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Evaluation of varying spatial resolution in power system modelling

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Power system models are frequently used in academia and by policymakers to study different designs of country or continent-wide electricity systems. To have them remain computationally feasible, simplifications are made in many areas. When assessing the variability of renewable generation sources, weather data is an important input to such models. Yet, the spatial resolution of weather data (e.g., from reanalysis or satellites) is often more detailed than the resolution of the models using them. Hence, it is common to use averages or other aggregation techniques to use the weather data in the power system model.

Using our power system model highRES, we compare the performance of an aggregated version (NUTS1 and 3- level) to an unaggregated grid cell level one based on ERA5 reanalysis data (30 km), to assess the benefits and drawbacks of this simplification: In the former, the aggregation is performed on the inputs already before handing them to the model (an hourly zonal average capacity factor for each technology is computed from all cells in that region before running the model), while the latter is allowed to pick and choose the grid cells that are to be used to deploy variable renewable generators in each region. The resulting grid cell model makes use of the high spatially resolved weather data. Using this framework, we seek to understand how varying spatial resolution impacts the cost and design of the power systems it produces, with different shares of renewable generation technology penetration.