

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

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Motivation & Methodology

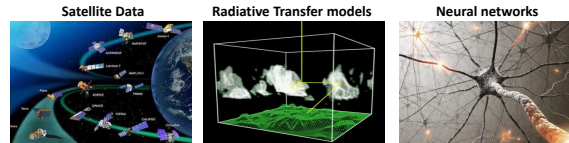
In light of efforts made by the Government of the Arab Republic of Egypt to achieve the desired economic growth while preserving the environment, the government tries to address the demand for energy efficiency through the use of renewable energy sources. In the framework of the HORIZON 2020 GEO-Cradle project (www.geocradle.eu), 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 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 and Global Horizontal Irradiances (DNI and GHI respectively), while the spatial resolution is almost 5 km, maximizing the exploitative value of the solar energy technologies. On the other hand, the operational Solar Energy Nowcasting System (SENSE) of the GHI and DNI is developed in the framework of the solea project (www.solea.gr) and is based on a synergy of large (2.5M record) Radiative Transfer Model simulation look-up tables, neural networks and satellite-based cloud (Meteosat) and aerosol inputs (Copernicus Atmosphere Monitoring Service, CAMS) in real time. This system is able to produce 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.

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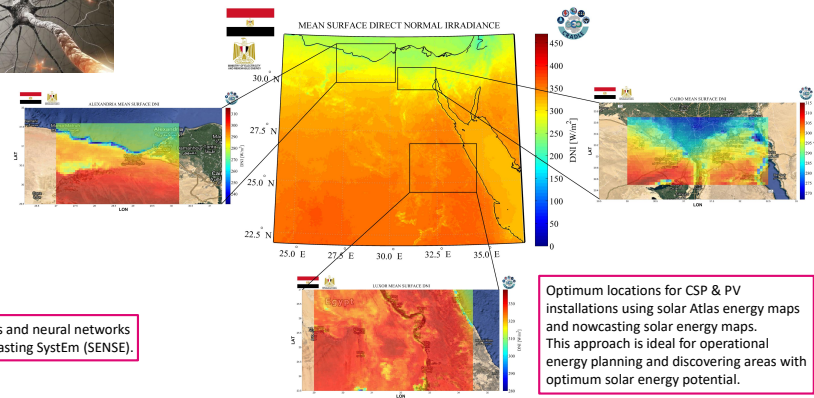


The expected future energy status in Egypt. Demographic trends in Egypt require informed long-term planning of energy sector investments on the national level to expand existing electricity production capacities and meet growing demand. At the same time Egypt has conditions for the largest production of renewable energy in the world. There has been demonstrated market traction for the region's solar power in a growing export market for clean energy.

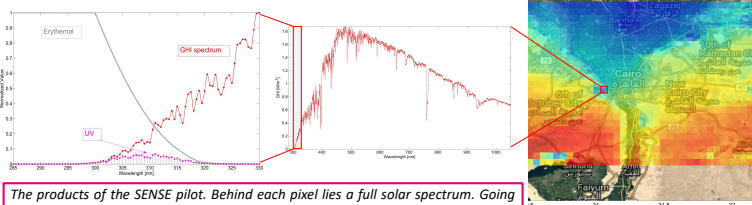
1. The SENSE



2. The Solar Energy Potential



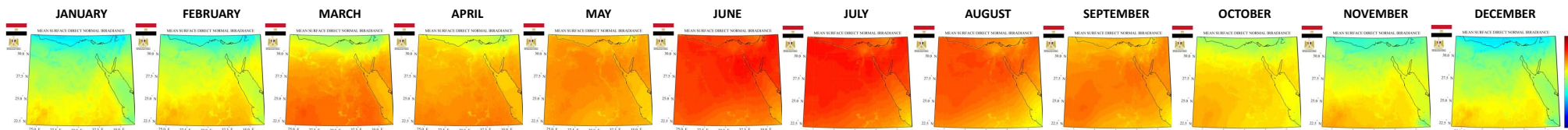
3. The Products



The products of the SENSE pilot. Behind each pixel lies a full solar spectrum. 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.

The synergistic use of satellite data, radiative transfer models and neural networks for the development and evolution of the Solar Energy Nowcasting System (SENSE).

4. The Solar Atlas



The Solar Atlas maps are based on a 15-year climatology from the solar radiation databases and products of the EUMETSAT's Satellite Application Facility on Climate Monitoring (CM SAF), taking into account the clouds and aerosols impact on Direct Normal and Global Horizontal Irradiance (DNI and GHI respectively), while the spatial resolution is almost 5 km, maximizing the exploitative value of the solar energy technologies. The DNI applies to Concentrated Solar Plant (CSP) installations while the components of the GHI applies to Photovoltaic (PV) installations.

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Major Applications & Contribution to Emerging Technology

- Location studies for the placement of SCP plants and CPV installations
- Large-scale and precise solar energy calculations to assist Public Authorities in energy planning policy
- Supporting the work of various scientific communities
- Provision of specialized data of high spectral precision for private and public sectors dealing with health protection, energy consumption and solar energy exploitation