Dataset: Rooftop PV potential data for the Swiss building stock

When using the provided data, please cite the following article:

Walch, Alina, Roberto Castello, Nahid Mohajeri, and Jean-Louis Scartezzini. "*Big Data Mining for the Estimation of Hourly Rooftop Photovoltaic Potential and Its Uncertainty*." Applied Energy 262 (2020).

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Summary:

The provided dataset contains data for the PV potentials on building rooftops, evaluated for 9.6 M roof surfaces in Switzerland. In the process of generating this dataset, the following aspects were included:

- Meteorological conditions in Switzerland (solar radiation, temperature, snow cover)
- Local shading and sky coverage from surrounding buildings and trees (based on a Digital Surface Model)
- Obstruction of roof surface due to roof superstructures such as dormers and chimneys (estimated based on data from the canton of Geneva[1])
- The panel and inverter efficiencies, as a function of the solar radiation and temperature

Several aspects were estimated and hence include some uncertainty, due to the input datasets and the modelling methodology. For details on the sources of uncertainty and the limitations, please refer to the mentioned article. Estimates for these uncertainties are provided alongside the variables.

Data description:

The rooftop PV potential data has been computed at **monthly-mean-hourly** temporal resolution (i.e. 24 hours for each of the 12 months) for each individual **roof surface**, based on a national roof surface dataset created by SwissTopo (see https://www.uvek-gis.admin.ch/BFE/sonnendach/). The data given in this dataset is aggregated, in order to make the data easier to use for studies inside as well as outside Switzerland, to reduce the file size and to respect license agreements.

Two types of aggregation are provided:

1. Aggregation **per building**, using the object ID of the SwissBuildings3D[2] cadastre as identifier.
   Note: This aggregation contains only the ***suitable*** roof surfaces, namely those with an aspect angle below 90° (south-facing roofs) and with a minimum available area to install PV panels of 8 m^2. A justification for these thresholds is provided in the referenced paper.

2. Aggregation **per roof type**, separating between 4 categories:
   - **Altitude** (above sea level), in 3 classes (roughly characterizing the different climatic regions in Switzerland):
     - *< 800m*: Most urban areas in the Swiss plateau and the Rhone valley
     - *800m - 1600m*: Pre-alps and the Jura mountains
     - *> 1600m*: Alpine terrain
   - **Tilt** angle (in degrees), rounded to multiples of 10°
   - **Aspect** angle (in degrees), rounded to multiples of 10°
     Note: The angle convention is in clockwise degrees from South, i.e. S = 0°, W = 90°, N = +/- 180°, E = -90°; flat roofs have no aspect angle and are instead labelled as 'flat'

[1] https://ge.ch/sitg/fiche/1148
[2] https://shop.swisstopo.admin.ch/en/products/landscape/build3D2

- Roof **area** (in m^2), rounded to multiples of 10 m^2 for areas < 100 m^2, multiples of 100 m^2 for areas < 1000 m^2, etc.

  Note: Due to their low number, all areas > 10 000 m^2 have been joined in one class

If a different type of aggregation or the data per individual roof surface is required, please do not hesitate to get in touch directly via the email provided above.

Building aggregates:

The building aggregate files have the following format: *rooftop_PV_CH_*[VAR] *_by_building.csv*
The VAR denotes the different variables which are provided as part of the dataset. These are:

- **"annual"**: Annual values for the PV potential for each building (identifier: SB_UUID), as well as additional useful variables (columns):

Variable	Description
`GWR_EGID`	Building ID in the Swiss registry of buildings and dwellings (GWR/RegBL), as matched by the Sonnendach project[3]
`XCOORD`	Building x-coordinate (in the Swiss coordinate system LV03, EPSG:21781)
`YCOORD`	Building y-coordinate (in the Swiss coordinate system LV03, EPSG:21781)
`EPV_kWh_a`	Annual PV potential, summed over all suitable roof surfaces (in kWh/year)
`EPV_kWh_a_std`	Uncertainty (as standard deviation) related to `EPV_kWh_a`
`Gt_kWh_m2_a`	Tilted radiation (incl. shading effects), averaged across all suitable surfaces (in kWh/m^2/year)
`Gt_kWh_m2_a_std`	Uncertainty (as standard deviation) related to `Gt_kWh_m2_a`
`APV`	Available area to install PV (incl. strong shading and the effects of roof superstructures), summed over all suitable roof surfaces (in m^2)
`APV_std`	Uncertainty (as standard deviation) related to `APV`
`APV_ratio`	Ratio of `APV` to the total (suitable) roof area
`EPV_kWh_m2roof_a`	Annual PV potential per m^2 of (suitable) roof area

- "**EPV_W**": Monthly-mean-hourly PV potential (in W), summed over all suitable roof surfaces of a building (identifier: SB_UUID). The columns are timestamps that have the format:

  2001-[MONTH]-15, [HOUR]:00

  i.e. we use as proxy the 15th of each month of the year 2001. The year 2001 is chosen as a "dummy", as the meteorological data is taken from the average between 2004-2015. The 15th is chosen as it is close to the "representative day" of each month. Only non-zero time stamps are given in the dataset. For all other timestamps (e.g. 2001-01-15, 05:00), the PV potential is zero.

- "**EPV_W_std**": same as above, but giving the estimated uncertainty for each time stamp and each building.

- "**Gt_W_m2**": Monthly-mean-average tilted radiation (in W/m2), taken as weighted average across all available area (APV) on each building roof. The timestamps are identical to "EPV_W".

- "**Gt_W_m2_std**": same as above, but giving the estimated uncertainty for each time stamp and each building.

[3] https://www.bfe.admin.ch/bfe/de/home/versorgung/statistik-und-geodaten/geoinformation/geodaten/solar/solarenergie-eignung-hausdach.html

Category aggregates:

The categorically aggregated files have the following format: *rooftop_PV_CH_*[VAR] *_by_category.csv*
The VAR denotes the different variables which are provided as part of the dataset. The 4 categories used as index in each of the files are listed on page 1. The variables are:

- **"annual"**: Annual values for the PV potential for each roof type, i.e. for each combination of the 4 categories (altitude, aspect, tilt, area), as well as additional useful variables (columns):

Column	Description
`altitude`	Altitude above sea level, in 3 classes (roughly characterizing the different climatic regions in Switzerland): < 800 m; 800 – 1600 m; > 1600 m
`aspect`	Aspect angle (in degrees), rounded to multiples of 10° (in CW deg. from south, flat areas labelled as "flat")
`tilt`	Tilt angle (in degrees), rounded to multiples of 10°
`area`	Roof area (in m2), rounded to multiples of 10 m2 for areas < 100 m2, multiples of 100 m2 for areas < 1000 m2, etc.; roofs > 10 000 m2 are grouped
`EPV_kWh_a`	Annual PV potential, averaged across each roof type (in kWh/year)
`EPV_kWh_a_std`	Uncertainty (as standard deviation) related to `EPV_kWh_a`
`Gt_kWh_m2_a`	Tilted radiation, averaged across each roof type (in kWh/m^2/year)
`Gt_kWh_m2_a_std`	Uncertainty (as standard deviation) related to `Gt_kWh_m2_a`
`APV`	Available area to install PV, averaged across each roof type (in m^2)
`APV_std`	Uncertainty (as standard deviation) related to `APV`
`APV_ratio`	Ratio of `APV` to the total roof area
`EPV_kWh_m2roof_a`	Annual PV potential per m^2 of the total roof area
`Roof_count`	Number of roof surfaces for each roof type (i.e. each combination of the 4 categories). This information is useful to group the data over the given categories.

- "**EPV_W**": Monthly-mean-hourly PV potential (in W), averaged for each roof type (see above for the description of altitude, aspect, tilt, area). The columns are timestamps that have the format:

  2001-[MONTH]-15, [HOUR]:00

  i.e. we use as proxy the 15th of each month of the year 2001. The year 2001 is chosen as a "dummy", as the meteorological data is taken from the average between 2004-2015. The 15th is chosen as it is close to the "representative day" of each month. Only non-zero time stamps are given in the dataset. For all other timestamps (e.g. 2001-01-15, 05:00), the PV potential is zero.

- "**EPV_W_std**": same as above, but giving the estimated uncertainty for each time stamp and each roof type.

- "**Gt_W_m2**": Monthly-mean-average tilted radiation (in W/m2), taken as weighted average across all available area (APV) on each roof type. The timestamps are identical to "EPV_W".

- "**Gt_W_m2_std**": same as above, but giving the estimated uncertainty for each time stamp and each roof type.

Version history:

- **V1.0.0: created 07/01/2020** – first version of building and category aggregates