NextSENSE: solar energy nowcasting & short-term forecasting system

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The e-shape project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement 820852

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HELLENIC REPUBLIC MINISTRY OF DEVELOPMENT AND INVESTMENTS | GSRI GENERAL SECRETARIAT FOR RESEARCH AND INNOVATION

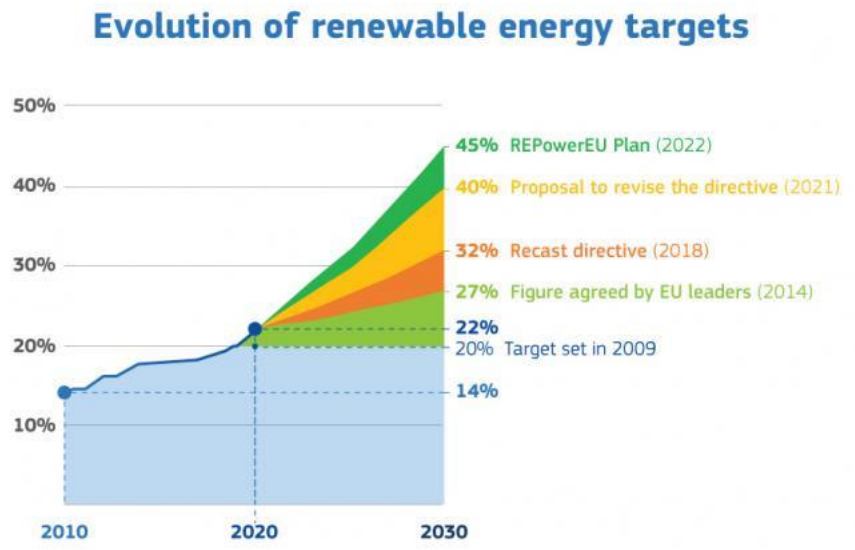
European Commission

- Global and international initiatives for the mitigation of climate change ➔ Renewables will play a key role

European Green Deal

E-Shape: Applications powered by Europe:

- UN 2030 Agenda for Sustainable Development :
  UN Sustainable Development Goal 7
  - 7.1: ensure universal access to affordable, reliable, and modern energy services
  - 7.2: increase the share of renewable energy in the global energy mix



- EU directives for renewable energy goals
  - The Paris Climate Agreement
  - The GEO Initiative GEO-VENER (GEO Vision for Energy) and GEO-CRADLE initiative

Ukraine: energy security concerns

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The problem

- Increase demand for solar energy ➔ more efficient production and integration to the electricity grid is needed – minimize cost for PV installations & infrastructure
- Fast, accurate, high spatial and high temporal resolution energy forecasts can contribute significantly towards this direction
- In order to now-cast or forecast solar energy in different time scales we need to know and understand changes in the Atmosphere, and how they affect solar radiation
- **European EO resources:** Utilize and provide innovative and mature products and services for renewable energy development and management

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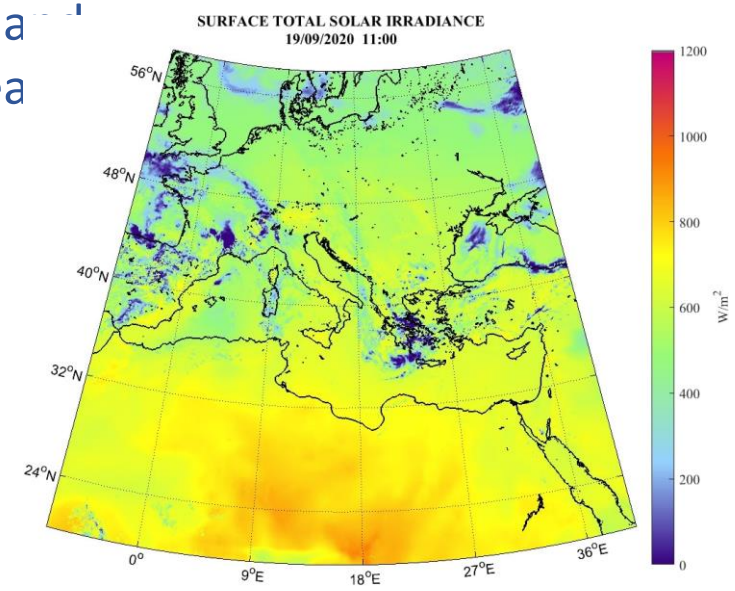
The Solar Energy nowcasting and short-term forecasting system (nextSENSE)

- **Objective:** provide EO and Copernicus (CAMS) based nowcasting (real-time) and short/long-term forecasting of broadband and spectral surface solar irradiance a[illegible] solar energy, at high spatiotemporal resolution (coverage: Europe, Mediterranea basin, MENA)



- Support of TSOs, DSOs and national solar plant development initiatives.
- **Expected user community:** Grid operators, Power and Electricity corporations, ministries, energy trading companies, researchers in Energy and citizens.
- **Supporting infrastructure:** GEO-CRADLE, Beyond Collaborative Ground Segment Data Site
- Partners:

pmod wrc · ARMINES · TRANSVALOR · CEDARE

EuroGEO · GEO GROUP ON EARTH OBSERVATIONS · Copernicus

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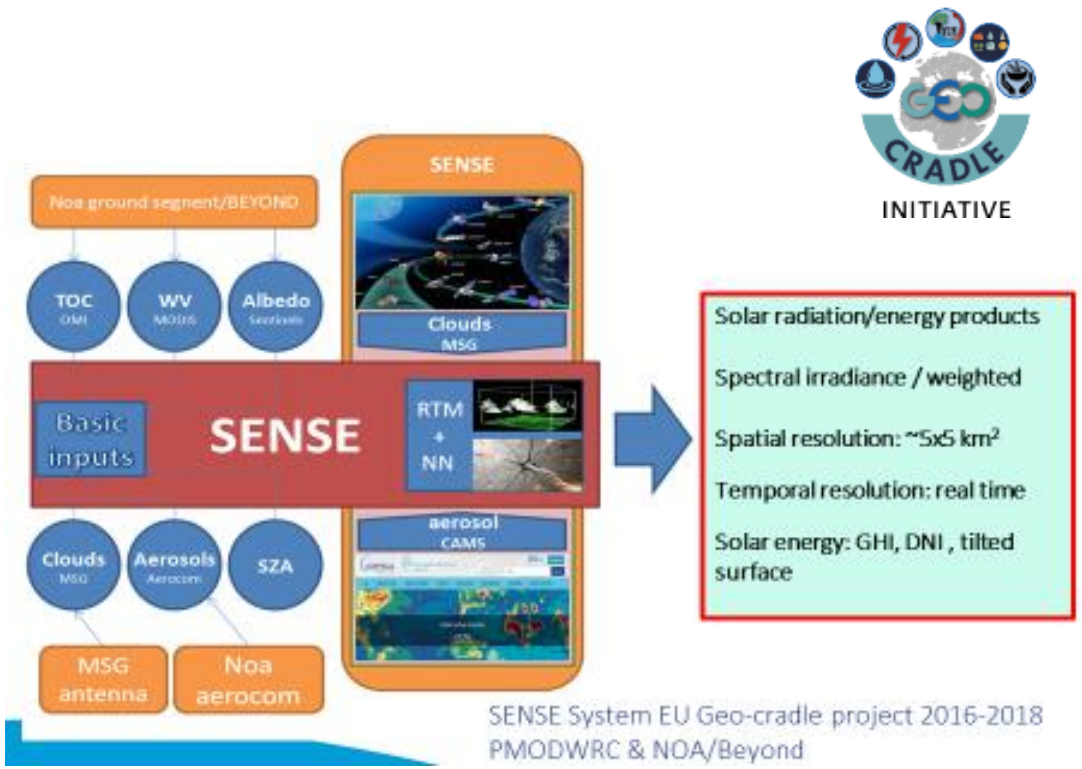
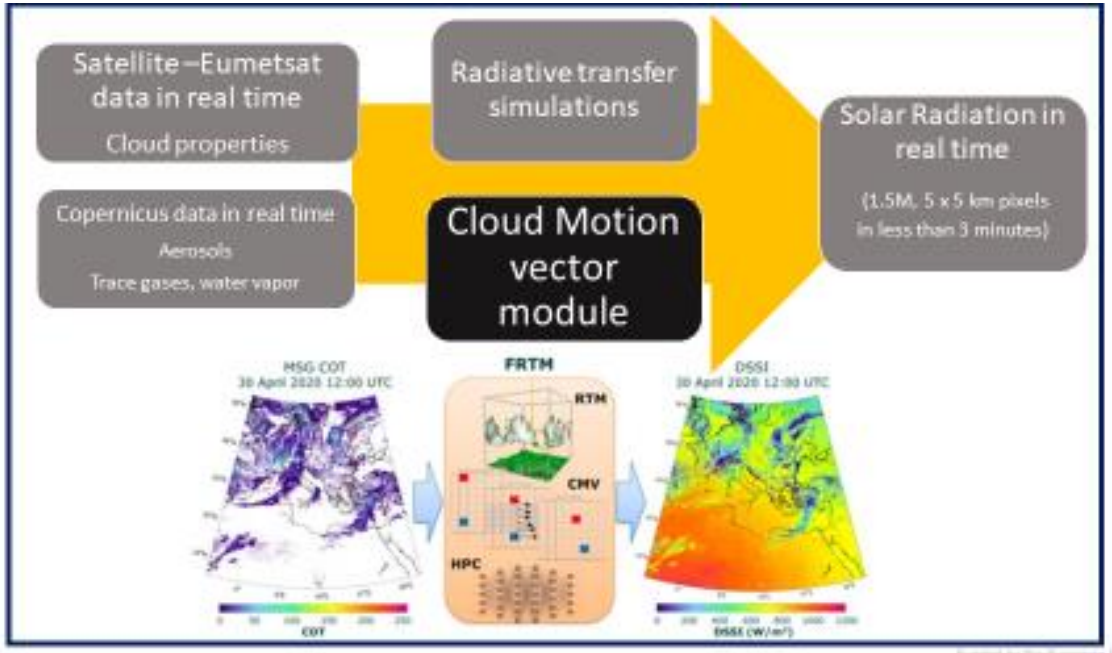
Sense Nowcasting System



SENSE System EU Geo-cradle project 2016-2018
PMODWRC & NOA/Beyond

NextSense Forecasting System



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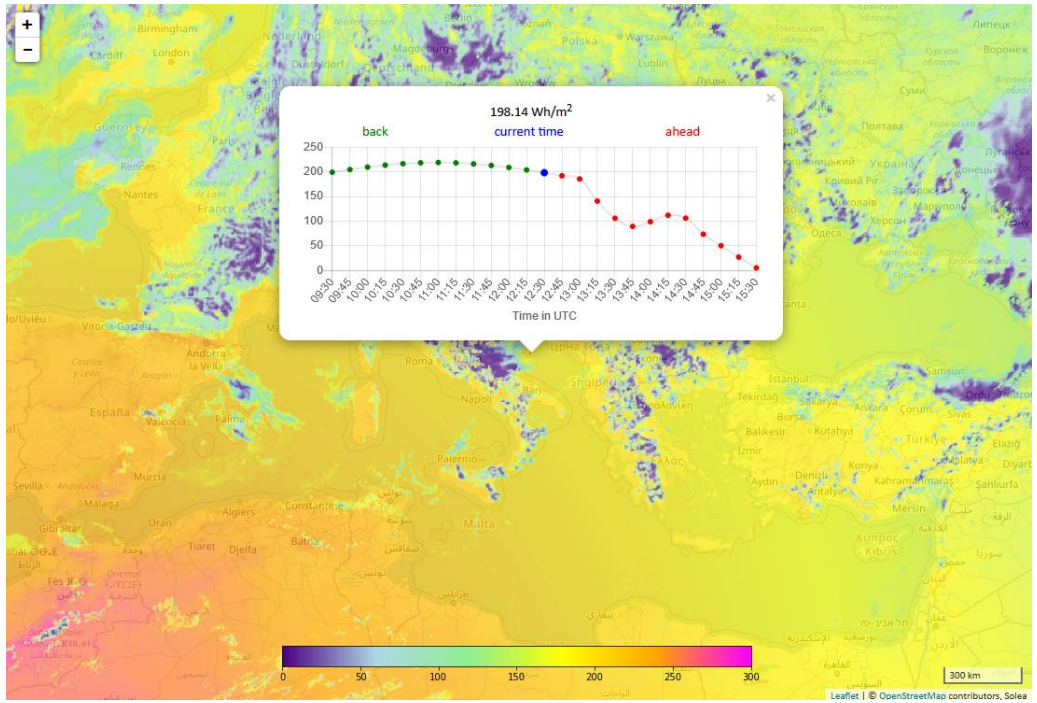
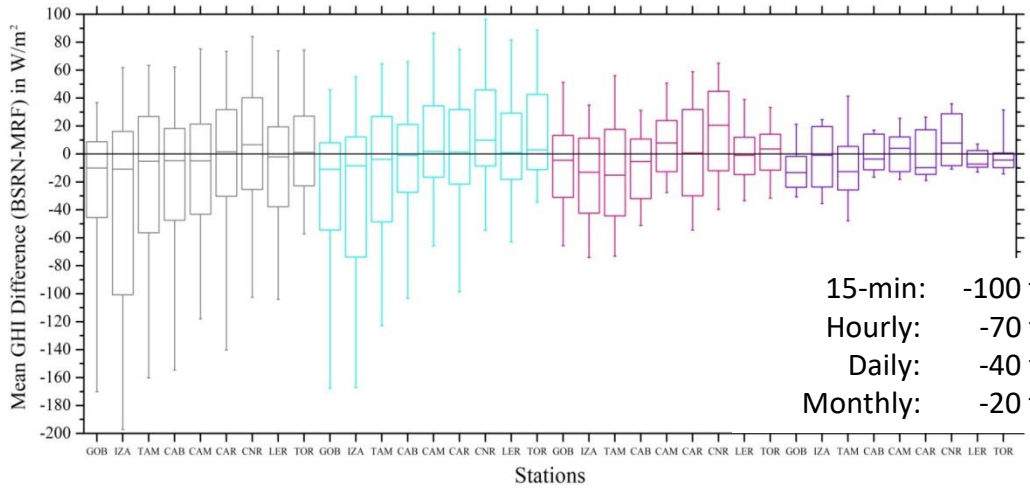
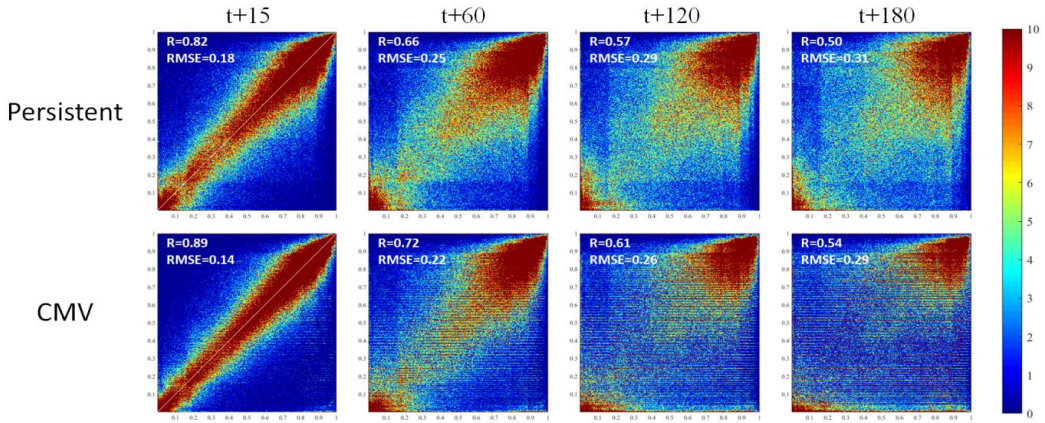
Output:
Real time solar radiation for Europe, NAME (5Km², 15 min)



Validation



15-min: -100 to 40 W/m²
Hourly: -70 to 40 W/m²
Daily: -40 to 30 W/m²
Monthly: -20 to 20 W/m²



Kosmopoulos & Kazadzis., 2018

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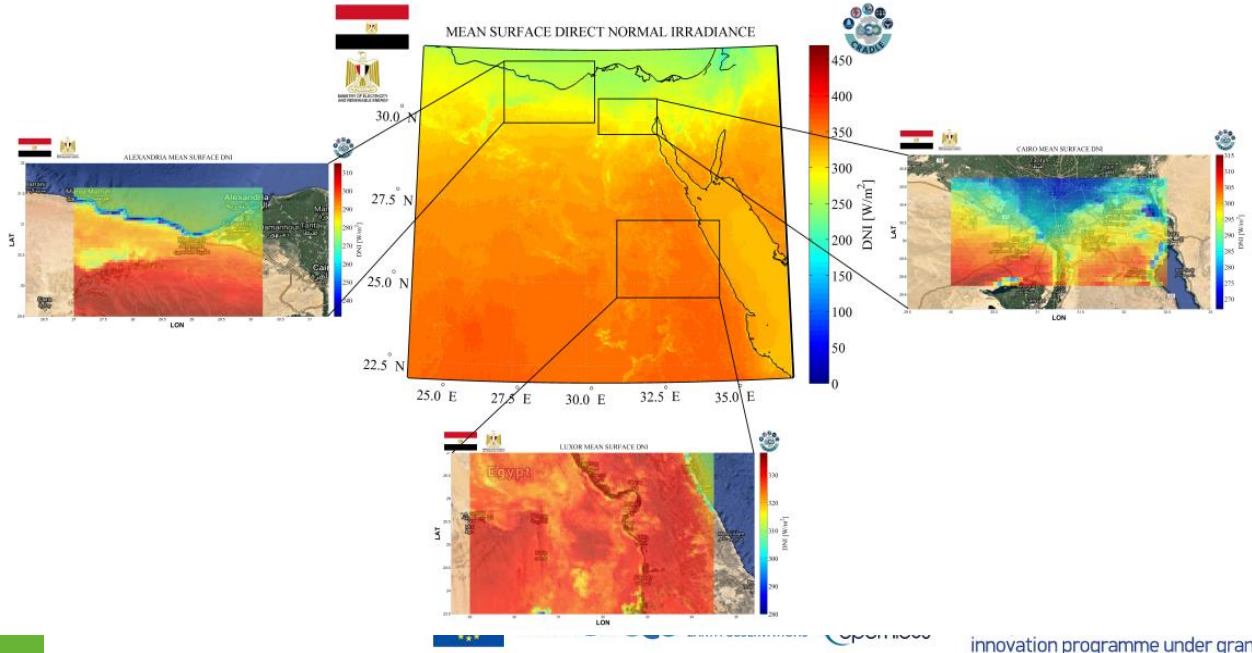
The Solar Energy forecasting pilot of E-shape & co-design aspects

- Past data: Exploitation of historical data to define long term solar potential to specific areas

Solar park characterization/planning and economic studies

Ministry of electricity and renewable Energy of Egypt &Mahdi Yacoub Heart Foundation Center, Egypt



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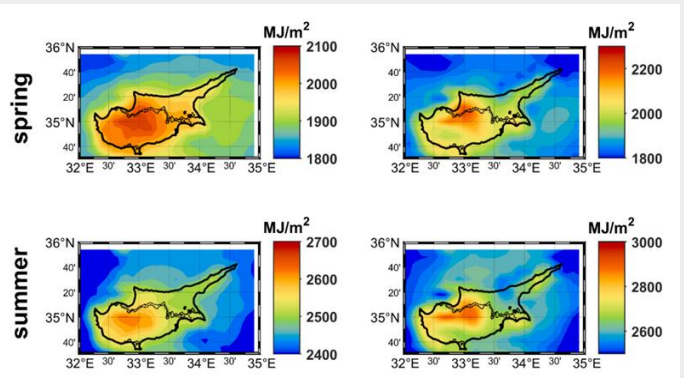
The Solar Energy forecasting pilot of E-shape & co-design aspects

- Now-casting: Provide in real time the current solar radiation/energy at a pan-European and middle East and North African scale

Cyprus Solar

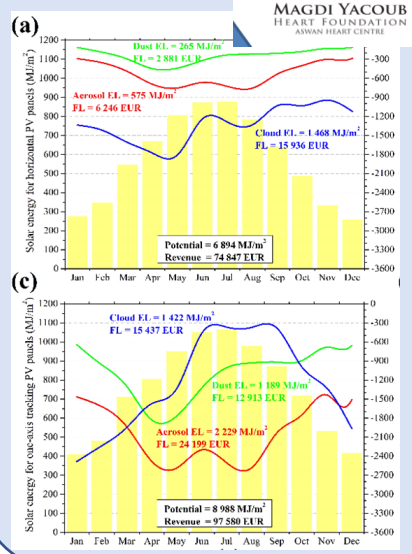
EXCELSIOR

GHI DNI



Egypt: Economic impact

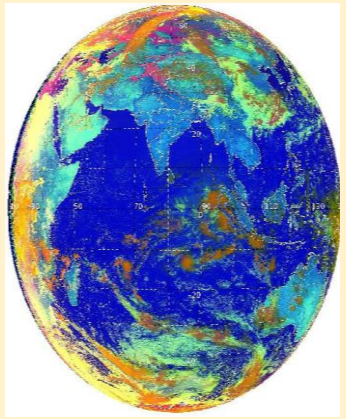
MAGDI YACOUB HEART FOUNDATION
ASWAN HEART CENTRE

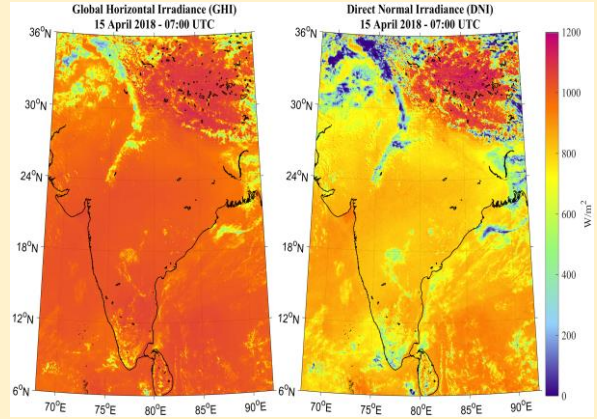


India: Sunel & Adani power

adani Power

SUNEL





Masoom & Kazadzis, 2020

EuroGEO GEO GROUP ON EARTH OBSERVATIONS Copernicus

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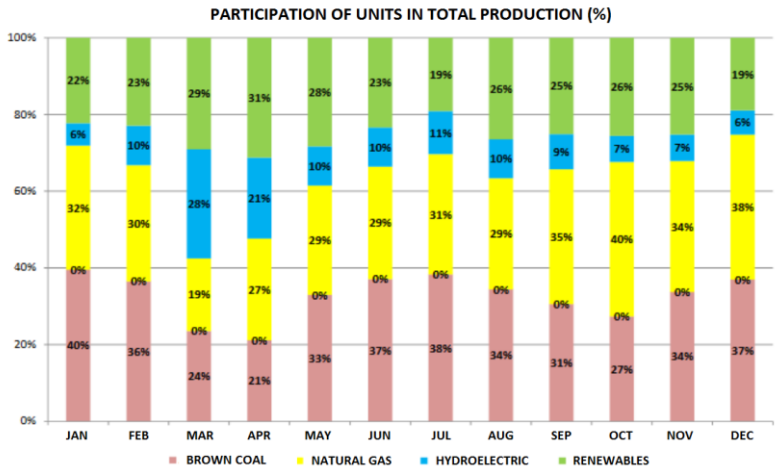
The Solar Energy forecasting pilot of E-shape & co-design aspects

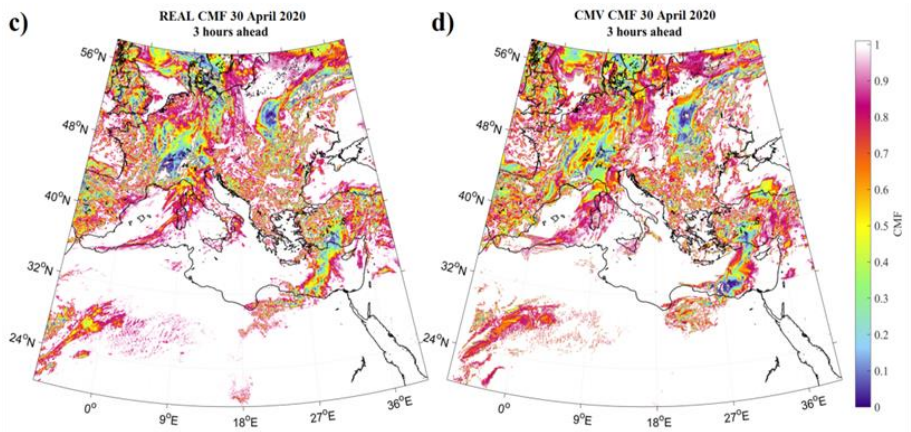
- Short term forecasting: Provide a forecast for the next 0 to 4 hours solar radiation/energy at a pan-European and middle East and North Africa scale

Ind, Power transmission Operator Greek TSO



Public Power Corporation Renewables

Management of new PV parks
Energy demand and trade (new legislation)



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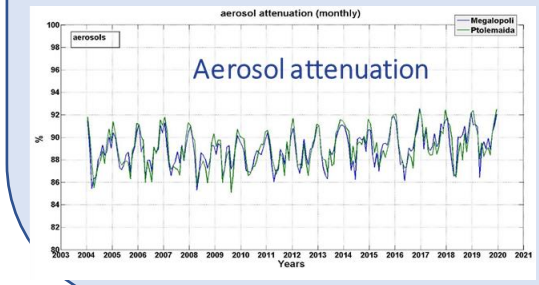
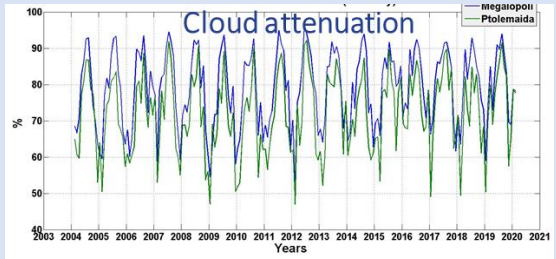
The Solar Energy forecasting pilot of E-shape & co-design aspects

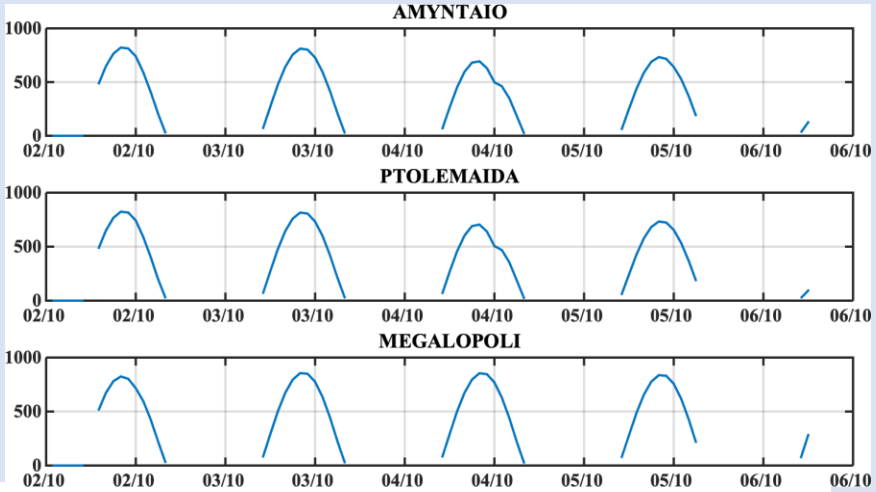
- Long term forecasting: Provide a forecast for the next 1 to 4 days solar radiation/energy

Public Power Corporation Renewables

Greek REN Authority ->
Forecast NWP 1-2 days ahead
Aerosol & cloud nowcasting / historical data
Management of new PV parks
Energy demand and trade (new legislation)







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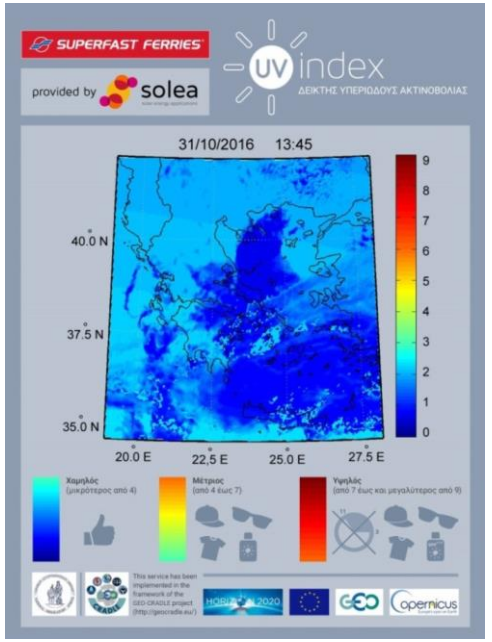
Other applications developed / Use of Spectral solar data

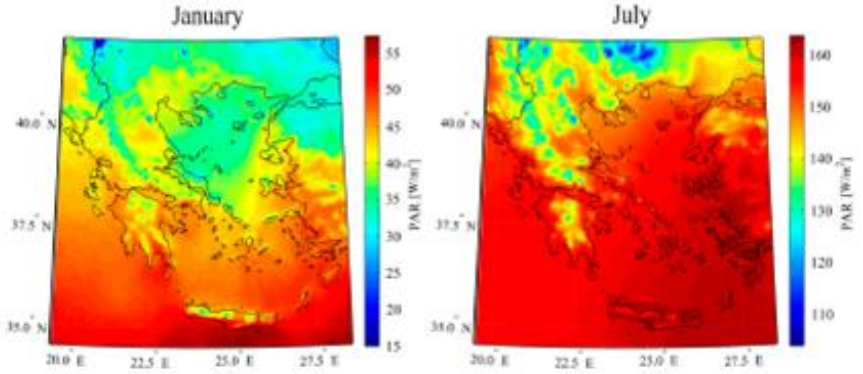


Health:

- UVIOS: system for nowcasting of the solar UV index (UV irradiance erythema on human skin)
- Vitamin D production
- Drastical doses for DNA damage (plants and animals)

Agriculture:

PAR (400 – 700 nm): photosynthetically active radiation



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Conclusions - Remarks

NextSense: development of Earth observation and Copernicus based products and services for energy management aiming to promote collaboration between users and providers of Earth observation, scientists and renewable energy related end uses

Future needs:

- Downscalling and user needs adaptation: From pan-European demonstration to roof top or PV park scale including real time data assimilation
- Support end-to-end energy production systems (including planning, generation, transmission, distribution);
- Access to data and supported by cloud facilities provided by the European program Copernicus
- Accelerating EO technology, digitalisation, new services and business models including solar forecasting accuracy aspects
- Combine various renewable energy solutions – holistic approach on management: use, storage, trade..
- Attract investments, involvement of citizens, contribute to regional policy frameworks on clean energy transition

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Action group on Renewable Energy
Support the research and development towards Earth observation products and services for energy management

Applications to support combined (e.g. solar, wind..) end-to-end energy production systems (including planning, transmission, distribution)

Improve accuracy of models and applications downscaling to spatial user need levels with the use of in situ data

Enhance the use of the open-source business-compliant Earth Observation (EO) access to data and supported by cloud facilities provided by the European program Copernicus.

Explore new technologies, creation of more end user based data for Copernicus databases, closer look at future satellite possibilities

Building a national, regional and local policy framework supporting the clean energy transition (support to integrated EU systems based on EU green deal priorities, national strategic plans, down to end user do-designing practises)

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