Access to solar energy applications using EO data through GEO activities: validation and demonstration of the SENSE system

Panagiotis Kosmopoulos[1]*, Stelios Kazadzis[2,1], Charalampos Kontoes[3], Hesham El-Askary[4], Dimitris Zografos[5] and George Krestos[5]

*Corresponding author: pkosmo@meteo.noa.gr

[1]Institute for Environmental Research and Sustainable Development, National Observatory of Athens, Greece, [2]Physicalisch-Meteorologisches Observatorium Davos, World Radiation Center, Switzerland, [3]Institute for Astronomy, Astrophysics, Space Applications and Remote Sensing, National Observatory of Athens, Greece, [4]Schmid College of Science and Technology, Chapman University, Orange, CA, USA, [5]Independent Power Transmission Operator, Athens, Greece

Southern Europe and North Africa present unique solar energy potential and its exploitation is critical for the regional sustainable development, through an effective energy planning, power transmission and distribution. In the framework of the H2020, EU-funded GEO-CRADLE project(http://geocradle.eu/en/), we have demonstrated a novel Solar Energy Nowcasting System(SENSE; http://solea.gr/), in order to provide tailored solutions to the Energy Sector. It addresses solar energy related end-user needs that have been defined during the course of GEO activities(e.g. GEO-Vener) and other initiatives(International Energy Agency, United Nations, SDGs, etc). The niche for this feasibility study is the operational, satellite-driven SENSE that produces instant estimates and short-term forecasts(STF) of solar energy in high spectral, spatial and temporal resolution(1nm, 0.05x0.05 degrees, 15min). SENSE is based on the synergy of Radiative Transfer Model(RTM) simulations, speed-up technologies (neural networks and multi-regression functions) and Big Earth Observation(EO) Data as inputs in real-time. For the SENSE's STF of 0 to 3 hours ahead, we performed a cloud motion vector analysis by using a nonlinear autoregressive exogenous model. End-users of the above solar energy services are the Independent Power Transmission Operator of Greece(IPTO; http://www.admie.gr/) and the Ministry of Electricity and Renewable Energy of Egypt(MOEE; http://www.moee.gov.eg/). The reliability of SENSE's outputs and STF was tested against Baseline Surface Radiation Network(BSRN) measurements, under high aerosol loads and for various atmospheric conditions, as observed by the Spinning Enhanced Visible and InfRared Imager onboard the Meteosat Second Generation satellite, the Moderate Resolution Imaging Spectroradiometer onboard the Aqua satellite and the Copernicus Atmosphere Monitoring Service. The exploitation of EO data through GEO activities and SENSE will provide access to advanced solar energy related products, in support to large scale solar farm projects, grid operators, national and private electrical transmission and handling entities, so as to guarantee the uninterrupted energy flow and the power grid stability.

Keywords: Solar energy, GEO, Short-term forecasting, SENSE, Radiative transfer model, EO