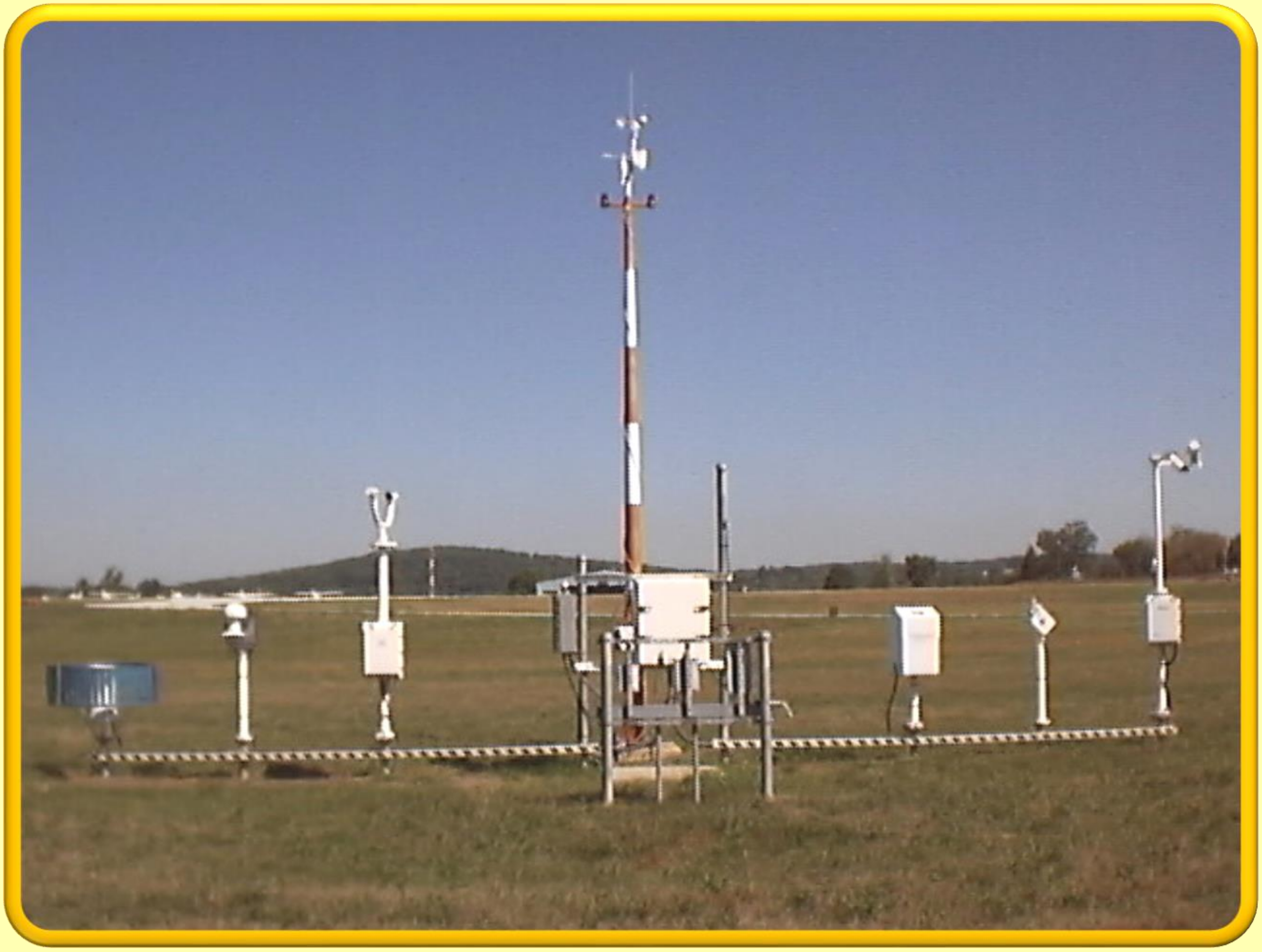
Automated Surface Observing System (ASOS)



Guide to understanding what an ASOS is, how it operates, and how to use the information it provides

Audience and Scope

This guide is intended to explain what an ASOS is, how it measures data, and how its data can be used for safety and as a climate record. A definition and description of all the ASOS sensors will be provided as well as how to interpret the data the ASOS provides. This document will familiarize those people who are, or will be, working in association with ASOS sites, such as new National Weather Service employees, aviation pilots, and air traffic controllers.

Introduction

An Automated Surface Observing System is a suite of weather sensors which measure, collect, and disseminate weather data. This serves to help meteorologists, pilots and flight dispatchers prepare and monitor weather forecasts, plan flight routes, and provide necessary information for correct takeoffs and landings. ASOSs are federally funded as a joint program between the National Weather Service, the Federal Aviation Administration, and the Department of Defense. ASOSs have been operational since the early 1990s and are located at over 900 sites nationwide. These sites provide round the clock observations and are crucial for the safety of pilots, airplanes, and passengers. Since safety is the main concern with air travel, most ASOSs are located at airports to ensure that the most accurate conditions are being reported to the National Weather Service and air traffic controllers. Overall, ASOS sites' continuous streams of data provide crucial observations to enable accurate forecasting by acting as a valuable climatological tool.

Components

The ASOS consists of three main components:

1. **A sensor group**, consisting of individual weather sensors and a Data Collection Package (DCP). The DCP continuously gathers and processes the raw data from the sensors and prepares it to be transferred to the ACU. This component is found at every ASOS site.
2. **The Acquisition Control Unit (ACU)**, which is the Central Processing Unit for the ASOS site. It performs the final processing, formatting, quality control, and storage of the data, and makes it available to its users. The ACU is located inside a temperature controlled room near the sensor groups. This component is found at every ASOS site.
3. **The Operator Interface Device (OID)**, which allows an observer to enter backup or augmented observations directly into the ACU. This component is found only at airports that offer backup support.

The ASOS sensor group is composed of the following:

- **Wind Speed & Direction-** A wind vane (for wind direction) and rotating anemometer cups (for wind speed). Wind gusts are measured by looking for winds that are stronger than the current wind and are sustained over a period of time. Figure 1 seen below shows the wind vane and anemometer.

Figure 1. Wind Sensor

- **Altimeter (Barometric pressure) -** Two or three pressure transducers measure barometric pressure. The transducers must be within a certain range of each other for the pressure to be reported. The barometers are located in the bottom tray of the ACU, and can be seen in Figure 2 below.

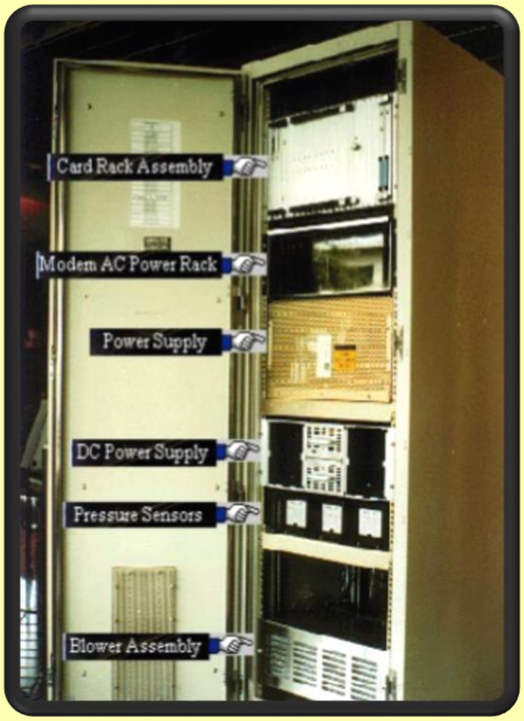


Figure 2.

Pressure Sensors in ACU

- **Relative Humidity/Dew Point-** A hygrothermometer is used to measure dewpoint. The process involves using a fan to draw ambient air into the housing and over a mirror that has been electronically cooled to a lower temperature. The cooling process continues until the dewpoint temperature is reached, at which time a layer of dew forms on the mirror. A laser beam and detector are used to detect dew formation. At that time, the mirror temperature is read and recorded as the dewpoint temperature. Figure 3 below shows the sensor.

Figure 3. Hygrothermometer

- **Air Temperature-** This measurement is made by a thermistor, a type of electronic thermometer. Readings are generally very accurate. It is located in the same place as the hygrothermometer seen in Figure 3.

- **Precipitation Type & Amount-** This is determined by a light-emitting-diode weather identifier, or LEDWI. This device measures the passage of particles through a sensor beam. Much of this instrument's logic is tied into calculations, relating to fall velocity patterns. Snow falls slowly and makes one type of pattern, while rain falls at a faster rate, creating another signature. The LEDWI was designed only to report the occurrence of rain or snow at precipitation fall rates of .01 inch per hour or greater. The precipitation Identifier can be seen in Figure 4 below.

Figure 4. Precipitation Identifier

- **Visibility-** This is determined by a scatter meter, which is a device that measures the amount of radiation scattered from a beam of light by particles in the air such as fog, rain, snow, or other airborne particulates. This yields a measurement of air clarity. The measurement is processed through algorithms designed to correlate the readings with familiar visibility values. The scatter meter is shown in Figure 5 below.

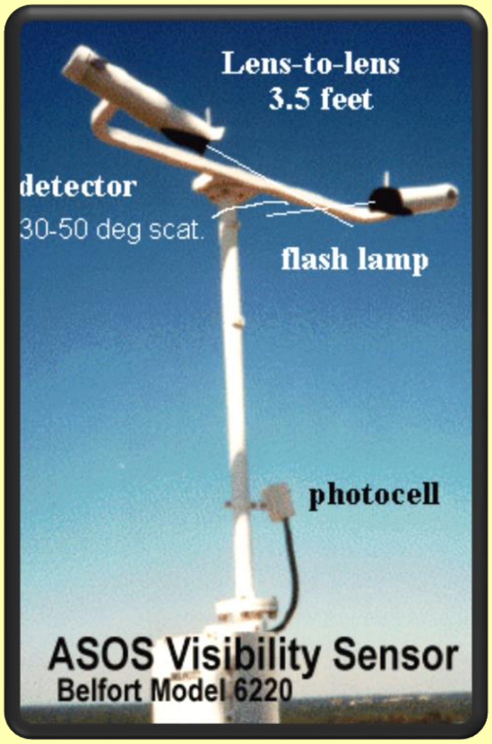


Figure 5.

Scatter Meter

- **Cloud Height & Density-** A laser beam ceilometer is used to measure cloud height, vertical visibility, and sky cover. A laser beam is pointed directly up in the sky; when clouds are overhead it reflects back to the sensor and is converted into a height measurement. The laser beam ceilometer is shown in Figure 6 below.

Figure 6. Laser Beam Ceilometer

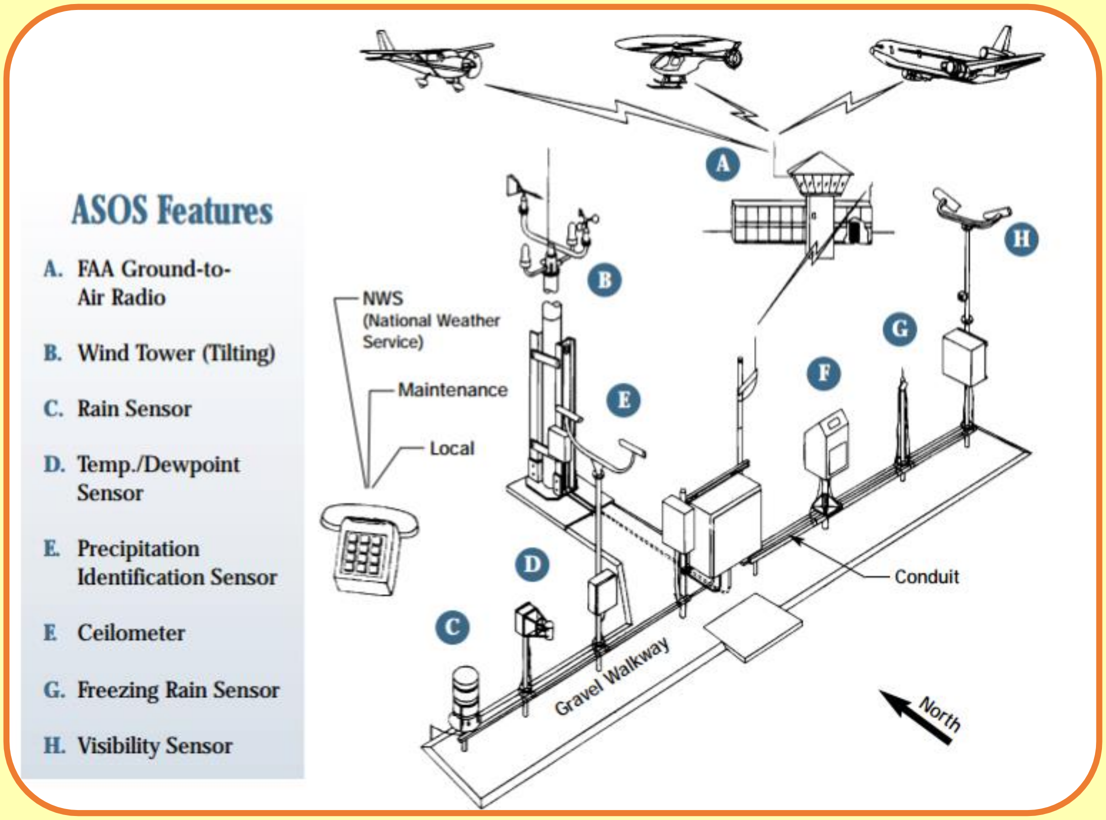
- **Lightning Detection-** This sensor can detect cloud to ground and cloud to cloud lightning strikes. All strikes are counted, but only cloud to ground strikes are used to estimate the distance from the sensor. The strikes are then placed into either the 0 to 5 mile category, 5 to 10 mile category, or the 10 to 30 mile category. The lightning sensor can be seen in Figure 7 below.

Figure 7. Lightning Sensor

Putting the Parts Together

Now that each part of the ASOS has been introduced, the full picture of the sensor suite can be seen below in Figure 8. The sensors relay the raw data to the DCP, which then transmits it to the ACU where the data is processed and formatted to be sent out.

Figure 8. ASOS Sensors



Strengths and Weaknesses of the ASOS

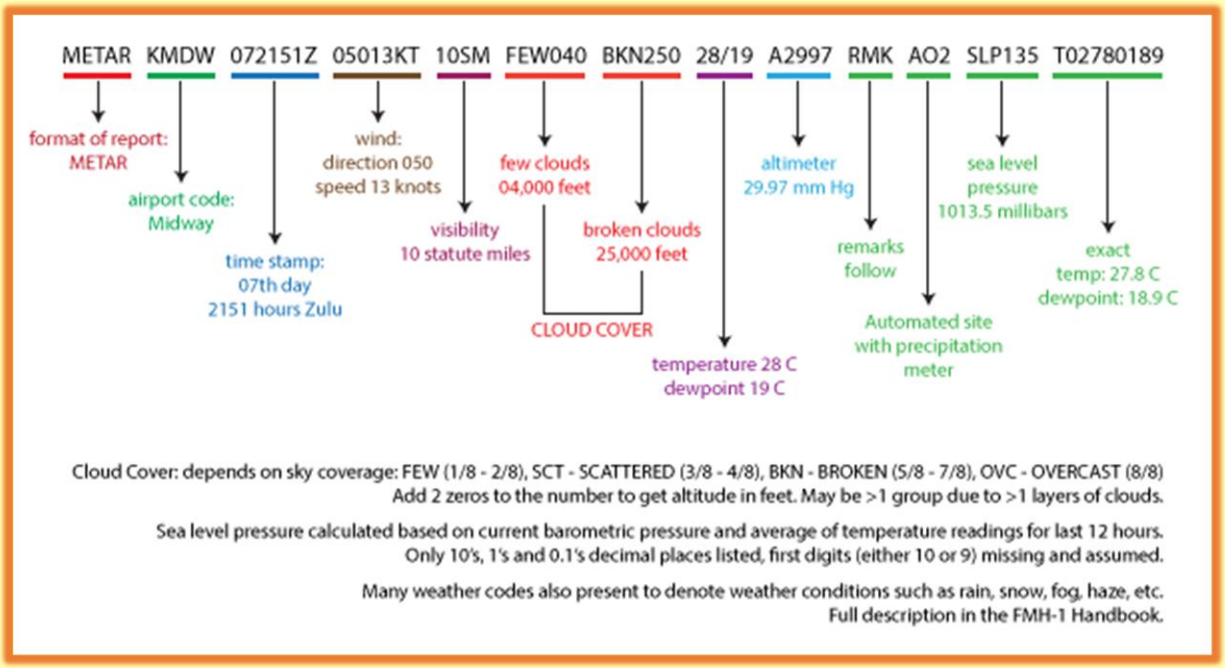
While the ASOS is a very advanced piece of weather observing technology, it is not without flaws. One strength of ASOS is that it operates 24 hours a day, 7 days a week. This means it provides a more consistent stream of data at more locations than human observers.

The main weakness of the ASOS is its inability to observe weather events (or clouds) on the horizon. For example, should there be a storm front moving in with darkening conditions, ASOS will not detect it until the storm begins to move over the sensors. Likewise, ASOS cannot see patchy fog that is not located directly at the station location. In other words, ASOS doesn't have the ability to look at the sky as a whole, it can only sample small portions. In some cases, this can lead to misinformation, therefore forecasters and aviation employees have to be cautious when interpreting ASOS observations.

METARs

METARs (Meteorological Terminal Aviation Routine Weather Report) is the language by which the ASOS communicates to the user. METARs follow a specific format and have various abbreviations for weather phenomena. The typical format can be seen in Figure 9 below.

Figure 9. METAR format



Conclusion

While not a perfect imitator of humans, ASOS is a valuable tool used by meteorologists and aviators alike. The constant monitoring that ASOS provides allows for around the clock information to aid in air travel safety. Forecasters and aviation employees must remember that even with all of ASOS's strengths, it sees only a portion of the current atmosphere and effort should be taken to determine the full picture of the atmosphere from other sources.

Works Cited

1. "ASOS Automated Surface Observing System." *Air Safety Foundation.* Web. n.d. 9 October 2014. <http://flighttraining.aopa.org/students/crosscountry/topics/SA09_ASOS.pdf.>

2. "Automated Surface Observing Systems (ASOS)" *NOAA.* Web. n.d. 9 October 2014. <http://www.srh.noaa.gov/jetstream/remote/asos.htm>.

3. "Automated Surface Observing Systems (ASOS) User's Guide" *NOAA.* Web. n.d. 9 October 2014 <http://www.nws.noaa.gov/asos/aum-toc.pdf.>

4. "FAA ASOS" *All Weather Inc.* Web. n.d. 9 October 2014. <http://www.allweatherinc.com/programs/faa-asos/>.

5. Cover Page Image

   ASOS station. Digital image, Web. n.d. 8 October, 2014. <http://www.allweatherinc.com/programs/faa-asos/>.

6. Figure 1

   Wind Sensor. Digital Image, Web. n.d. 9 October 2014.

   <http://flighttraining.aopa.org/magazine/2008/November/200811_Departments_The_Weather_Never_Sleeps.html>.

7. Figure 2

   Pressure Sensor. Digital Image, Web. n.d. 9 October 2014.

   <http://www.nws.noaa.gov/asos/aum-toc.pdf>.

8. Figure 3
   Hygrothermometer. Digital Image, Web. n.d. 9 October 2014.

   <http://www.nws.noaa.gov/asos/aum-toc.pdf>.

9. Figure 4
   Precipitation Identifier. Digital Image, Web. n.d. 9 October 2014. <http://en.wikipedia.org/wiki/Automated_airport_weather_station>.

10. Figure 5
    Scatter Meter. Digital Image, Web. n.d. 9 October 2014.

<http://avwxworkshops.com/etips/07-10-09.html>.

11. Figure 6
Laser Beam Ceilometer. Digital Image, Web. n.d. 9 October 2014.
<http://en.wikipedia.org/wiki/Automated_airport_weather_station#mediaviewer/File:Ely_Airport_ASOS_Ceilometer.jpg>.

12. Figure 7
Lightning Sensor. Digital Image, Web. n.d. 9 October 2014.
<http://en.wikipedia.org/wiki/Automated_airport_weather_station#mediaviewer/File:Ely_Airport_ASOS_Thunderstorm_Sensor.jpg>.

13. Figure 8
ASOS Sensors. Digital Image, Web. n.d. 9 October 2014.
<http://flighttraining.aopa.org/students/crosscountry/topics/SA09_ASOS.pdf>.

14. Figure 9
METAR format. Digital Image, Web. n.d. 9 October 2014.
http://essayweb.net/geology/weather.shtml