Coordinating and integRating state-of-the-art Earth Observation Activities in the regions of North Africa, Middle East and Balkans and Developing Links with GEO related intiatives toward GEOSS

GEO-CRADLE Project Meeting 2
Thursday, 17th November, 2016

Roadmap for the solar energy application for GEO-Cradle

Stelios Kazadzis,
P. Kosmopoulos, H. El-Askary, M. Taylor

Physical Meteorological Observatory Davos, World Radiation Center

Eratosthenes Research Centre
Limassol, Cyprus

The GEO-CRADLE project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 690133.

Access to energy (Sense), Partners: PMOD/WRC, NOA

Sense: a solar energy now-casting system +

Purpose:

- demonstrate ways to maximize value and benefits at the RoI
- Create synergies with public and private sector (solar plants, energy distributors, solar energy related end-users).

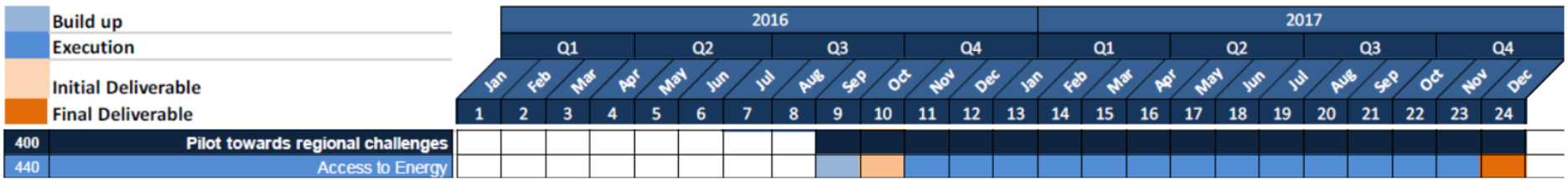
Provision of (tailored to end-user):

- Now-casting of solar radiation and solar energy
- Long term solar energy atlases for various areas with high temporal and spatial detail
- Solar radiation related products (real time and forecasts) related with: health (UV Index (melanoma), DNA damage, cataract, Vitamin D efficiency), agriculture (photosynthesis), scientific..

Access to energy (Sense), Partners: PMOD/WRC, NOA

Questions to be answered:

- Specific content, objectives and outcome of the pilot
- Input data sets (EO, future, Copernicus)
- Definition of the specific pilot sites
- Future ..



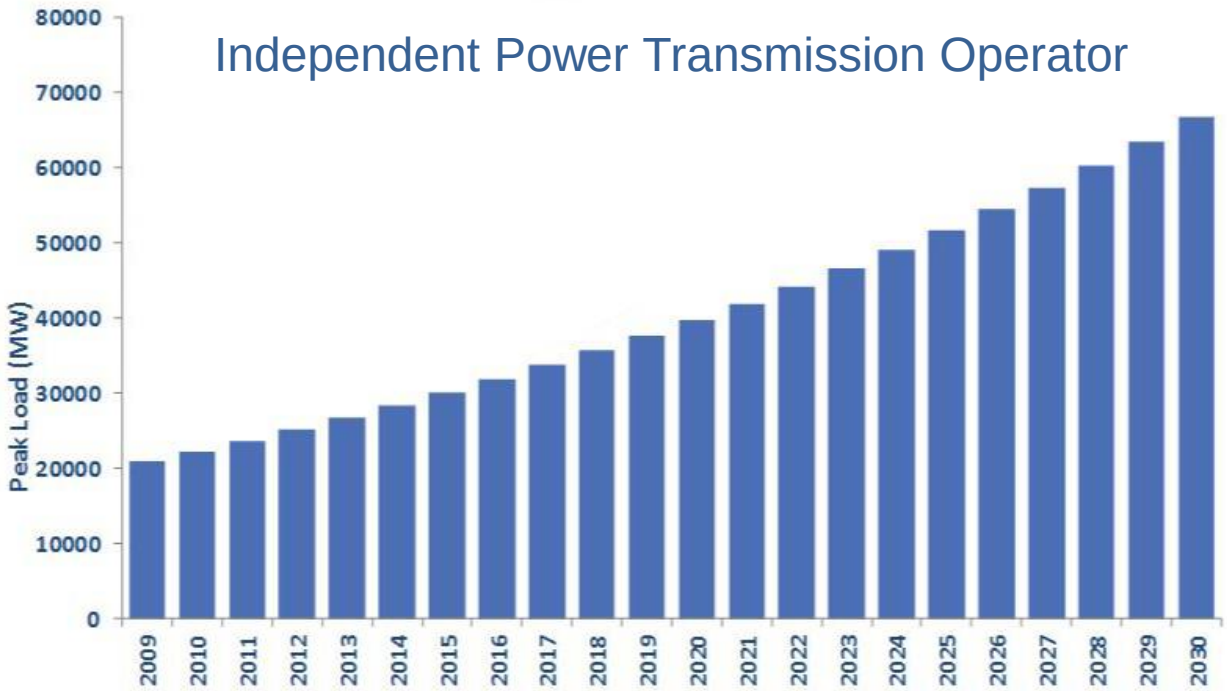
Specific content, objectives and outcome of the pilot

Identifying gaps at RoI

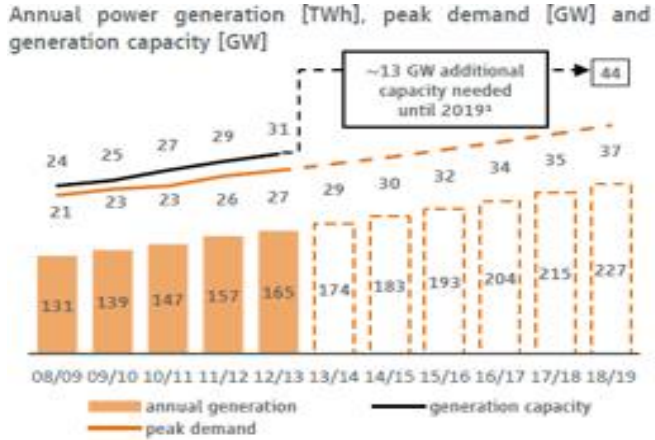
Solar energy - Greece

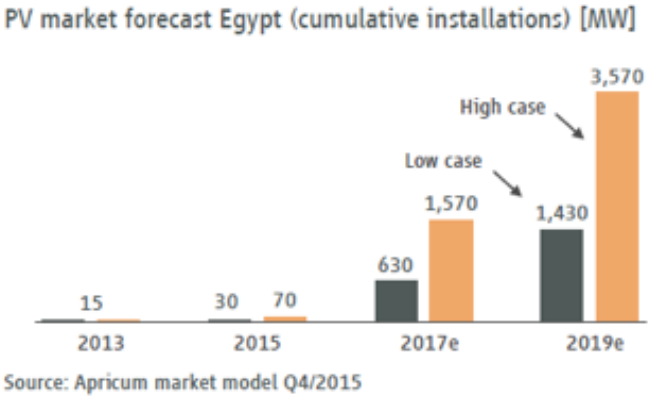
	PV (MW)
1998	0.07
1999	0.1
2000	0.2
2001	0.3
2002	0.8
2003	1.4
2004	1.7
2005	2
2010	4
2015	7

Expected Evolution of Peak Demand



Energy consumption in North Africa and Middle East

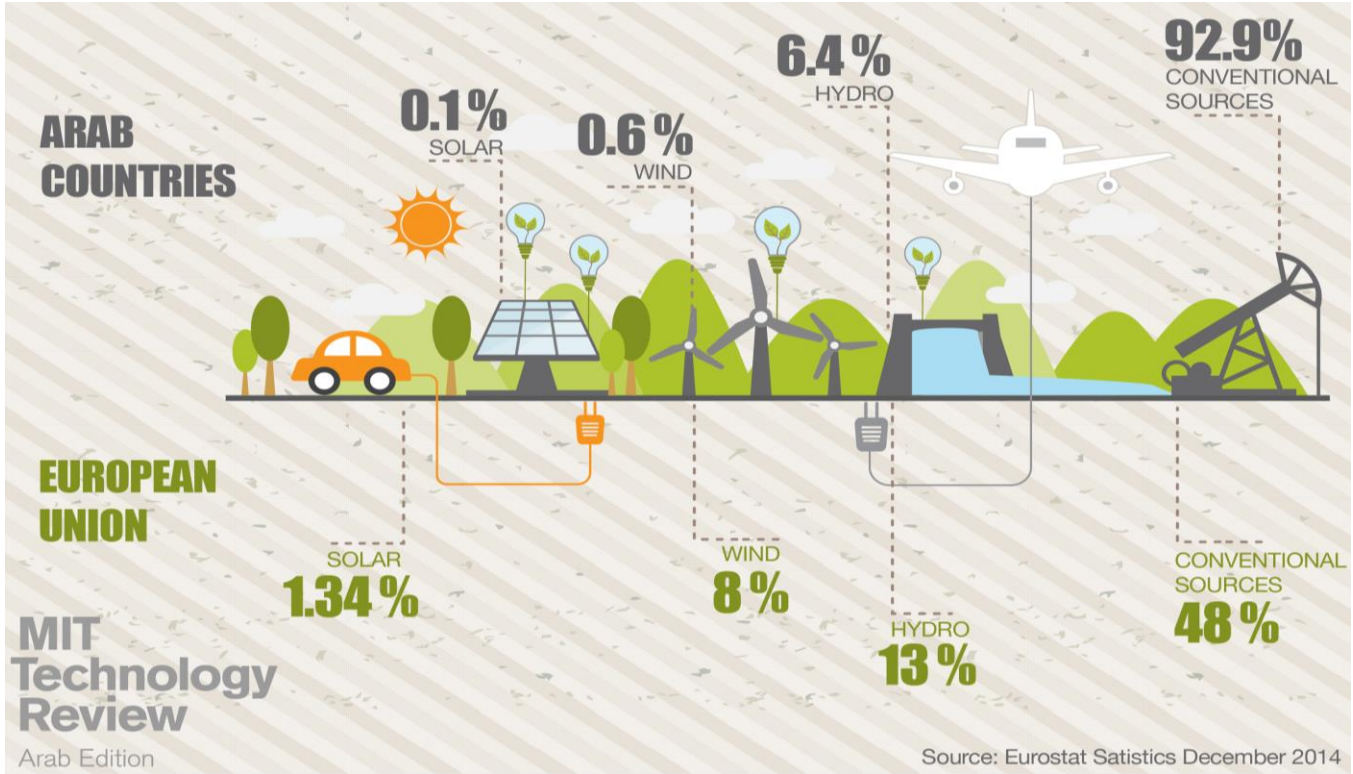




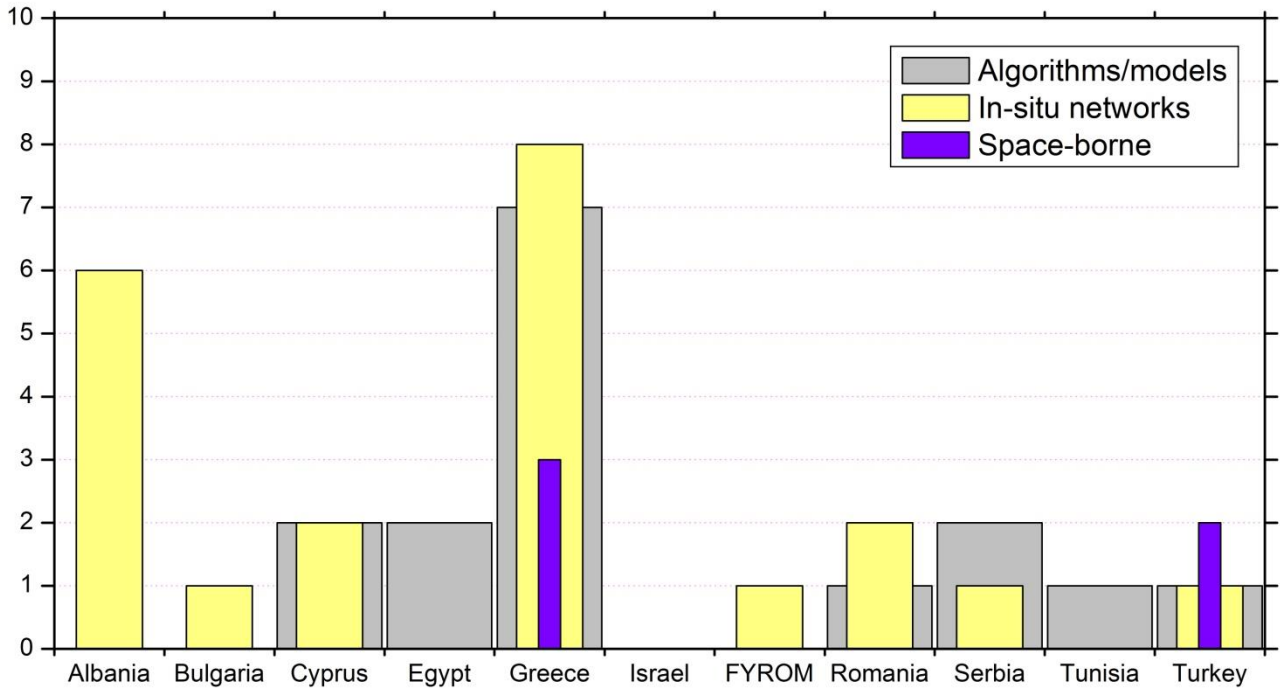
Source: Apricum market model Q4/2015

Egypt

The Expected Future Energy Status in Egypt



Link with WP2 and WP3: maturity indicators

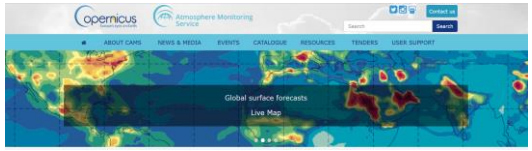


- Real-time data for the first time with SENSE
- No data policy info
- Exploitation without capacities

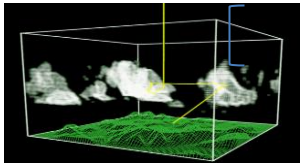
The Solar Energy Nowcasting SystEm (Sense) + EO inputs

Satellite Data

Copernicus Atmospheric Monitoring Service



Radiative Transfer models



Neural networks

START

Clear or Cloudy?

Clear sky pixel

CAMS

Input : AOD

Input : TOC

Sentinel 4, 5 and 5P

Cloud improvement
Trace gases
Aerosols

Cloud Input MSG

RT-NN system

solar radiation spectra

Solar Irradiances

Output : DNI, GHI, DHI

END

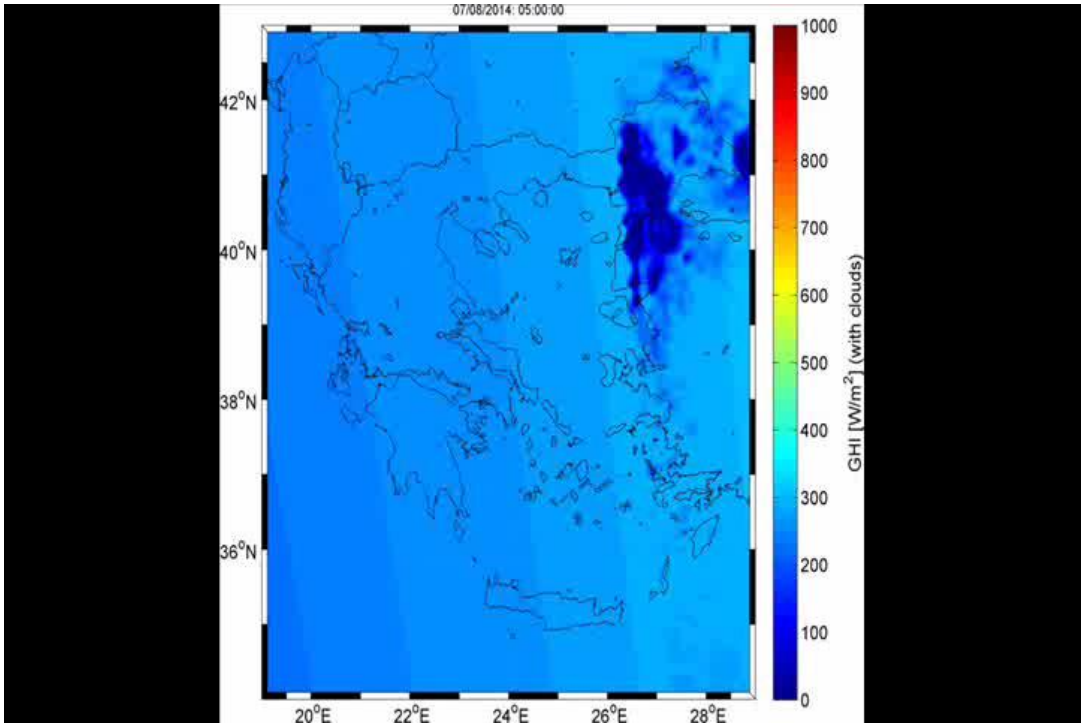
Definition of the specific pilot sites

Region	Product	Maturity	User
Greece	Energy Nowcasting + forecasting	high	Independent Energy Operator
Egypt	Nowcasting + solar atlas	Mod	Dep. Of Energy Egypt
Aegean and Adriatic sea	Solar UV Index	Mod	Superfast ferries

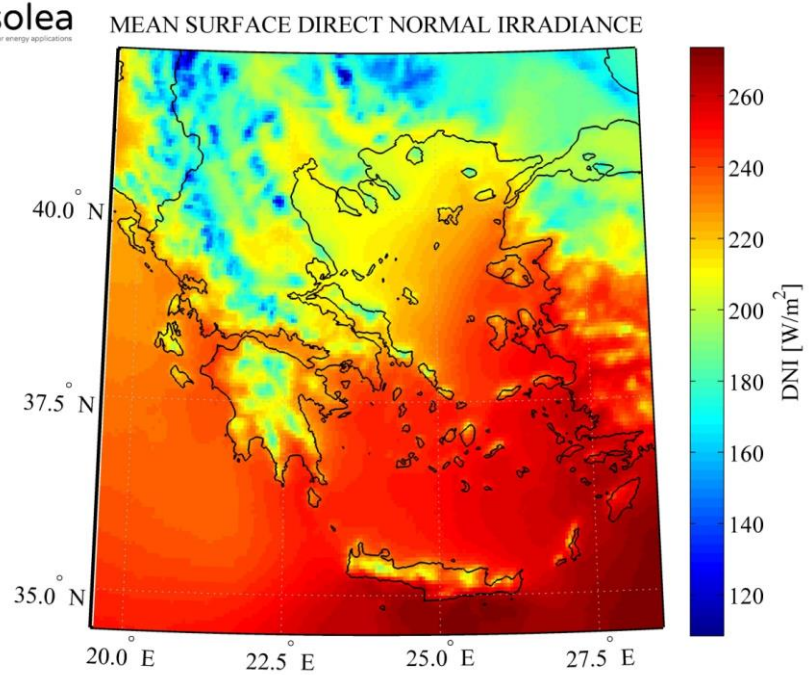
Pilot #1

Independent Power Transmission Operator, Greece

Solar Energy now-casting



Pilot #1



Optimum locations for CSP & PV installations using solar Atlas energy maps

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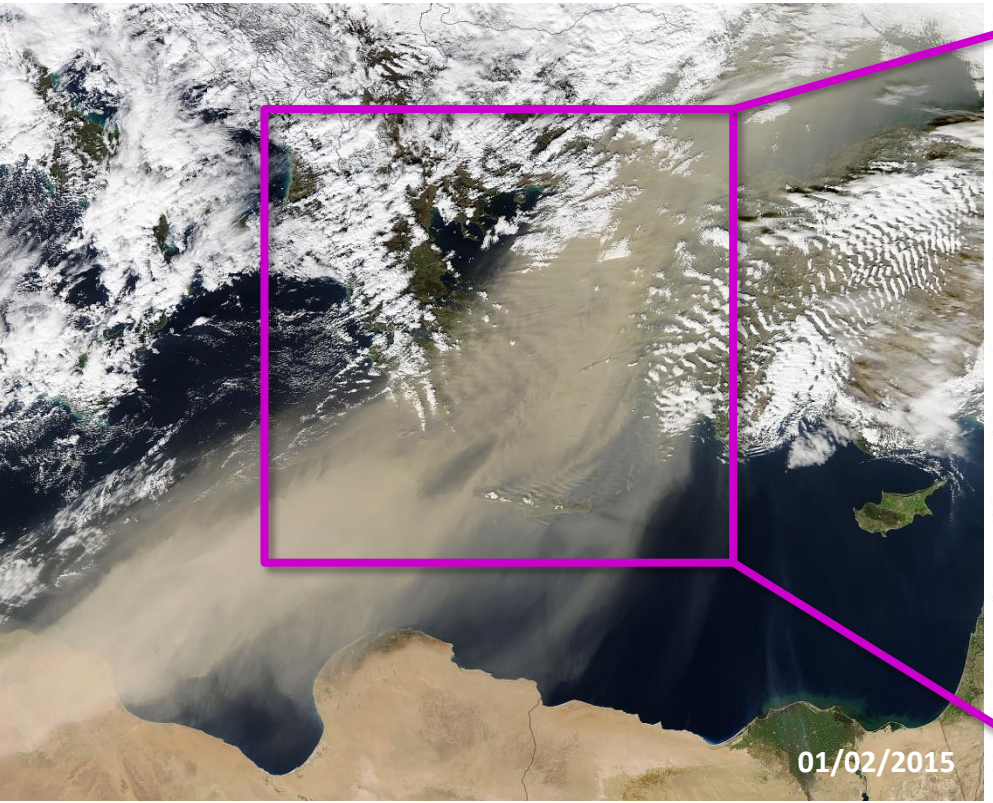
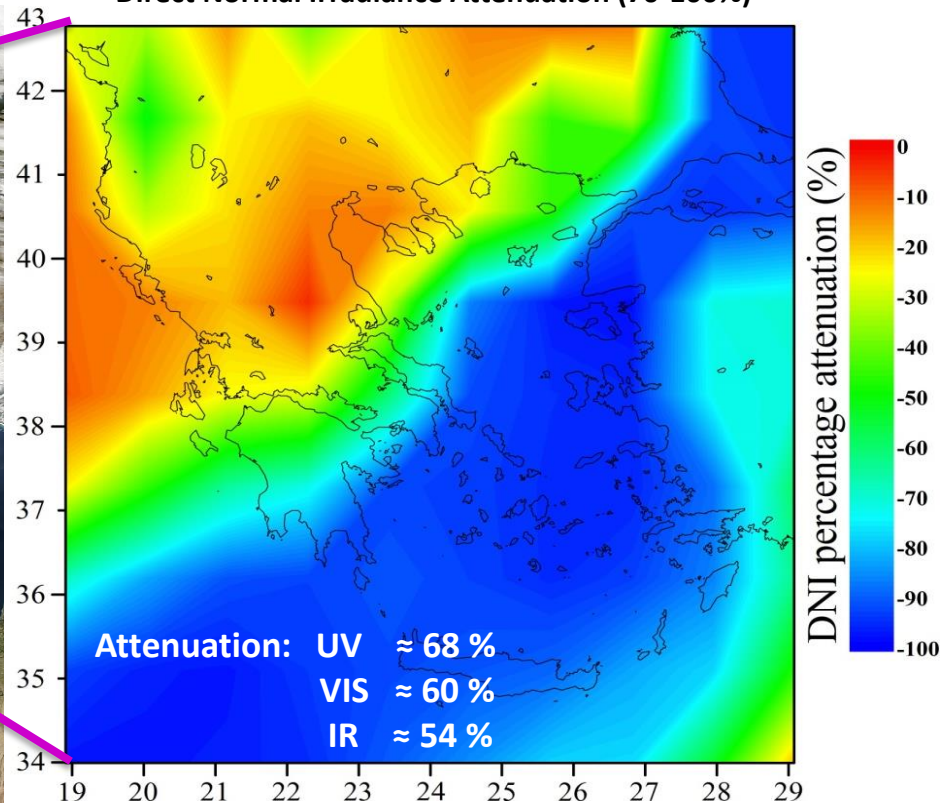
EUMETSAT: 1999-2013

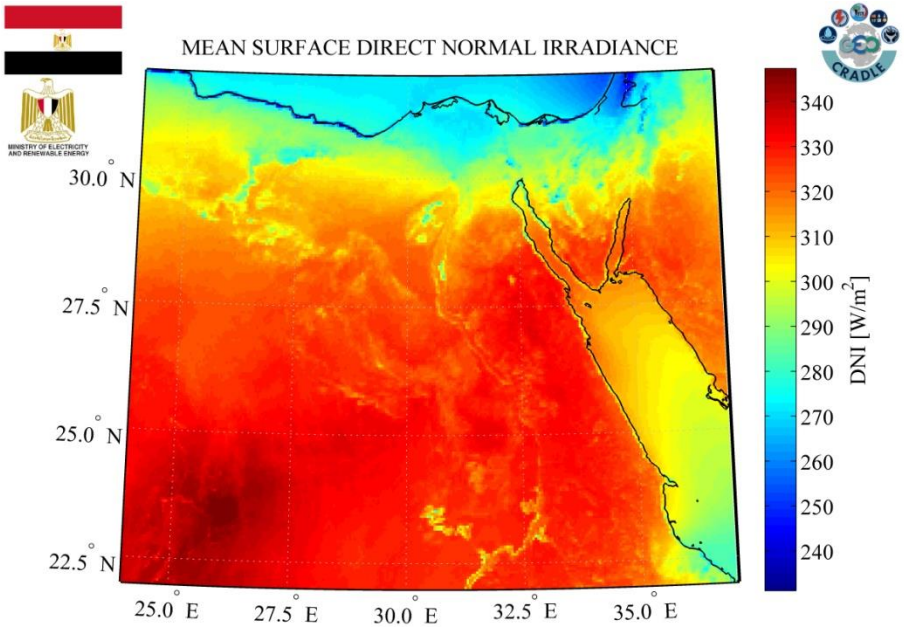
Corrections / Further research: Aerosols impact on Energy

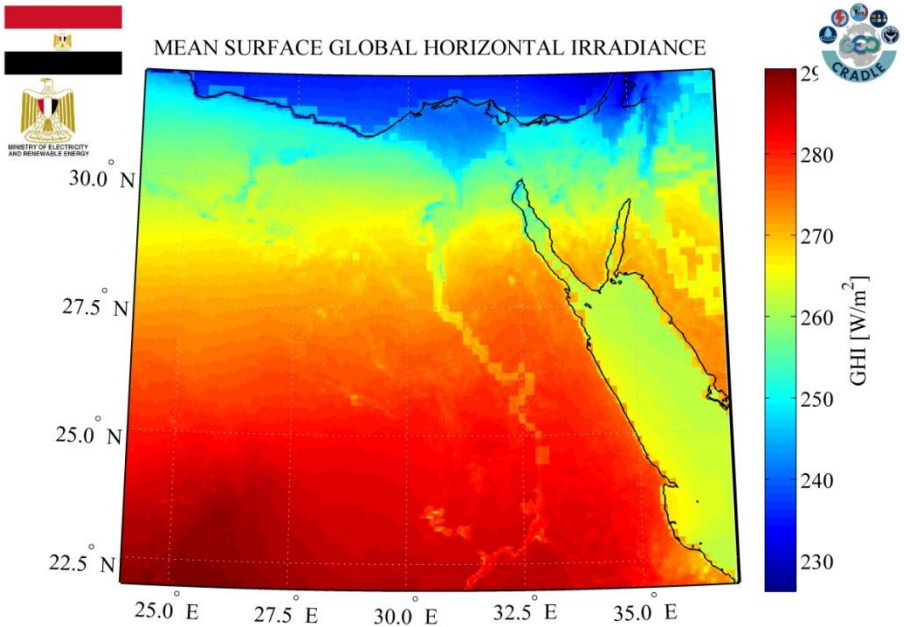




- The inclusion of cloud and aerosol effects means that this approach is ideal for correct assessments of solar power operational loads.

Solar Atlas for PV & CSP installations

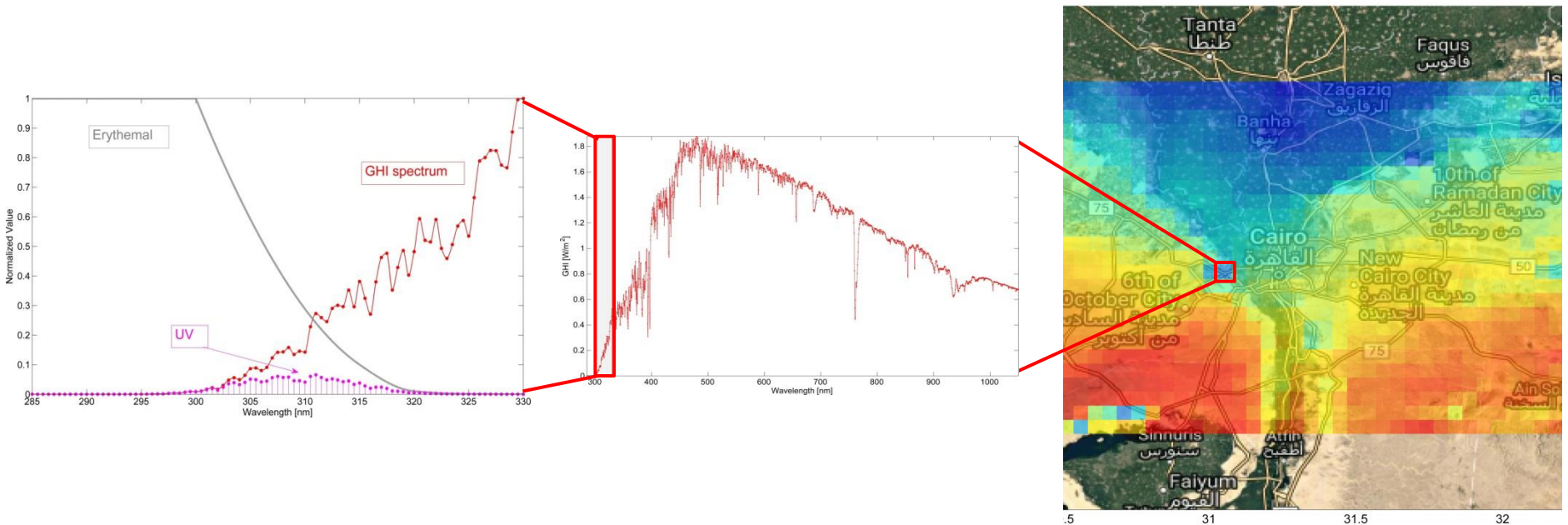




Ministry of electricity and renewable energy of Egypt

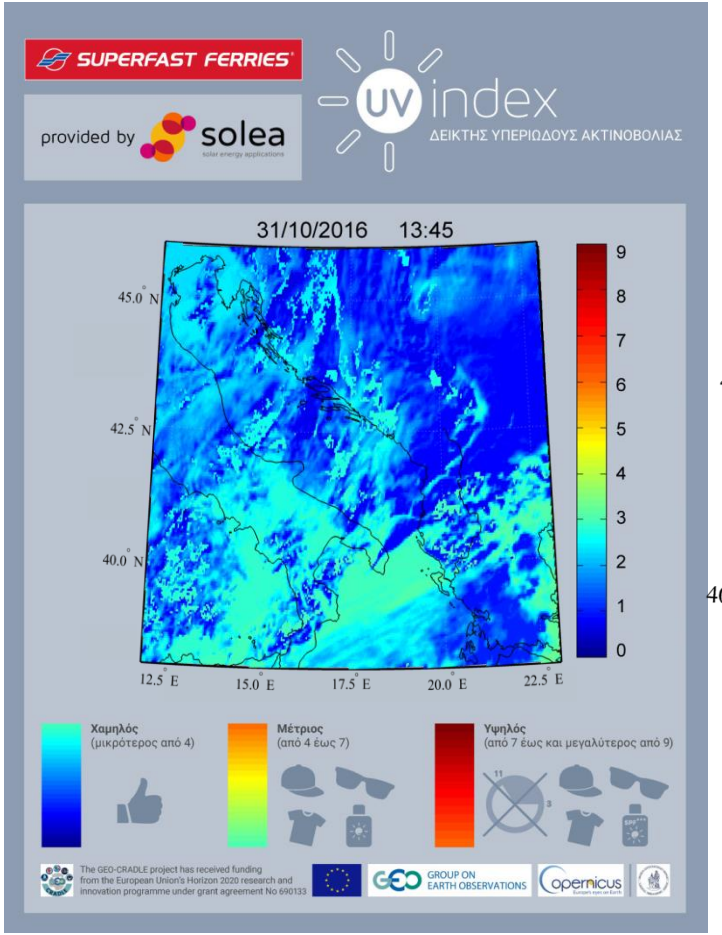
- Optimum locations for CSP & PV installations using solar Atlas energy maps

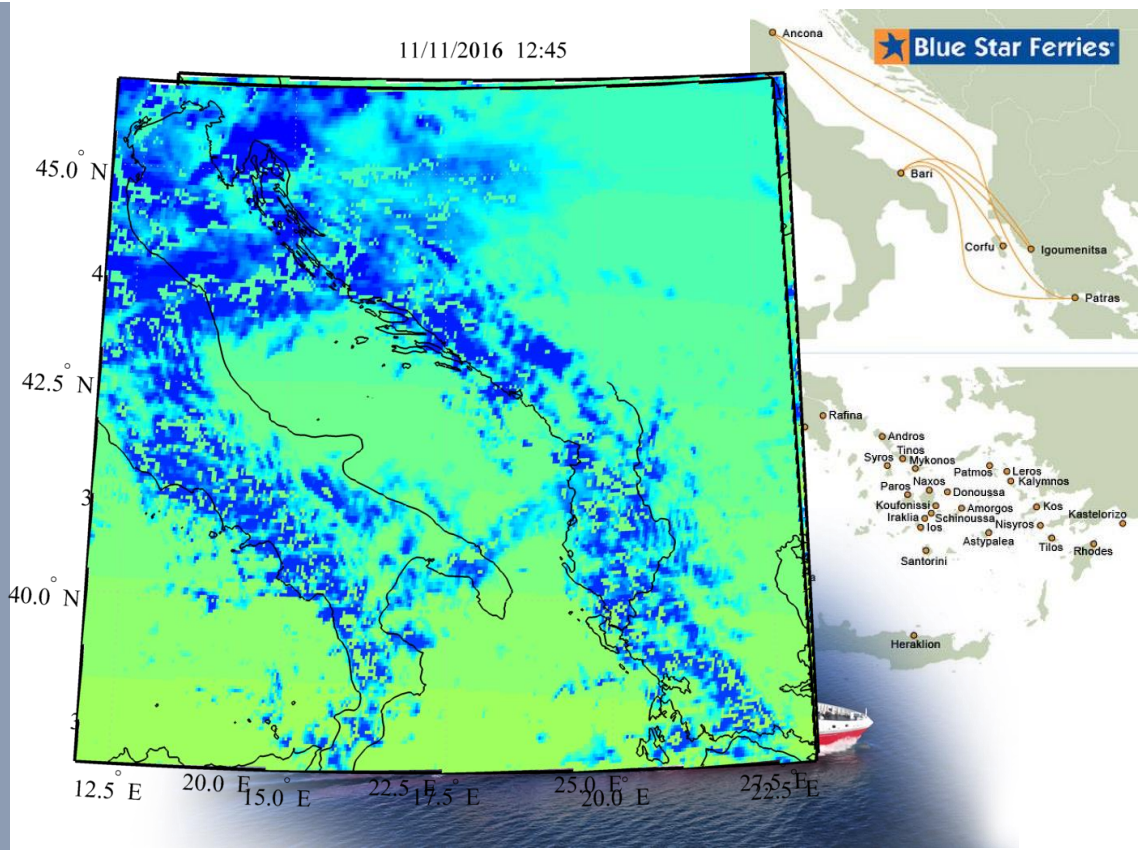
Behind each pixel lies a full solar spectrum



➢ A zoom sequence showing the deep science behind the solar energy maps. Going from right to left: the Global Horizontal Irradiance for Cairo, the insolation spectrum in a single pixel, and finally, the spectrally-weighted UV radiation spectrum.

End-user Attica Group





Time table

Region	Product	Start	end
Greece	Energy Now casting forecasting Solar atlas	01/17 07/17 01/17	12/17 12/17 4/17
Egypt	Nowcasting solar atlas	01/17 01/17	12/17 4/17
Aegean and Adriatic sea	Solar UV Index	01/17	12/17

Long term funding: Science towards applications

Private sector (direct, indirect).

Public sector (energy operators, EPAs, public information sectors e.g. weather and meteorology related bodies)

Government based initiatives

EU projects (GEOS related, user oriented products, case studies)

Bilateral calls

Copernicus related calls

Purpose:

- **demonstrate ways to maximize value and benefits at the RoI**

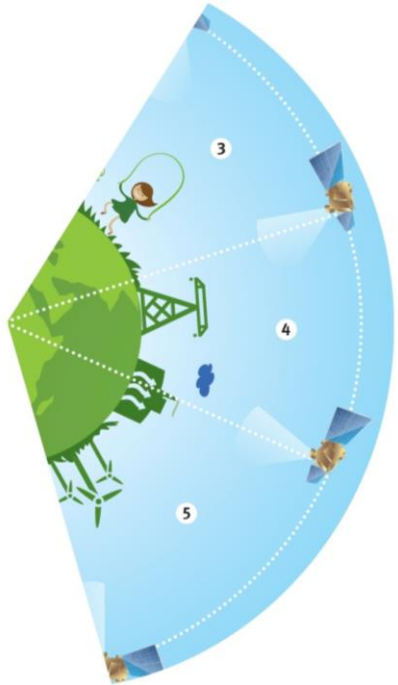
Sense can be implemented anywhere on RoI – tailored products

- **Create synergies with public and private sector (solar plants, energy distributors, solar energy related end-users).**

Through GEO-Cradle, new projects, conferences to "advertise" the product.
Spin-off opportunity.

Thank you


3 PUBLIC HEALTH
4 ENERGY MANAGEMENT
5 CARBON MANAGEMENT


3
4
5

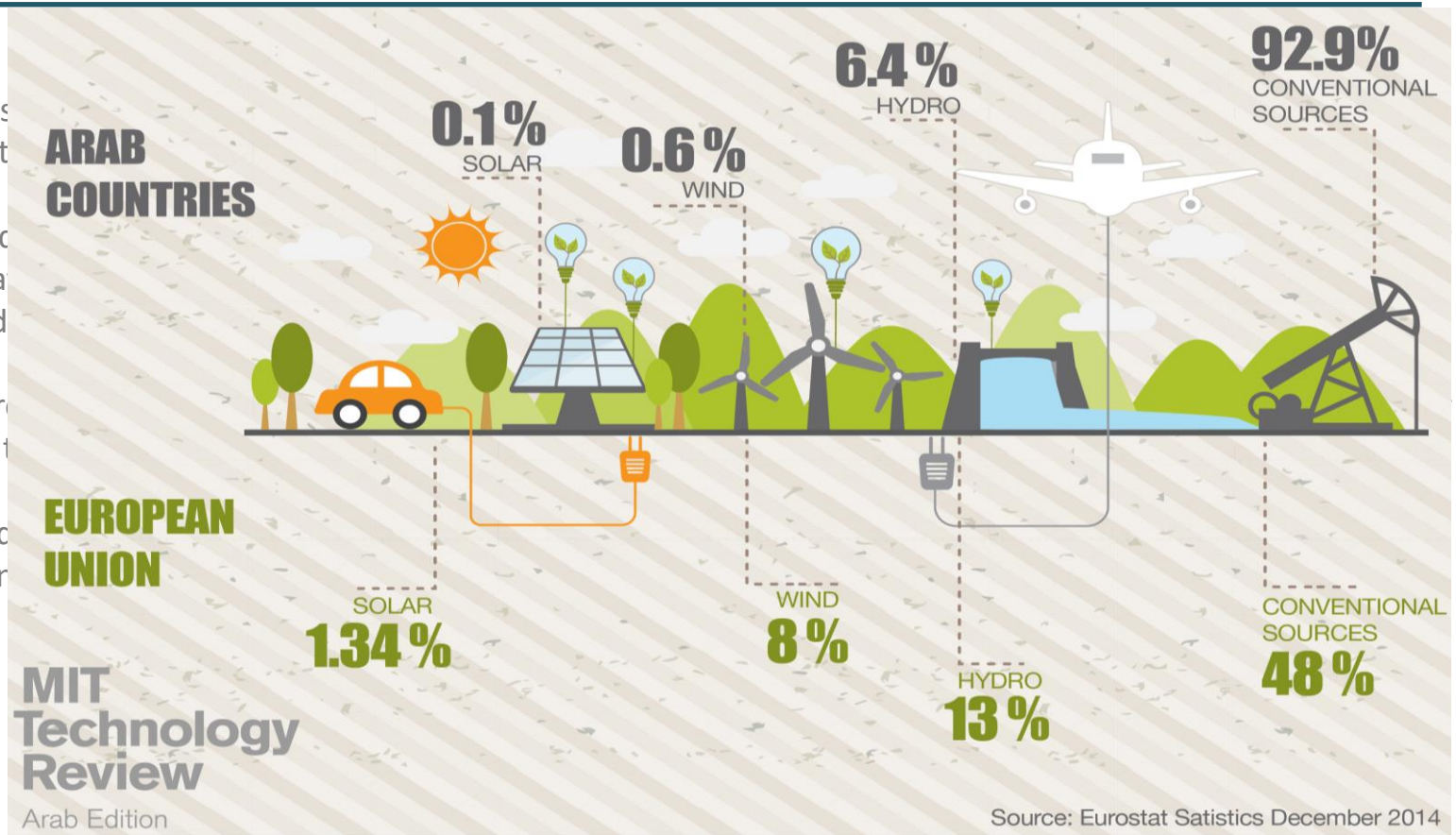
User needs – Capacities – Maturity in Energy

Equitable access
economic activit

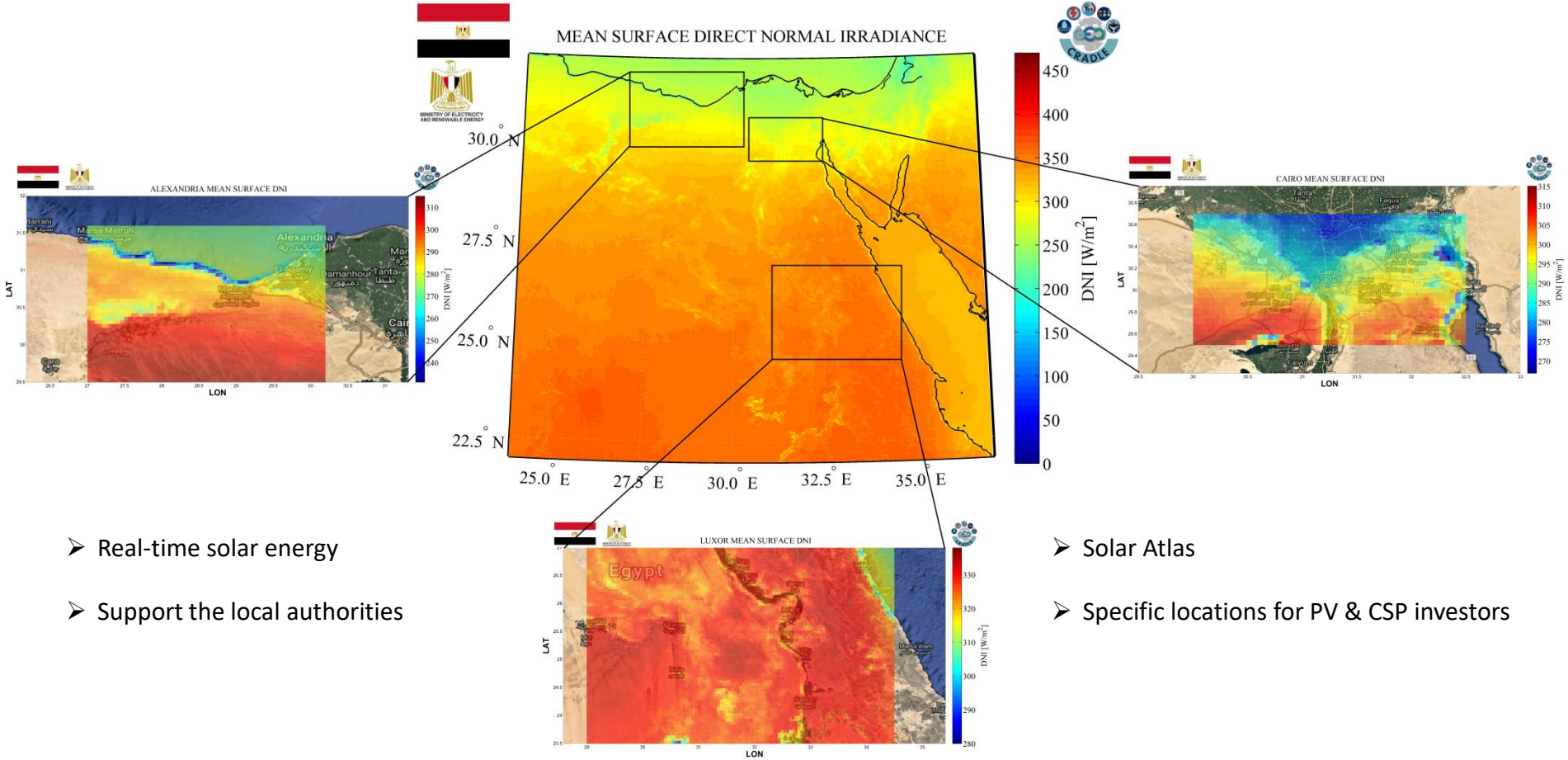
Exploitation and
efficiency, and a
energy standard

Demographic tr
investments on t

North Africa and
has been demor



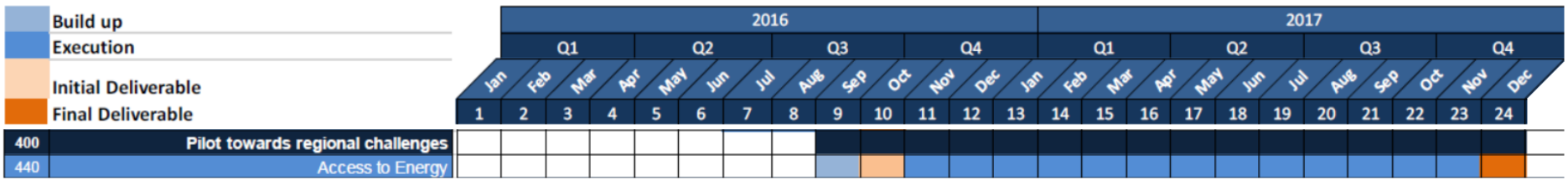
Egyptian Ministry of Electricity and Renewable Energy



- Real-time solar energy
- Support the local authorities
- Solar Atlas
- Specific locations for PV & CSP investors

Timetable

The Solar Energy Nowcasting SystEm (SENSE) pilot comes to unite the multifarious regional s
sustainable development policies with the nowadays available capacities and state-of-the-art
use of developed and improved EO and CAMS real time and climatology services, products
pilot aims to stimulate the interest of relevant stakeholders and decision makers like Minis
Renewable Energies (Egypt), Electric Power Transmission Operators (Greece) and Solar Ene
private sector.



This pilot activity will span a period of 15 months and based on the in-depth analysis per
WP300 now is totally refined and customized to the specialized regional needs.

Link with WP2 and WP3: user needs analysis

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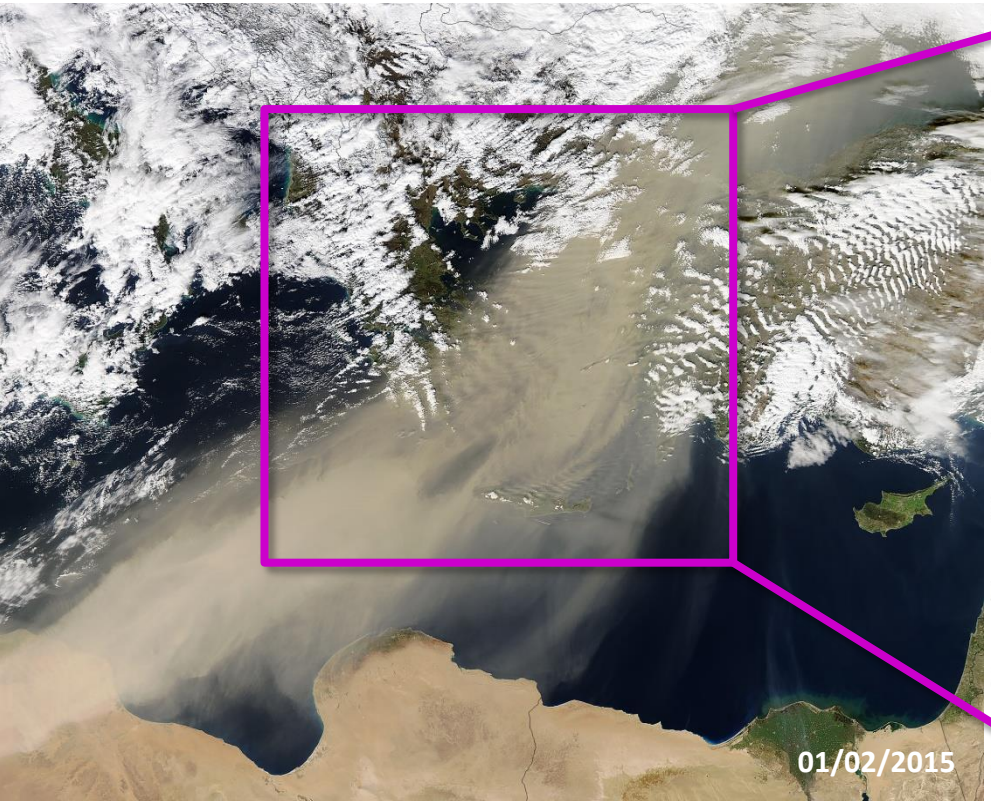
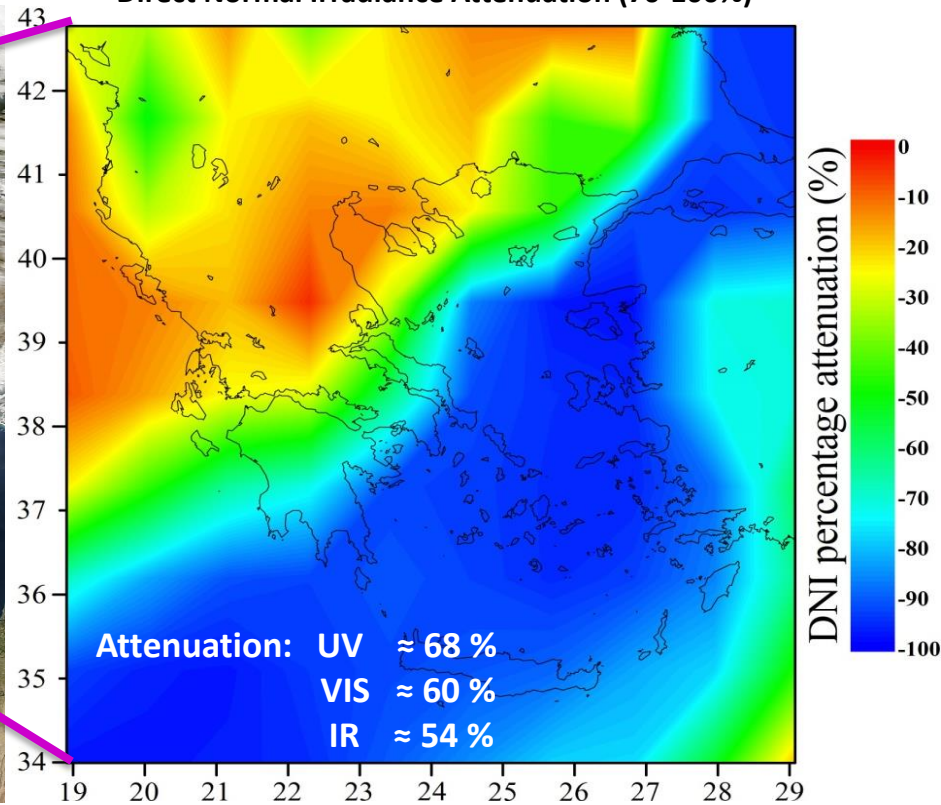
ΜΕΤΑΦΟΡΑΣ ΗΛΕΚΤΡΙΚΗΣ ΕΝΕΡΓΕΙΑΣ

- Control the energy demands

Corrections / Further research: Aerosols impact on Energy





- The inclusion of cloud and aerosol effects means that this approach is ideal for correct assessments of solar power operational loads.

Regional needs related to Energy

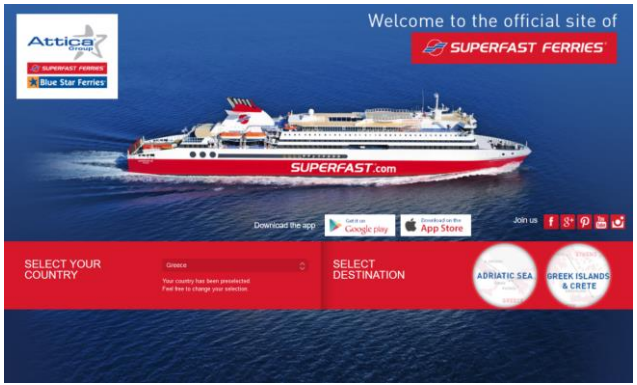
North Africa, Middle East and Balkans are places with a serious amount of solar energy potential and its exploitation is critical for their national sustainable development through an efficient energy planning and a gradual independence from fossil fuels.

The currents solar energy EO capacities in the RoI are degraded and as a result this field needs a complete and comprehensive revision and promotion in order to be established as a main contributor to national portfolios.

The SENSE pilot comes to fulfill these regional needs for optimum solar energy exploitation and for active and effective integration of these technologies to the national sustainable development economies and strategies.

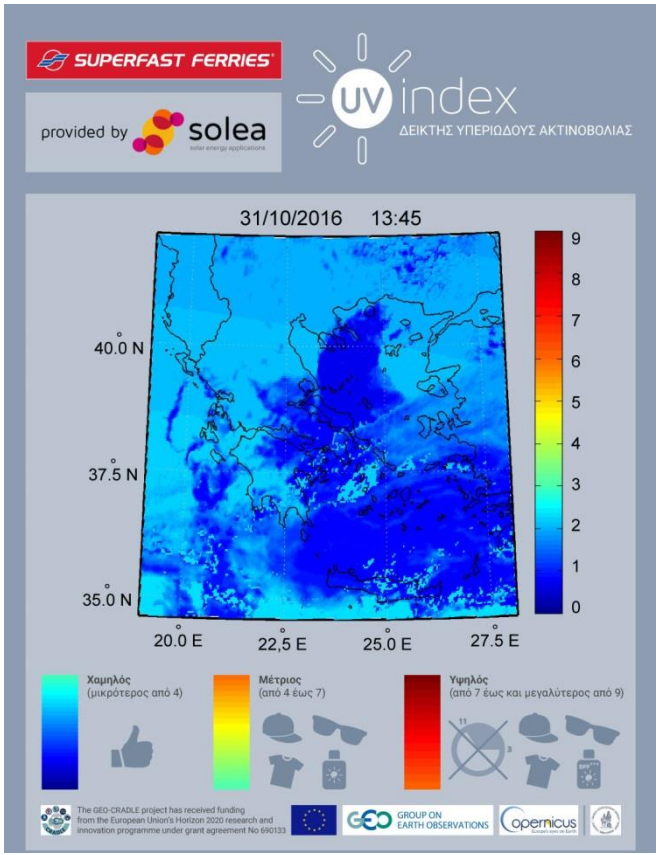
The quantification of the clouds' and aerosols' impact on the solar energy potential guarantees the reliability of the SENSE pilot. Simultaneously, the synergistic inclusion from models, ground-based and satellite-based databases can be applied to the real time pilot services as well as to the solar Atlases requested from major regional end users.

Private Sector



- More than 4.5 M passengers
- Health-based pilot service

UV-index



References

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M. Taylor, P.G. Kosmopoulos, S. Kazadzis, I. Keramitsoglou, C.T. Kiranoudis, 2015. Neural network radiative transfer solvers for the generation of high resolution solar irradiance spectra parameterized by cloud and aerosol parameters. *Journal of Quantitative Spectroscopy & Radiative Transfer, 168, pp 176-192*

P.G. Kosmopoulos, S. Kazadzis, K. Lagouvardos, V. Kotroni, A. Bais, 2015. Solar Energy prediction and verification using operational model forecasts and ground-based solar measurements. *Energy, Vol. 93, DOI: 10.1016/j.energy.2015.10.054, pp 1918-1930.*

PG. Kosmopoulos, M. Taylor, S. Kazadzis, 2015. The SOLEA Project: nowcasting solar energy spectra and UV products. *15th European Meteorological Society (EMS) Annual Meeting & 12th European Conference on Applications of Meteorology (ECAM), Sofia, Bulgaria, 7-11 September 2015.*

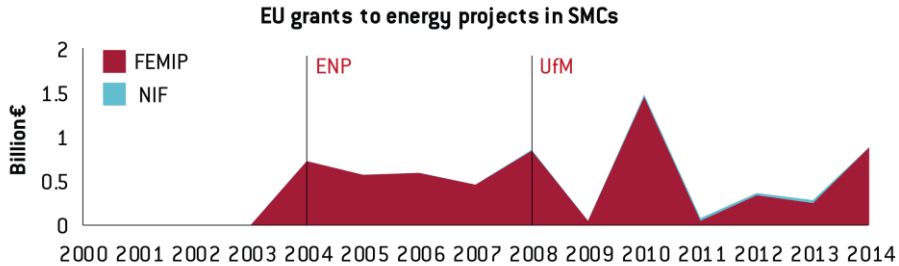
M. Taylor, P.G. Kosmopoulos, S. Kazadzis, I. Keramitsoglou, C.T. Kiranoudis, 2015. A machine learning approach to derive surface solar irradiance spectra directly from satellite. *15th European Meteorological Society (EMS) Annual Meeting & 12th European Conference on Applications of Meteorology (ECAM), Sofia, Bulgaria, 7-11 September 2015.*

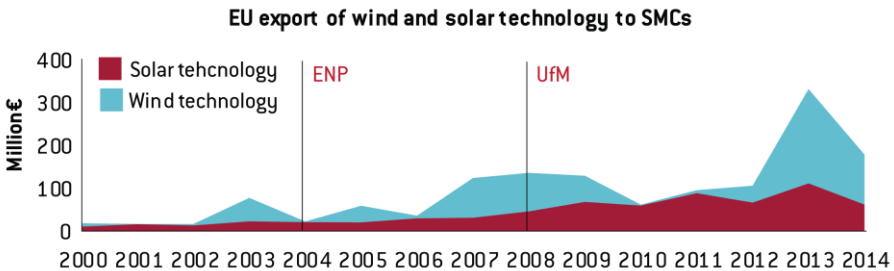
P.G. Kosmopoulos, M. Taylor, S. Kazadzis, 2016. A model of dust episode impact on surface solar irradiance. *International Skynet Workshop, Rome, Italy, 2-4 March 2016.*

P.G. Kosmopoulos, M. Taylor, S. Kazadzis, 2016. Solar energy potential nowcasting and forecasting services in real time. Invited talk at the *Independent Power Transmission Operator (IPTO or ADMIE), Athens, Greece, 15 April 2016.*

P.G. Kosmopoulos, S. Kazadzis, M. Taylor, A. Bais, K. Lagouvardos, V. Kotroni, I. Keramitsoglou and C. Kiranoudis, 2016. Estimation of the solar energy potential in Greece using satellite and ground-based observations. *13th International Conference on Meteorology, Climatology and Atmospheric Physics, COMECAP 2016, Thessaloniki, Greece, 19-21 September 2016.*

Access to Solar Energy from the Southern Mediterranean countries (SMCs)





ENP: EU Neighborhood Policy UfM: Union for the Mediterranean

After almost two decades of unproductive regional cooperation attempts, the EU should reshape its energy cooperation efforts in the Mediterranean through new bilateral approaches. In concrete terms, we propose the establishment of Sustainable Energy Funds with selected SMCs.

This would allow support to be provided to sustainable energy projects in partner countries, making them more economically stable and safeguarding the EU's gas security of supply. This might also represent a significant business opportunity for the EU energy industry, especially in the context of the sluggish EU energy outlook.

Coordinating and integRating state-of-the-art Earth Observation Activities in the regions of North Africa, Middle East and Balkans and Developing Links with GEO related intiatives toward GEOSS

GEO-CRADLE Project Meeting 2
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Energy application for GEO-CRADLE, overview of the pilot activity

Stelios Kazadzis

Physical Meteorological Observatory Davos, World Radiation Center

pmod wrc

Eratosthenes Research Centre
Limassol, Cyprus

The GEO-CRADLE project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 690133.

Update

- Very brief description of the task at hand in WP4 (pilot activities).
- Acknowledgement of inputs from previous WPs, namely the inventory of capacities and user needs analysis from WP2 and the gap analysis, indicators and priorities from WP3.
- Bridge outputs of WP2/3 with WP4.
- Propose your pilot project idea in detail – but don’t obsess too much with the technical part.
- Describe **how** your pilot project addresses the needs of the RoI.
- Focus on the sustainability of your pilot project and its long term prospects.

T4.4 SENSE

Insert a Gantt chart or a timetable briefly outlining the key milestones of your pilot activities.

DO:
Provide a high level abstract description of the key inputs / outputs
Set feasible milestones
Have internal skype meetings to keep everything on track
Discuss with the regional coordinators and the project coordinator

DON'T:
Overanalyze
Discuss technical details in the timetable

Session on Access to Solar Energy

II) PARALLEL SESSION ON ACCESS TO SOLAR ENERGY (in parallel with Session I)

12:00-13:15 Support and improvement of the regional EO infrastructures through the Solar Energy Nowcasting SystEm (SENSE)

- 15' Energy application for GEO-CRADLE, overview of the pilot activity

  Speaker: **Stelios Kazadzis**, Physical Meteorological Observatory Davos / World Radiation Center (PMOD/WRC), Switzerland
- 15' Update on the use of EO and Copernicus related products for the energy pilot

  Speaker: **Panagiotis Kosmopoulos**, National Observatory of Athens (NOA), Greece
- 15' Pilot applications for Greece and Egypt related end-users

  Speakers:

  Panagiotis Kosmopoulos, National Observatory of Athens (NOA), Greece

  Hesham El-Askary, Centre for Environment and Development for the Arab Region and Europe (CEDARE), Egypt
- 15' Discussion on the pilot areas to be used for GEO-CRADLE
- 15' Q&A