Introduction to Aviation Weather Services

Session Time: One, 50-minute session

DESIRED RESULTS

ESSENTIAL UNDERSTANDINGS

Understanding how weather affects flight is one of the essential skills of a pilot.

Pilots must know how to use the weather services that are available to help form an understanding of the weather situation and make better flying decisions.

ESSENTIAL QUESTIONS

1. What tools are available to better understand how weather might affect my flight?

LEARNING GOALS

Students Will Know

- That pilots have a wide variety of resources available to them to improve decision-making and navigate hazardous weather
- Why it is important for pilots to be able to accurately interpret weather reports and the processes that went into their creation
- That to understand the larger weather picture, a variety of different weather resources should be consulted

Students Will Be Able To

- *Identify* sources of weather information used in flying. (DOK-L1)
- *Distinguish* the limitations and advantages of forecasting. (DOK-L2)
- *Summarize* the differences between weather reports and weather forecasts. (DOK-L2)

ASSESSMENT EVIDENCE

Warm-up
As a class, students will listen to a National Weather Service recording of the day's forecast for their area; they will record the forecast and compare it to the actual weather conditions, beginning a routine that they shall continue through the unit. Students will then participate in a class discussion contrasting the kinds of weather information that ordinary people and pilots need.

Formative Assessment
Students will answer written questions on weather reports and forecasts, and will participate in classroom discussion involving two additional questions.

Summative Assessment

Students will answer questions about the different types of weather reports and forecasts, how to obtain a weather briefing, and the responsibilities of the Pilot in Command.

LESSON PREPARATION

MATERIALS/RESOURCES

- Introduction to Aviation Weather Services Presentation
- Introduction to Aviation Weather Services Student Activity 1
- Introduction to Aviation Weather Services Student Activity 2
- Introduction to Aviation Weather Services Teacher Notes 1
- Introduction to Aviation Weather Services Teacher Notes 2
- Student Daily Weather Diary

LESSON SUMMARY

Lesson 1: Introduction to Aviation Weather Services
Lesson 2: Aviation Weather Observation and Reporting
Lesson 3: Aviation Forecasts and Weather Charts

The lesson begins with a Warm-Up in which students are asked to listen to a recorded broadcast from the National Weather Service, and take notes on the content of that broadcast. These notes will be added to the students' weather diaries. Students will then be asked to compare their recorded forecasts with the actual weather as it develops. Students will also be asked pertinent questions about the sources of weather information, and whether the information gleaned from these sources is adequate for pilots to make good flying decisions.

The lesson will then focus on specific sources of weather information, including government agencies charged with gathering and disseminating critical reports and forecasts. Students will also consider the differences between forecasts and reports and the value in having both types of information for determining the safety of a proposed flight. Students will next look at how to get the information needed for a preflight weather briefing as well as the types and sources of information available in the cockpit.

Finally, students will be introduced to the concept of Pilot in Command, with emphasis on the responsibility of the PIC to obtain, interpret and act on the various sources of weather information in making sound decisions about when and where to fly. Additional emphasis will be placed on the importance of gathering weather information from a variety of sources and to integrate those sources into a usable picture of current and future weather.

BACKGROUND

A major part of a pilot's job is to manage risk. One of the main risk factors in aviation is weather; pilots and other aviation professionals must gather as much weather information as possible before and during each flight to maximize both the safety and efficiency of the flight.

In the early days of aviation, there was no official weather reporting system specifically for pilots. Pilots were left to do their own weather research, often no more than a simple observation of clouds and wind, and to base their decision on whether to fly on very limited data. Consequently, many pilots were killed when they flew into clouds, strong turbulence, or powerful winds.

Since pilots travel great distances in a relatively short time, they must know what the weather is not only at their departure point but also along their route of flight and at their destination. For this reason, pilots are trained to read and interpret both weather *reports* (observed/actual weather) and weather *forecasts* (predictions of what the weather

will be at a given time in the future). Based on this information, a pilot can decide whether the planned flight is safe to make.

Today's pilots are trained in weather theory and interpretation and take advantage of hundreds of reports and forecasts in formulating a flight plan or go/no-go decision. The growth and availability of this weather information, and the increased emphasis on weather in pilot training, have greatly increased flight safety. Today, while weather remains a leading cause of aircraft accidents, the rate at which these accidents occur has gone down dramatically since the early years.

The U.S. government, through its many agencies, has become the most important source of weather information for pilots. Critical weather information is collected from thousands of points across the country and integrated into a reporting system accessed by pilots through a variety of means, from simple telephone calls and website visits to in-flight recordings, cockpit screens, and printers. Weather information is distributed as printed text, spoken words, or charts, graphs, or other visualizations that provide an overall picture as well as specific details about a particular location. Today's pilot is armed with the most up-to-date and accurate weather information available; this information, combined with the pilot's training, has made aviation safer today than ever before.

MISCONCEPTIONS

Student exposure to weather products may be limited to what students receive on their phone, smart speaker, radio, or TV. They may not realize that weather services and products are produced and disseminated by numerous governmental and non-governmental organizations. They also may not be aware that, while they may originate from some of the same sources, the weather services and products that pilots rely on are typically different from those used by the general public.

DIFFERENTIATION

To help students organize their learning throughout the lesson, the teacher may provide a list of terms with blanks for students to fill in the definitions. Include terms such as observation, report, forecast, and PIREP. Students can then retain these worksheets to use in future lessons.

LEARNING PLAN

ENGAGE

Teacher Material: Introduction to Aviation Weather Services Presentation
Student Material: Student Daily Weather Diary

Session 1

Slides 1-3: Introduce the topic and learning objectives of the lesson.

Slides 4-5: Conduct the **Warm-Up**.

Warm-Up

Prior to class, use this list from the National Weather Service to find a recorded weather forecast for your area: https://www.weather.gov/dial-a-forecast/.

- When class begins, call the number and play the recording for the class. Instruct students to take notes about the forecast, focusing on temperature and the times and durations of precipitation and other weather phenomena.

- Before coming to the next class, students should see how the forecast they recorded compared to the day's actual conditions.

- For the remainder of the unit, students should continue to record forecast data from the source of their choosing each day and then compare the forecast to actual conditions. Students should add all this information to the **Student Daily Weather Diary** they began in Unit 1.

After listening to the day's weather forecast, ask students the following questions:

- *Where do you routinely get weather information?*
- *Is the information that you get sufficient for a pilot to make good flying decisions?*
- *What else do you think pilots might need to know?*

Lead a discussion based around these questions. Student answers will vary, but students should reach the conclusion that the weather reports that most people get on their phone, radio, television, or smart speaker—while they may reveal whether it is necessary to carry an umbrella or wear a heavy coat—typically don't provide enough information for a pilot to make good decisions about flying.

[DOK-L2; *relate*]

EXPLORE

Teacher Materials: Introduction to Aviation Weather Services Presentation

Slide 6: Weather is a major risk factor for pilots. Of the causes of aviation accidents, weather is the most likely to be lethal. For this reason, it is very important that pilots learn about weather—particularly how to get the most updated and accurate information for each flight, and how to know when it's safe to fly and when it's not. Pilots must learn how to "read" the weather, including when conditions are likely to improve or worsen.

So, where do pilots get weather information before their flights?

Slide 7: The answer is everywhere! A good pilot will begin watching weather trends on TV or radio weather forecasts days before their flight. They want to get a general idea, in advance, if their planned flight is likely to be cancelled due to weather. They may talk to other pilots about weather trends, or may take in those news reports but also factor in their own personal knowledge of weather in their local area or at their destinations. All of these things may go into the very early planning for a flight, and may provide the first indications of whether the flight can be conducted safely.

General media weather forecasts can be useful in early planning, but the main source of weather information comes from specialized weather reports and forecasts. These are delivered to pilots in the form of a briefing which gives the pilot much or all of the information needed to make a decision whether to fly or not. Briefings contain current and forecast weather and are available prior to or while in flight.

This weather information comes from a variety of sources, most of which are government agencies charged with collecting and disseminating weather data. The National Weather Service is the lead agency, with the FAA, Department of Defense, NOAA and private groups adding to the information collected. The FAA, through its contracted Flight Service Stations, consolidates the weather info collected by other agencies and formats that data into briefings delivered to pilots, either by phone, radio, or online.

Slide 8: For weather information to be available to pilots, it first has to be collected, analyzed, and put into a form usable by the aviation community. The National Weather Service (NWS) is an agency of the Federal Government funded by taxpayer dollars. NWS collects important weather information from thousands of locations around the country. This information is gathered in two ways: 1) automatically, through a network of equipment, and 2) manually,

through physical observations by trained weather professionals. Whichever method is used, information is gathered concerning:

- Humidity
- Wind direction and speed
- Air temperature and dew point
- Cloud heights
- Type and severity of precipitation (rain, snow, sleet, hail, etc.)
- Visibility
- Atmospheric pressure at the surface and at various altitudes aloft
- Other weather factors

Meteorologists at the NWS then take this raw data and create weather reports of observed weather, as well as forecasts of future weather up to several days in advance. The NWS then publishes these reports and forecasts in paper format and online for use by the public and other weather reporting agencies and private organizations.

Slide 9: The FAA gathers similar weather information, mainly through automated stations at airports around the country. These automated stations often have the capability of reporting critical weather information directly to pilots through the aircraft's onboard radios.

The FAA distributes weather reports and forecasts generated by the NWS, as well as full-scale briefings generated by the FAA's own meteorologists and automation. FAA Flight Service Stations provide highly trained on-site specialists whose job it is to provide pilots with the most complete and updated weather information.

FSS can be reached by phone (1800WXBRIEF) or website (1800WXBRIEF.COM) for briefings. FAA-generated briefings are also available to pilots in the cockpit through datalink technologies. Whether delivered by telephone, internet, or datalink, these briefings are an important part of every pilot's preflight planning.

Slide 10: Other government agencies are also deeply involved in gathering and analyzing weather data.

The National Oceanic and Atmospheric Administration (NOAA) is the parent agency of the National Weather Service and is charged with gathering weather information at sea and in the air. NOAA gathers data from ships and through specially equipped aircraft that take important atmospheric readings for later analysis. NOAA is perhaps best known by the public for their famous Hurricane Hunter aircraft that fly directly into hurricanes to gather weather information.

- "The Hurricane Hunters" (Length 2:14)
  https://video.link/w/fX0q

For teachers who are unable to access Safe YouTube links, the video can also be found here: https://www.youtube.com/watch?v=JulJhamN7d8

NOAA takes the raw data it collects and produces numerous weather reports and forecasts for use by pilots and others. These reports are available in printed format as well as electronically through several websites and private networks. Many pilots rely on one of NOAA's most popular sites, www.aviationweather.gov, to get the most detailed reports and graphical forecasts.

The Department of Defense (DOD) also gathers weather information, mainly in support of military operations. The DOD employs ships, aircraft, and satellites to get the most accurate and detailed information for the generation of reports and forecasts critical to the safe and effective deployment of military assets. The DOD does not play a major role in the development of weather briefings for civilian aviation.

EXPLAIN

Teacher Material: Introduction to Aviation Weather Services Presentation, Introduction to Aviation Weather Services Teacher Notes 1
Student Materials: Introduction to Aviation Weather Services Student Activity 1

Slide 11: It is important for pilots to understand the type of information they are receiving in order to use that information to make good flying decisions.

Weather information can be broken down into two basic types: 1) Reports, and 2) Forecasts.

Reports contain information about current weather or weather that has occurred in the past. Reports are used to learn what the conditions are now or what conditions were in the past few hours. They are sometimes referred to as "nowcasts" because they report what the weather is now, not what it will be in the future. If a pilot wants to know what the weather is currently so he or she can make decisions about whether to begin a flight, the pilot would consult a report. Reports come in a variety of types, from basic text descriptions of temperature, wind, cloud height, and visibility to very elaborate graphical depictions of nationwide weather or severe conditions such as thunderstorms. Reports come from observations, usually made by automated equipment, but sometimes by trained weather observers.

Forecasts, on the other hand, are not observations, but rather predictions of what the weather will be in the future. While based on observations of current weather and trends, forecasts attempt to give pilots a good idea of what the conditions will be along a route and at the destination. Forecasts are often generated using detailed mathematical models of air mass movement and trends. If pilots want to know what kind of weather they will encounter during a flight, they would consult a forecast, not a report. Forecasts predict the future, and good aviation forecasts are critical for safe flight.

Slide 12: There are many types of weather reports, and each serves a specific need.

For example, surface observations are often used at airports to advise pilots of local conditions and to assist them in planning for their departure or arrival. These observations will often include information concerning wind speed and direction, cloud height, visibility, and atmospheric pressure. Surface observations are often made by machines called Automated Weather Observation Stations, but are also sometimes made by specially trained airport personnel. Surface observations are a part of preparing for every flight.

Upper air observations are taken by weather balloons or aircraft, and provide pilots with valuable information about conditions aloft. These observations commonly provide information about wind and temperature, but may also include other important weather data. Pilots often report on conditions they observe during flight. These pilot reports or "PIREPs" often provide the most current and accurate picture of conditions at various altitudes, and are relied upon heavily by pilots seeking the best possible information.

Slide 13: Radar observations are useful to pilots seeking to avoid clouds and potentially dangerous weather. Radar signals will bounce off of the water droplets and snow or ice found in clouds, so observations of this precipitation can help pilots avoid the worst weather. Collections of radar observations can be consolidated into summary charts that show clouds and precipitation over a large area, aiding pilots in planning routes that may cover hundreds or even thousands of miles.

Satellite imagery has been a boon to weather reporting, as it enables meteorologists and weather scientists to observe weather and its movement over a large area. Satellites can see weather forming at the poles and in the tropics, and data derived from these observations can be put into graphical or photographic displays that give pilots a true 'birds eye view' of weather, its intensity, and direction of movement.

- "How Are Weather Forecasts Made" (Length 3:06)
  https://video.link/w/md0q

For teachers who are unable to access Safe YouTube links, the video can also be found here: https://www.youtube.com/watch?v=fdErsR8_NaU&t=62s

Slide 14: Commonly used reports include METARs and PIREPs. METARs contain information about temperature, dew point, cloud heights and bases, visibility, and pressure. PIREPs are filed by pilots for pilots and contain information

about whatever the pilot is experiencing, such as turbulence, precipitation, visibility, and other conditions that impact their flight.

Slide 15: Commonly used forecasts include Terminal Aerodrome Forecasts (TAFs), Graphical Forecasts, Prognostic Charts, and Wind and Temperature Aloft Forecasts. TAFs provide information about expected weather at some of the larger airports around the country. Graphical forecasts show weather overlaid on a map, and are available for the entire country or for individual regions. Prognostic charts are similar to graphical forecasts but look ahead for 48 hours. Wind and Temperature Aloft Forecasts provide information about winds and temperatures at a variety of different altitudes and are used by pilots to help select the most efficient altitude for a flight.

Slide 16: Other types of weather products are advisory in nature and focus on hazardous weather conditions such as convective activity, instrument flight rules (IFR) conditions, major storms, and other types of significant weather. These products include AIRMETs, SIGMETs, Convective SIGMETs, and Significant Weather Prognostic Charts. Students will learn more about all types of weather products in upcoming lessons.

Questions

Do TV and radio weather reports provide pilots with the kind of information they need in flight planning?

No. Media weather reports provide general information. Will the weather be good or bad? Will it rain or snow? Will it be windy? Pilots need much more detailed information. What direction will the wind come from? What will the wind speed be? How high will the clouds be? What kind of precipitation will fall? When will it start and stop? Aviation demands more complete information than that provided by news reports.

Slide 17: Complete the **Formative Assessment**.

Formative Assessment

Students will answer written questions. Teacher will provide students with an Introduction to **Aviation Weather Services Student Activity 1** worksheet. Correct answers and sample responses are provided in Introduction to **Aviation Weather Services Teacher Notes 1**.

[DOK-L1; *name,* DOK-L2; *classify*]

Slide 18: While it's relatively easy to gather information for weather reports (just look outside), it's much more difficult to produce good weather forecasts. A famous baseball player, Yogi Berra, once said, "Predictions are hard to make, especially about the future." He was right, and especially right when it comes to weather predictions.

The science of weather forecasting has come a long way, but it often produces forecasts that are at least partially incorrect, and sometimes completely wrong. That is not surprising, given the complexity of predicting air mass movements, temperature exchanges, horizontal and vertical movement of the air and the like.

- Why It's Hard to Forecast the Weather" (Length 1:56)
  https://video.link/w/zd0q

For teachers who are unable to access Safe YouTube links, the video can also be found here: https://www.youtube.com/watch?v=6ES_MIJQH_A

Slide 19: Weather forecasters at the NWS, NOAA, the FAA and other official weather agencies utilize complex mathematical and computer modeling methods to predict future weather. These models and formulas take into consideration dozens or hundreds or thousands of weather variables at the same time, factor in probabilities of certain changes occurring, then produce a result that is then examined by trained meteorologists. These weather scientists then apply their knowledge and experience to the data provided by the computer models in producing a forecast. They are usually pretty accurate, but not always. Weather forecasting is still an inexact science.

- "How does chaos limit weather forecasts? Experiments with a double pendulum" (Length 3:08) https://video.link/w/fnlr

For teachers who are unable to access Safe YouTube links, the video can also be found here:

https://www.youtube.com/watch?v=HPAYf2zpmOo

Slide 20: Pilots can get weather briefings and updates in a variety of ways from a number of sources. Sometimes it's as easy as picking up a phone. Other times they get their information from the internet. And still other times they can get what they need by using the tools in the cockpit, including the radio and avionics.

The three most common ways to get a complete *preflight* briefing are by telephone, radio, and via the internet. A special network of FAA facilities known as Flight Service Stations (FSS) has been established expressly for the purpose of providing preflight briefings to pilots. Pilots choosing to get their preflight briefings by phone simply call an FSS weather specialist at 1-800-WX-BRIEF. They tell the specialist the name of the airport they are departing from and their destination, time of departure, type of aircraft, and planned altitude. The specialist then delivers a complete briefing, including reports of current conditions as well as forecasts for weather along their route of flight and at their destination. These specialists can also respond by radio for pilots calling for a briefing or update from the cockpit.

Another way for many pilots to obtain a complete briefing is through a dedicated FAA-sponsored website, www.1800wxbrief.com. Pilots fill in several fields for their departure point, destination, route of flight, altitude, and type of aircraft, and the website generates a complete briefing, including all the details obtained through a live telephone briefing. Many pilots prefer this method, as it provides a written briefing that the pilot can mull over and refer back to. The website also features dozens of graphical weather pages, showing current and forecast conditions over a wide area.

Alaskan pilots have a special method for obtaining weather information. The Telephone Information Briefing Service, TIBS, lets pilots call a phone number and listen to recorded information regarding weather along popular routes. This is a very convenient service, and often provides updated weather faster than calling and waiting for a live briefer.

Slide 21: The Transcribed Weather Enroute Broadcast is similar to TIBS except it is delivered over the cockpit radio instead of the telephone. Pilots tune to the appropriate frequency and listen to a recording of weather and other aeronautical information along selected routes, generally those most traveled by pilots.

The Hazardous Inflight Weather Advisory Service (HIWAS) is a recording of hazardous weather, AIRMETS, SIGMETS, Center Weather Advisories and Urgent PIREPs. HIWAS recordings are broadcast over select VOR frequencies.

The FAA and other governmental agencies have made important weather information available to pilots through a variety of sources and technologies. Pilots obtain weather information from one or more of these sources before each flight, as part of their preflight planning. Referencing multiple sources enables the pilot to get the big weather picture, to plan accordingly, and to avoid weather that could be dangerous.

Slide 22: Many modern cockpits are equipped with receivers that enable weather to be displayed graphically. This equipment displays weather along the flight path, and includes precipitation, tops of clouds, direction of movement, as well as surface weather such as winds, ceilings, and altimeter setting. Most displays are color coded to indicate intensity, enabling pilots to maneuver to avoid the worst weather.

While many of these displays require expensive in-panel installations, it is now possible for pilots to receive the same weather graphics on a portable iPad or other tablet with Sirius XM or ADS-B receivers.

The advent of in-cockpit displays of important weather promises to make flying even safer, giving pilots immediate access to information not available even a few years ago. Even so, it has some limitations, such as delays of several minutes, that can be critical to pilots trying to navigate severe weather.

EXTEND

Teacher Material: Introduction to Aviation Weather Services Presentation

Slide 23: Getting a good weather briefing and staying updated on changes and trends is not just a good idea for pilots - it's a regulatory requirement. Federal Aviation Regulations (14 CFR 91.103) specifically requires pilots to become familiar with all available information concerning their flight, including:

- Weather reports and forecasts
- Takeoff and landing distances required
- Fuel requirements
- Alternates if flight cannot be completed as planned

It's important for pilots to use multiple sources of information to ensure they receive a valid overview of the weather.

EVALUATE

Teacher Materials: Introduction to Aviation Weather Services Presentation, Introduction to Aviation Weather Services Teacher Notes 2
Student Material: Introduction to Aviation Weather Services Student Activity 2

Slide 24: Conduct the **Summative Assessment**.

Summative Assessment
In the **Aviation Weather Services Student Activity 2** worksheet, students will answer questions about reports and forecasts and weather briefings.

[DOK-L2; *summarize*, *distinguish*]

Summative Assessment Scoring Rubric

- Follows assignment instructions
- Postings show evidence of one or more of the following:
    - Knowledge of how to obtain a weather briefing
    - Provides details about the sources of weather information
    - Can discriminate between weather reports and forecasts
- Contributions show understanding of course of the concepts covered in the lesson
- Contributions show in-depth thinking including analysis or synthesis of lesson objectives

Points	Performance Levels
9-10	The student thoroughly understands the different types of weather reports and forecasts, how to obtain a weather briefing, and the responsibilities of the Pilot in Command; Answers 9-10 of the questions correctly
7-8	The student understands most of the different types of weather reports and forecasts, how to

obtain a weather briefing, and the responsibilities of the Pilot in Command; Answers 7-8 of the questions correctly
5-6 The student understands some of the different types of weather reports and forecasts, how to obtain a weather briefing, and the responsibilities of the Pilot in Command, with many gaps in understanding; Answers 5-6 of the questions correctly
0-4 The student shows little or no understanding of the lesson objectives; Answers 0-4 of the questions correctly

STANDARDS ALIGNMENT

NGSS STANDARDS

Three-Dimensional Learning

- **HS-ETS1-2** - Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.
    - Science and Engineering Practices
        - Asking Questions and Defining Problems
        - Constructing Explanations and Designing Solutions
    - Disciplinary Core Ideas
        - ETS1.A: Defining and Delimiting Engineering Problems
    - Crosscutting Concepts
        - None
- **HS-ETS1-3** - Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics as well as possible social, cultural, and environmental impacts.
    - Science and Engineering Practices
        - Constructing Explanations and Designing Solutions
    - Disciplinary Core Ideas
        - ETS1.B: Developing Possible Solutions
    - Crosscutting Concepts
        - None

COMMON CORE STATE STANDARDS

- **RST.9-10.2** - Determine the central ideas or conclusions of a text; trace the text's explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text.
- **RST.9-10.4** - Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 9-10 texts and topics.

- **WHST.9-10.6** - Use technology, including the Internet, to produce, publish, and update individual or shared writing products, taking advantage of technology's capacity to link to other information and to display information flexibly and dynamically.
- **WHST.9-10.8** - Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the usefulness of each source in answering the research question; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and following a standard format for citation.
- **WHST.9-10.9** - Draw evidence from informational texts to support analysis, reflection, and research.

FAA AIRMAN CERTIFICATION STANDARDS

PRIVATE PILOT

- **PA.I.C.K1** - Sources of weather data (e.g., National Weather Service, Flight Service) for flight planning purposes.
- **PA.I.C.K2** - Acceptable weather products and resources required for preflight planning, current and forecast weather for departure, en route, and arrival phases of flight.
- **PA.I.C.R2** - Limitations of:
    - **PA.I.C.R2a** a. Onboard weather equipment
    - **PA.I.C.R2b** b. Aviation weather reports and forecasts
    - **PA.I.C.R2c** c. Inflight weather resources

REMOTE PILOT

- **UA.III.A.K1** Internet weather briefing and sources of weather available for flight planning purposes.
- **UA.III.A.K2** Aviation routine weather reports (METAR).
- **UA.III.A.K3** Terminal aerodrome forecasts (TAF).
- **UA.III.A.K4** Weather charts.
- **UA.III.A.K5** Automated surface observing systems (ASOS) and automated weather observing systems (AWOS).

REFERENCES

Aviation Weather, FAA AC 006b
Aviation Weather Services, FAA AC 00-45H
https://www.aviationweather.gov/adds/
https://www.nws.noaa.gov/