



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 initiatives
toward GEOSS

GEO-CRADLE Regional Workshop
Thursday, 25th May, 2017

Pilot applications for Egypt related end-users



Hesham El-Askary

Chapman University

Panagiotis Kosmopoulos

National Observatory of Athens

Stelios Kazadzis

Physical Meteorological Observatory Davos, World Radiation Center



*Le Meridien Heliopolis Hotel
51 El-Orouba, Almazah, Cairo, Egypt*



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Regional needs related to Energy

North Africa and Middle East 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.

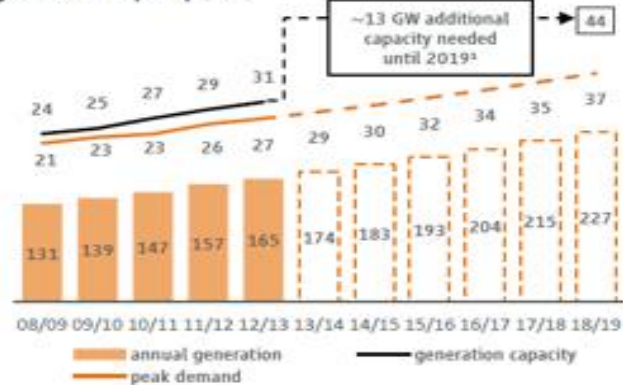


Estimation of the solar energy potential in Egypt by developing high resolution solar Atlas & nowcasting service in real time

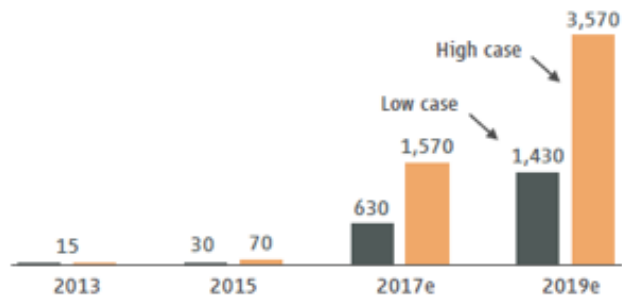


- In light of efforts made by the Government of the Arab Republic of Egypt to achieve the desired economic growth while preserving the environment, the government tries to address the demand for energy efficiency through the use of renewable energy sources.
- In the framework of the HORIZON 2020 GEO-Cradle 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.

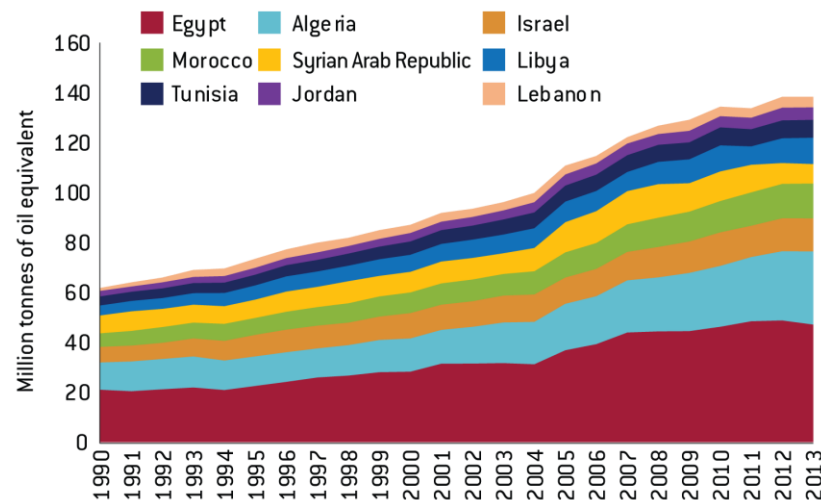
Annual power generation [TWh], peak demand [GW] and generation capacity [GW]



PV market forecast Egypt (cumulative installations) [MW]

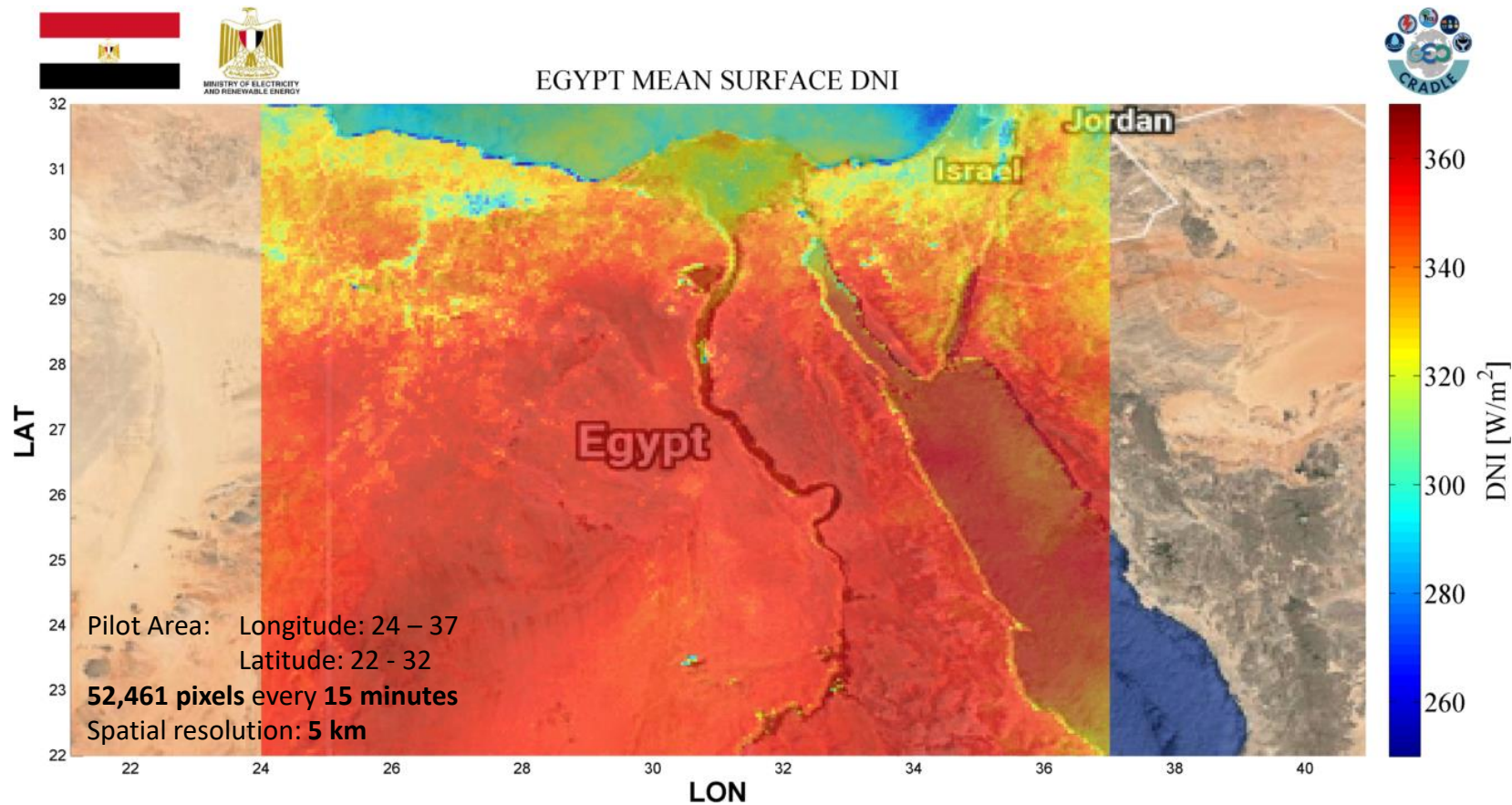


Source: Apricum market model Q4/2015

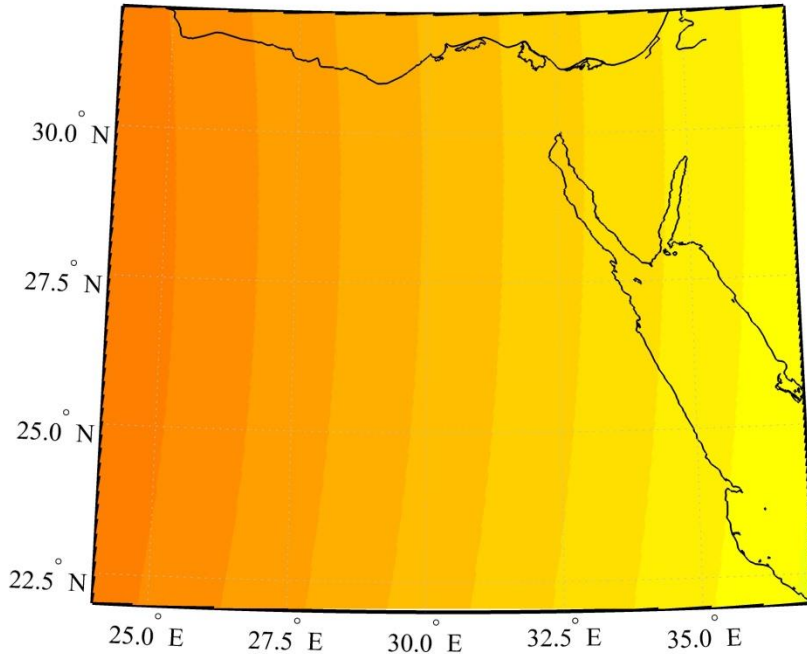


The Expected Future Energy Status in Egypt

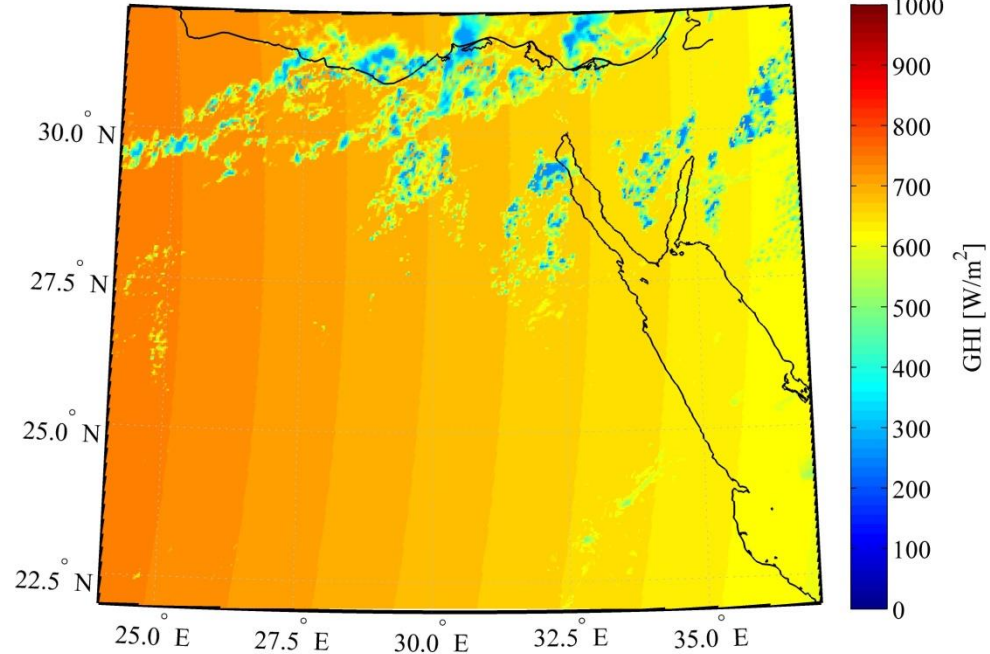




SURFACE TOTAL SOLAR IRRADIANCE
04/06/2016 15:45

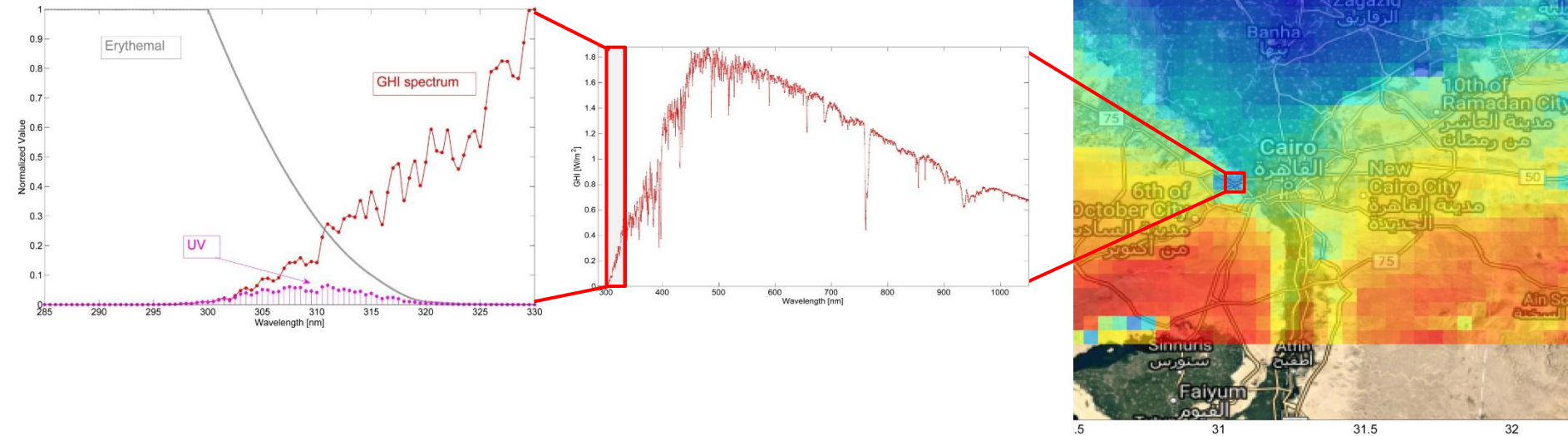


SURFACE TOTAL SOLAR IRRADIANCE
04/06/2016 15:45



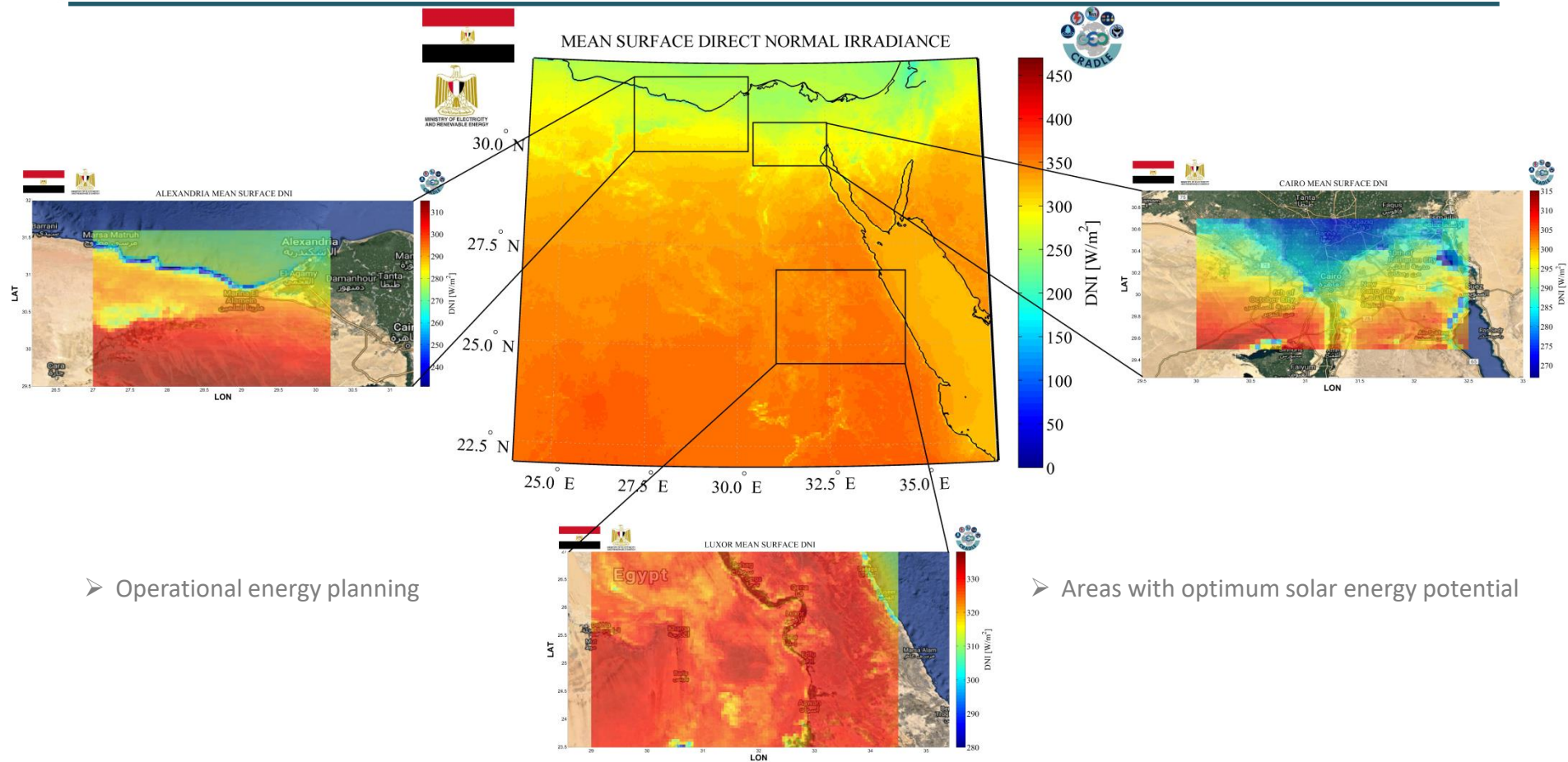
➤ The inclusion of cloud and aerosol effects means that this approach is ideal for correct assessments of solar power operational loads.

Behind each pixel lies a full solar spectrum

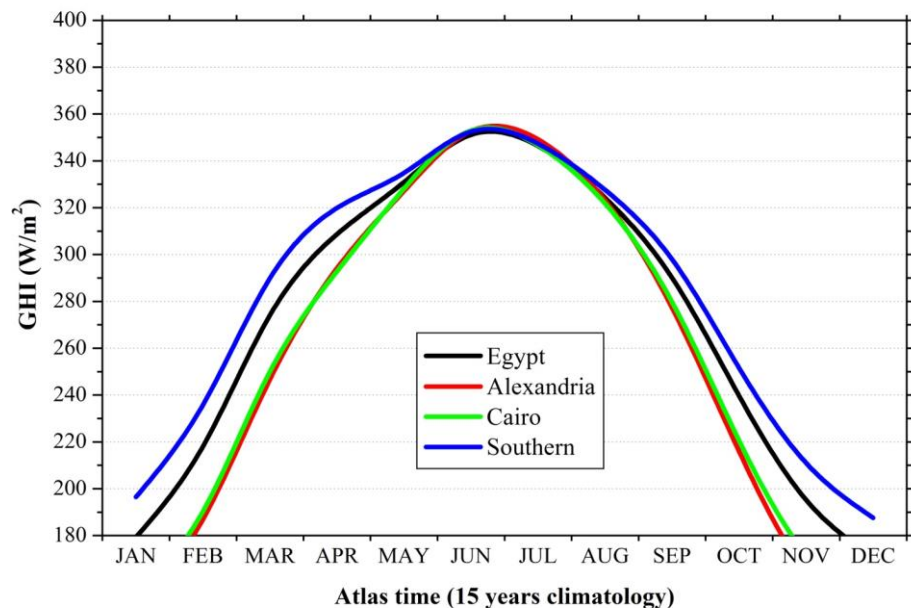


➤ A zoom sequence showing the deep science behind the solar energy maps. Going from right to left: the Global Horizontal Irradiance for Cairo, the insolation spectrum in a single pixel, and finally, the spectrally-weighted UV radiation spectrum.

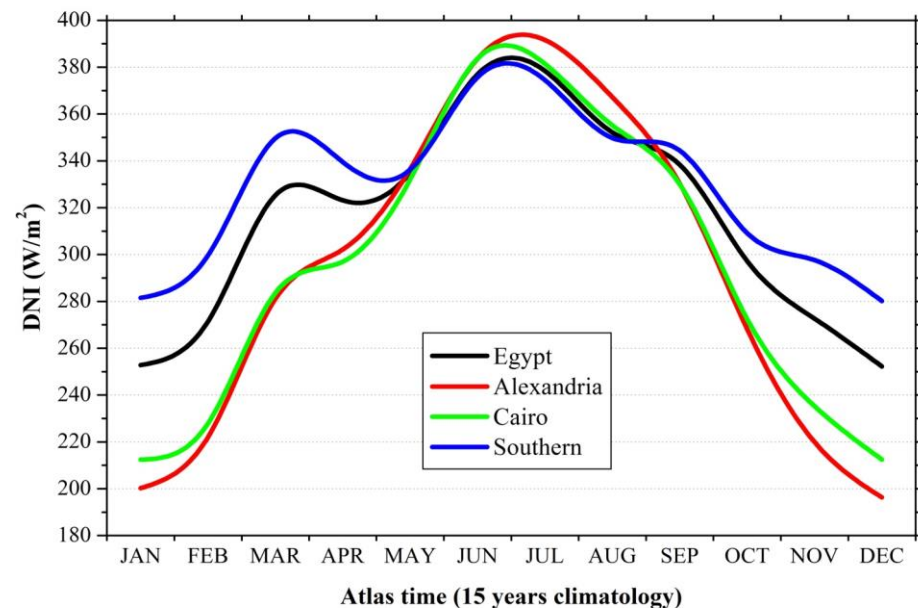
Momentum of this pilot study for Egypt



Global Horizontal Irradiance



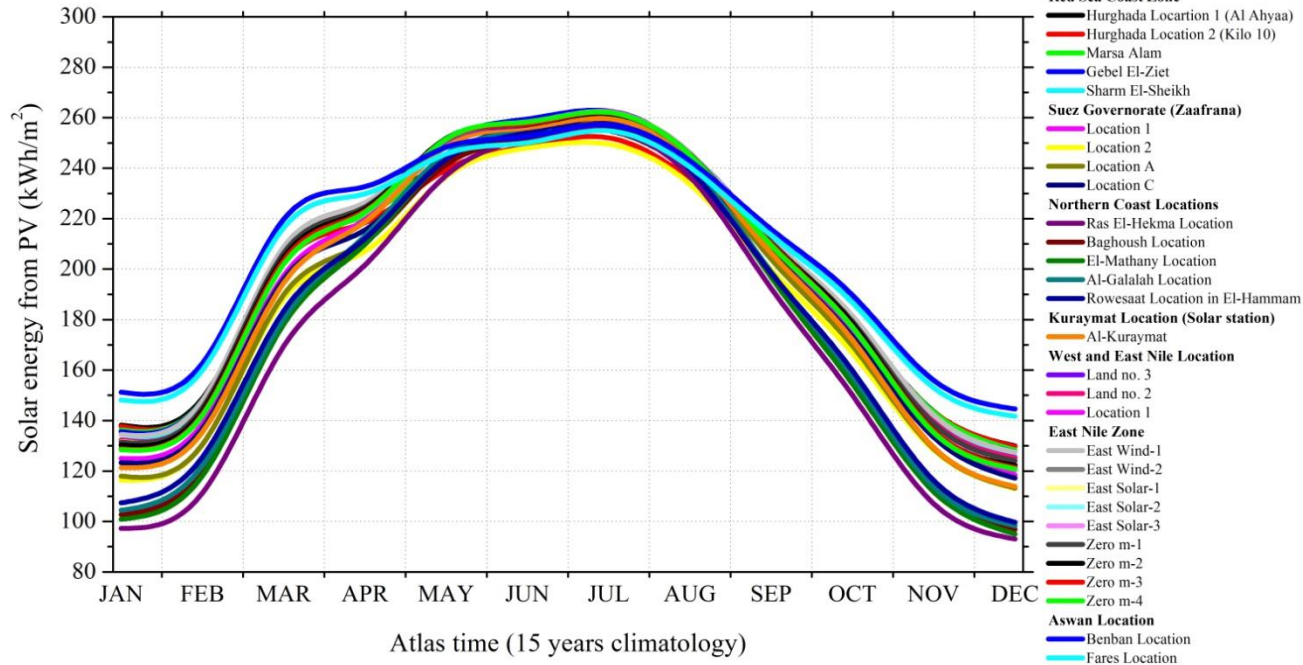
Direct Normal Irradiance



Atlas 15 years climatology	Solar power (W/m ²)		Solar energy (kWh/m ²)	
	DNI	GHI	CSP	PV
Egypt	292	252	2554	2208
Alexandria	294	255	2572	2230
Cairo	328	279	2875	2447
Southern	315	269	2756	2357

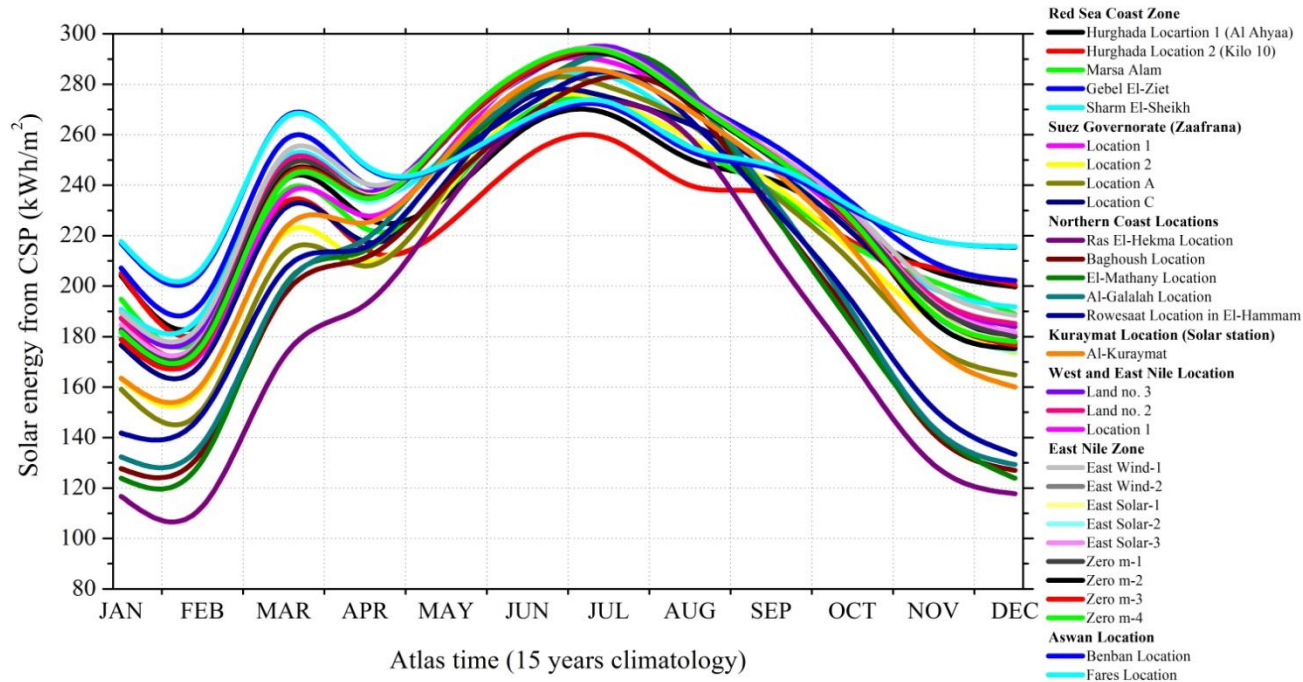
NREA lands solar power and energy potential for PV and CSP installations

Solar energy for PV in kWh/m²



NREA lands solar power and energy potential for PV and CSP installations

Solar energy for CSP in kWh/m²



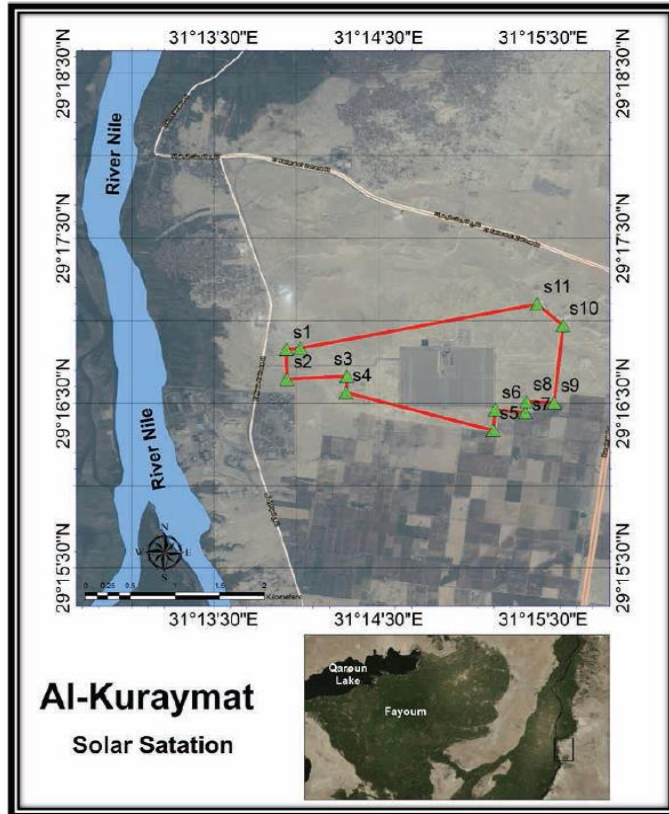


NREA lands solar power and energy potential for PV and CSP installations



KURAYMAT LOCATION (SOLAR STATION)

Land area 660 Feddan devoted by Presidential Decree No 212 of year 2003, Date 11/8/2003, its coordinates are as follows:



KURAYMAT LOCATION (SOLAR STATION)

Monthly mean solar energy in kWh/m² for PV & CSP systems for the lands of Kuraymat Location (Solar Station).

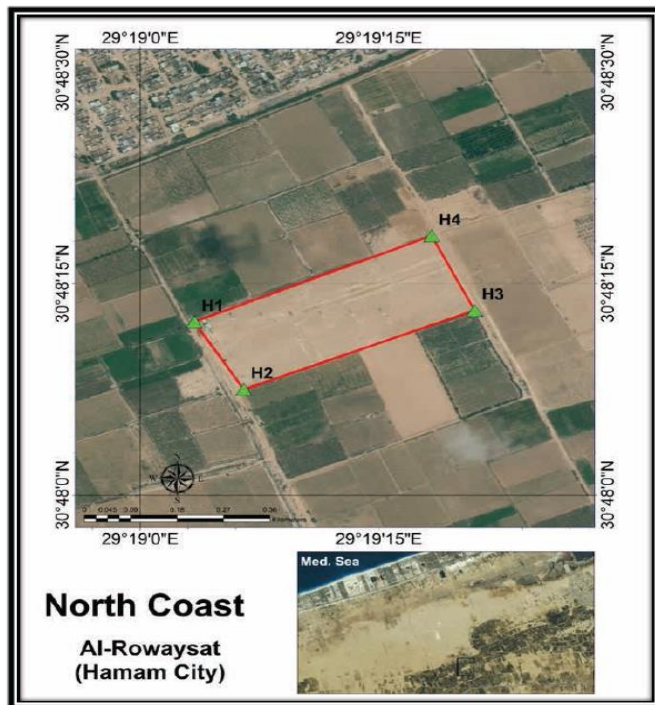
SOLAR ENERGY (KWH/M2)		
	CSP	PV
JAN	121	164
FEB	136	161
MAR	194	222
APR	219	225
MAY	249	252
JUN	256	280
JUL	260	285
AUG	243	269
SEP	206	246
OCT	172	215
NOV	129	176
DEC	114	160
TOTAL	2296	2653

NREA lands solar power and energy potential for PV and CSP installations

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ROWESAAT LOCATION IN EL-HAMMAM CITY

Land of area (19 1 16) devoted by Presidential Decree No. 399 year 2006, date 20/11/2006. Its coordinates are as follows:



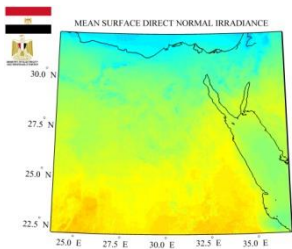
Monthly mean solar energy in kWh/m² for PV systems for the 5 lands of the northern coast zone.

SOLAR ENERGY PV (KWH/M2)					
LOCATION	1	2	3	4	5
JAN	97	103	101	104	107
FEB	111	120	118	122	126
MAR	169	179	178	180	183
APR	202	210	210	213	212
MAY	237	241	244	246	244
JUN	252	252	255	255	254
JUL	255	258	261	261	260
AUG	237	241	242	242	240
SEP	192	197	197	199	198
OCT	150	156	155	158	160
NOV	107	112	112	114	116
DEC	93	97	95	98	100
TOTAL	2100	2162	2164	2190	2197

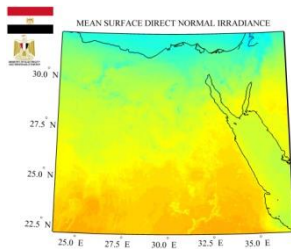
Monthly mean solar energy in kWh/m² for CSP systems for the 5 lands of northern coast zone.

SOLAR ENERGY CSP (KWH/M2)					
LOCATION	1	2	3	4	5
JAN	117	128	124	132	142
FEB	113	134	131	138	149
MAR	172	196	200	199	206
APR	193	211	214	219	215
MAY	232	240	248	252	248
JUN	266	267	277	277	272
JUL	273	283	293	292	285
AUG	259	272	278	276	266
SEP	214	230	230	235	232
OCT	170	187	184	190	194
NOV	129	142	143	144	151
DEC	118	127	124	129	133
TOTAL	2250	2413	2443	2479	2491

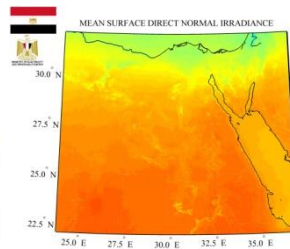
JANUARY



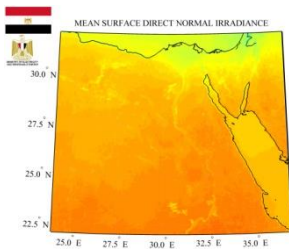
FEBRUARY



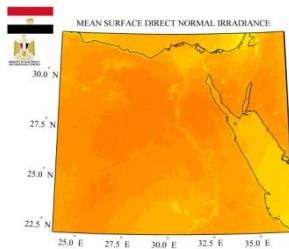
MARCH



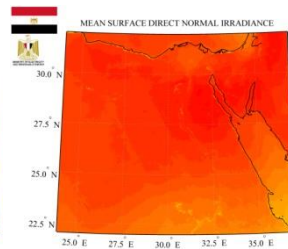
APRIL



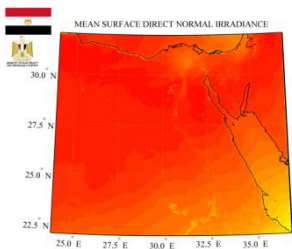
MAY



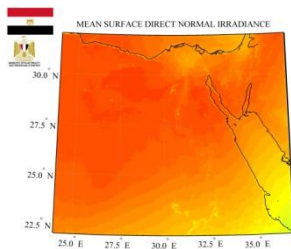
JUNE



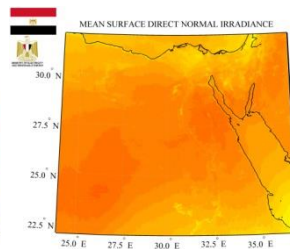
JULY



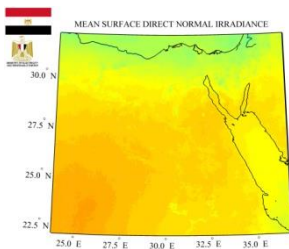
AUGUST



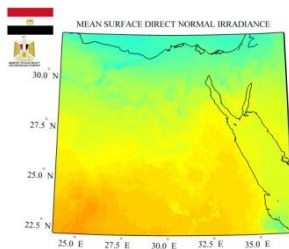
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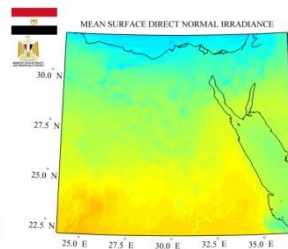
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NOVEMBER

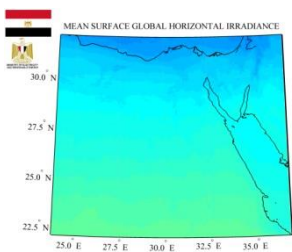


DECEMBER

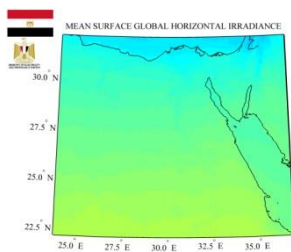


➤ The mean monthly solar energy maps are based on a 15-year complex and highly variable climatology taking into account the clouds and aerosols impact on **Direct Normal Irradiance** and **Surface Incoming Solar radiation (DNI and SIS respectively)**, while the spatial resolution is almost 5 km, maximizing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

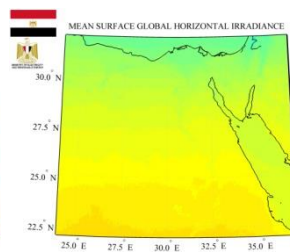
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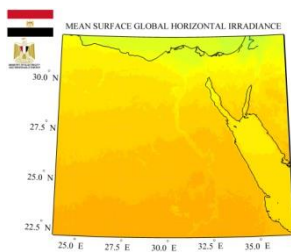
FEBRUARY



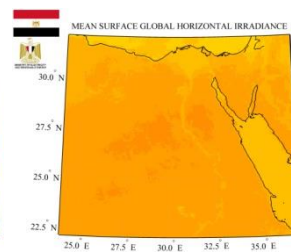
MARCH



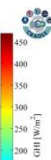
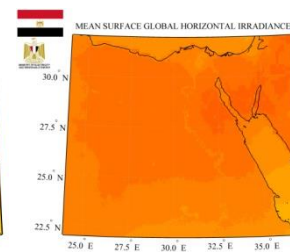
APRIL



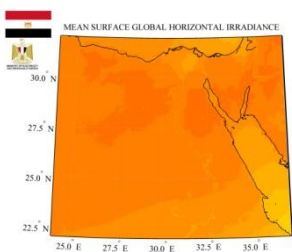
MAY



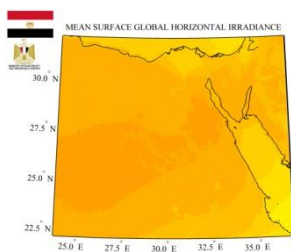
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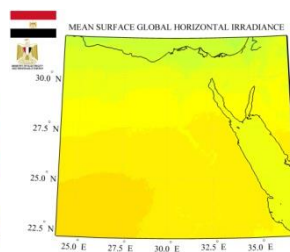
JULY



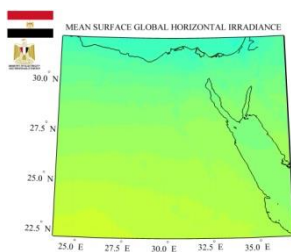
AUGUST



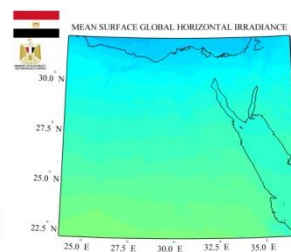
SEPTEMBER



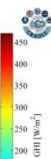
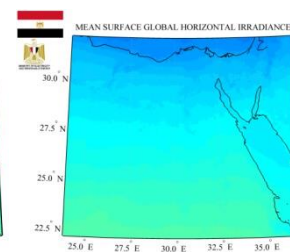
OCTOBER



NOVEMBER

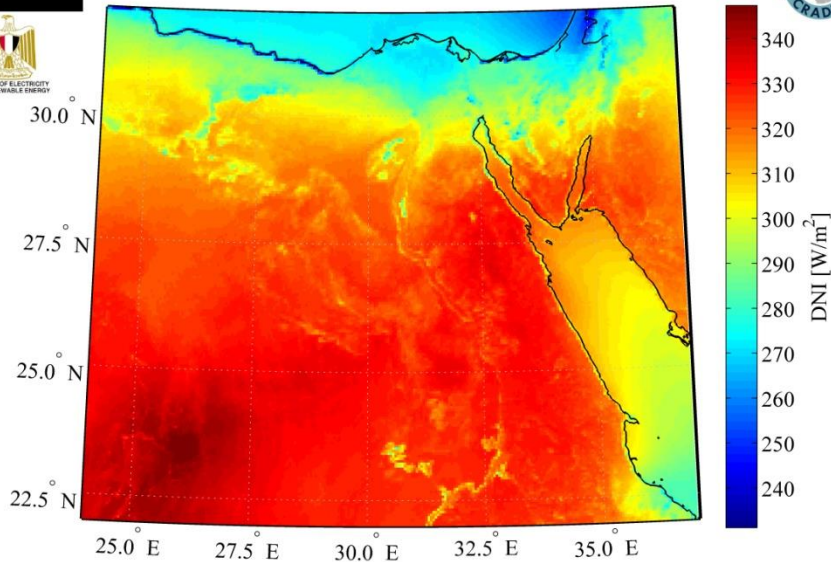


DECEMBER

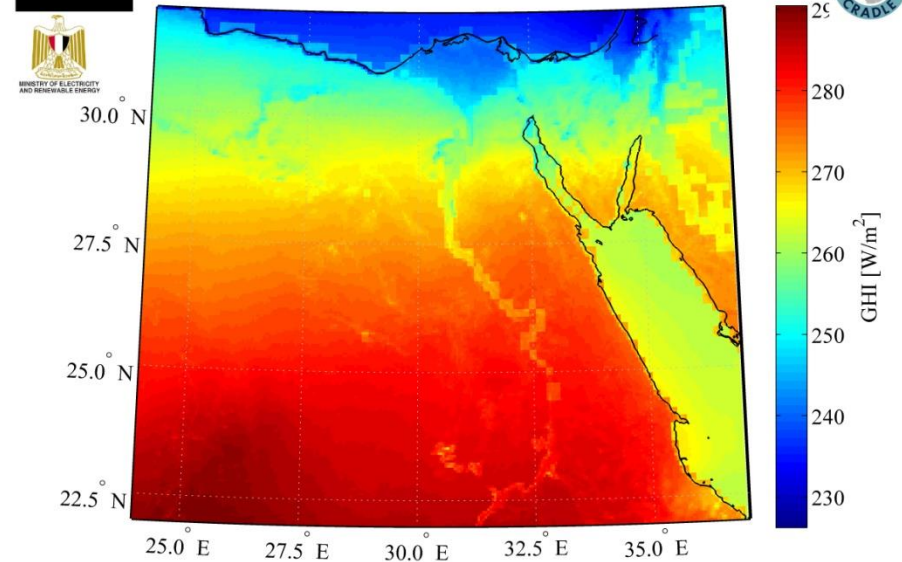


➤ The **Direct Normal Irradiance (DNI)** applies to Concentrated Solar Plant (CSP) installations while the components of the **Surface Incoming Solar radiation (SIS)** applies to Photovoltaic (PV) installations.

MEAN SURFACE DIRECT NORMAL IRRADIANCE

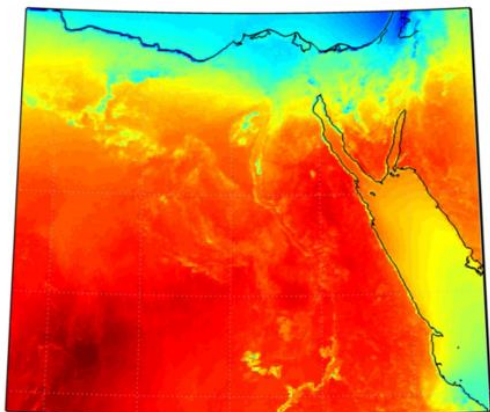


MEAN SURFACE GLOBAL HORIZONTAL IRRADIANCE

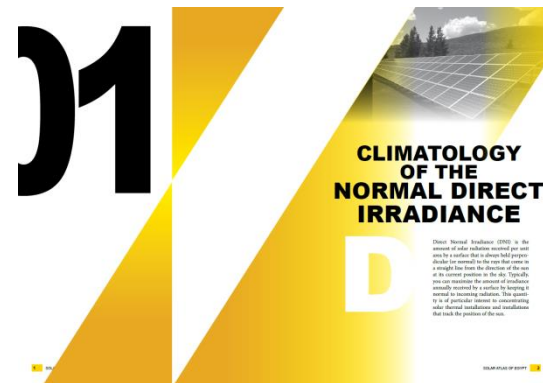


➤ Optimum locations for CSP & PV installations using solar Atlas energy maps

The Solar Atlas of Egypt



Panagiotis Kosmopoulos
Stelios Kazadzis
Hesham El-Askary

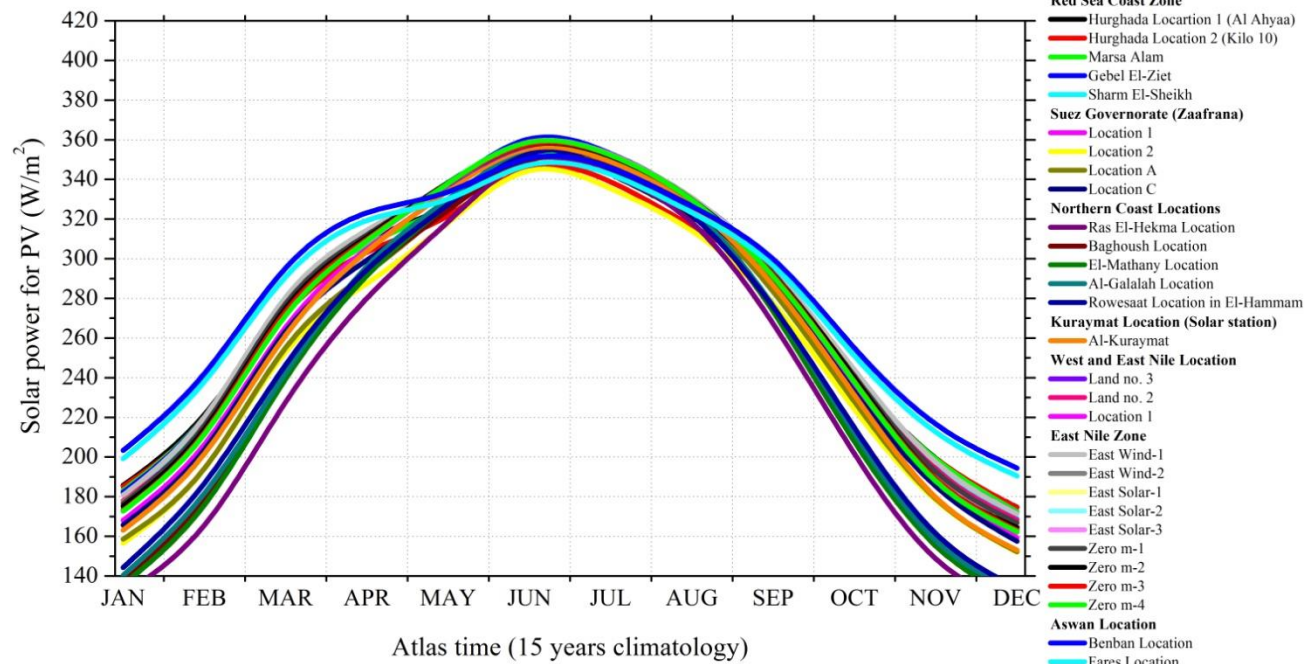


*Thank
you*



NREA lands solar power and energy potential for PV and CSP installations

Solar power for PV in W/m^2



NREA lands solar power and energy potential for PV and CSP installations

Solar power for CSP in W/m^2

