Dynamical Solar Atlas of Egypt

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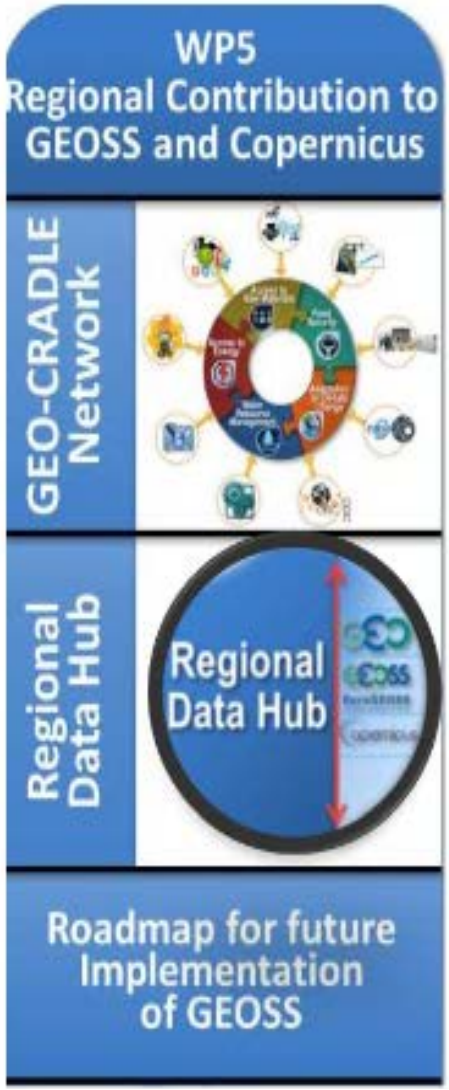
Studies & Project deliverables
Monitoring Networks (Space, Airborne & In-situ)
Catalogues of Space, Airborne & In-situ data
Services & Products
Archives of Data (Space, Airborne & In-situ)
Access to Raw Materials
Food Security
Access to Energy
Regional Data Hub
Adaptation to Climate Change
Water Resource Management
Analysis Tools (Image processing, Spatial Analysis, Statistical Analysis etc.)
Metadata
Research Models
Portals of Open Geospatial & Linked Data


WP5
Regional Contribution to GEOSS and Copernicus
GEO-CRADLE Network
Regional Data Hub
Regional Data Hub
Roadmap for future Implementation of GEOSS

Momentum of this pilot study for Egypt

Solar Energy Nowcasting

Why the exploitation of Solar energy in North Africa and Middle East is critical?

They are places with a serious amount of solar energy potential and its exploitation is important for:

- Sustainable development through efficient energy planning
- Gradual independence from fossil fuels

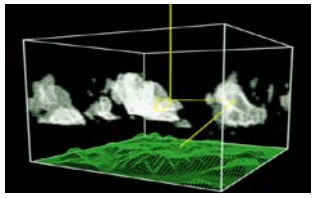
- Here we introduce Solar Energy Nowcasting SystEm (SENSE) pilot with niche in:
  - Realistic assessment of solar potential
  - Being operational, satellite-driven providing real-time system
  - Quantifying the clouds' and aerosols' impact on the solar energy potential

The Solar Energy Nowcasting SystEm (SENSE)

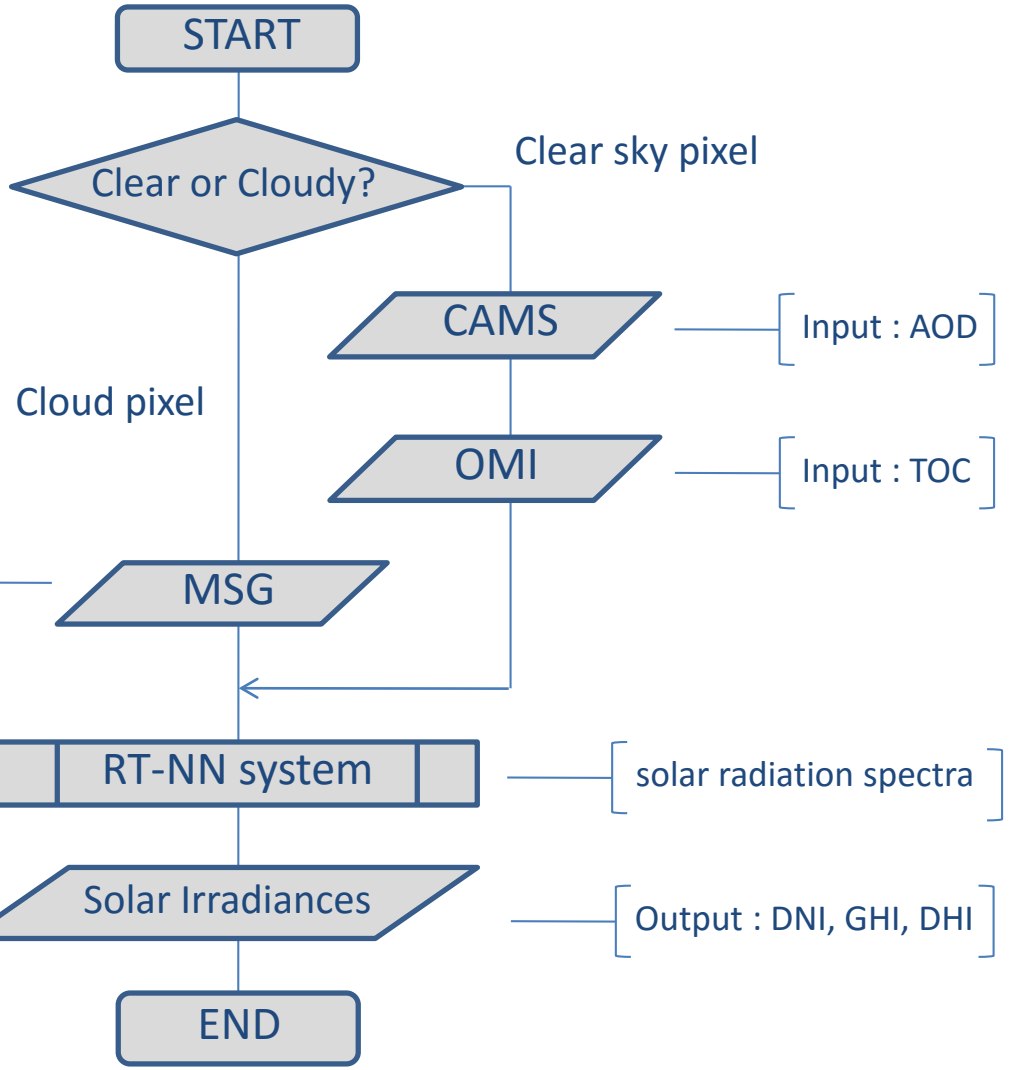
Satellite Data

Copernicus Atmospheric Monitoring Service

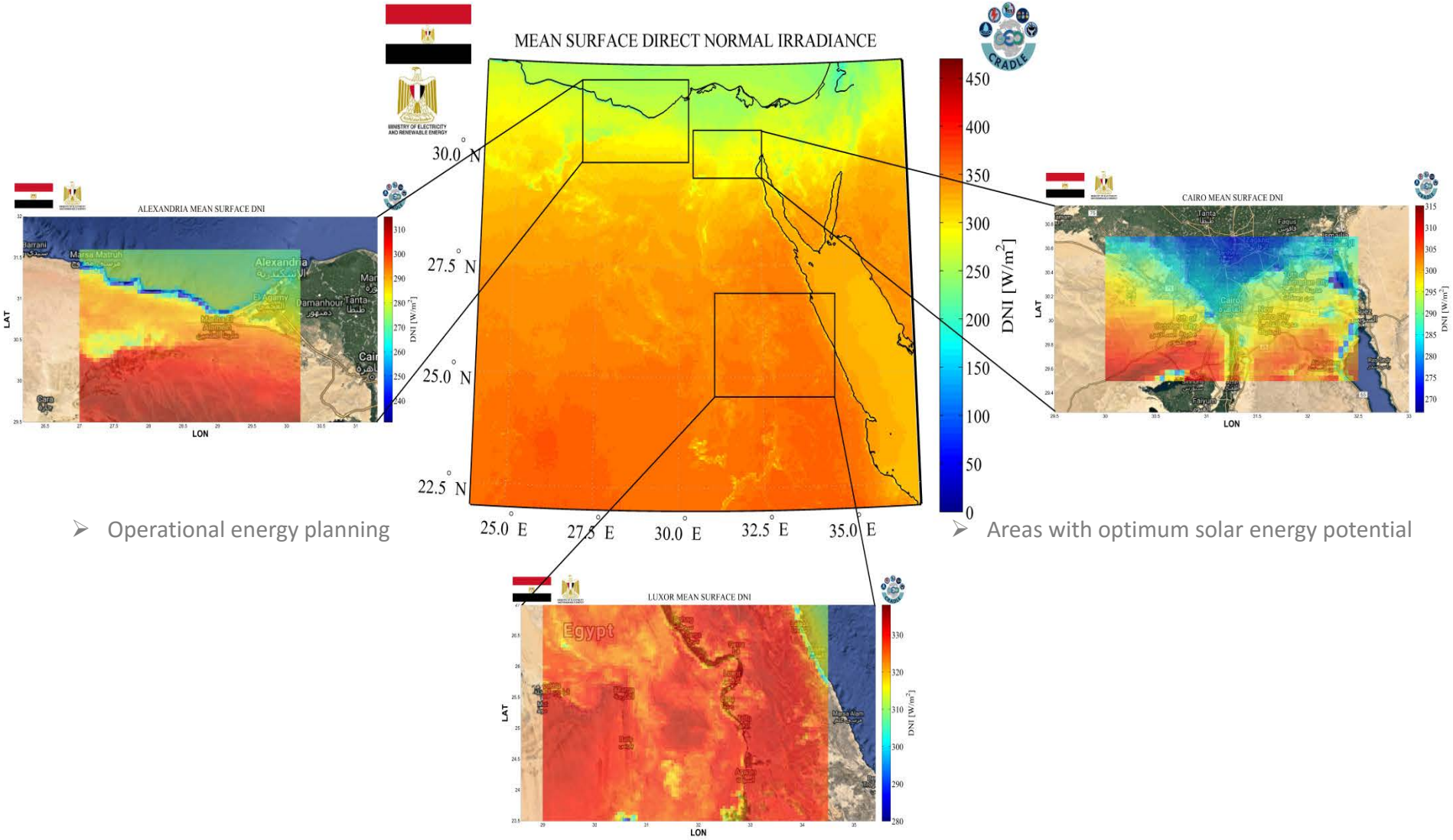
Radiative Transfer models



Neural networks and/or multi linear functions



Pilot study for Egypt



- Operational energy planning
- Areas with optimum solar energy potential

01

SOLAR ATLAS CLIMATOLOGY OF EGYPT (1999-2013)

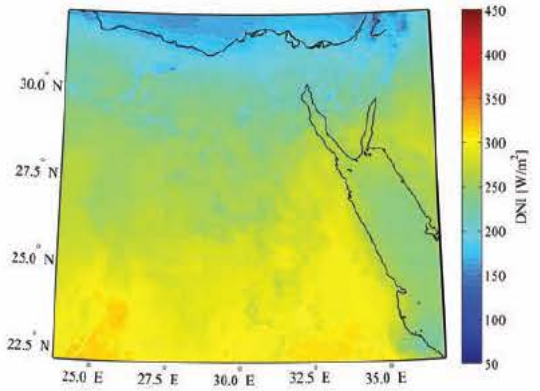
This Section presents an analysis of the solar power potential in Egypt with specific reference to solar power plants for electricity production. In the analysis provided, the mapping of solar radiation components is calculated from long-term monthly EUMETSAT data of DNI and GHI over a period of 15 years (January 1999 - December 2013). The climatological solar power results of this Section are in W/m2. These data enable the modeling of PV and CSP production for several sunshine-privileged locations where solar power plants exist, are under construction, or being planned by NREA. This analysis helps establish the solar potential for electricity generation in Egypt, and can support the design and decision-making process for solar energy systems in the country.

The 15-years mean monthly DNI and GHI reveals a clear seasonal variability with the maximum solar inputs in summer months and the minimum in winter months. In all months we highlight the distinct anthropogenic impact in large cities mainly in the northern Egypt, along the Nile and in the Delta of Nile. In April, May and September the impact of dust is intense in the southern part of Egypt, while the cloud presence can be extended in October in addition to the spring season as a result of the synoptic climatological conditions. The impact of dust aerosols and clouds on DNI is much stronger than on GHI, and this effect is clearly reflected in the following solar atlas maps and in mean monthly curves in the following Sections.

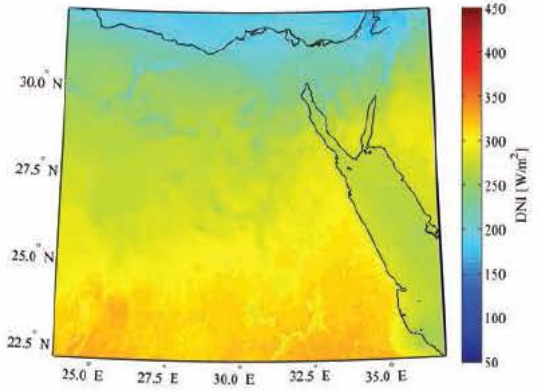
DIRECT NORMAL IRRADIANCE (DNI A&B)

MEAN SURFACE DIRECT NORMAL IRRADIANCE

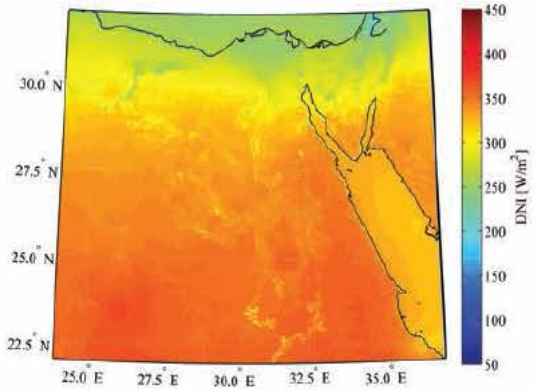
JANUARY



FEBRUARY



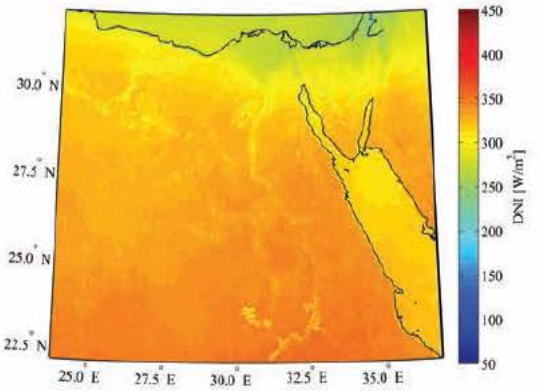
MARCH



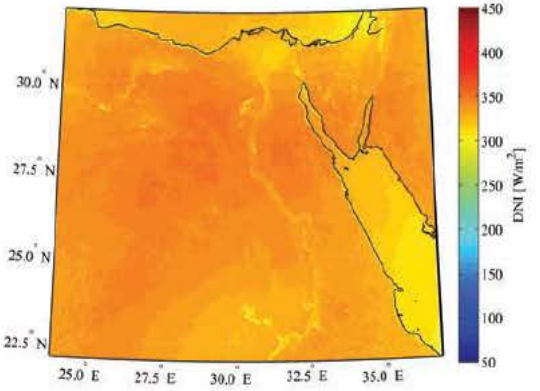
Direct Normal Irradiance (DNI) is the amount of solar radiation received per unit area by a surface that is always held perpendicular (or normal) to the rays that come in a straight line from the direction of the sun at its current position in the sky. Typically, you can maximize the amount of irradiance annually received by a surface by keeping it normal to incoming radiation. This quantity is of particular interest to concentrating solar thermal installations and installations that track the position of the sun.

MEAN SURFACE DIRECT NORMAL IRRADIANCE

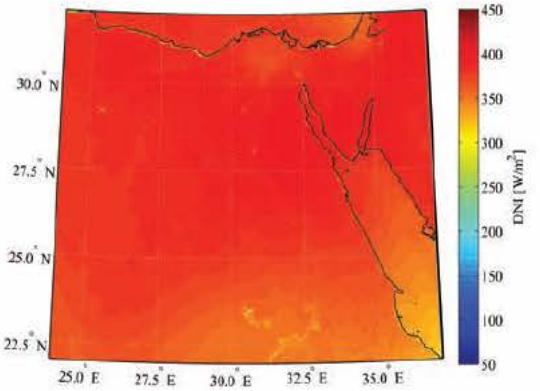
APRIL



MAY



JUNE



Solar Atlas for PV & CSP installations

MINISTRY OF ELECTRICITY AND RENEWABLE ENERGY

02

SOLAR ATLAS CLIMATOLOGY OF NORTHERN, CENTER AND SOUTHERN EGYPT (1999-2013)

03

SOLAR ATLAS OF TOTAL DNI AND GHI

CAIRO

DNI

GHI

ALEXANDRIA

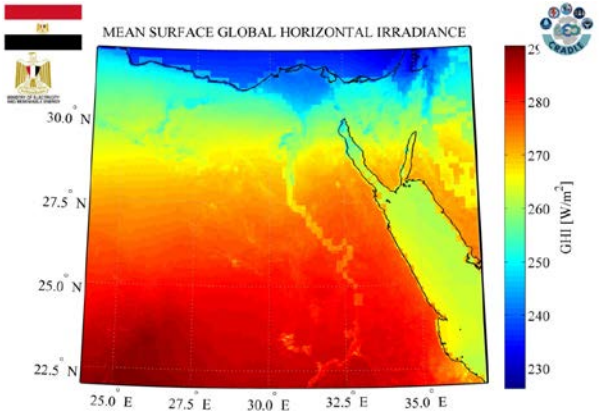
DNI

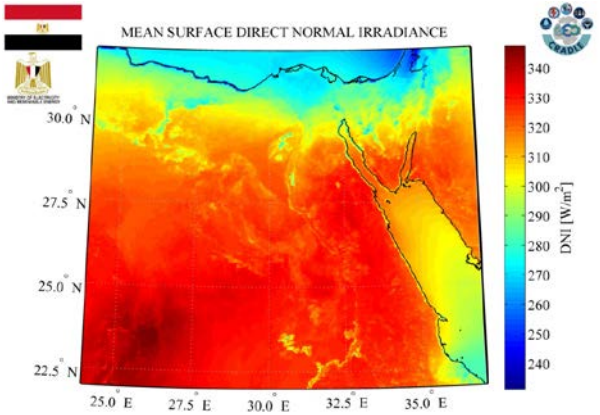
GHI

SOUTHERN EGYPT

DNI

GHI





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

04

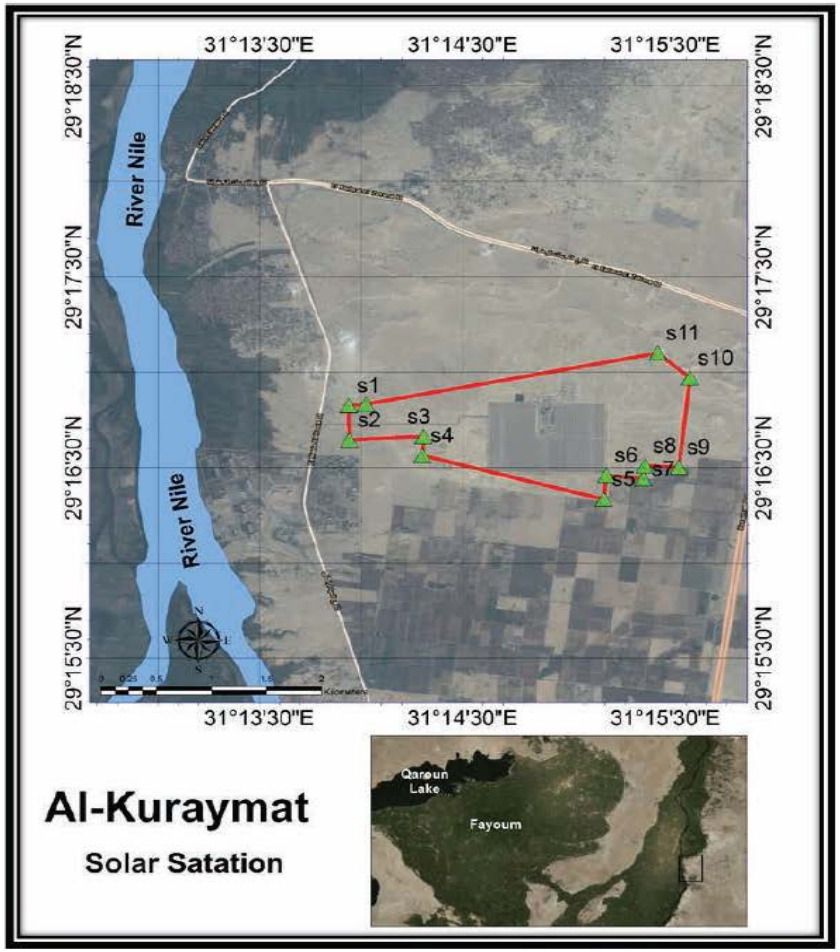
LANDS DEVOTED TO DEVELOPMENT AND USING BY THE NEW AND RENEWABLE ENERGY AUTHORITY (NREA) THROUGH A PRESIDENTIAL DECREE

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

MINISTRY OF ELECTRICITY AND RENEWABLE ENERGY

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).

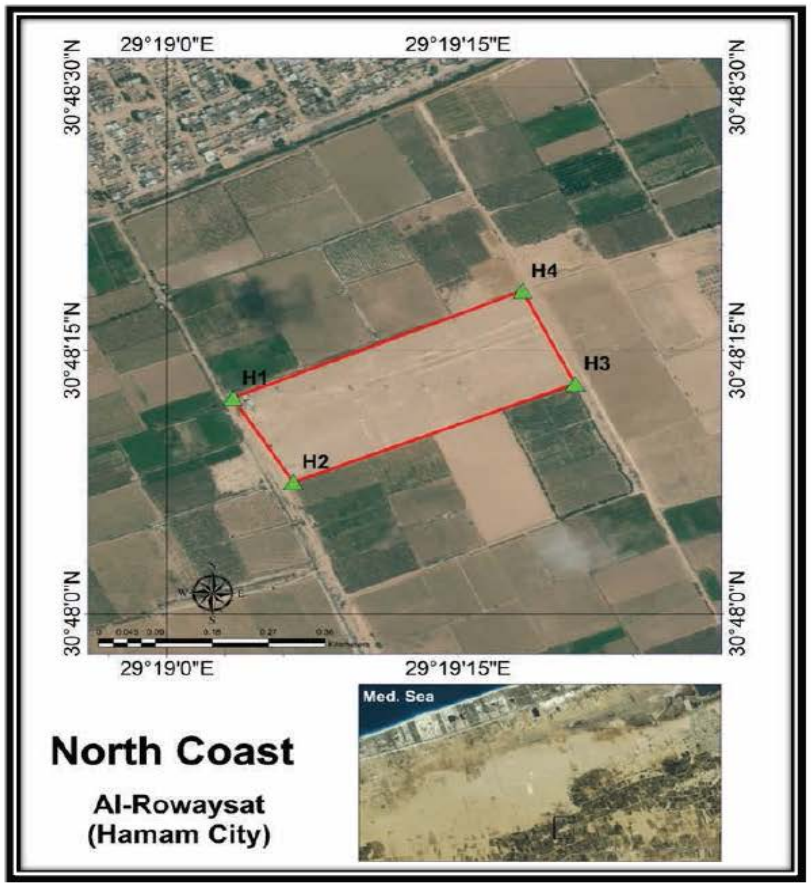
	SOLAR ENERGY (KWH/M2)	
	CSP	PV
JAN	121	164
FEB	136	161
MAR	194	222
APR	219	225
MAY	249	252
JUN	256	280
JUL	260	285
AUG	243	269
SEP	206	246
OCT	172	215
NOV	129	176
DEC	114	160
TOTAL	2296	2653

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

MINISTRY OF ELECTRICITY AND RENEWABLE ENERGY

5 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

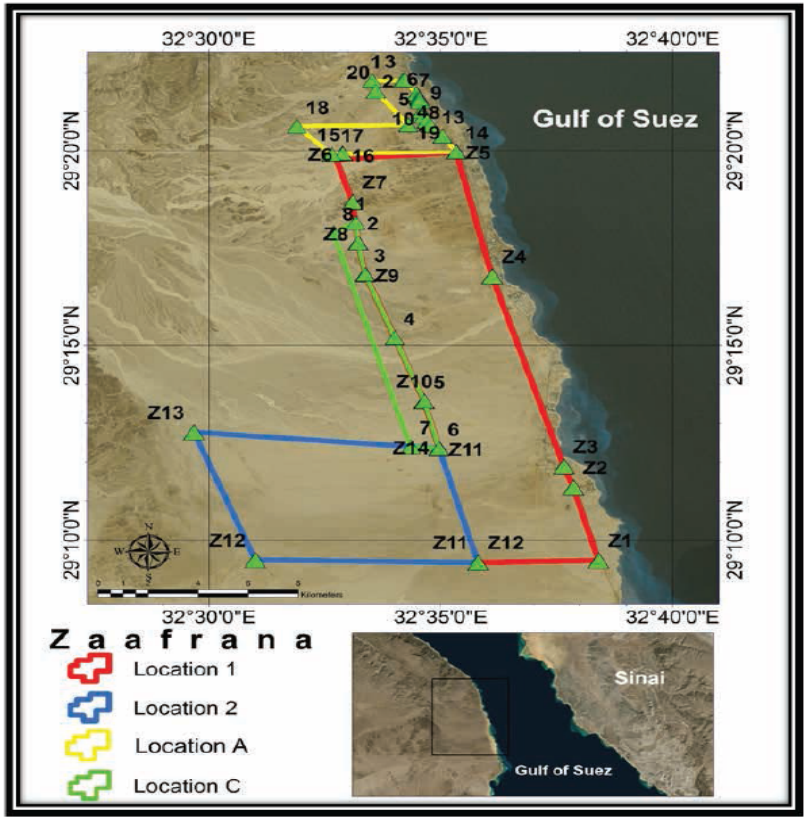
Monthly mean solar energy in kWh/m2 for CSP systems for the 5 lands of northern coast zone.

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

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

MINISTRY OF ELECTRICITY AND RENEWABLE ENERGY

MAP OF THE FOUR LOCATIONS OF ZAAFRANA AREA



Monthly mean solar energy in kWh/m2 for PV systems for the 5 lands of the Suez Governorate (Zaafrana Zone).

SOLAR ENERGY PV (KWH/M2)

LOCATION	1	2	3	4
JAN	125	116	118	123
FEB	139	131	131	137
MAR	197	188	190	196
APR	220	207	211	216
MAY	249	237	243	245
JUN	258	248	257	255
JUL	261	250	258	256
AUG	244	234	242	242
SEP	208	200	204	207
OCT	174	167	170	173
NOV	134	128	129	133
DEC	118	113	113	117
TOTAL	2326	2216	2262	2298

Monthly mean solar energy in kWh/m2 for CSP systems for the 5 lands of Suez Governorate (Zaafrana Zone).

SOLAR ENERGY CSP (KWH/M2)

LOCATION	1	2	3	4
JAN	181	163	159	177
FEB	174	160	151	170
MAR	235	221	213	230
APR	228	210	208	218
MAY	253	237	239	242
JUN	285	272	279	275
JUL	289	273	279	275
AUG	274	259	264	264
SEP	251	241	237	247
OCT	224	214	209	221
NOV	195	187	176	192
DEC	181	174	165	178
TOTAL	2767	2607	2577	2685

Reply Reply All Forward

Sun 10/1/2017 12:09 PM

Mohammed El-Khayat

Re: Atlas is ready for review

To mohammed ahmed; El-Askary, Hesham

Cc Ehab Ismail; Ehab Kahil; salah.abououf2015@gmail.com; Amgad Elhewehy; Raafat Abdel-KADER; NREA Chairperson

You forwarded this message on 10/12/2017 1:42 PM.

Dear Prof Dr Hesham

Thank you very much for your e-mail and distinguished efforts to support RE activities in Egypt. Regarding Solar Atlas, once getting your permission on the final version, we will launch it and disseminate it among the designated national entities; i.e. Universities, national and international Agencies, i.e. IRENA, WB, LAS, IEA, ... Consequently, we do appreciate receiving your recommendations, either potential entities or the cover letter, which will refer to our mutual co-operation. **Our target, is to consider the Solar Atlas as an official reference.**

Regarding the operational decision support system, we do support this direction too, as already discussed with your good self. Consequently, please let me know, how could we support such project.

Also, It is our pleasure to meet you at the coming German Chamber work shop on October 8th. I will keep you updated.

Dr. Eng. Mohamed Mostafa El-Khayat
Executive Chairman
New and Renewable Energy Authority, NREA
Chair of Renewable Energy and Energy efficiency of Arab Experts Committee, League of Arab States, LAS.

Support from the Government

Solar Energy Nowcasting

THE SOLAR ATLAS OF EGYPT

Our Atlas is considered as the official document of the government for the purpose of solar energy planning

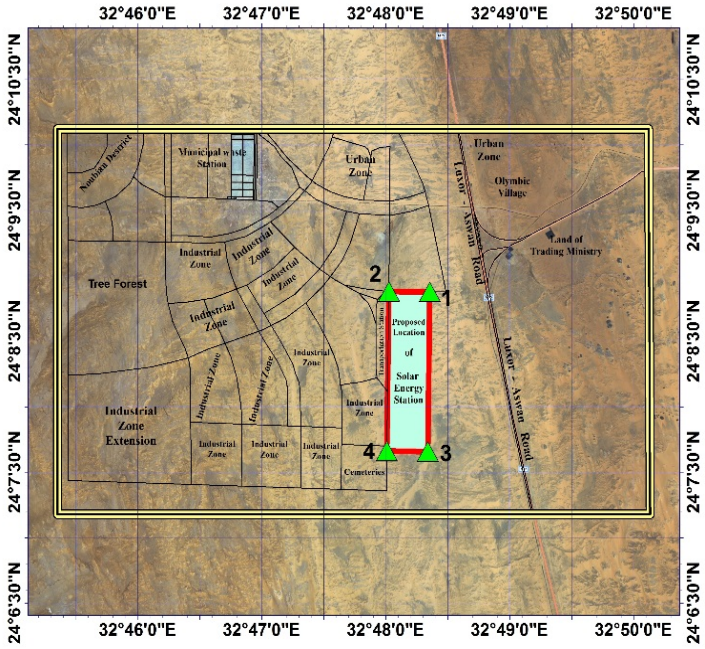
Business Plan for the establishment, operation and exploitation of a Solar Farm

Aswan's Solar Plant Project
Extension of Sir Magdi Yacoub Heart Hospital

Pn	E	N
1	803455.06	169623.71
2	803578.36	169542.63
3	803675.11	169605.05
4	803702.70	169605.10
5	803761.93	169504.59
6	803772.75	169481.86
7	803492.54	169189.17
8	803477.10	169251.05
9	803347.34	169540.31

Pn	E	N
7'	803504.03	169201.10
13	803511.80	169169.37
14	803530.40	169164.35
15	803782.59	169363.27
16	803768.16	169388.76
17	803781.38	169391.68
18	803793.80	169417.31
6'	803768.28	169477.19

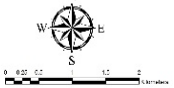
Pn	E	N
1	803455.06	169623.71
2	803578.36	169542.63
3	803675.11	169605.05
4	803702.70	169605.10
10	803528.93	169680.90
11	803656.05	169656.24
12	803684.22	169963.62

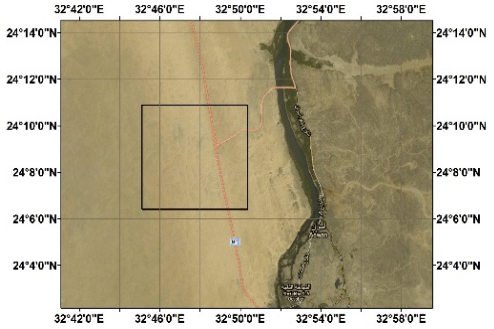


Proposed Location of Solar Station of Dr. Magdy Yacoub Medical Center in Aswan

Area – 1260000 m2 (300 Feddan)

CORNERS	NORTH	EAST
1	N 24° 08' 05.54"	E 32° 48' 21.94"
2	N 24° 08' 52.27"	E 32° 48' 01.55"
3	N 24° 07' 56.07"	E 32° 48' 00.73"
4	N 24° 07' 39.28"	E 32° 48' 00.07"





The resultant set of five “families” of scenarios provide a wide range of deployment options

	#	CSP		PV	
		PT	ST	CS	CdTe
“Minimal”	1			10	
	2				10
	3			3	7
	4			7	3
1 12MW	5	12			
	6		12		
	7			12	
	8				12
2 20MW	9	20			
	10		20		
	11			20	
	12				20
	13	12		8	
	14	12			8
	15		12	8	
	16		12		8

Single technology
Hybrid approach

	#	CSP		PV	
		PT	ST	CS	CdTe
3 50MW	17	50			
	18		50		
	19			50	
	20				50
	21	12		38	
	22	12			38
	23		12	38	
	24		12		38
	25	10		40	
	26	10			40
	27		10	40	
	28		10		40
4 Max. Area	29	45			
	30		35		
	31			86	
	32				97
	33	12		62	
	34	12			70
	35		12	56	
	36		12		63

5 **Phased Approach**

#	CSP		PV	
	PT	ST	CS	CdTe
37		12		56

A wide range of possible combinations, e.g.12+50, 12+20 or 20+50, of which one has been highlighted in the report.

MAGDI YACOUB
HEART FOUNDATION
ASWAN HEART CENTRE

THE SOLAR ATLAS OF
EGYPT

Thank You

Communicate and Collaborate with GEO:

http://geocradle.eu/en/

https://www.facebook.com/geocradle/