Central africa photovoltaic pv systems

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Africa has abundant renewable energy resources. Traditionally reliant on hydropower, the continent is turning to solar photovoltaics (PV) to bolster energy security and support rapid economic growth in a sustainable manner. With recent substantial cost reductions, solar PV offers a rapid, cost-effective way to provide utility-scale electricity for the grid and modern energy services to the approximately 600 million Africans who lack electricity access.

IRENA estimates that with the right enabling policies, Africa could be home to more than 70 gigawatts of solar PV capacity by 2030. The report discusses challenges in policy making and proposes a co-ordinated effort to collect data on the installed costs of solar PV in Africa, across all market segments. Such information will improve the efficiency of policy support and accelerate deployment.

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Each site in such a subset would have to be attributed to its own resource strength, temporal variability and associated grid and road network expansion costs. Once fed into a capacity expansion model, this would allow elucidating the optimal deployment of VRE plants, i.e. a portfolio of solar and wind power plants across the most appropriate locations. For the African continent, whose burgeoning power systems imply a chance to plan power grids from the outset to accommodate VRE5, the need for such modelling exercises is especially high.

One attempt to provide such subsets of attractive VRE plant sites, focused on the Eastern and Southern African regions, was previously published in literature15,16. However, this methodology focused exclusively on near-grid resources (within 50-100 km of existing grid infrastructure) and did not calculate annual yields of VRE in a bottom-up manner based on open-source hourly meteorological conditions.

The principle of MSR creation is based on the combination of various geospatial datasets to lead to a representative subset of sites that can, in practical terms, be considered attractive sites for VRE plant deployment. A flowchart of the modelling process described in this section is given in Fig. 1. The model is implemented five Python-based scripts which execute the different stages described below: MSR creation, hourly profile generation, attribution, screening and clustering.

The MSR toolset comprises of five Python scripts that are run sequentially. A high-level description of each script and process flow is illustrated in this figure.

The process of MSR creation is indicated schematically in Fig. 2 for a hypothetical rectangular country (panel (i) in Fig. 2), and summarised hereafter. Starting from the map of the African continent, the following parameters are used to select a geographically referenced subset of sites within each country (details are given in the Methods section "Additional methodological details"):

Process of MSR creation. This schematic shows the various steps of MSR creation (see also Methods), starting from (i) the boundaries of a hypothetical rectangular country, through (ii) the exclusion of unsuitable areas, (iii) the classification of the suitable areas into different bins representing VRE resources of different strength, (iv) the polygonization of the areas in each bin, and (v) the breakdown of each polygon into smaller cells, to arrive at (vi) a collection of pre-screened MSRs, each with their own specific characteristics, for the country.

Only sites where average VRE resources (irradiation and wind speed) are above a certain minimum threshold, typical for commercial exploitation, are considered for inclusion.

These inclusion areas contain geographically close areas with steep resource gradients. To separate areas of different resource strength from each other, each country"s map of inclusion areas is first classified into five bins (iii) that reflect VRE resources of different strength (see Methods section "Additional methodological details"). The binned areas are then polygonised (iv), i.e. marking boundaries around contiguous included sites, to define a set of contiguous areas that belong to the same bin.