Bridging Climate Services and Solar Energy Transition: Insights from C3S NCP Greece and ReEnergy-MED projects

C. Giannakopoulos[1], V. Amiridis[2], I. Fountoulakis[2], M. Gratsea[1], S. Kartsios[2], S. Misios[2], N. Papadimitriou[2]

[1]National Observatory of Athens, Greece

[2]Academy of Athens, Greece

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Abstract

The Mediterranean region is among the sunniest areas of the world and holds significant potential for renewable energy production from both solar and wind resources. Despite this advantage, these energy sources remain underexploited in many Mediterranean countries. Maximizing their potential requires not only the expansion of infrastructure—such as increased photovoltaic (PV) and wind power capacity—but also the efficient use of available climate and energy resources. In this context, climate information plays a crucial role. Seasonal to decadal forecasts, together with long-term climate projections, can support improved estimates of renewable energy production and energy demand, enabling more effective energy management and planning. This is particularly important for the Mediterranean, which is recognized as a climate change hotspot, experiencing warming and variability at rates exceeding the global average. The use of climate data and services provided by the Copernicus Climate Change Service (C3S) offers valuable opportunities to support data-driven decision-making in the renewable energy sector. By integrating climate intelligence into planning processes, stakeholders can enhance the resilience, efficiency, and sustainability of energy systems across the region.

ClimateHub: The C3S National Collaboration Program (C3S-NCP) in Greece

ClimateHub delivers a pioneering national climate service, providing seasonal to decadal probabilistic predictions forecasts for energy demand and renewable energy production. The information is available by a publicly accessible portal (https://portal.climatehub.gr, accessed on 26 March 2026), bridging the gap between advanced climate data and actionable insights for stakeholders.

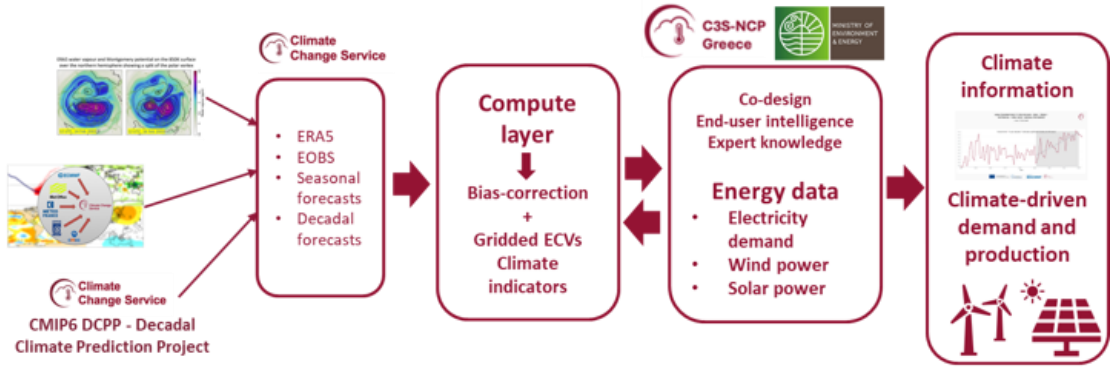

Figure 1: Workflow of the C3S-NCP Climatehub energy prediction system.

The service employs the ECMWF/SEAS5 seasonal forecasts and provides forecasts of photovoltaic and wind energy production up to 3 months ahead. In addition, decadal outlooks are also available for photovoltaic and offshore wind energy production (only for summer). Last but not least, ClimateHub aims to deliver seasonal predictions on climate-related electricity demand by combining ENTSO-E time series and national data.

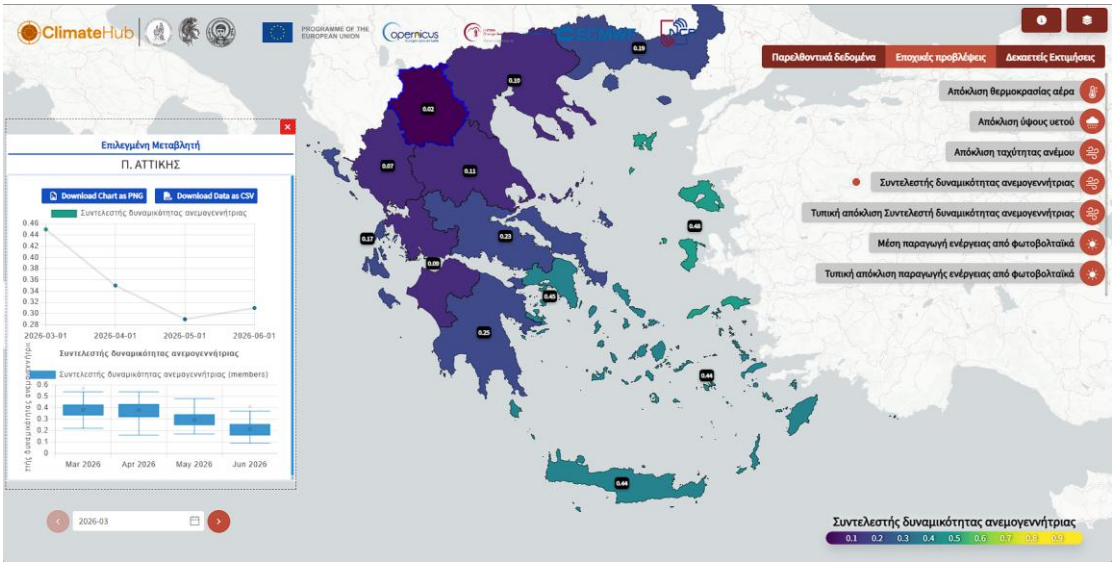

Figure 2: Wind capacity factor in March 2026 based on ECMWF/SEAS5 seasonal forecasts (initialization 01 March 2026) for each Region in Greece. The pop-up window on the left depicts the timeseries of the average wind capacity factor for the period March-June 2026 (top) for the Region of Attica, while the box-plot time series (bottom) presents the spread of the ensemble members.

ReEnergy-MED: Seasonal and long-term predictions to support REnewable ENERGY transition in Eastern and Southern MEDiterranean: demonstration cases in Greece and Morocco

While ClimateHub focuses on the provision of seasonal forecasts and decadal predictions on a national level, ReEnergy-MED focuses on three demonstration cases and aims to provide site specific (downscaled and bias-adjusted) seasonal forecasts and long-term projections of the solar power potential, as well as information that can be used by the involved companies and the local/regional authorities for energy management planning and decision making. The three demonstration cases are shown in Figure 3.

Figure 3: Demonstration cases in Greece and Morocco: (a) three Greek islands with different climatic conditions and touristic growth, (b) solar parks at Evros region in Northern Greece, and (c) three regions in Morocco.

The energy prediction system that is being developed is focused on seasonal and long-term time scales based on Copernicus C3S and CAMS. C3S temperature and radiation data are downscaled for the selected demonstration cases using either ERA5-land data (cases (a) and (c)) or CERRA-Land data (case (b)) and energy production simulations are then conducted using the Global Solar Energy Estimator (GSEE) model. Long-term projections are available for three Shared Socioeconomic Pathways (SSPs): SSP1-2.6, SSP2-4.5 and SSP5-8.5. The new products are validated using the produced energy and solar radiation measurements that are available at the test sites.

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