ASOS & Climate Observations

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What is ASOS?

The Automated Surface Observing System, or ASOS, is an array of instruments for observing temperature, precipitation, wind, sky cover, visibility, and pressure. It was developed as a joint effort between the National Weather Service (NWS), Federal Aviation Administration (FAA), and Department of Defense (DOD).

ASOS serves as the nation's primary surface observing system and takes meteorological readings every minute, 24-hours a day, every day of the year at almost 1000 locations nation-wide.

Where are these ASOS Stations?

In general, ASOS stations are located at airports. However, there are a few exceptions where a scaled-down version has been installed at locations that are significant to the community. A few examples of this are Central Park in New York City and the Baltimore Science Center in Baltimore, Maryland.

Since ASOS primarily serves the aviation community, the sensors are physically located at airports. This means that they may not represent the best locations for collection of climate data (or the best climate observing sites).

What advantage does ASOS have over a human observer?

ASOS provides up-to-the-minute observations with a continuous weather watch except during equipment malfunctions. Our maintenance program and preventative maintenance scheduling allows the system to be operating more than 99% of the time.

There are, however, situations where a human observer is more suited to collecting information, such as snow observations. A human has the ability to take into account the surroundings and is able to take measurements of snow that is already on the ground. ASOS is only able to measure the water equivalent of snow that actually falls into the rain gauge, which has drawbacks as snow does not always fall straight down, but instead could blow past the gauge. Wind shields were designed to help reduce the missed snowfall caused by strong winds, but are not always effective. To help maintain accurate snowfall measurements, the NWS enlists the help of human snowfall observers at locations that are used for climate observations.

Why do we use ASOS for climate observations?

In a word, continuity. Historically, most climate observing sites, representing city locations, were located at airports where the NWS had staff to take meteorological measurements. During the modernization of the NWS, many offices were consolidated and we lost the human observers at the smaller locations, or the office completely moved away from the airport. In order to maintain the long history of observations, ASOS observations were used to continue the climate records at these locations.

When the climate records from a human observer and an automated system are merged, there may be an artificial shift in the averages at the time of change. Fortunately, the NWS and the National Centers for Environmental Information (NCEI) maintain records indicating when these changes took place. Using that information, the climate record can be normalized for use in long term climate comparisons.

The NWS also manages a network of human observers called the Cooperative Observer (COOP) Network. These are NWS-trained individuals that have volunteered to take weather readings from their locations. Currently there are over 8500 COOP sites. So why don't we just use the COOP Network? Even though there are more COOP locations, they generally only report precipitation and temperature and only do so once a day. ASOS also reports other important parameters such as wind, sky cover, visibility and pressure on a continuous basis.

How accurate is ASOS?

The ASOS sensors contain state-of-the-art technology and the associated software provides data quality checks to guarantee accuracy. Each sensor has different accuracy ratings. For the primary sensors used for climate, temperature can measure from -80F to +130F with an accuracy of less than ±2F. The rain gauge is accurate to 0.01 inches.

What is the value of ASOS to the general public and what are the challenges with the data?

ASOS supports aviation, and instruments are located at airports. While the news media report these conditions to the public, they may not necessarily reflect the areas where the public live, such as in the downtown metropolitan areas or in the suburbs. They do, however, give a general idea of what the weather is like in the area.

One thing ASOS has reminded us is that microclimates exist everywhere. ASOS is reporting correctly for the location at which it is installed. However, there are many non-meteorological things that affect the sensors readings, such as expanses of concrete or grass; a nearby water source such as a lake or river; even the lay of the land can affect measurements. If the ASOS sits in a shallow depression it may experience pooling of cooler temperatures at night.

There are also some things that you would think affect the readings but generally don't, such as jet exhaust. There are algorithms (computer code) in ASOS that take these quick fluctuations into account. These algorithms have been developed and tested to provide the most accurate and sensible data for a given sensor by using sampling over a period of time and other methods proven to weed out spikes in the sensor data that are caused by non-meteorological influences.

For more information please contact your local National Weather Service Office