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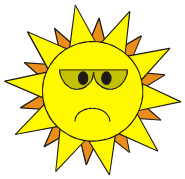
Has the Sun Set on Weather Data?



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Weather Data Crisis

Dynamic building energy simulation programs, such as DOE-2, BLAST, SPARK, TRNSYS, etc., all need detailed weather information, preferably hourly, as inputs for the simulation. Design simulations are often done with typical year weather data such as TMY2 or WYEC2, but there are many instances when actual year weather data is needed to diagnose measured building energy performance or to weather-normalize predicted savings in energy management. The major sources of this weather information are the surface weather observations reported by the National Weather Service (NWS)[1] and the Federal Aviation Administration (FAA)[2] at airports and other sites and archived at the National Climatic Data Center (NCDC)[3]. Unfortunately, beginning in 1992, the NWS and the FAA began to change the method used to collect the observations along with the types of data being collected. Credible building energy simulations can no longer be completed using the weather data currently being reported from these sites.

For building energy simulation, these minimum weather data are required:

- dry-bulb temperature
- some measure of humidity (wet-bulb, dew point temperature or relative humidity)
- station pressure
- wind speed and direction
- some measure of solar radiation.

All of these parameters except the last are generally available in the surface observation data. If measured solar radiation is unavailable then researchers use analytical and empirical models to estimate the amount of total, direct and diffuse solar radiation from reported conditions of cloud type, cloud cover and sky cover.

The Automated Surface Observing System (ASOS)[4]

In 1992, the NWS, the FAA and the Department of Defense began replacing manual observations with automated sensors and reporting systems, either ASOS or Automated Weather Observation System (AWOS). As of February 1999, there were 694 commissioned ASOS or AWOS stations in the United States. When the planned 900-plus stations are in place at the end of 1999, they will be the primary source of surface observations in the United States.

The ASOS instrumentation was designed primarily to meet aviation needs; data recorded include ambient and dew point temperatures, wind conditions, precipitation accumulation, cloud height to 12,000 ft and other weather phenomena such as lightning

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[1] *http://www.nws.noaa.gov/*
[2] *http://www.faa.gov/sitem.htm*
[3] *http://www.ncdc.noaa.gov/index.html*
[4] *http://www.nws.noaa.gov/asos/*

or freezing rain. A laser beam ceilometer[5] provides the only information on sky conditions. In addition to reporting ceiling heights to 12,000 ft, ASOS uses an algorithm that analyzes 80 ceilometer readings over an hour to deduce five categories of sky cover: Clear, Few, Scattered, Broken or Overcast. Data on cloud cover above 12,000 ft and minutes of sunshine may be included in the future through additional instrumentation or manual augmentation. ASOS data are reported on a one-minute interval format in the Aviation Routine Weather Report (METAR)[6]. Hourly data for previous periods of record can be obtained from the NCDC[7].

The Problem with ASOS

The reported ASOS data present major difficulties for those of us who perform building energy calculations because of the very limited information available on solar conditions. Furthermore, the automated methods that are used to determine cloud height and sky cover are not compatible with previously developed solar models.

There is a proposal to upgrade the ASOS/AWOS network to record minutes of sunshine; however, even if this proposal is adopted, a new solar model would have to be developed to make such sunshine data usable for building energy calculations.

For the present, procedures are urgently needed to estimate solar radiation from the weather elements now being reported by the automated weather stations. For predicting average year energy use, the older weather data are adequate, but for running weather normalization calculations, current data are necessary. And only with the development of new procedures can the currently available data be made usable for this type of building energy simulation.

What Is Being Done?

The ASHRAE weather committee is currently considering the implications of ASOS weather data and deciding what steps should be taken to address the problem. If you have an opinion or a solution, please contact either
Dru Crawley (Drury.Crawley@ee.doe.gov) or Joe Huang (YJHuang@lbl.gov), president and secretary, respectively, of the ASHRAE weather committee.

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[5] *http://grappa.meteo.mcgill.ca/ceilometer.html*

[6] *http://www.nws.noaa.gov/oso/oso1/oso12/metar.htm format*

[7] *http://www.ncdc.noaa.gov/*