

Importing Simulation Weather Data

FAQ: I'm developing an energy model for a building located at a site for which HAP does not currently offer a simulation weather data file. What is the best way to handle this situation?

ANSWER: While HAP offers a library of simulation weather data for over 500 cities worldwide, that does not cover all the possible locations for your building. A feature available starting in HAP v4.6 allows you to import simulation weather data from external data files into your projects. This article explains how to import simulation weather data and provides application information regarding how to find weather from external sources, how to determine your data format and how to validate imported weather data.

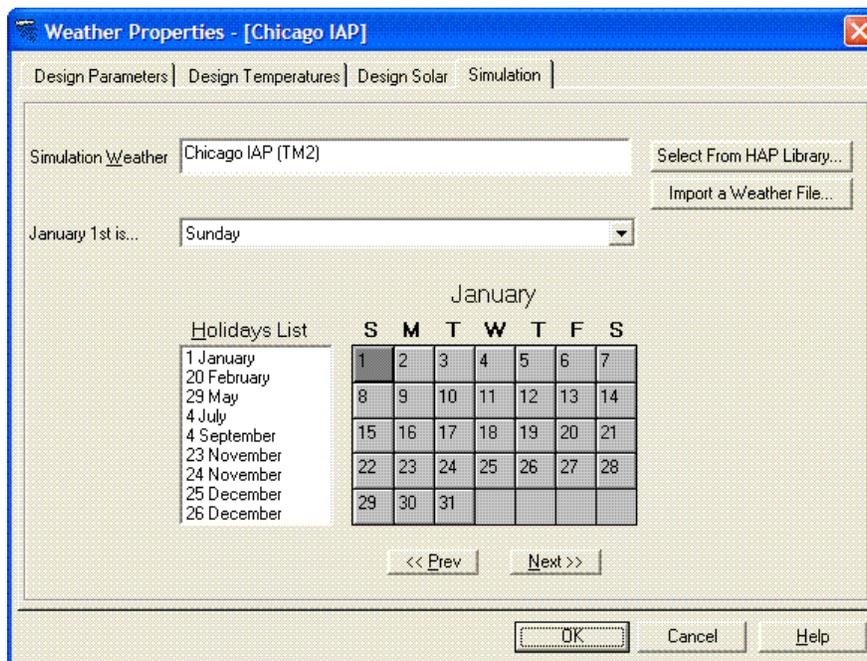


Figure 1. Simulation Tab, Weather Properties Window

Procedure for Importing Weather. When entering Weather data on the Simulation Tab of the Weather Properties window you have two choices for adding simulation weather data to a project, represented by buttons in the upper right (Figure 1). The first option is selecting a city from the HAP weather library. The second option is importing a weather file from an external source. When the "Import a Weather File" button is pressed, the Import a Weather File selection window appears (Figure 2). Using this window importing a weather file requires three steps:

1. **Choose File Format Type** - At the bottom of the window select your file format in the "Files of Type" drop-down list. File format is determined by your source of data. The Application Information section below describes how to determine your file format. Choices in the drop-down list include EnergyPlus EPW, ASHRAE IWE, ASHRAE IWE2, USA TMY2 and USA TMY3. Once a file format is selected, the window will only display files of that type.

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- Browse to Locate File** - Next use the file navigation features at the top of the window to navigate to the folder on your computer containing the desired weather file. If you obtained the file from a web site, you will previously have downloaded and the file into a specific folder on your computer. If you are working from data on a CD, in some cases you can navigate to the proper folder and read data directly from the CD..
- Select File** - Once you have your desired weather file displayed in the file list on the window, click it once to select it. Then press the Open button in the lower right. HAP will translate data from your chosen file and store it in the proper format in your project. When translation is complete, a message is displayed explaining how to quality check the data. The Application Information section below also contains information about quality checking imported data.

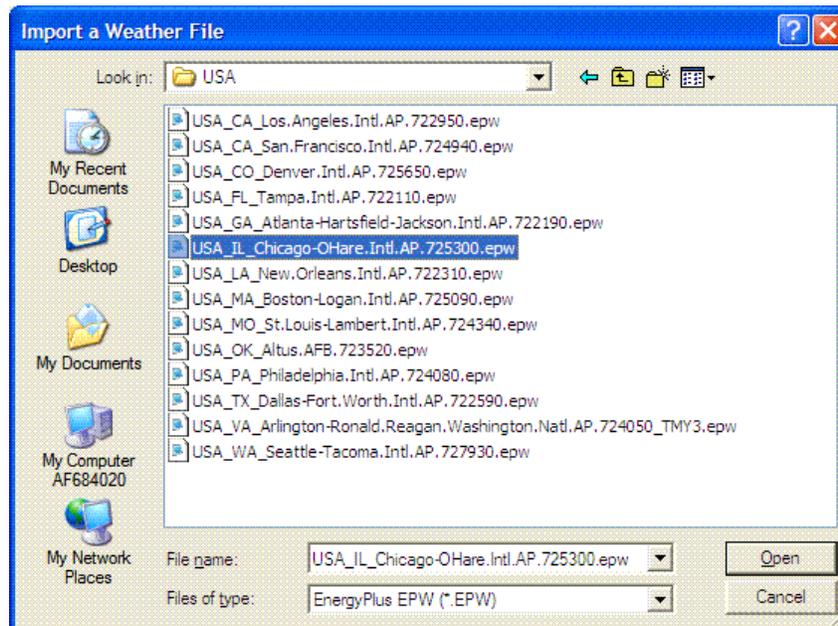


Figure 2. Import a Weather File Window

Application Information.

- What is My Data Format?** The first question when importing data from an external source is "what format do I have?"

"Format" refers to how weather data is arranged in the data file. HAP is programmed to recognize several common weather data file formats. When you specify the format, HAP knows where to find data within that specific kind of file. Each format arranges data differently so it is critical to properly identify the format of your file. Otherwise, HAP will not be able to read the data.

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File format is indicated by the "extension" of the file name. File names are comprised of two parts - the body and the extension. In the sample file name below, the file extension is ".epw". The body is everything that comes before the ".epw".

USA_IL_Chicago-OHare.Intl.AP.725300.epw

The extensions for file formats currently supported by HAP are:

- .EPW = EnergyPlus EPW format
- .IWC = ASHRAE IWEC format
- .CSV = ASHRAE IWEC2 format
- .TM2 = USA TMY2 format
- .CSV = USA TMY3 format

The file extension is a reliable indicator of file format if you obtained the file from a primary source such as the DOE EnergyPlus web site, or an ASHRAE IWEC CD for example. Identifying the file format can sometimes be tricky, however. Common pitfalls are described below:

- a. **Pitfall 1 - Secondary Source** - If you obtained the file from a secondary source - a colleague e-mailed you the data for example - there is a risk the file has been renamed and the extension may no longer be a reliable indicator of the format. If the file has an .EPW extension but is not in EnergyPlus format, for example, HAP will not be able to read the data and will display a message indicating the file format is not correct.
- b. **Pitfall 2 - Format Determined from Body of File Name** - In some situations the body of the file name includes information that might be mistaken for the file format. For example the file *USA_PA_Philadelphia.Intl.AP.TMY3.epw* contains "TMY3" in the body of the file name. However, this only means the original source of the data is the TMY3 library. The file extension says this file is in EnergyPlus EPW format.
- c. **Pitfall 3 - Not All .CSV Files are TMY or IWEC2** - Files using the TMY3 and IWEC2 formats both have a .CSV file extension. However, this file extension is shared with a vast number of Excel spreadsheet files saved in comma separated value (CSV) format. Therefore, just because you have a file with a .CSV extension does not necessarily mean it is in TMY3 or IWEC2 format. The key is to make sure you obtained the file from a primary source - the ASHRAE IWEC2 CD-ROM or the NREL TMY3 web site.
- d. **Pitfall 4 - Renaming a File Does Not Format It** - If you have weather data in one format, renaming the file to use one of the extensions HAP recognizes does not automatically make it formatted. For example, suppose a colleague e-mails you some weather data in Excel XLSX format. You notice HAP does not offer XLSX as a file format, so you rename the file with the .EPW extension and try to import it as an EnergyPlus EPW file. This will fail because the data is still in Excel format. Giving the file a .EPW extension did not change its format.

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2. **How Do I Obtain Weather Files from External Sources?** There are many primary sources for simulation weather data files. The most common sources are noted below.

- a. **EnergyPlus Web Site** - One of the most widely used sources of data is the US Department of Energy (DOE) EnergyPlus web site. The DOE has collected simulation weather data from many sources and converted them to a single standard format. As a result this web site serves as a single repository of data for thousands of cities worldwide. You can find this site by a web search using the phrase "EnergyPlus weather".

Files downloaded from this site are in ZIP format. The ZIP file contains multiple files. The file you need to extract to use with HAP is the one with the .EPW file extension.

- b. **ASHRAE** - ASHRAE offers for sale CD-ROMs containing the International Weather for Energy Calculations (IWEC) or IWEC version 2 (IWEC2) weather libraries. For IWEC, files can be read directly from the CD-ROM. For IWEC2 files on the CD are zipped, so the file must be copied to your hard disk and unzipped to produce a .CSV file before it can be imported into HAP.
- c. **TMY3** - Typical Meteorological Year version 3 (TMY3) files for cities in the United States can be downloaded from a National Renewable Energy Laboratory (NREL) web site. You can find this site by a web search using the phrase "NREL TMY3 weather data". Files downloaded from the web site are not zipped and can be used directly once saved on your hard disk.
- d. **Other** - Other organizations and governments have created their own weather files in one of the formats supported by HAP. Most frequently the .EPW format is used. These files can be obtained from the organization or government body that created the files.

3. **How Do I Quality Check Imported Data?** Users should always be skeptical about the quality of data imported from an external source. Even if it comes from the EnergyPlus web site, ASHRAE or a government source, it can contain erroneous data.

Erroneous data exists either due to a malfunction of weather station equipment when data was recorded or errors in data processing afterwards. Erroneous data is unusually high or low values of temperature, humidity or solar radiation for the given location, time of year or time of day. Erroneous data can have adverse effects on the accuracy of your simulation. For example, suppose a data processing error for results in little or no beam solar radiation being included in the file. This will result in summer cooling loads being smaller than actual, and will result in winter heating loads being larger than actual. Simulation results will be significantly skewed using this weather data.

After importing weather from an external source Carrier recommends quality checking the data as follows:

- a. After the data is imported click OK to save and return to the HAP main window. From the main window generate the following two weather reports: (i) Simulation Weather Summary and (ii) Simulation Temperature Profile Graph for Jan 1 thru Dec 31.
- b. Inspect the Simulation Weather Summary Report. Table 2 provides statistics for the maximum and minimum temperatures each month. Compare this data with your summer and winter design points for the city. It is normal for the simulation weather file to have temperatures that exceed the summer and winter design values by several degrees. But if maximum or minimum temperature are significantly out

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of line, this may indicate a problem. Further, look for unusual temperatures based on time of year. For example, a maximum of 95 F (35 C) in a mid-winter month in a cold climate city should be raise suspicion. When odd data is found, the Simulation Temperature Profile Graph report can be used to identify when the odd data occurs and whether it is reasonable or not.

Table 3 in this report contains solar radiation statistics. The data to inspect is the monthly clearness indexes on the right side of the table. Clearness index is the ratio of daily total solar on a horizontal surface at ground level divided by total daily solar on a horizontal surface at the outer edge of earth's atmosphere. Maximum values should be in the 0.6s or 0.7s. Any values in the 0.8s or 0.9s indicates solar is too high. Maximums in the 0.5s or lower may indicate solar is underestimated. However you should also consider local climates with persistent cloudiness such as a monsoon season that could explain unusually low values. For the minimum clearness index data look for values of 0.00. Even when it is very cloudy, there is a little bit of diffuse solar radiation reaching the ground, so values of 0.00 should not occur. This tends to indicate a problem with underestimated solar. If problems with solar data are indicated the Simulation Solar Profile Graph report can be used to investigate further.

- c. Inspect the Simulation Temperature Profile Graph report. When this report is generated for the full year you can quickly identify questionable data. It will appear as sharp upward or downward spikes in the profile. Note that temperature and humidity can be highly variable so a certain amount of up and down spikes is reasonable. Spikes to unreasonable levels, such as to 95 F (35 C) in a cold mid-winter month, however should be investigated further.

If you find what appears to be erroneous data, engineering judgment must be used to determine whether to use the data or discard it. Three spikes in temperature data during the year each over a short duration of time may be judged insufficient to compromise accuracy of simulation results.

Persistent underestimating of beam solar radiation, on the other, hand may be judged so serious the data cannot be used for simulation.

If you are in the US or Canada and you have further questions about this issue, please contact Carrier software support at software.systems@carrier.utc.com. Otherwise, please contact your local Carrier sales office.

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