

# “From Academic to Industry for Solar Resources”

**MINES ParisTech**  
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Solar Resource Assessment with the Global Atlas  
for Renewable Energy  
ISES Webinar

16/06/2016



- **MINES ParisTech**

- **French school of engineers** with 225 years of history as a Graduate School
  - 260 professors-researchers
  - 1440 students
  - **18 research centers** (Earth Science, Environment, **Energy and Process**, Materials, Math, Economics)
- **Ranked # 1 in France** as the institute for partnership research (Industry & Technology 2014)

- **Center for Observation, Impacts, Energy**

- Assessment of solar, wind and marine resources for renewable energy using Earth Observation data (Model, satellite imagery and *in-situ*)
- Assessment of environmental impacts through the use of Life Cycle Assessment (LCA) approaches
- Dissemination of scientific data based on open standards through a Spatial Data Infrastructure

○ The **Heliosat** methods and the **Helioclim** databases of Surface Solar Irradiance

**Heliosat methods:** Open methods (Heliosat-1 1986), using images from geostationary meteorological satellite to provide estimation of Surface Solar Irradiance

- **Heliosat-2** (2004)

MINES ParisTech

*Cloud index based approach*

*HS-2 operationally used for*

*SSI databases Helioclim-1 and Helioclim-3*

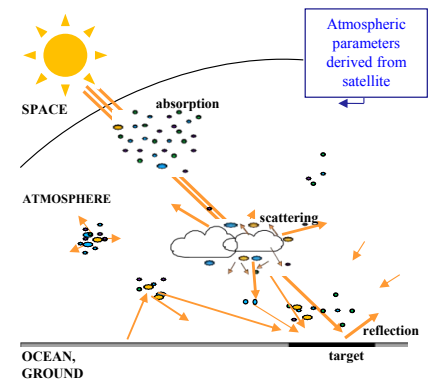
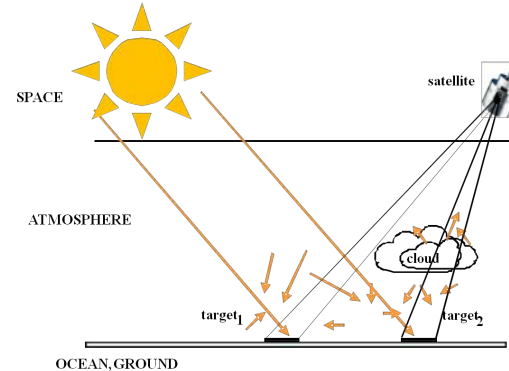
- **Heliosat-4** (2009)

MINES ParisTech / DLR (German Aerospace)

**Cloud properties** based approach

*HS-4 operationally used for the solar radiation service in Copernicus Atmosphere Monitoring Service ([CAMS](#))*

- *990+ citations of the Heliosat methods in Web of Science*



Blanc, P., B. Gschwind, M. Lefèvre, and L. Wald. 2011. "The Helioclim Project: Surface Solar Irradiance Data for Climate Applications." *Remote Sensing* 3 (12): 343–61. [doi:10.3390/rs3020343](https://doi.org/10.3390/rs3020343).

○ The **Heliosat** methods and the **Helioclim** databases of Surface Solar Irradiance

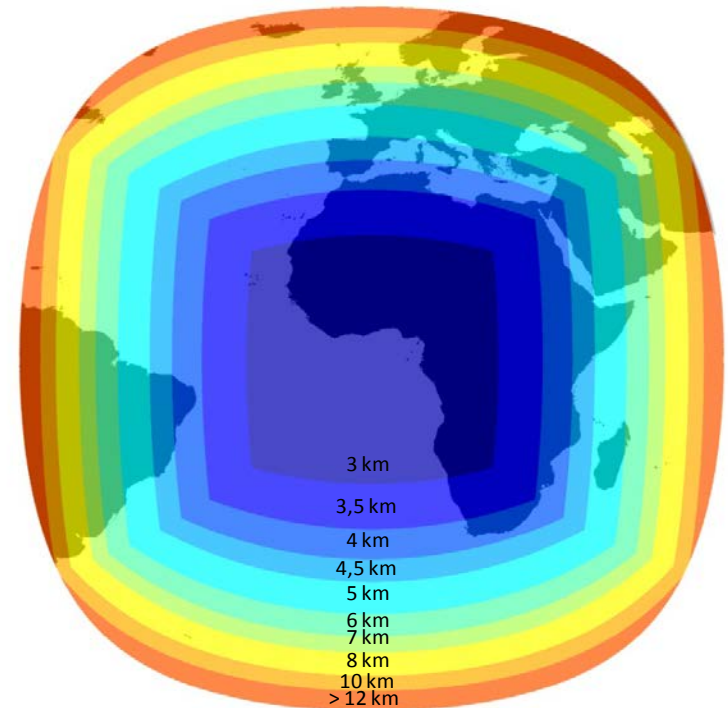
- **HelioClim-1 (HC-1)**

- **Heliosat-2**
- **Meteosat First Generation**
- Spatial resolution: 20 - 30 km
- Temporal resolution: daily values
- Temporal coverage: 1985 -2005
- Freely available 2011 (GEOSS Data-CORE)

- **HelioClim-3 (HC-3)**

- **Heliosat-2**
- **Meteosat Second Generation**
- Spatial resolution: 3 km
- Temporal resolution: 15 min
- Temporal coverage: since 2004
- 2004 - 2005 : free access (maps, times series)
- 2006 - real-time: commercial activities and tailored services by **Transvalor Innovation**
- 4+ millions / year of database accesses [www.soda-pro.com](http://www.soda-pro.com)

*Spatial coverage and resolution of HelioClim-3*



## ○ MINES ParisTech contribution

- As a **data provider** (over 300 resources)
  - **HelioClim-1**
    - Meteosat coverage - 32 maps of yearly mean of global Irradiance 1985-2005
    - Access to 21 years of time series in the Global Atlas (Tools - WPS)
  - **HelioClim-3**
    - Meteosat coverage - 39 maps of monthly mean GHI, DHI and DNI 2005
    - Mozambique – 52 maps of 10-years average (2004-2013) of monthly mean of daily irradiation GHI, DHI and DNI
    - Egypt – 92 maps of 10-years average (2005-2014) of monthly mean of daily irradiation GHI, DHI and DNI
    - SolarMedAtlas – GHI DNI maps of South Mediterranean countries
- As a **data integrator** for the renewable energy community
  - **BOM** – Australia – 20 maps of monthly and seasonal average daily solar exposure
  - **MERRA** – World – 30 gridded maps (Temp., pressure, humidity, wind speed and direction)
- As an **infrastructure provider** (<http://geocatalog.webservice-energy.org>)
  - Operate the **Spatial Data Catalog** for the Global Atlas (over 1600 resources / metadata)
  - Provide link to **GEOSS** (Global Earth Observation System of Systems)

- **Academic**

- Support for student and engineer education
  - Free Solar training - <http://www.soda-pro.com/research>

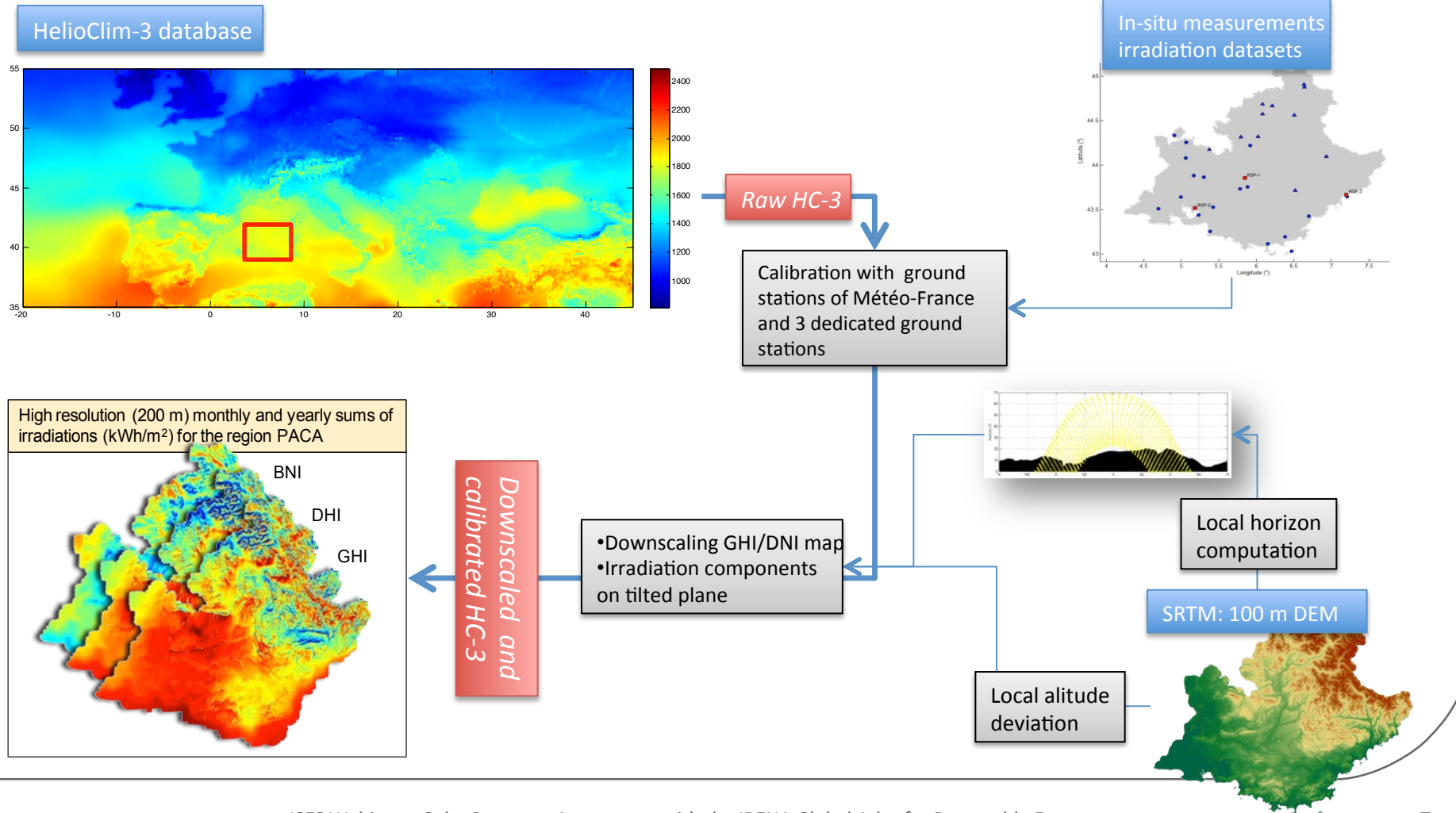
- **Research**

- One stop shop for data worldwide for renewable energy
- Central tool for dissemination of renewable energy resources
- Leverage visibility of data providers

- **Partnership research toward industry**

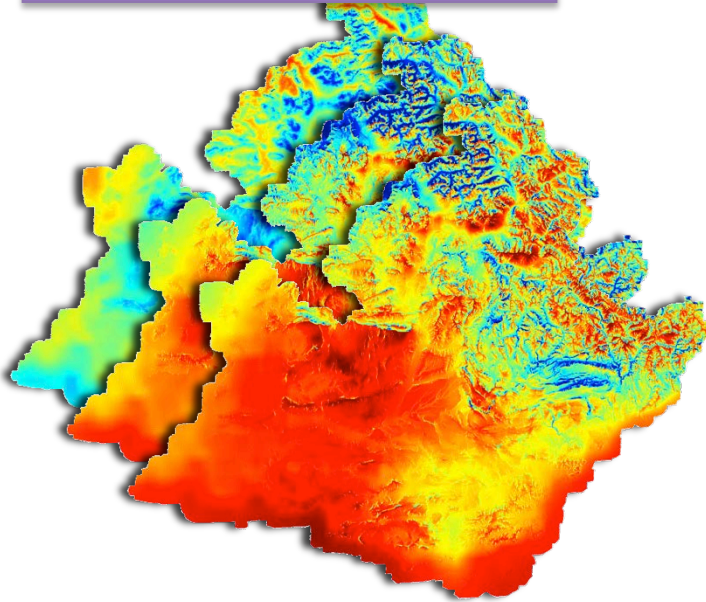
- Allows advertisement of “data for pay” to potential customers
- Enable industries partnership for R&D

- A "mashup" with **Helioclim-3** / In-situ measurements / SRTM (<http://www.atlas-solaire.fr/ises-swc-2011>)
- User profile: **Governmental** and **private sector**
  - Geographical analysis of local solar potential
  - Sitting and sizing power plants



- GIS analysis with additional Open geographical layers (Over 80 layers)  
<http://www.webservice-energy.org/viewer/heron/applications/atlas-paca/>

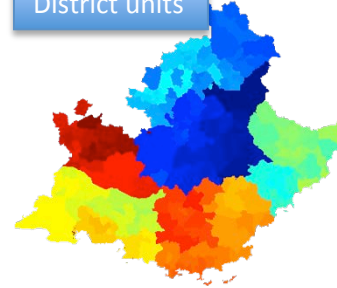
## 200 m irradiation maps



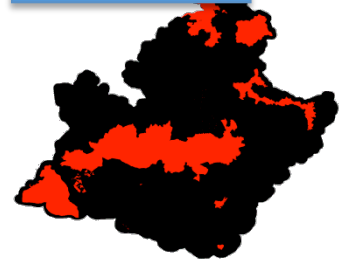
Territorial units



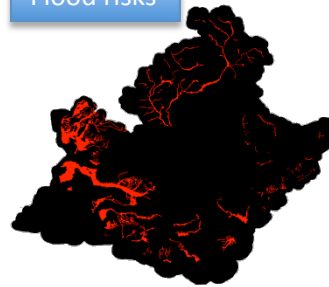
District units



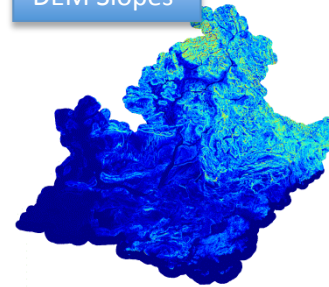
Natural reserves



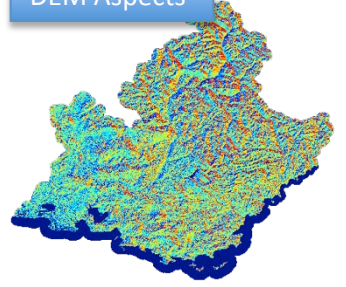
Flood risks



DEM Slopes

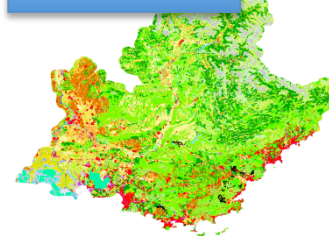


DEM Aspects

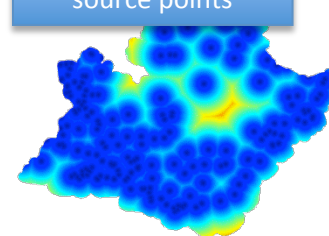


Land-use

Corinne Land Cover 2006



Distance to electric source points



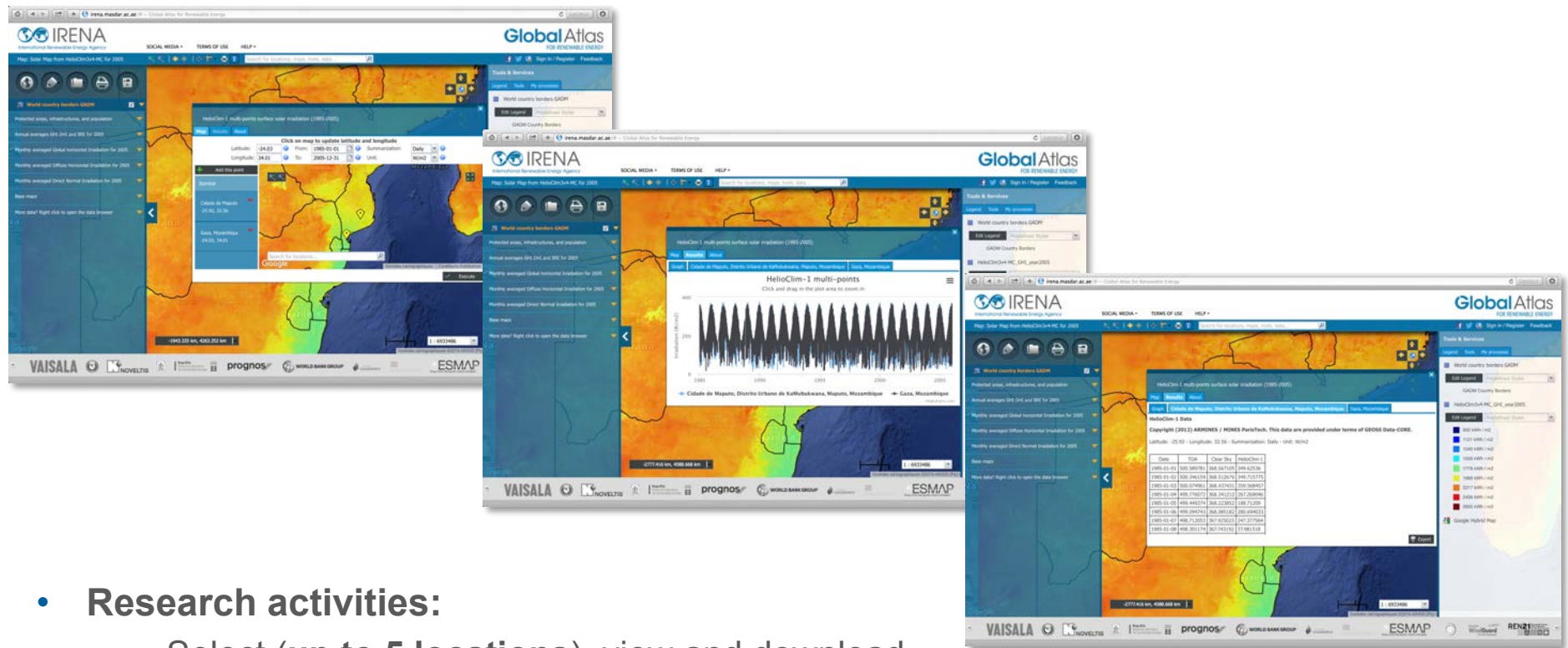
### Validation of irradiation data

- 21 Météo-France ground stations used for calibration (cross-validation)
- 3 dedicated ground stations used as test stations

GHI: bias < 1 %, RMSE ~ 5 % (~7 kWh/m<sup>2</sup>)  
 BNI: bias < 1 %, RMSE ~ 8 % (~12.5 kWh/m<sup>2</sup>)



○ Satellite-based solar time series – Daily values of Surface Solar Irradiation (SSI) for the period 1985–2005



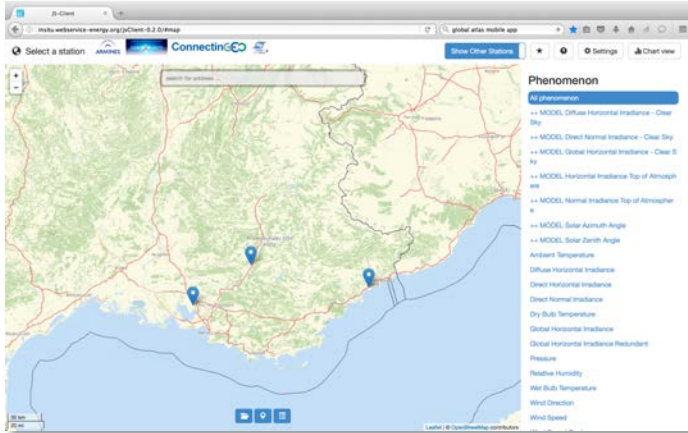
• **Research activities:**

- Select (up to 5 locations), view and download
  - Compare to ground measurements stations
  - Model electricity production of a given PV system (PVSYST, RetScreen, HOMER)
  - Helps in understanding the **potential** of a given site
  - **Comparing** PV technologies

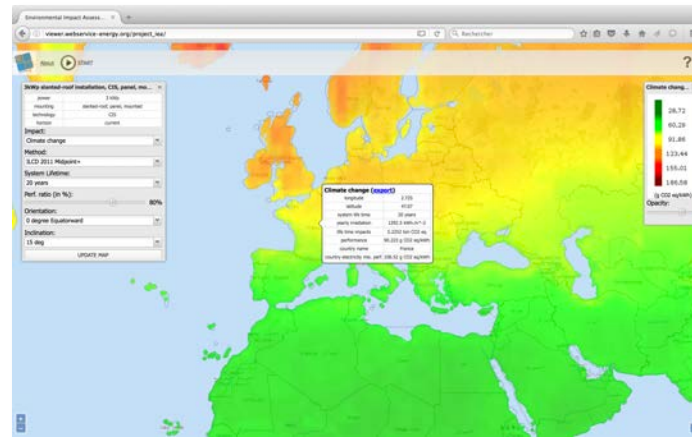
- Project development: consolidation phases and bankable report
  - Need of **accurate and long-term** solar and meteorological datasets and related uncertainties for the selected site
    - Long term (10y+) time series of solar and meteorological data from satellite and models
    - Short term (1y+) in-situ ground measurements for the site adaptation / calibration / merging
  - Need tailored expertise services
    - **HelioClim-3 - > Transvalor Innovation**
      - Annual subscriptions (Archive, Real Time, Forecast)
      - On-request services (Maps, Calibration, Completion, TMY,...)
  - Global Atlas “fitness for use” methodology
    - Concept paper (<http://tinyurl.com/zrk7swv>)
    - Metadata tags: “GlobalAtlasBusiness”

○ Possible addition to the Global Atlas

- **Access to in-situ measurements time series** (EC funded [ConnectinGEO](http://insitu.webservice-energy.org) project)  
<http://insitu.webservice-energy.org>



- **Environmental performance of PV systems** (IEA [PVPS Task12](http://viewer.webservice-energy.org/project_iea/))  
[http://viewer.webservice-energy.org/project\\_iea/](http://viewer.webservice-energy.org/project_iea/)



# Find out more....

# [www.webservice-energy.org](http://www.webservice-energy.org)

