



User Notes- PVGIS 5.2.1 Update

Prepared by O. Gounari, N. Taylor, A. Martinez

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1 Temperature Downscaling

Up to now, PVGIS 5 has a downscaling algorithm for temperatures, in part to compensate the low spatial resolution of ERA-Interim environmental data¹. The PVGIS 5.2 release maintained this feature, although this now uses the ERA-Land data with a much higher spatial resolution. Recently checks found that although it improves accuracy for locations with large elevation discontinuities (e.g. valleys/mountains), it introduces artefacts on a wider scale. For this reason, it is now removed, pending a detailed study on the most appropriate downscaling methodology.

The removal of downscaling temperature might lead to slight variations in results for yearly PV energy production [kWh] and year-to-year variability [kWh].

¹ T. Huld and I. Pinedo Pascua, Spatial Downscaling of 2-Meter Air Temperature Using Operational Forecast Data, *Energies* 2015, 8, 2381-2411; doi:10.3390/en8042381

2 Fixing SARA-2 Data Gaps

The SARA-2 dataset is extended to cover the full spatial extent of the data, as shown in the figure below, where the newly added regions are depicted in green. In these areas, SARA-2 is now available in addition to ERA5.

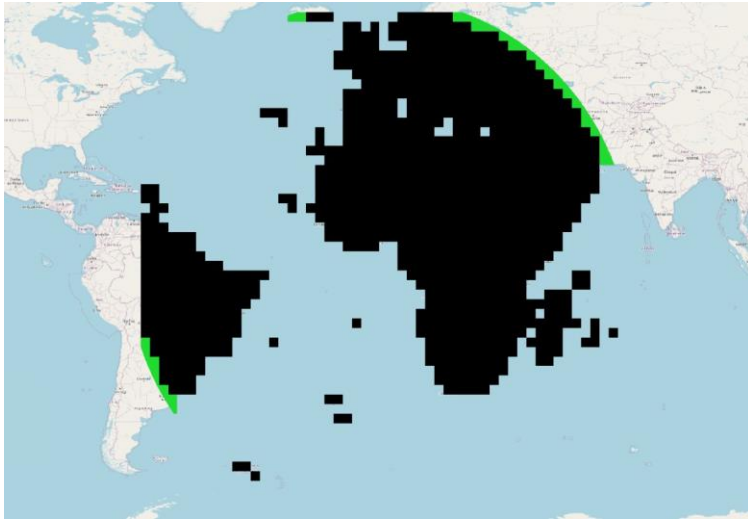


Figure: New regions (green) added for SARA-2 irradiance data.

3 Data Gaps in South America

Two horizon tiles in central South America were missing. Extracting PV performance maps lead to gaps as depicted below. New horizon tiles have been inserted.

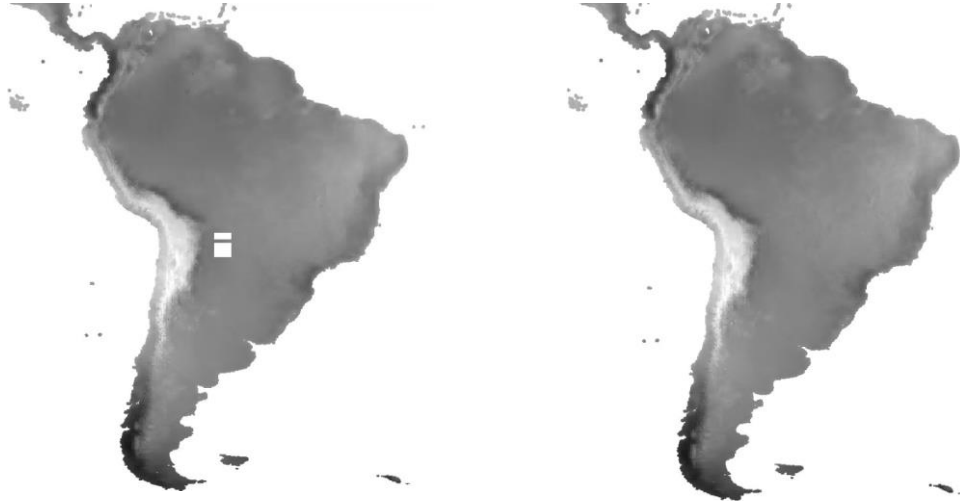


Figure: Example of PVGIS5.2 with corrupted (left) horizon tiles and 5.2.1 with replaced tiles (right).

4 Missing ERA5 Temperature Pixels in the UK

Missing temperature pixels in the UK led to anomalous results as depicted in the following image.



Figure: Missing ERA5 temperature pixels (left) and replaced (right).

5 Missing Elevation data in areas of North America

Some elevation files close to Longitude ± 180 , and others between Latitude (60, 62.5) and Longitude (-167.5, 61) were missing or corrupted, which meant that it was not possible to get results for these regions before.

6 World maps

After applying the above modifications, it is possible to create a global Yield map using the ERA5 dataset for irradiance data. Additionally, a Yield map with higher spatial resolution, covering the entire spatial extent of the SARA-2 dataset, can be generated using the SARA-2 dataset for irradiance data.

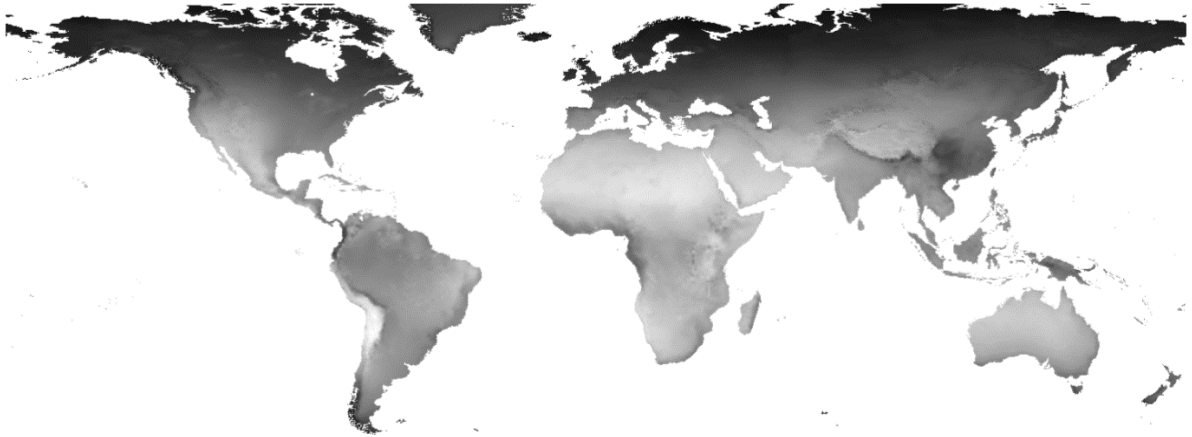


Figure 1 PV yield map 2005-2020, using ERA5 irradiance for the purpose of showing data completeness (lighter grey means higher yield in kWh/kWp)



Figure 2 PV yield map 2005-2020, using SARA-2 irradiance data for the purpose of showing data completeness (lighter grey means higher yield in kWh/kWp)

7 Variation change in PV yield

| Location | Latitude | Longitude | PVGIS 5.2.0 | PVGIS 5.2.1 (no downscaling of Temperature) | Percentage change |
|--------------------|----------|-----------|-------------------|---|----------------------|
| Iceland | 64.332 | -20.925 | 815.09 (ERA5) | 709.7 (SARAH2) | -12.93% |
| Finland | 63.529 | 26.101 | 842.9 (ERA5) | 815.09 (SARAH2) | -3.30% |
| Pakistan | 25.664 | 62.906 | 1847.44 (SARAH) | 1697.72 (SARAH2) | -8.10% |
| Buenos Aires | -34.669 | -59.728 | 815.57 (ERA5) | 812.64 (SARAH2) | -0.36% |
| SARAH-2 North | 63.088 | 9.520 | 716 (SARAH2) | 720.7 (SARAH2) | 0.66% |
| SARAH-2 East | 39.551 | 43.024 | 1343.23 (SARAH2) | 1331.97 (SARAH2) | -0.84% |
| SARAH-2 South | -33.907 | 18.625 | 926.83 (SARAH2) | 943.23 (SARAH2) | 1.77% |
| SARAH-2 West | -11.640 | -61.750 | 1010.56 (SARAH2) | 1020.08 (SARAH2) | 0.94% |
| SARAH-2 Central | 45.812 | 8.622 | 1329.3 (SARAH2) | 1341.36 (SARAH2) | 0.91% |
| Paraguay | -19.836 | -61.231 | No Data | 988.53(SARAH2) | - |
| UK | 52.497 | -0.006 | 14586.01 (SARAH2) | 1040.1(SARAH2) | -92.87% |

In most areas, minor changes are expected due to the removal of the temperature downscale (less than 1%), which should be a bit higher in mountainous terrains. In areas already covered by SARAH2, this should be the only reason for the changes observed. In areas where the previous coverage was SARAH or ERA5, the changes are expected to be higher, as shown in the examples above.

Note that the big change shown as an example in the UK, only affects a small region where the temperature data was corrupted, as shown in Section 4.