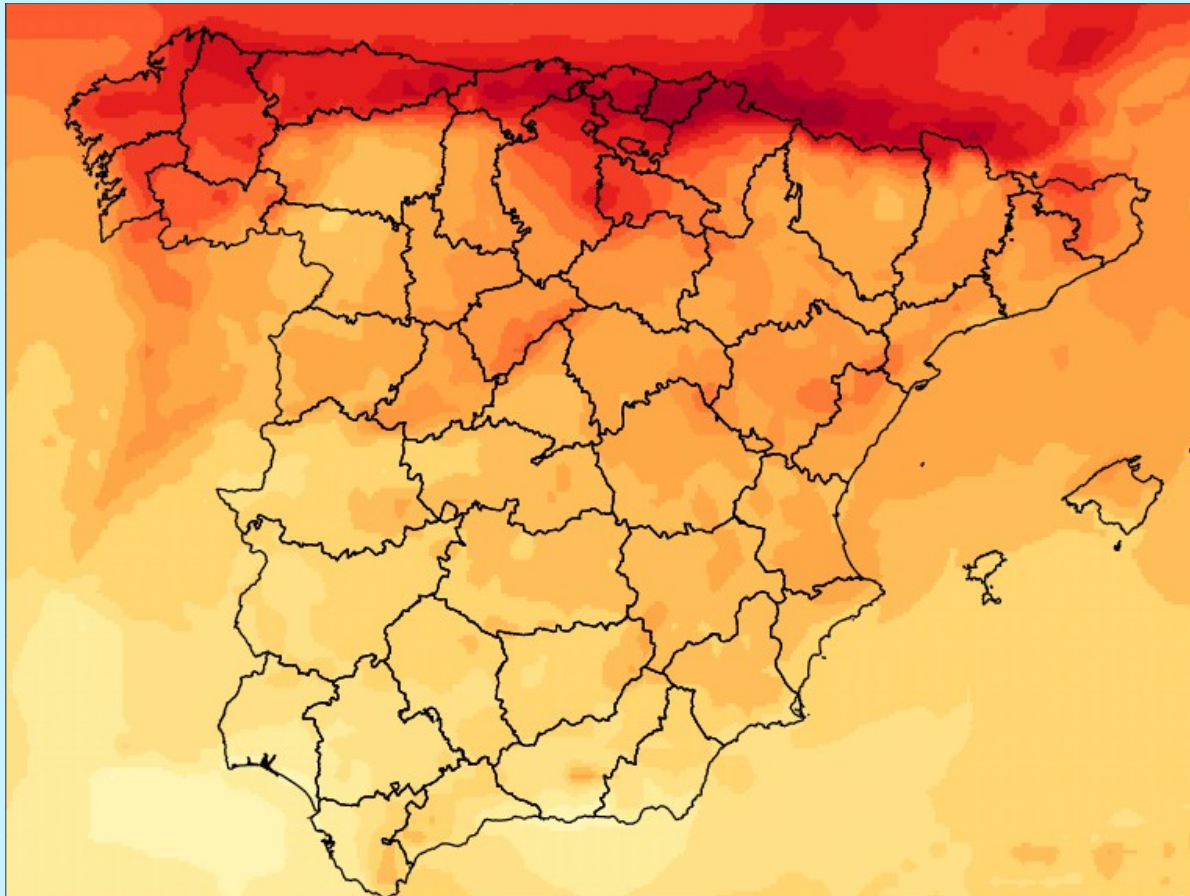
Direct irradiance in Morocco



Source: DLR & SOLEMI 2007

Economic ranking based on irradiance and additional factors



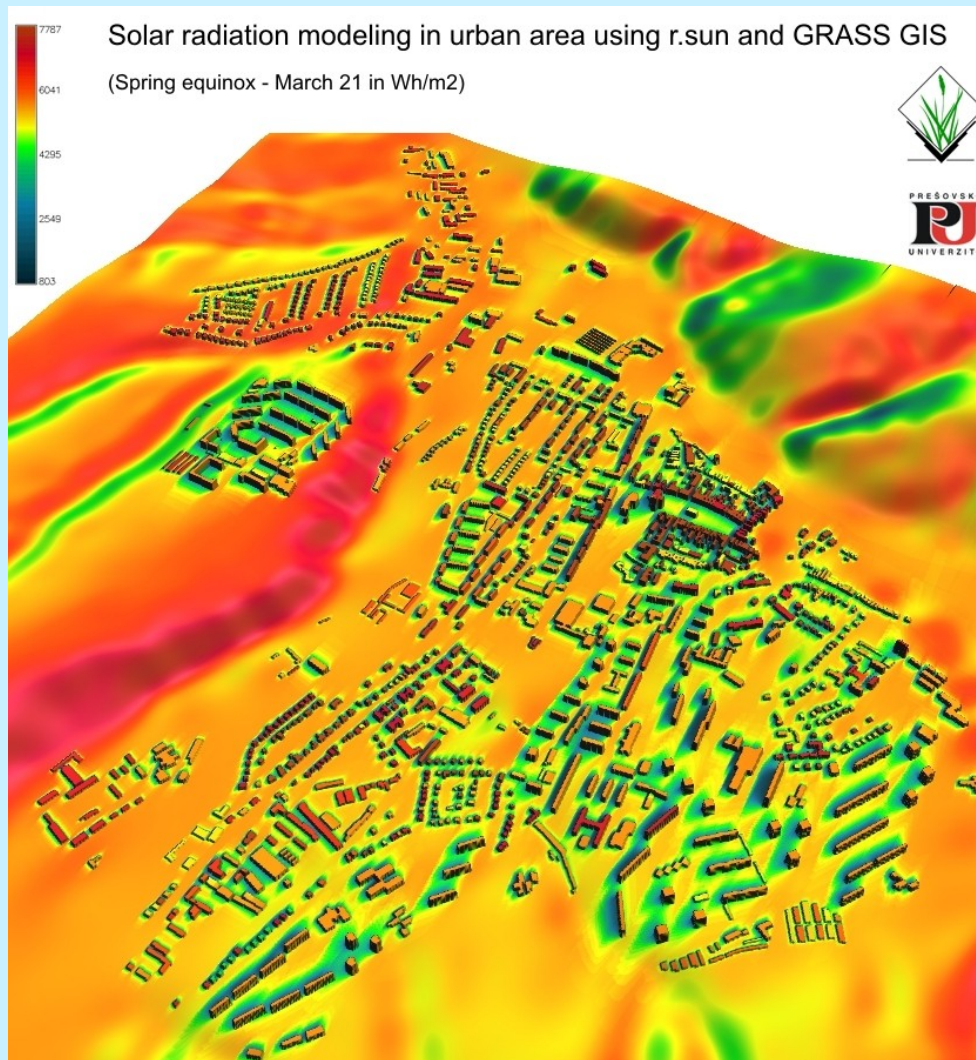


Source: Lamigueiro 2011

SolaR:

R package for
solar radiation and
photovoltaic
simulations

Example:
Solar irradiance in
Spain



r.sun:

GRASS module for
solar radiation

Example:
Solar irradiance in urban
area of Slovakia

Source: Hofierka & Kaňuk 2006

Great data is available

We are excited to hear
what you're doing with it!