Increasing the spatial resolution of MERRA-2 reanalysis data for energy system modeling

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MERRA-2 resolution

Solar PV potential for Upper Bavaria, using low-resolution MERRA-2 data
What existing models can do
What existing models cannot do

Regions with homogeneous solar PV potentials within Europe

Regions with homogeneous wind potentials within Europe
How the tool works

Shapefile

Reanalysis data

Global maps: land use, protected areas, topography, etc.

param: technology, suitability, availability

paths: to files saved locally

GitHub:
tum-ens/renewable-timeseries

Time series
Maps of potential
Reports
How the tool works

```python
if __name__ == '__main__':
    paths, param = initialization()
    generate_weather_files(paths)
    generate_landsea(paths, param)  # Land and Sea
    generate_landuse(paths, param)  # Landuse
    generate_bathymetry(paths, param)  # Bathymetry
    generate_topography(paths, param)  # Topography
    generate_slope(paths, param)  # Slope
    generate_population(paths, param)  # Population
    generate_protected_areas(paths, param)  # Protected areas
    generate_buffered_population(paths, param)  # Buffered Population
    generate_wind_correction(paths, param)  # Correction factors for wind speeds
    for tech in param['technology']:
        calculate_FLH(paths, param, tech)
        masking(paths, param, tech)
        weighting(paths, param, tech)
        reporting(paths, param, tech)
        find_locations_quantiles(paths, param, tech)
        generate_time_series(paths, param, tech)
```
How the results look like

### Parameter

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Available_Area_km2</td>
<td>15431</td>
</tr>
<tr>
<td>FLH_Mean_MW</td>
<td>1756</td>
</tr>
<tr>
<td>FLH_Median_MW</td>
<td>1818</td>
</tr>
<tr>
<td>FLH_Max_MW</td>
<td>4260</td>
</tr>
<tr>
<td>FLH_Min_MW</td>
<td>41</td>
</tr>
<tr>
<td>FLH_Mean_Masked_MW</td>
<td>1831</td>
</tr>
<tr>
<td>FLH_Median_Masked_MW</td>
<td>1856</td>
</tr>
<tr>
<td>FLH_Max_Masked_MW</td>
<td>4260</td>
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<tr>
<td>FLH_Min_Masked_MW</td>
<td>120</td>
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<tr>
<td>FLH_STD_Masked_MW</td>
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<tr>
<td>Power_Potential_GW</td>
<td>2686</td>
</tr>
<tr>
<td>Energy_Potential_TWh</td>
<td>4716</td>
</tr>
<tr>
<td>Energy_Potential_Weighted_TWh</td>
<td>210</td>
</tr>
<tr>
<td>Energy_Potential_Weighted_Masked_TWh</td>
<td>197</td>
</tr>
</tbody>
</table>
Use cases

GitHub:

tum-ens/
renewable-timeseries

Modeling:
- Generation of time series and potential limits for small regions (cities)
- Generation of time series and potentials for any user-defined regions

Policy/Society:
- Impact of constraints and policy choices on potentials
Back up
The big picture
Wetterdaten

Windpotenzial für Europa

Legend
FLH in kWh/kWp
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000

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