Standard Year 8760s

Cal-Adapt
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Overview

A Standard Year is one year of hourly data that represents a statistical percentile of meteorological conditions for a location over a set amount of time (30 years). For example, for each hour of the year, the 90th percentile is taken across the same hour of the year from each of the 30 years of data. A Standard Year can be generated for any climate variable (temperature, solar radiation, etc.), any desired percentile (median and extremes), and for any location of interest.

On Cal-Adapt, Standard Years can be generated for **gridded areas** and **point locations** across WECC. The Standard Year profile is built by selecting the real simulation value closest to the selected percentile for each hour of the year. The Standard Year profile is a synthetic profile, and thus differs from using a single continuous year of climate model data. Functionality to generate a "delta Standard Year" is also provided, in which a difference between the timeframe of interest and the historical reference period is returned. This can be used to evaluate climate change impacts on energy systems over time (see our guidance on reference periods). Standard Years generated for gridded areas are aggregated across all model gridcells within the desired region.

Applications

Cal-Adapt Standard Year profiles are intentionally produced for each model, all contained within one Standard Year file. No further aggregation or downsampling is performed, as the appropriate approach depends on the user's specific application and need for the Standard Year information. The following guidance is provided to support next steps in using these data.

When to evaluate the range of results

The differences between profiles from each climate model represents a sample of uncertainty from model differences and the natural variability of the climate. Examining these differences can provide valuable information about the possible range of future climate conditions. When an application requires understanding a range of future climate impacts using climate profiles, it is recommended to generate profiles at multiple percentiles for comparison. From there, users should evaluate the differences between models to determine how they inform the analysis. At this stage, users may elect to aggregate the model climate profiles within the Standard Year file and conduct an uncertainty analysis across the results.

> **Fast-Access Standard Year Profiles**
>
> Cal-Adapt has pre-generated Standard Year profiles for 5 common-use variables (air temperature, relative humidity, heat index, wind speed, solar radiation) and multiple percentiles (p5, 10, 40, 50, 60, 90, 95). These profiles are available via the Cal-Adapt Data Download Tool.

When to aggregate results

If an application requires a single climate profile, users may elect to aggregate results across climate models. It is recommended to first evaluate climate profiles from all of the available models to understand the spread of results and how that may affect the aggregated result.

- **Multi-model median**: Computing a multi-model median across all model climate profiles is recommended when the application is sensitive to outliers or extreme values within the model range.
- **Multi-model mean**: Computing a multi-model mean across all model climate profiles is recommended when the application is not sensitive to outliers or extreme values within the model range.
- **Multi-model range**: Consider calculating the multi-model difference for each hour between the “max” and “min” model spread of conditions as a measure of uncertainty in addition to the multi-model aggregation.

When to select a single model

If an aggregated Standard Year (e.g., multi-model median) is not appropriate or desired (e.g. when it is necessary to retain a single model’s synthetic record rather than aggregate), users may elect to pick a climate profile from a particular model. It is recommended to first evaluate all of the available models to understand where each falls in the spread of conditions. Additionally, it is strongly recommended to document *which* model was selected and *why*.

- Based on whether the application is sensitive to outliers and extreme values, select either the median model (application is sensitive) or the most average model (application is not sensitive).
- If the range between models is very small, or not critical for the application or location, any model can serve as a representation of the ensemble.

When to weight results

Weighting may be appropriate when an application involves multiple locations in the analysis of Standard Year data. Weighting options can include:

- **Population weighting**: for building capacity, or in comparison across different locations
- **Location-based weighting**: if your area of interest falls between several different weather stations
- **Load weighting**: for generation and demand forecasting capacity across a service territory
- **Building design weighting**: for comparison amongst different building types (e.g., commercial vs. residential)
- **Weighting amongst different variables** for a given location (e.g., temperature, humidity)

Methodology

Step 1: Identify the Standard Year profile information

A user will first select four primary settings, with additional options:

1. The **variable** of interest to build the Standard Year. A user can optionally select alternative units, if so desired.
2. The **percentile** of interest, at which the variable is evaluated against the statistical distribution. The default percentile is the 50th percentile (median conditions).
3. The **location** of interest, including both gridded areas (e.g., county, service territory) and point-locations (e.g., weather station, utility asset).
4. The **timeframe** of interest. Standard Years are calculated using global warming levels. A user can generate a Standard Year with any desired warming level, including custom levels (e.g., 1.37°C) and custom window-size (e.g., 30 years). Standard Year profiles can also be generated using a "time-based" approach by providing the "year" of interest, which is used to identify the nearest global warming level to compute the profile. A user can also optionally elect to calculate a delta Standard Year or an absolute Standard Year. An absolute Standard Year represents the values at the designated warming level, while a delta Standard Year calculates the difference between the selected warming level and a 1.2°C historical reference warming level.

Step 2: Compute distribution and select candidate hour for each hour

At this stage, the data corresponding to the user selections (Step 1) are retrieved, and the statistical distribution is computed. The closest value from the distribution of simulation values at a given hour is then identified and returned for each hour of the year. This process is repeated for all 8 available dynamically-downscaled models on AE, including all bias-adjusted models. A user can specify if they only want the bias-adjusted models as well.

The bias-adjusted and non-bias adjusted models are not collectively evaluated on the same distribution. Rather, the distribution is developed per model, and a separate profile for each model is returned. If a delta Standard Year is requested, the process is repeated for the selected warming level and the historical reference warming level (1.2°C) and the difference calculated for each model.

Step 3: Generate the Standard Year 8760 file

Once each representative hour is selected, each model's climate profile information is compiled into a single Standard Year file, with clear designations for each model's profile. Standard Year files are exported in .csv format for ease of use.

How long does it take to generate a custom Standard Year profile? A Standard Year profile for a point location takes approximately 5 minutes to generate, and 20 minutes for a gridded area (based on LA County) through the Cal-Adapt: Analytics Engine.

> **Note**
>
> A Standard Year can be generated for all of California, but it will take over an hour to complete.