Ghana solar resource map

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Over 20 years of research in solar radiation at the National Renewable Energy Laboratory (NREL) is now poised to advance power system planning and solar energy deployment across Africa, Eastern Europe, and the Middle East. It comes in the form of a new, high-resolution solar timeseries data set on the Renewable Energy Data Explorer (RE Data Explorer) tool, tailored to the needs of stakeholders in energy sectors across national governments, academia, and private industry.

Undertaking a project of this size required collaborative effort. The USAID Missions, or satellite offices, in Ukraine and Tanzania first worked with their partners at NREL to establish what the research and analysis priorities for each country would be. Based on those priorities, the team at NREL saw how this data set could address some of their overlapping needs.

"Rather than processing all of the data twice and splitting the regions, or just processing one region, it"s way more efficient to do it together," NREL"s Ukraine program lead Ilya Chernyakhovskiy said. "This way, both regions benefit."

RE Data Explorer is a publicly available geospatial analysis tool that gives users the ability to access renewable energy data customized to their needs. Its data can feed into tools such as the System Advisor Model, PVWatts, and others that can inform ongoing and future analysis, policymaking, and power system planning. RE Data Explorer has thousands of dedicated users who have shared how its capabilities are instrumental in their clean energy project development, long-term energy planning, and academic research.

To produce this new data set, the researchers compiled data sources covering Africa, Europe, and the Middle East from 2005 through 2022. Using imagery captured every 15 minutes by the European Union"s (EU) Meteosat geostationary weather satellites, NREL"s partners at the University of Wisconsin modeled key factors like cloud cover and composition. NREL also integrated satellite data from NASA representing aerosols (such as smoke, dust, and other airborne particulates) to estimate the solar irradiance reaching the surface on a four-kilometer (km) grid.

The cloud properties are then run through NREL"s radiative transfer model--called the Fast All-sky Radiation Model for Solar (FARMS)--on the laboratory"s high-performance supercomputer, pixel by pixel, time step by time step, to create a high-resolution grid over the 18-year period of the final data set.

Having easy and free access to these robust data is vital for solar developers and potential purchasers of the electricity (e.g., a public utility) because it helps them estimate the expected amount of electricity generated for a given percentage of years of a project, which informs an important parameter called the exceedance probability.

"Those numbers are important because they"re used to inform project risk and help secure financing. To calculate exceedance probabilities, you need the long-term record of the solar resource to represent interannual variability, and this feeds into project bankability," Maclaurin explained. "It provides an assessment of the generation potential and its uncertainty, and thus informs the project risk for a financier or a bank."

In Ukraine, planners and developers are looking to incorporate more renewable energy as the country rebuilds its grid and searches for new means to become less dependent on foreign resources.

"The focus is all about making the grid more resilient during the war and rebuilding," Chernyakhovskiy explained. "One of the goals for the Ukrainian Ministry of Energy is to rely less on imports of natural gas and imports of diesel for backup generators. They hope to utilize domestic wind and solar resources while diversifying the geographic concentration of power system resources; that"s really where they"re interested in renewables right now."

A major hurdle Ukraine faces, however, is easily accessible, accurate, detailed information on its wind and solar output capabilities. Chernyakhovskiy said because Ukraine is not yet part of the EU, many of the more detailed data sets for the EU do not include Ukraine. "It really helps with planning and understanding where the resources are--where it is most cost effective to build distributed resources that will help to decentralize the grid," he explained.

Part of what makes grid planning in Ukraine difficult is the diversity of solar and wind resources and thus potential generation. The spatial and temporal variability of solar irradiance captured in this new data set, for example, gives planners and developers a clear picture of where they could competitively build photovoltaics (PV) as they work to decentralize the grid. This long-term, time series data set is vital in making new deployment a reality because it creates confidence in the analysis.