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
16th November, 2016

Pilot applications for Greece and Egypt related end-users

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

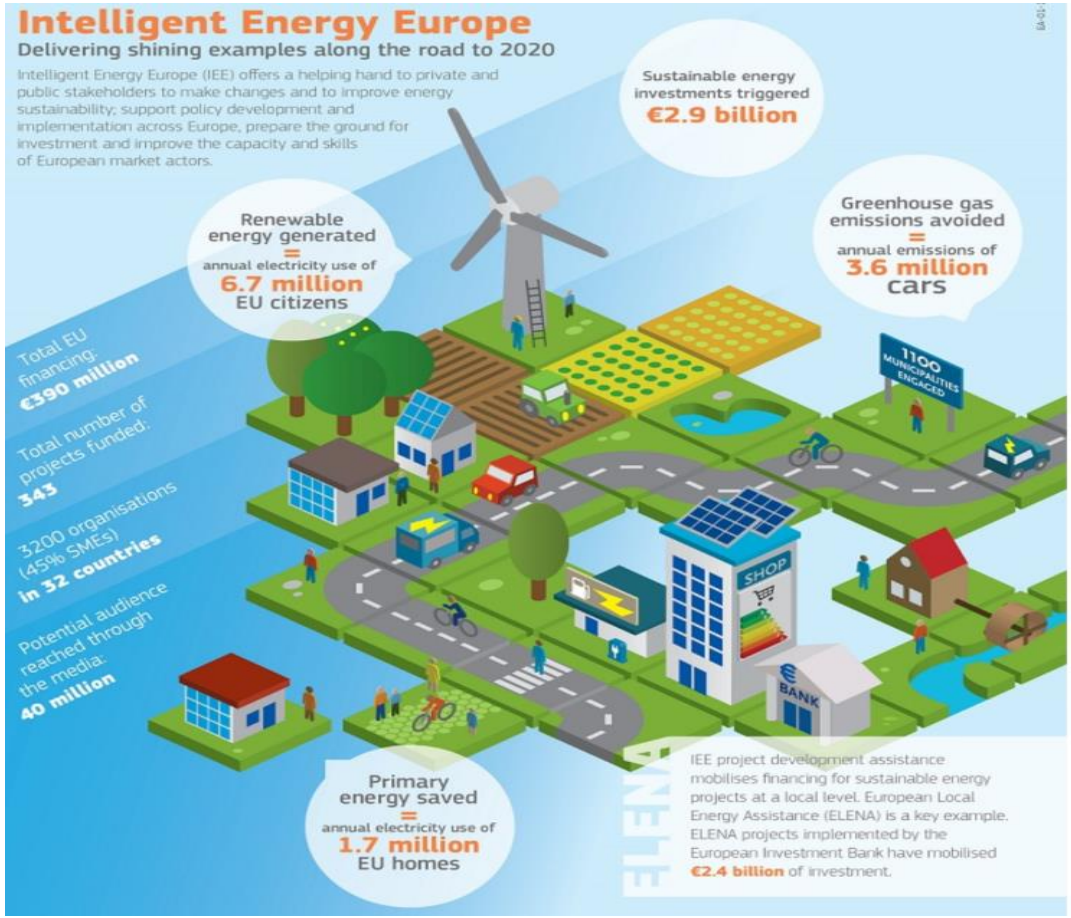
Regional needs related to Energy

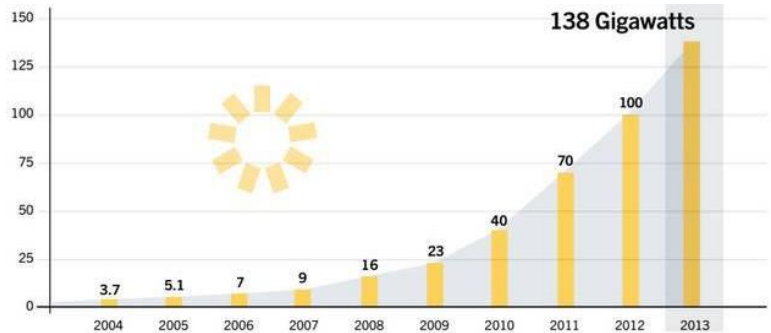
North Africa, Middle East and Balkans are places with a serious amount of solar energy potential and its exploitation is critical for their national sustainable development through an efficient energy planning and a gradual independence from fossil fuels.

The current 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.

Regional Users – Market Uptake





SENSE pilot initial roadmap

➢ Solar energy related interviews have revealed a variety of different aspects that are linked with the initial proposal of the SENSE pilot activities. As a result we re-introduce the Refined Solar Energy Nowcasting SystEm (SENSE) Pilot, the scope of which was established based on the specialized regional needs and existing maturity in relation to ''access to energy''.

➢ We took into account the results of the WP2 and WP3 with purpose to better refine the scope, objectives and upgraded methodologies of the SENSE pilot. From the results of WP2 and WP3 we concluded that there are potential end-users for the application of the SENSE pilot.

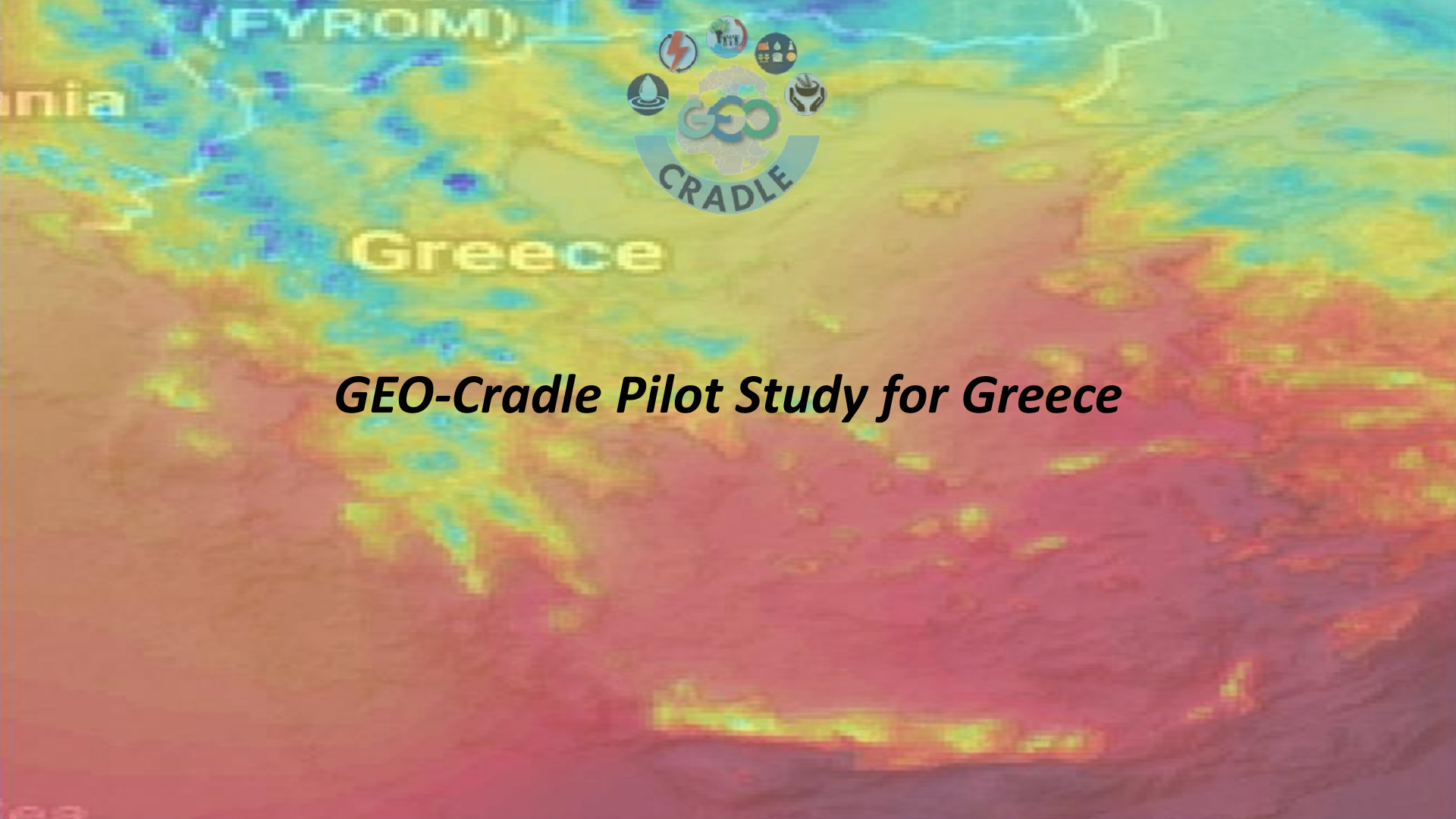
➢ Starting from Greece and Egypt, we discussed with the local stakeholders and we finally agreed to provide:

(i) the GHI nowcasting service to the Independent Power Transmission Operator (IPTO) of Greece

(ii) the same nowcasting service with additional the full solar Atlas of GHI and DNI to the Ministry of Electricity and Renewable Energy of Egypt

(iii) we will also provide the nowcasting UV-index service for the Bluestar and Superfast Ferries (private sector). This service is going to play at 13 ships which have connections to the Adriatic and Aegean Sea.

➢ From the other countries we could potentially achieve a collaboration with Romania (CEZ Trade and Tractabel Engineering SA GDF SUEZ) and Saudi Arabia (ARAMCO) concerning the solar energy nowcasting and Atlas services, something that we are hoping to be clarified in this meeting.

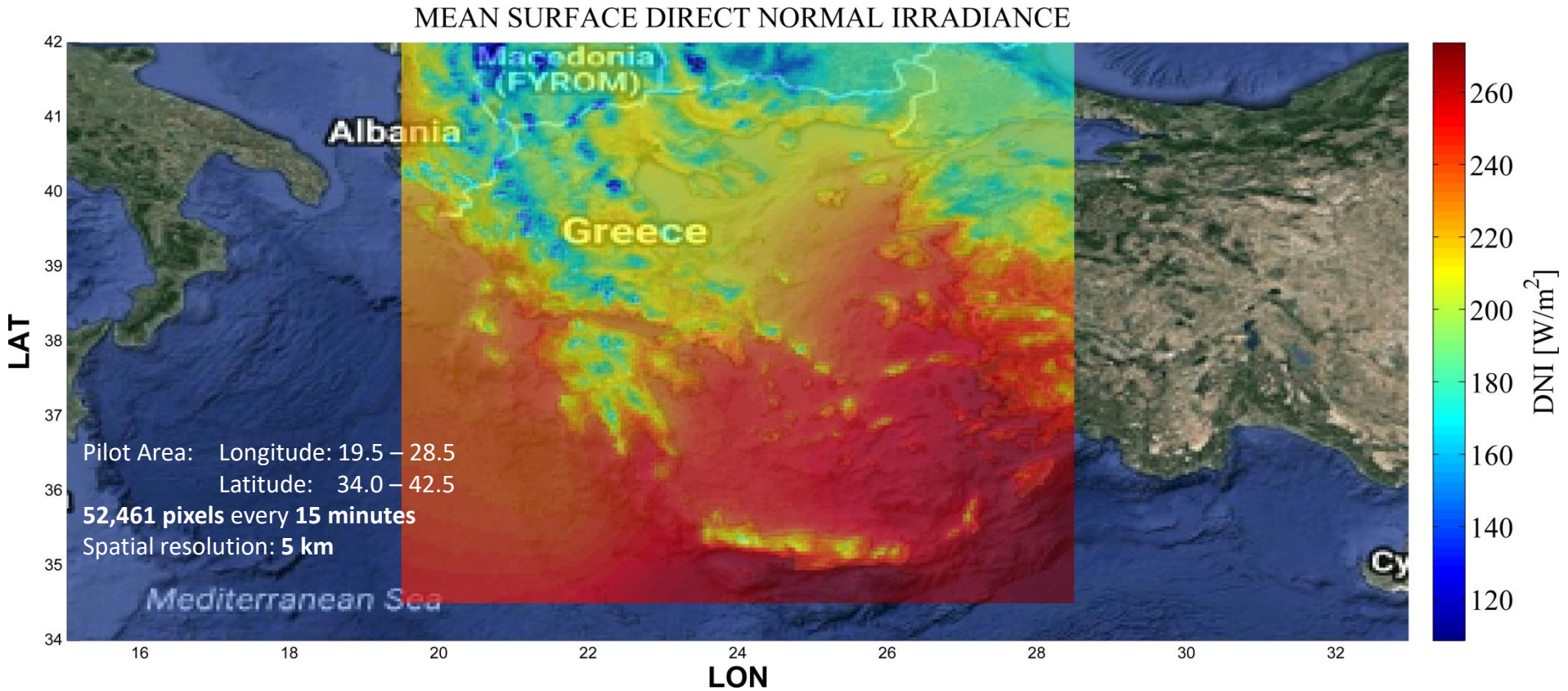


GEO-Cradle Pilot Study for Greece

Solar Energy production from PVs & CSPs in 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

SENSE pilot area

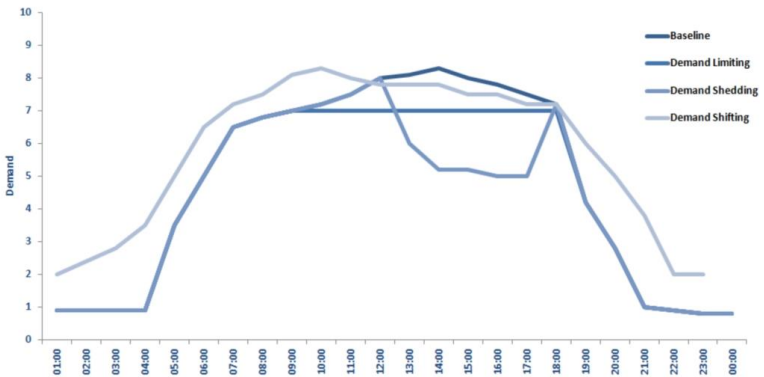


End-user IPTO

➢ IPTO is the Independent Power Transmission Operator for Greece

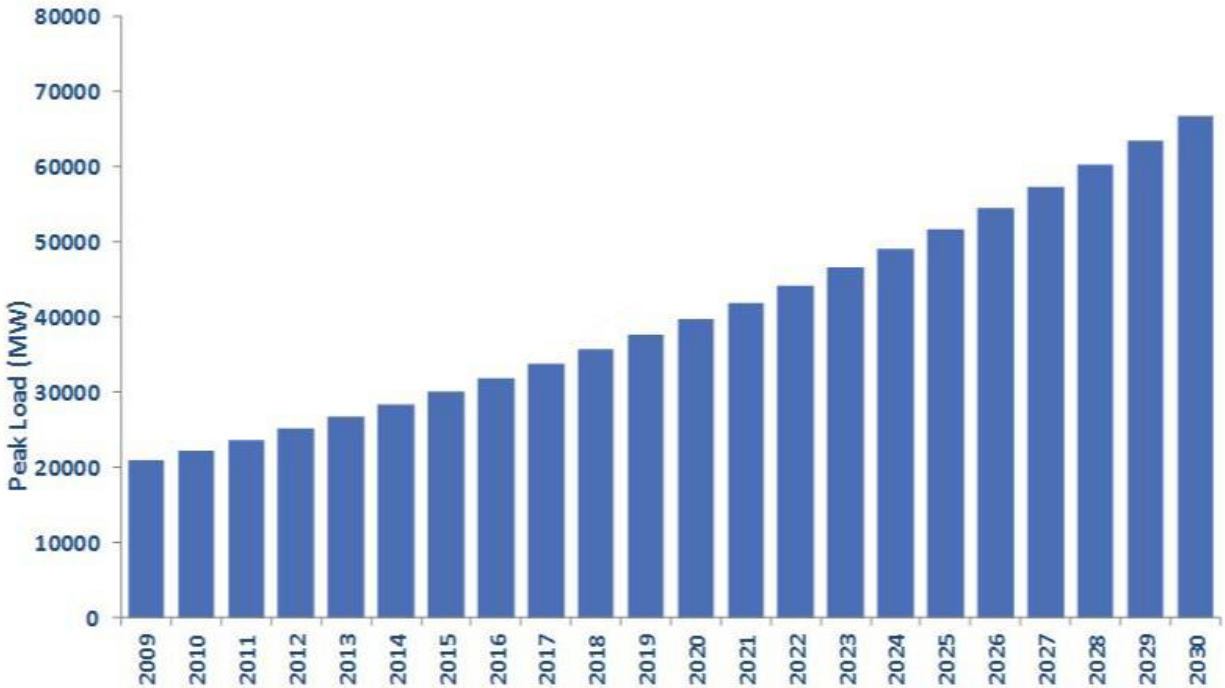
➢ Control the energy demands

ΑΔΜΗΕ
ΑΝΕΞΑΡΤΗΤΟΣ ΔΙΑΧΕΙΡΙΣΤΗΣ
ΜΕΤΑΦΟΡΑΣ ΗΛΕΚΤΡΙΚΗΣ ΕΝΕΡΓΕΙΑΣ



Example of the effect of implementing Demand-Side Management Strategies on the daily demand curve

Expected Evolution of Peak Demand



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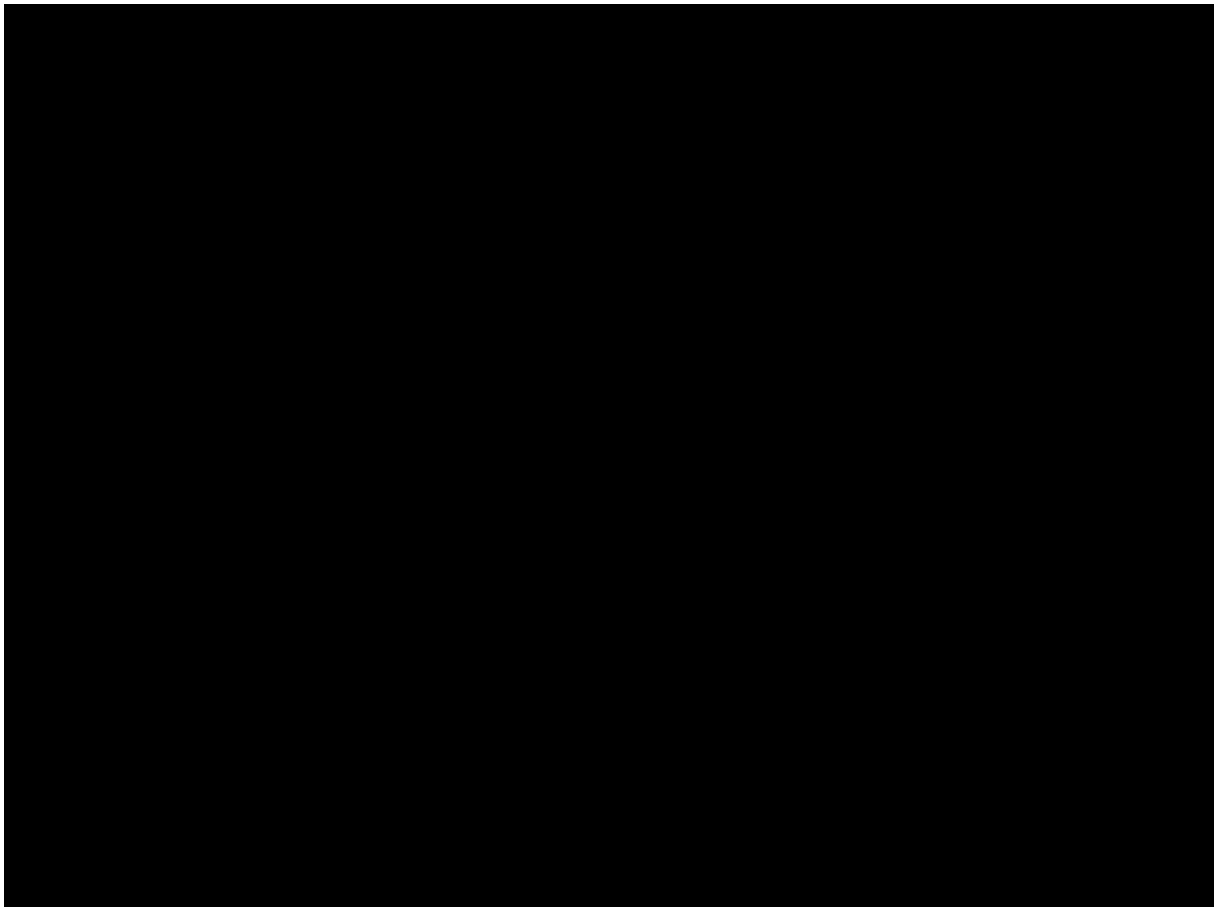
SENSE application for IPTO

Operational energy planning with nowcasting and short-term forecasting services in real-time



Efficient control the solar energy demands and solar energy production

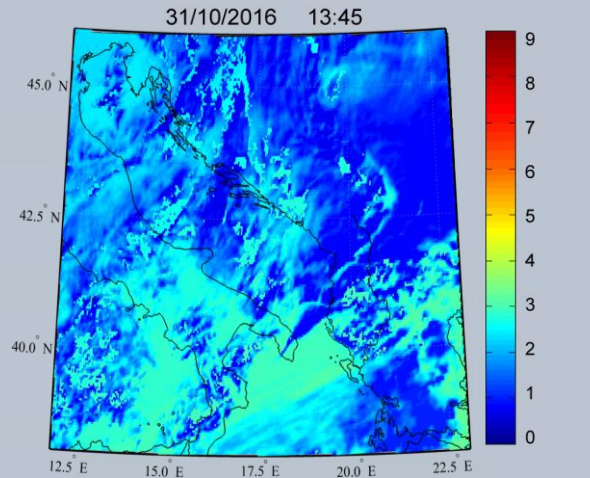
End-user Attica Group

SUPERFAST FERRIES

provided by solea

UV index

ΔΕΙΚΤΗΣ ΥΠΕΡΙΩΔΟΥΣ ΑΚΤΙΝΟΒΟΛΙΑΣ



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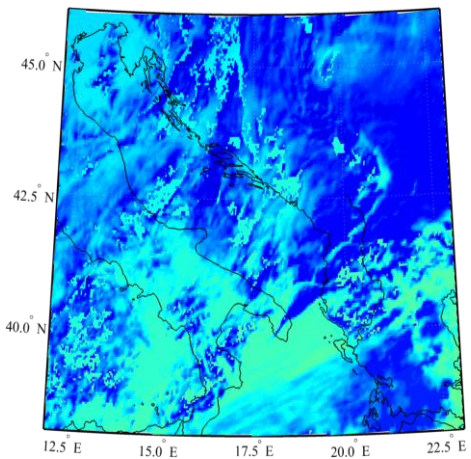
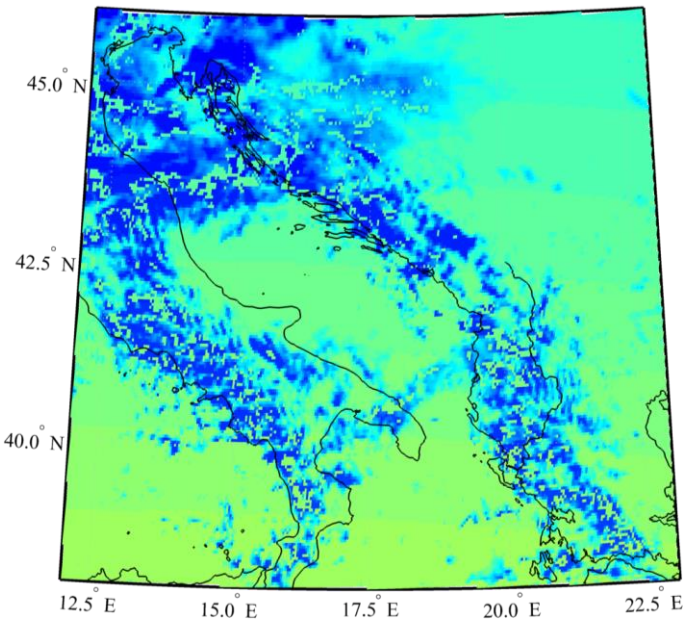
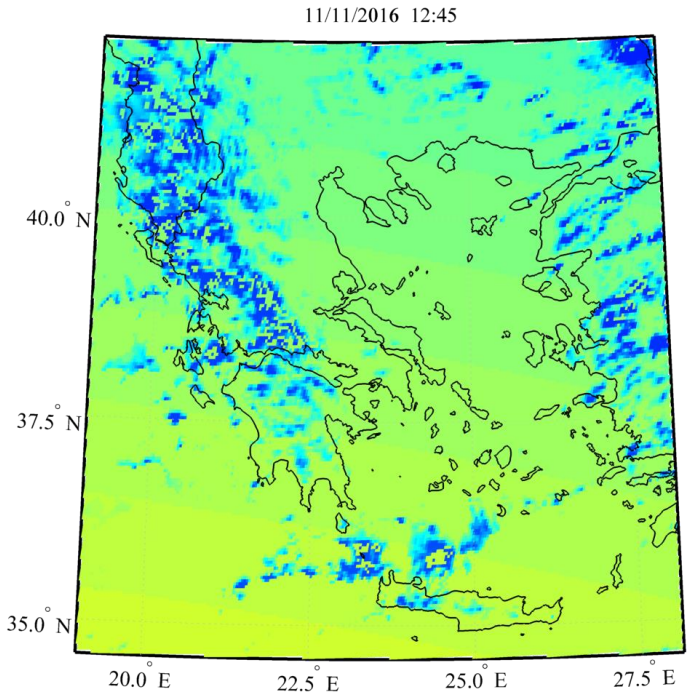
GROUP ON EARTH OBSERVATIONS

Copernicus

End-user Attica Group







Conclusions

In addition to the nowcasting activity of SENSE, we upgraded and refined the SENSE pilot with the followings:

✓ Short-term forecasts (0-2 hours)

✓ Impact of aerosols, mainly dust from Saharan Desert on energy forecasting using the Copernicus Atmosphere Monitoring Service (CAMS). We perform this aerosol upgrade because for the Northern Africa and the Mediterranean the aerosol is the most important factor for solar radiation (and hence solar energy) attenuation

✓ Development of regional Solar Atlases (climatology studies, yearly/monthly/daily), any spatial resolution

✓ Solar related effects on human health and agriculture (UV index, Vitamin D, DNA Damage, plant photosynthesis)

GEO-Cradle Pilot Study for Egypt

Estimation of the solar energy potential in Egypt by developing high resolution solar Atlas & nowcasting service in real time

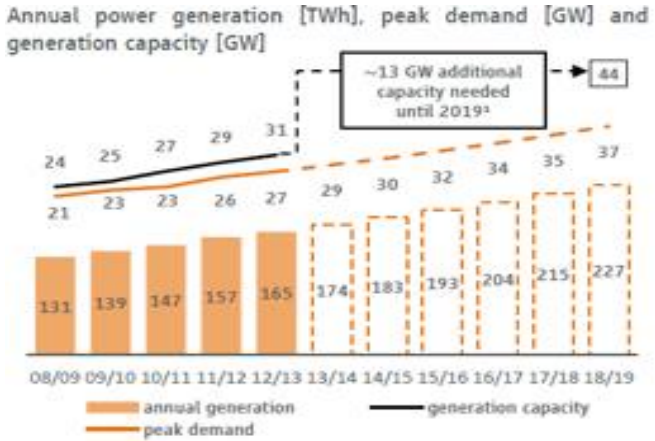
➢ In light of efforts made by the Government of the Arab Republic of Egypt to achieve the desired economic growth while preserving the environment, the government tries to address the demand for energy efficiency through the use of renewable energy sources.

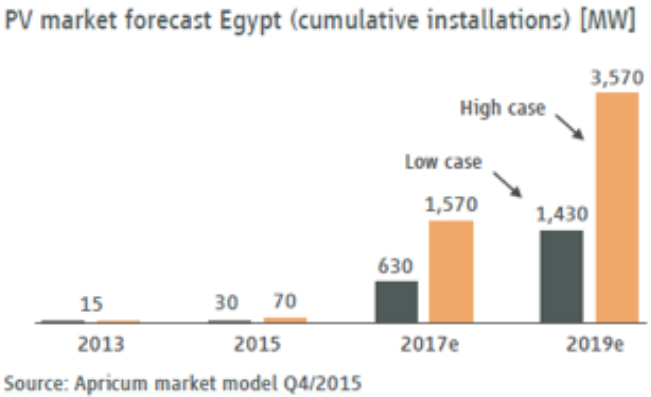
➢ In the framework of the HORIZON 2020 GEO-Cradle project, we report on the estimation of the solar energy potential in Egypt by developing the analytical solar Atlas of Egypt for optimal Photovoltaics and Concentrated Solar Power system installations as well as an innovative nowcasting service in real time based on a number of priority parameters (optical properties of clouds and aerosols, solar zenith angle, total ozone column, water vapor, etc) for efficient energy planning.

➢ The operational nowcasting service of the Global Horizontal (GHI) and Direct Normal Irradiance (DNI) is developed in the framework of the solea project (www.solea.gr) and is one of the main pilot studies of the European project GEO-Cradle. Its scope is the interconnection of the solar energy applications with potential end users from different countries (North Africa, Middle East, Balkans, etc).

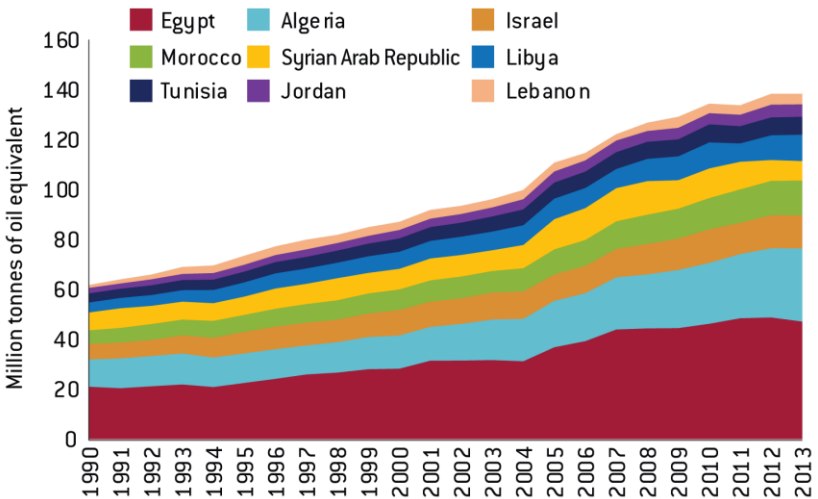
➢ This system is able to produce operational maps of Egypt at high resolution (1nm, 0.05 x 0.05 degrees, 15 min) and the whole approach is ideal for effective energy planning and services while it can support the local energy managing authorities.

Energy consumption in North Africa and Middle East

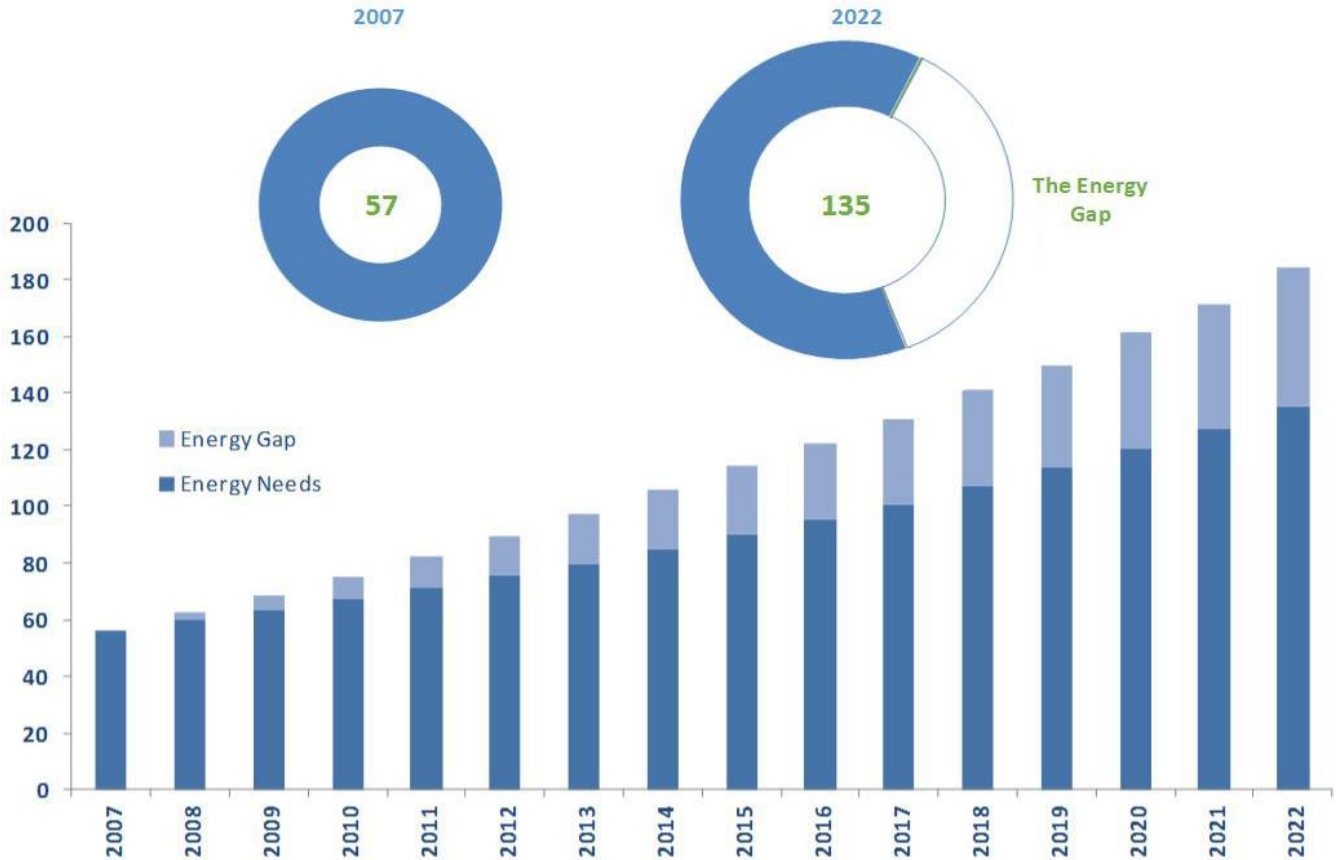




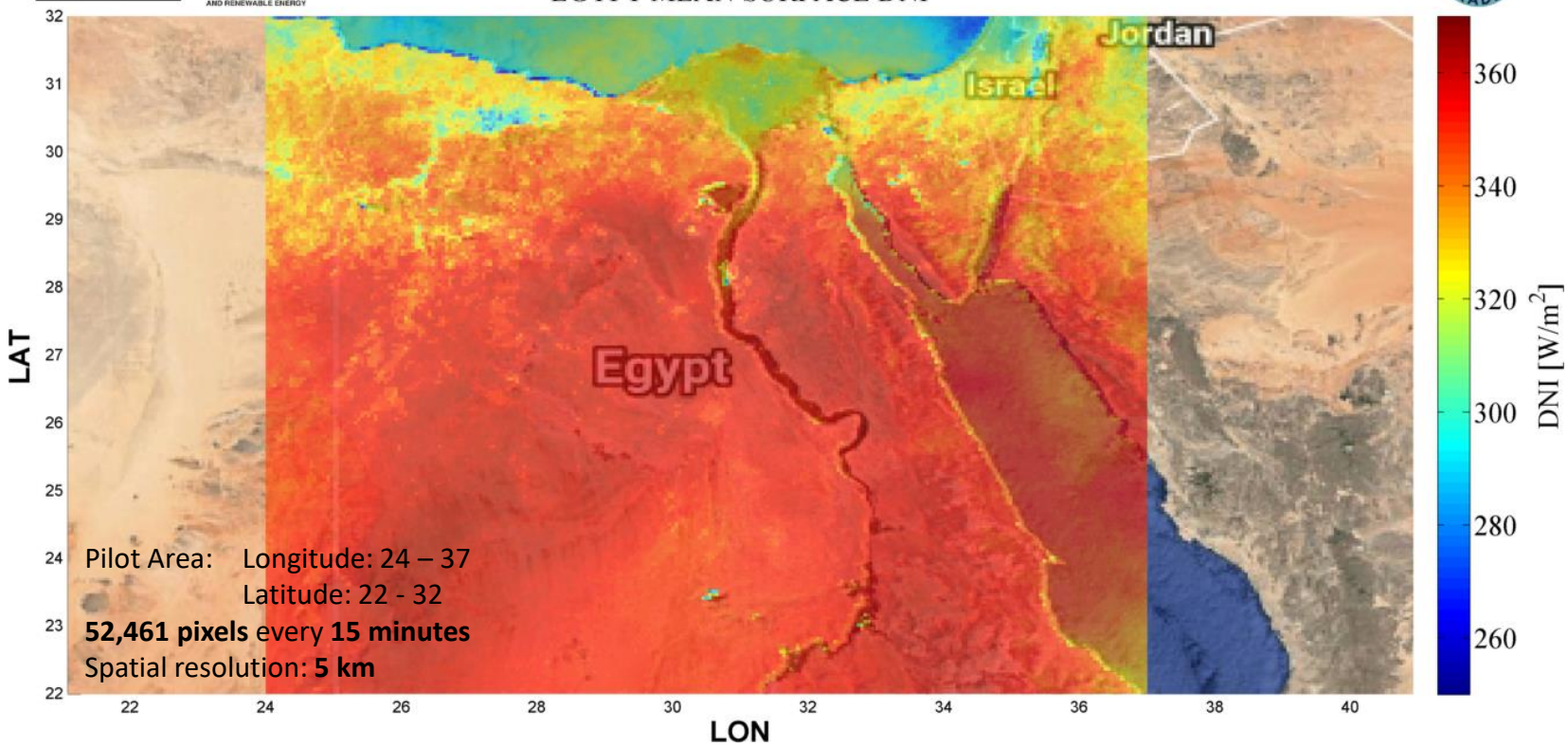
Source: Apricum market model Q4/2015



The Expected Future Energy Status in Egypt



SENSE pilot area

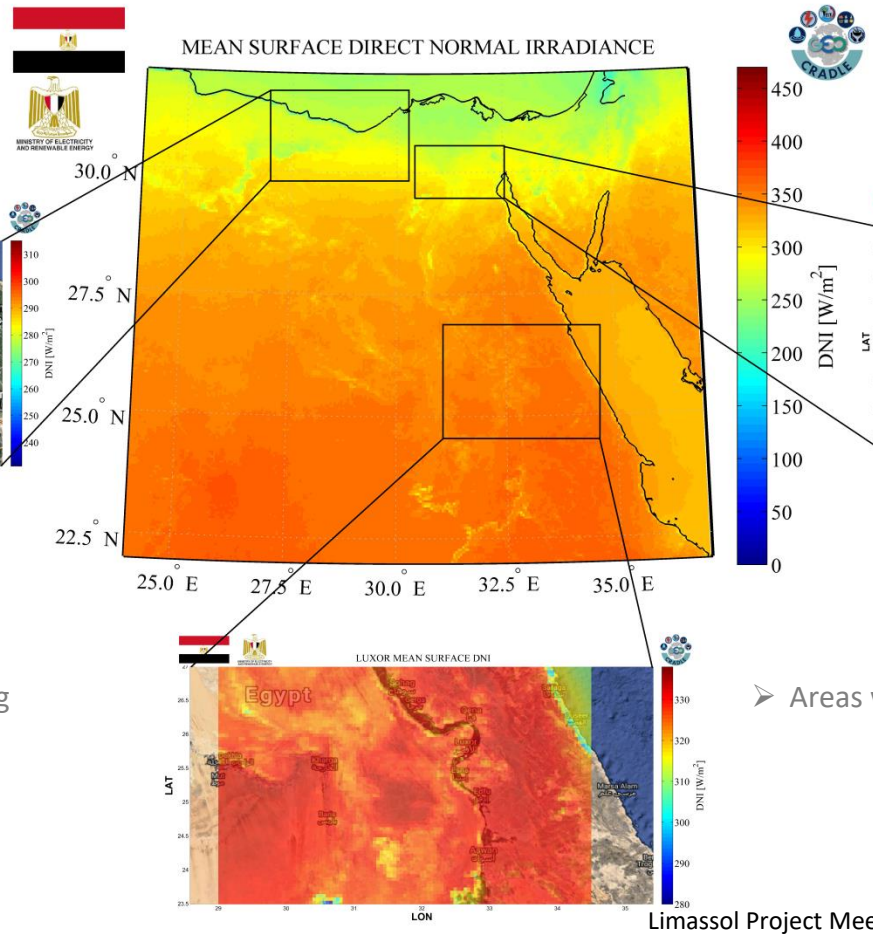


Pilot Area: Longitude: 24 – 37
Latitude: 22 - 32

52,461 pixels every **15 minutes**

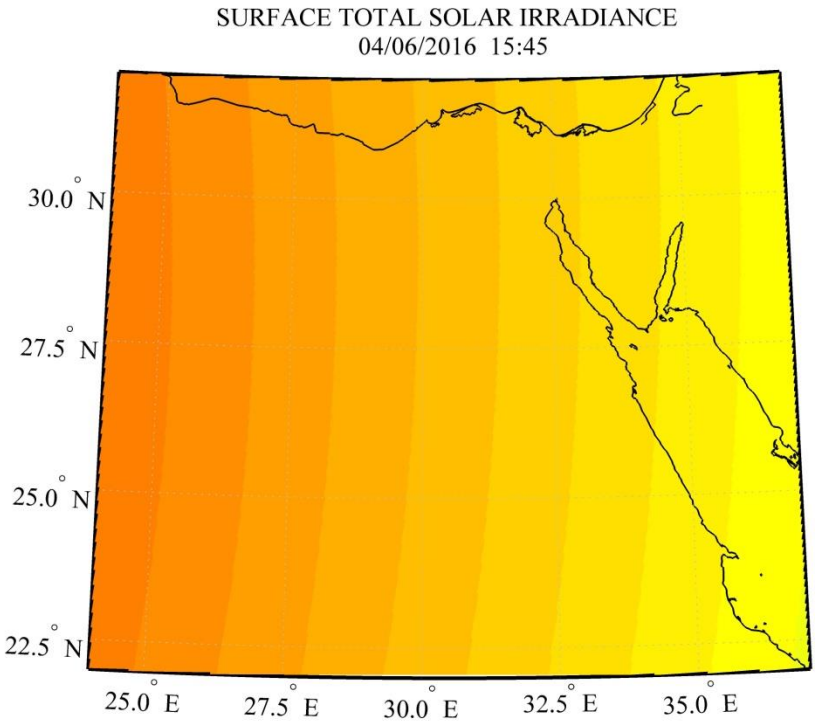
Spatial resolution: **5 km**

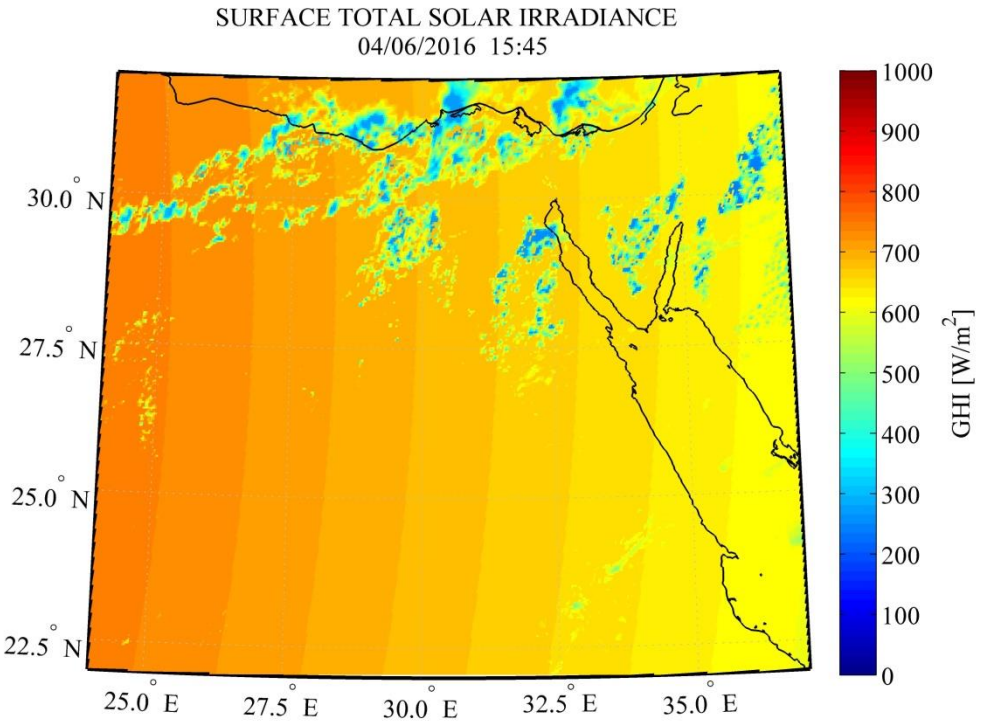
Momentum of this pilot study for Egypt



- Operational energy planning
- Areas with optimum solar energy potential

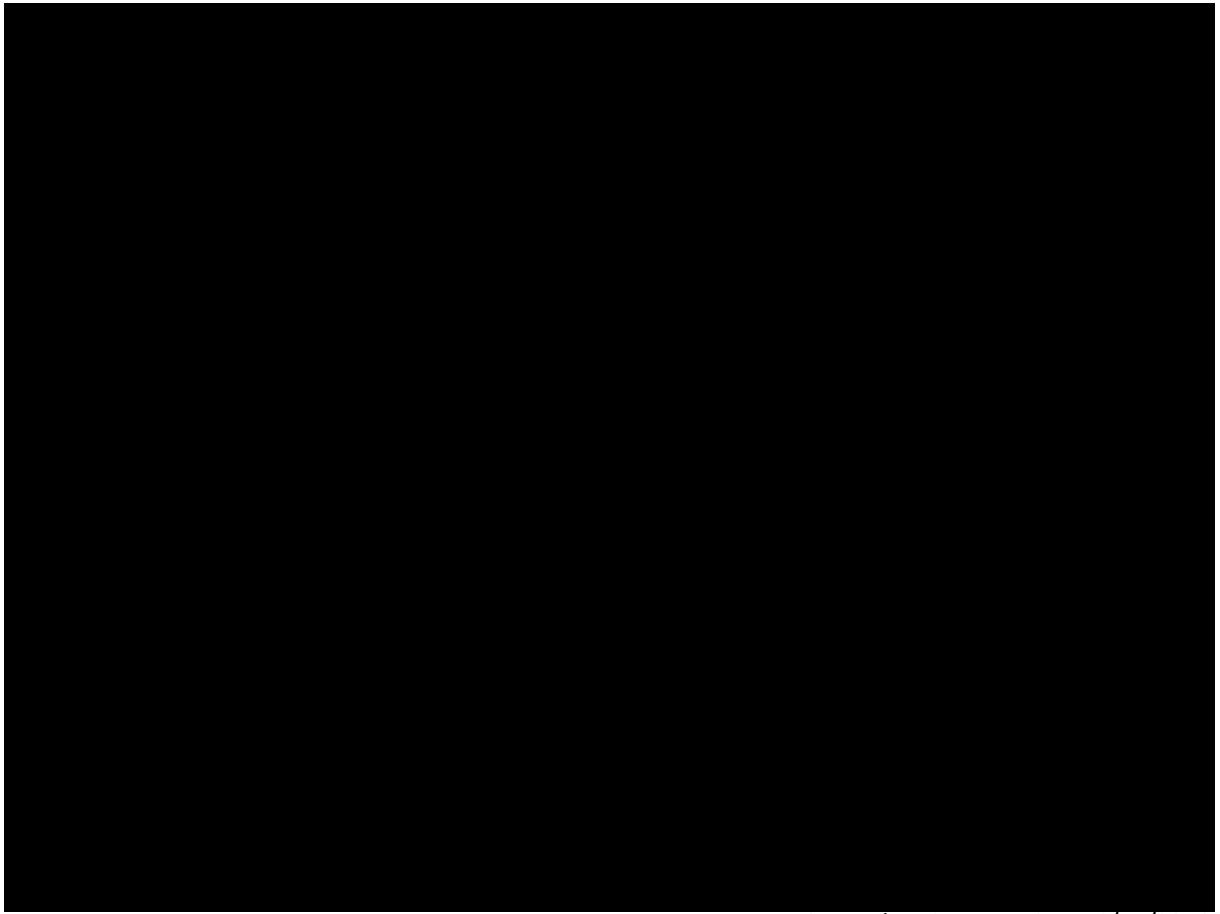
Cloud & aerosols impact



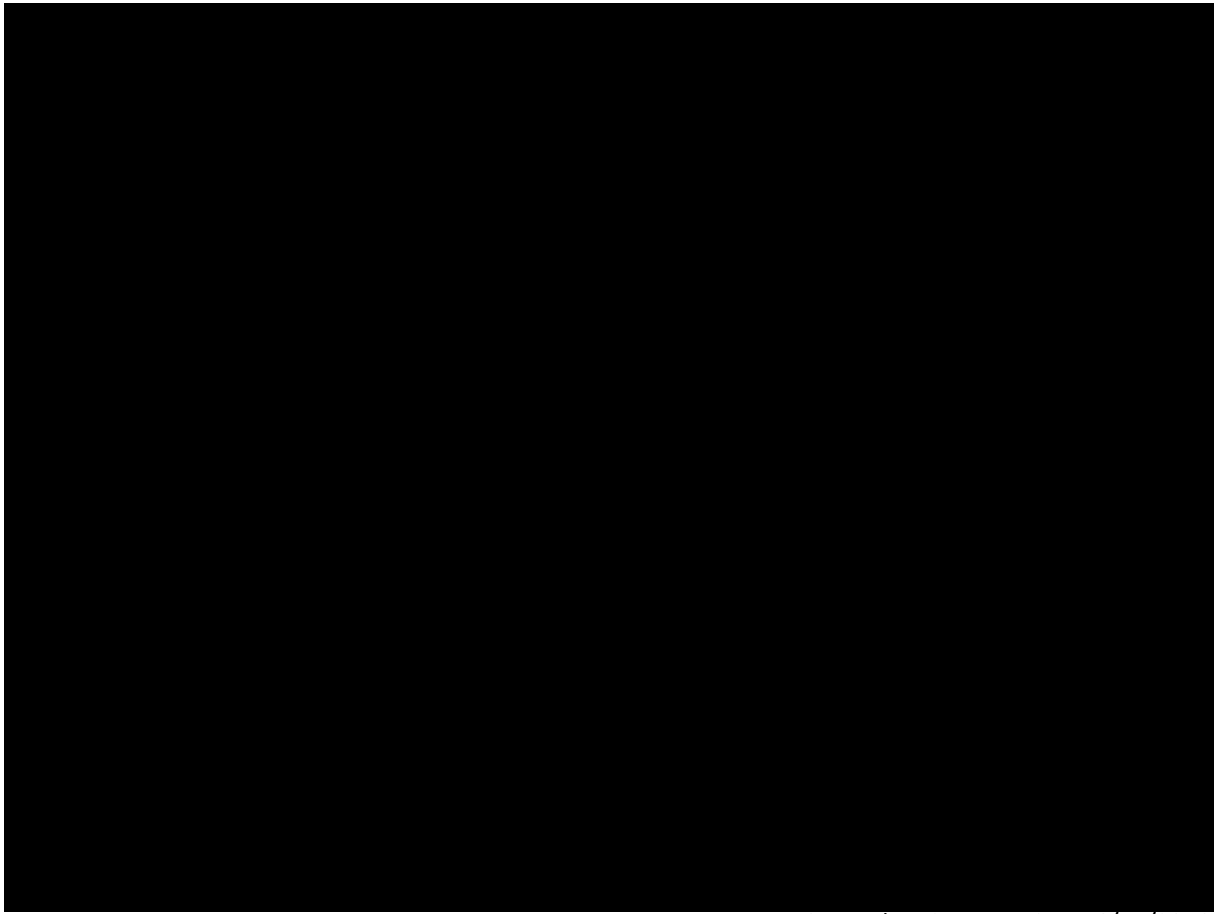


- The inclusion of cloud and aerosol effects means that this approach is ideal for correct assessments of solar power operational loads.

Nowcasting service (SENSE application)

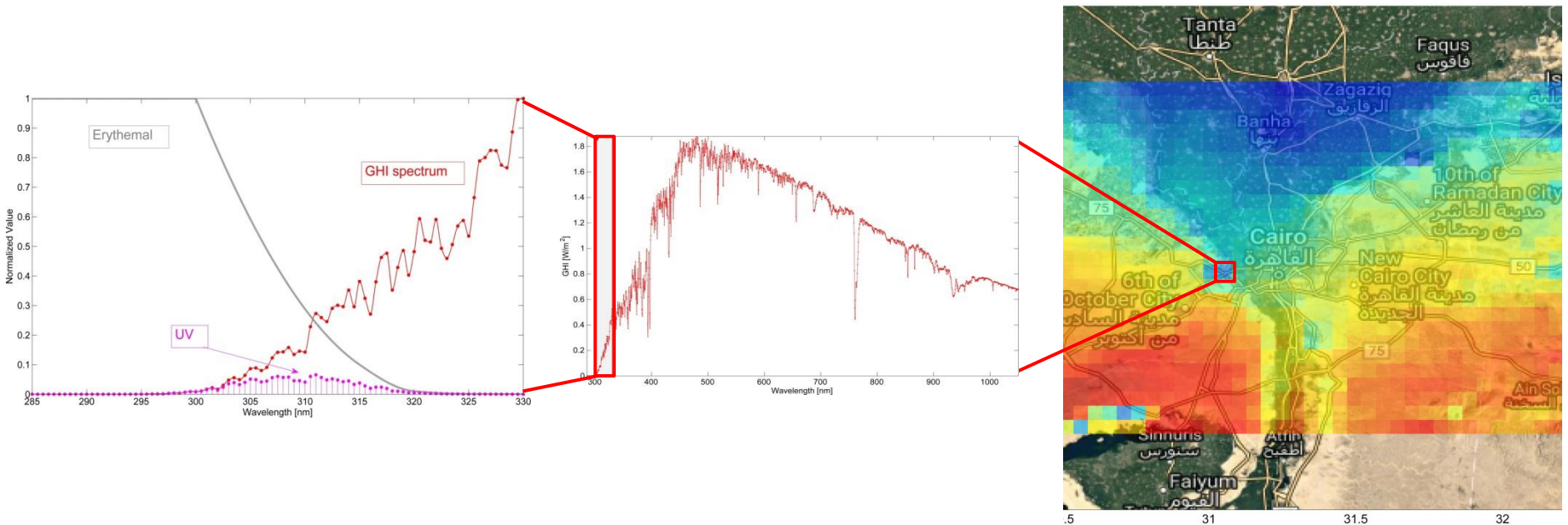


Nowcasting application (CAMS included)



Innovation

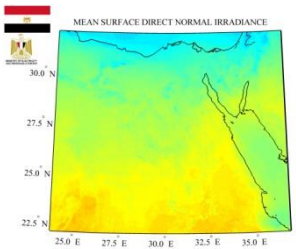
Behind each pixel lies a full solar spectrum



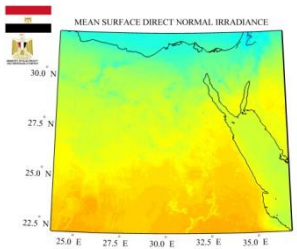
➢ A zoom sequence showing the deep science behind the solar energy maps. Going from right to left: the Global Horizontal Irradiance for Cairo, the insolation spectrum in a single pixel, and finally, the spectrally-weighted UV radiation spectrum.

Mean monthly climatological maps of DNI

JANUARY



FEBRUARY



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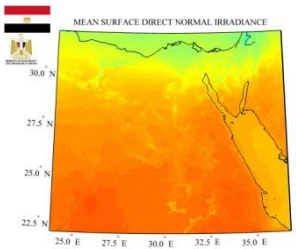
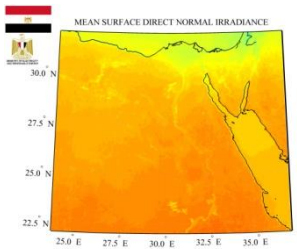


APRIL



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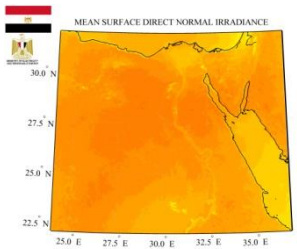

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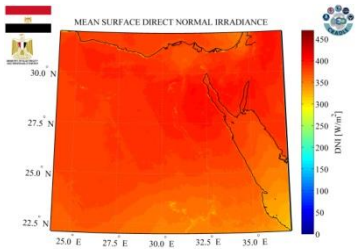

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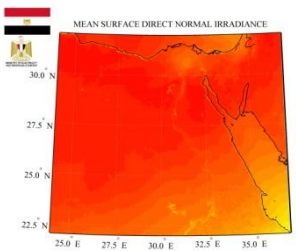

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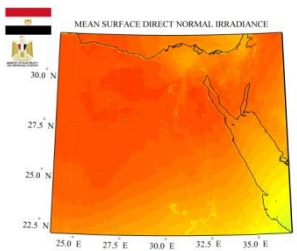
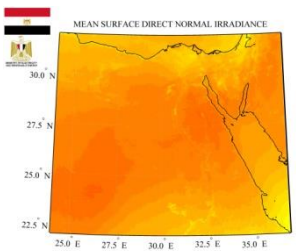


SEPTEMBER



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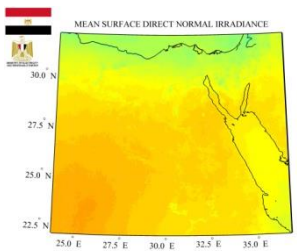

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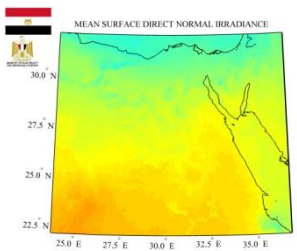

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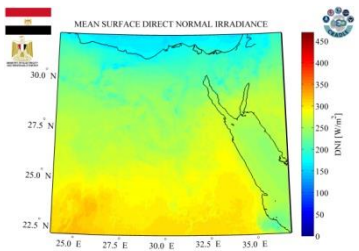
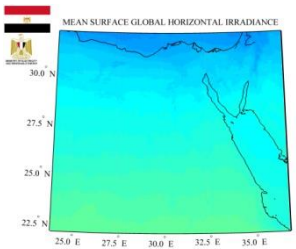


➢ The mean monthly solar energy maps are based on a 15-year complex and highly variable climatology taking into account the clouds and aerosols impact on **Direct Normal Irradiance** and **Surface Incoming Solar radiation** (**DNI** and **SIS** respectively), while the spatial resolution is almost 5 km, maximizing the exploitative value of the solar energy technologies.

Mean monthly climatological maps of SIS

JANUARY



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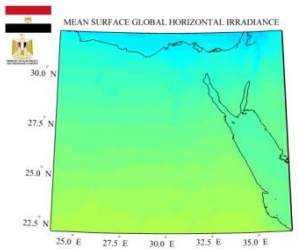

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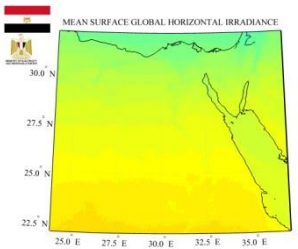

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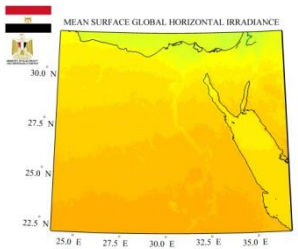

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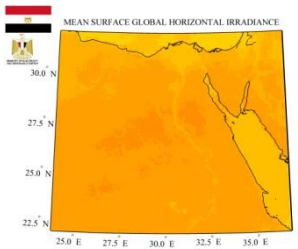

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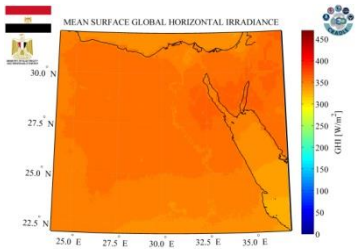

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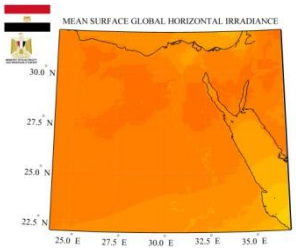
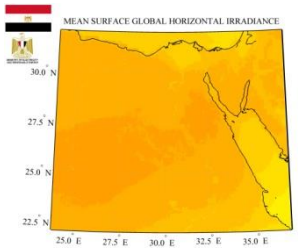


AUGUST



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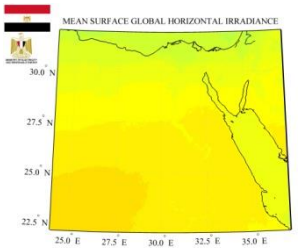

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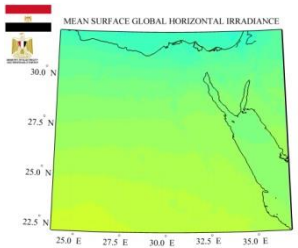

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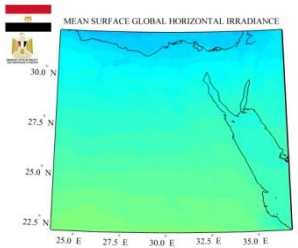

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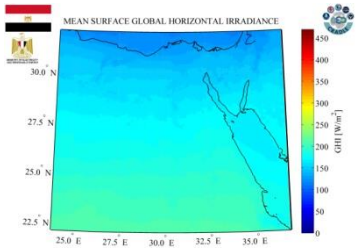
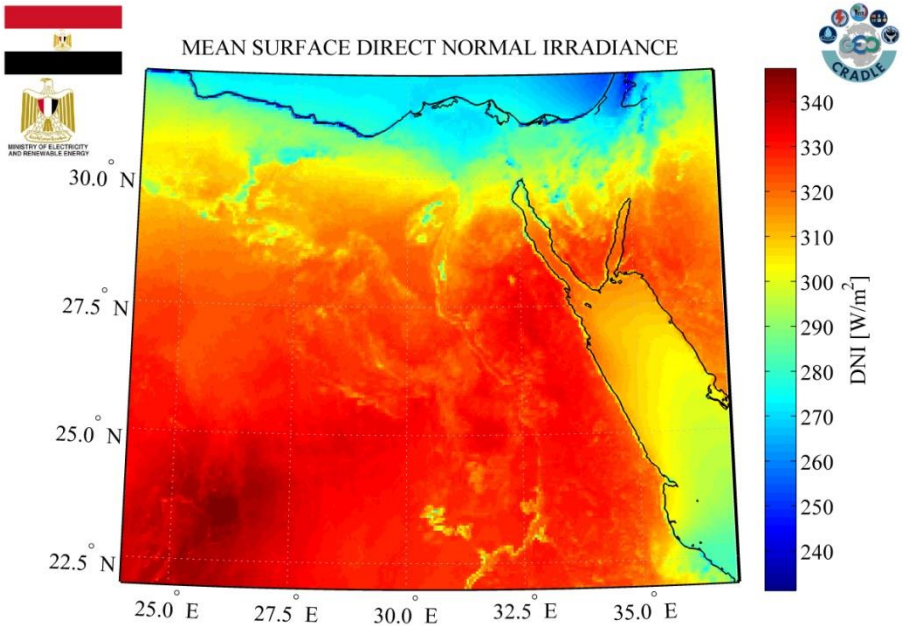
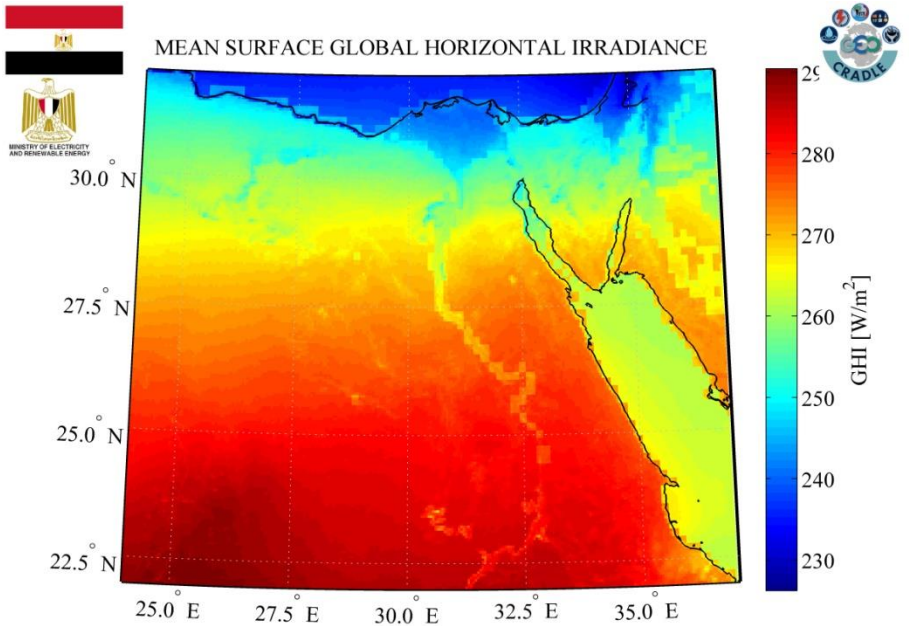


➢ The **Direct Normal Irradiance (DNI)** applies to Concentrated Solar Plant (CSP) installations while the components of the **Surface Incoming Solar radiation** (**SIS**) applies to Photovoltaic (PV) installations.

Solar Atlas for PV & CSP installations





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

In 14 and a half seconds, the sun provides as much energy to Earth as humanity uses in a day.

Open Discussion