III.B. Weather Information

Objectives	The student should develop knowledge of the elements related to weather information with the ability to interpret several weather sources and make a competent, well educated, Go/No Go decision. The student should also develop knowledge of the elements related to weather information, by analyzing weather reports, charts, and forecasts from various sources.
Key Elements	✈ Information sources ✈ EFAS—122.0 ✈ Go/No Go decision
Elements	✈ METAR ✈ TAF ✈ Surface analysis chart ✈ Radar summary chart ✈ Winds and temperature aloft ✈ Significant weather prognostic charts ✈ Convective outlook chart ✈ AWOS, ASOS, ATIS reports ✈ Weather briefing ✈ Weather information sources ✈ In-flight weather advisories ✈ Go/No-go decision
Schedule	1. Discuss objectives 2. Review material 3. Development 4. Conclusion
Equipment	✈ White board ✈ Markers ✈ References
Instructor's Actions	1. Discuss lesson objectives 2. Present lecture 3. Questions 4. Homework
Student's Actions	Participate in discussion Take notes
Completion Standards	The student can effectively interpret the necessary weather information, and has the ability to make a competent Go/No Go decision, based on the information.

References	AC 00-45H, *Aviation weather services* https://www.faa.gov/documentLibrary/media/Advisory_Circular/AC_00-45H_Chg_1.pdf

Instructor Notes

Introduction

Overview—review objectives and key ideas.
Why—weather can help our flying but in some cases can also hinder it. Through a complex system of weather services, government agencies, and independent weather observers, pilots are provided with a vast amount of information regarding weather patterns, trends, and characteristics, in the form of up-to-date weather reports and forecasts. These reports and forecasts enable pilots to make informed decisions regarding weather and flight safety.

METAR

Aviation routine weather report—observation of current surface weather reported in a standard international format.

- Type of report—there are two types, routine and special.
  Routine METAR is transmitted hourly. Special weather reports (SPECI) are given any time to update a METAR for rapidly changing weather, aircraft mishaps, etc.
- Station identifier—four-letter code (e.g. KLAF). Alaska begins with PA, Hawaii begins with PH.
- Date and time of report—reported in a six-digit group, first two digits are the date, last four are the time, in UTC.
- Modifier—denotes that the METAR came from an automated source or was corrected.
  AUTO—indicates the report came from an automated source.
  A01 and A02—indicate the type of precipitation sensors at the station.
  COR—indicates a corrected report.
- Wind—reported with five digits, unless the wind speed is more than 99 knots, in which case it becomes six digits.
  First three digits indicate wind direction in tens of degrees. Last two digits indicate the speed of the wind in knots. Gusting shown with the peak gust after the "G".
  If wind varies more than 60 degrees and the speed more than 6 knots, a separate group of numbers, separated by a "V" will indicate the extremes of the directions.
- Visibility—reported in statute miles.
  RVR is sometimes reported following visibility—the distance a pilot can see down the runway in a moving aircraft. "R", then runway number, a slant, and the visual range in feet.
- Weather—includes weather phenomenon and qualifiers.
  Phenomena describe precipitation, obscuration, etc. DZ, RA, HZ, SS, DS, SN, etc.
  Qualifiers show the intensity or proximity. -, +, VC, SH, TS, FZ, etc.
- Sky condition—reported in the sequence of amount, height, and type.

Height depicted with three digits, in hundreds of feet AGL. Clouds above 12,000 ft are not detected. Towering cumulus and cumulonimbus clouds are reported with their height.
The amount of sky coverage is reported in eighths of the sky from horizon to horizon.
SKC/CLR/FEW, FEW, SCT, BKN, OVC

- Temperature and dewpoint—in degrees Celsius. Temperatures below 0°C preceded by the letter "M."
- Altimeter setting—preceded by the letter "A" and reported in inches of mercury in a four digit number. "PRESRR" or "PRESFR" represent rising or falling pressure.
- Remarks—may include wind data, variable visibility, begin/end times of phenomenon, pressure info, and other necessary info.

TAF

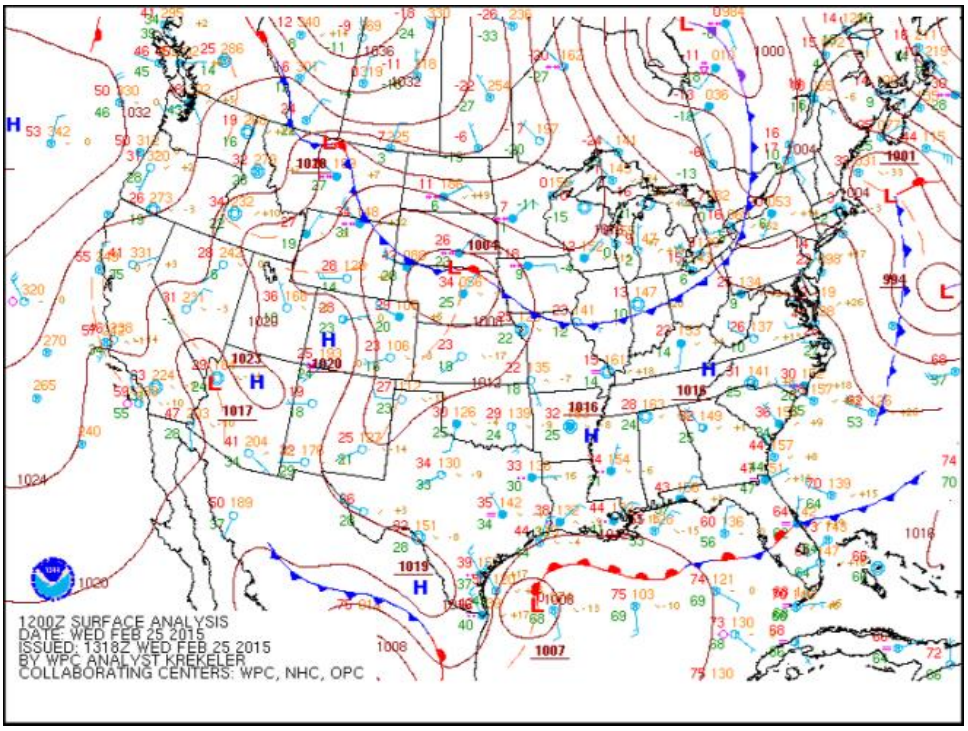
Terminal aerodrome forecast—report established for the 5SM radius around an airport. Valid for a 24-hr period, and updated four times a day (0000Z, 0600Z, 1200Z, 1800Z).
Utilizes the same descriptors and abbreviations as the METAR.

- Type of report—can be a routine forecast (RAF) or an amended forecast (TAF AMD).
- ICAO station identifiers—same as METAR.
- Date and time of origin—six number code, same as METAR.
- Valid period date and time—given by a 6-digit group: the first two are the date, the next two are the beginning time for the valid period; the last two are the end time.
- Forecast wind—the wind direction and speed forecast, given in a 5-digit group.
- Forecast visibility—given in statute miles; if greater than 6SM shown as P6SM.
- Forecast change group—includes the expected conditions and time period for any significant weather change forecast to occur.
  FM—from used when a rapid and significant change is expected within an hour
  BECMG—becoming used when a gradual change is expected over no more than two hours
  TEMPO—temporary used for temporary fluctuations, expected to last less than an hour.
- Probability forecast—percentage describing the probability of thunderstorms and precipitation occurring in the coming hours.

Surface analysis charts

Depicts an analysis of current surface weather. Transmitted every 3 hours, covers contiguous 48 states and adjacent areas. Shows areas of low/high pressure, fronts, temperatures, dewpoints, wind direction and speed, local weather, and visual obstructions.
Also depicts surface weather observations for reporting points across the US, each illustrated by a station model that includes:

- Type of observation—round is official weather observer, square is automated station.
- Sky cover—shown as clear, broken, overcast, or obscured/partially obscured.
- Clouds—cloud types represented by specific symbols. Low cloud symbols placed beneath station model; middle and high cloud symbols placed directly above station model. Typically only one type of cloud depicted.
- Seal level pressure—given in 3 digits to the nearest tenth of a millibar. For 1000 mbs or greater, prefix a 10 to the 3 digits; for less than 1000 mbs, prefix a 9 to the 3 digits.
- Pressure change/tendency—in tenths of mbs over the past 3 hours, depicted directly below the sea level pressure.
- Precipitation—precipitation that has fallen over the last 6 hours to the nearest hundredth of an inch.
- Dewpoint—in degrees Fahrenheit.
- Present weather—many different weather symbols used to describe the current weather.
- Temperature—in degrees Fahrenheit.
- Wind—true direction of wind, given by the wind pointer line, indicating the direction from the wind is coming. Short bar=5 knots, long bar=10 knots, pennant=50 knots.

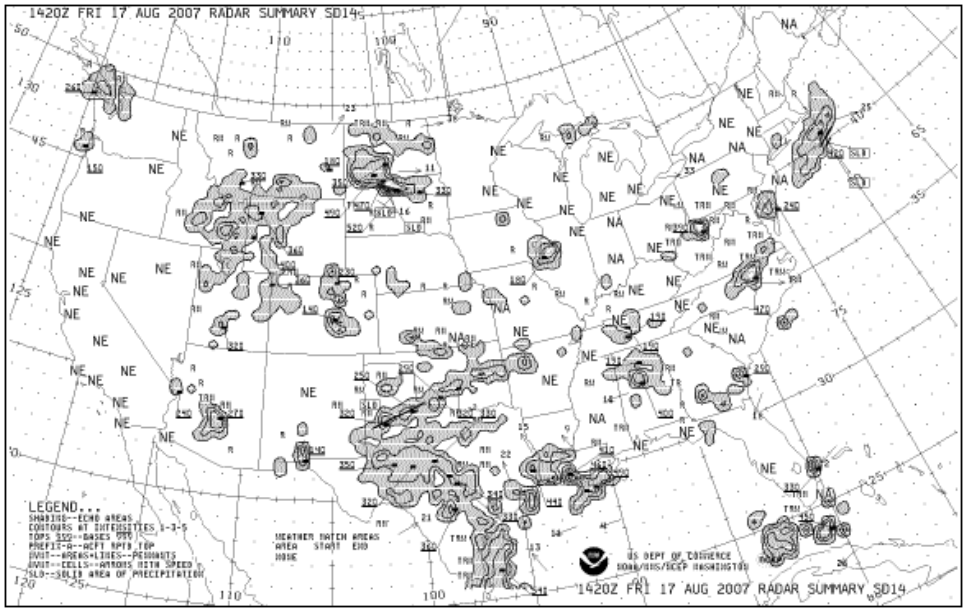


Radar summary chart

Graphically depicted collection of radar weather reports. Display areas of precipitation and information regarding the characteristics of precipitation.
Published hourly, at 35 minutes past the hour.

- No information—if information is not reported, it will say "NA." If no echoes are detected, it will say "NE."
- Precipitation intensity contours—described as one of six levels, shown by three contour intervals.
- Height of tops—heights of echo tops given in hundreds of feet MSL.
- Movement of cells—indicated by an arrow pointing in the direction of movement, speed in knots at the top of the arrow. "LM" indicates little movement.
- Type of precipitation—marked using specific symbols (not those used on METAR).
- Echo configuration—echoes shown as being areas, cells, or lines.
- Weather watches—depicted by boxes outlined with heavy dashed lines.

Only depicts areas of precipitation—will not show areas of clouds and fog with no appreciable precipitation. Will not show the heights of tops and bases of clouds.
Depiction of current precipitation, should be considered with current METAR and weather forecasts.



Winds and temper aloft chart (FD)

Provides wind and temperature forecasts for specific locations. Forecasts made twice a day, 0000Z and 1200Z.
Uses true altitudes through 18,000 ft and pressure altitudes above 18,000 ft.

Wind direction is always in reference to true north—wind speed always given in knots. No winds are forecast when a given level is within 1,500 ft of station elevation.
Wind direction and wind speed listed together in four-digit code:
- First two digits indicate direction the wind is blowing from in tens of degrees.
- Second two digits indicate the speed of the wind.

If windspeed is forecast to be greater than 100 knots but less than 199 knots, 50 is added to direction, and 100 is subtracted from the speed. Do the reverse to decode.
If windspeed is forecast to be 200 knots or greater, the wind group is coded as 99 knots.
Light and variable wind is coded as "9900."

Temperature is always given in degrees Celsius. No temperatures are forecast for a level within 2,500 ft of station elevation. Temperatures above 24,000 ft MSL are always negative.

Significant weather prognostic charts

Portray forecasts of selected weather conditions at specified valid times. Forecasts made from a comprehensive set of observed weather conditions that are extended forward in time and become forecasts by considering atmospheric and environmental processes.

Forecast made for various periods of time—each valid time is the time at which the forecast conditions are expected to occur, and is printed on the lower left corner of each panel. Issued four times a day, at 0000Z, 0600Z, 1200Z, and 1800Z.
12-hour prog—forecast of conditions with a valid time 12 hours after the observed time.

Altitude information referenced to MSL. True altitude below 18,000', pressure altitude above 18,000'.

Prog charts generated for two general time periods. Day 1 progs are forecast for the first 24-hour period and are prepared for 2 altitude references. Day 2 progs are forecast for the second 24-hour period.

Charts available for low-level significant weather and high-level significant weather.

Low level chart

Day 1 forecast of significant weather for the conterminous US. Weather information for layer from surface to FL240 (400 mbs). Information provided for two forecast periods: 12 hours and 24 hours. Provides overview of selected flying weather conditions up to 24,000 ft. We can use surface pressure patterns to infer surface winds. We can infer structural

icing in areas with clouds and precipitation above freezing levels, and in areas of freezing precipitation.

Four panels:

- Upper two panels depict 12- and 24-hr significant weather progs
  Display forecast weather flying categories (VFR, IFR, MVFR), freezing levels, and turbulence
- Lower two panels depict 12- and 24-hr surface progs
  Display forecast positions and characteristics of pressure systems, fronts, precipitation. Arrow indicates direction of movement of pressure center; speed in knots. Outline for areas of forecast precipitation and thunderstorms—shaded areas of precipitation indicate at least ½ the area is affected by the precipitation, and unique symbols indicate the type of precipitation.

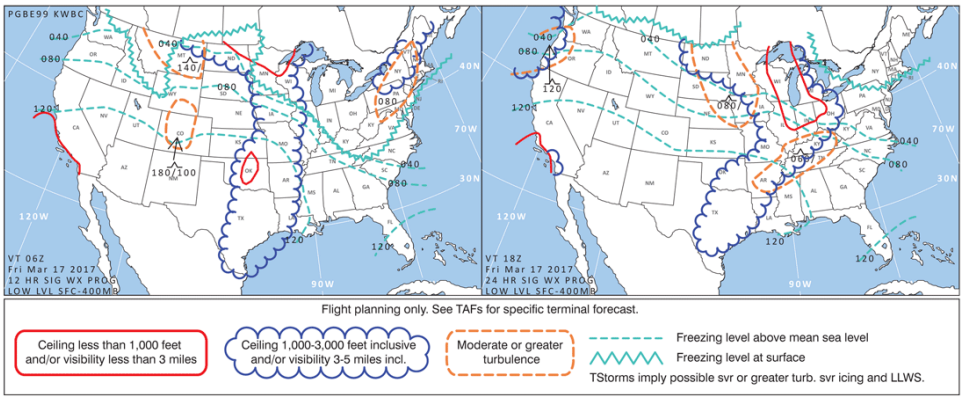
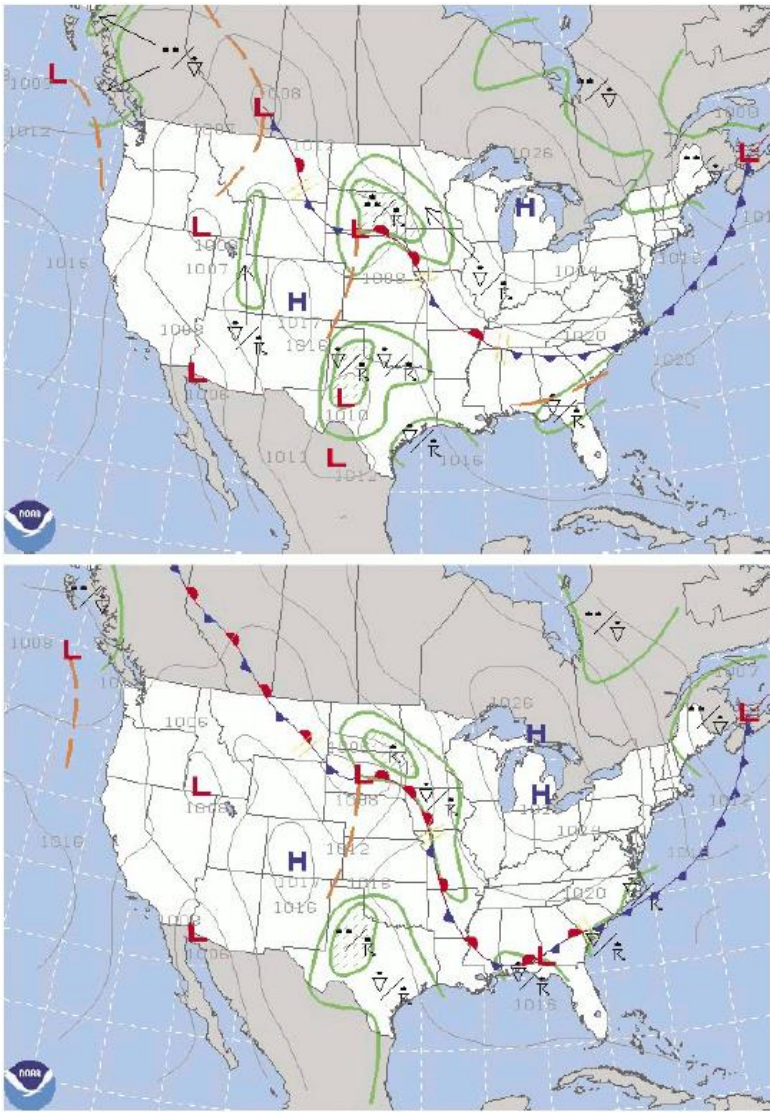


Figure 18. U.S. Low-Level Significant Weather Prognostic Charts. ©ASA

36- and 48-hr surface prog

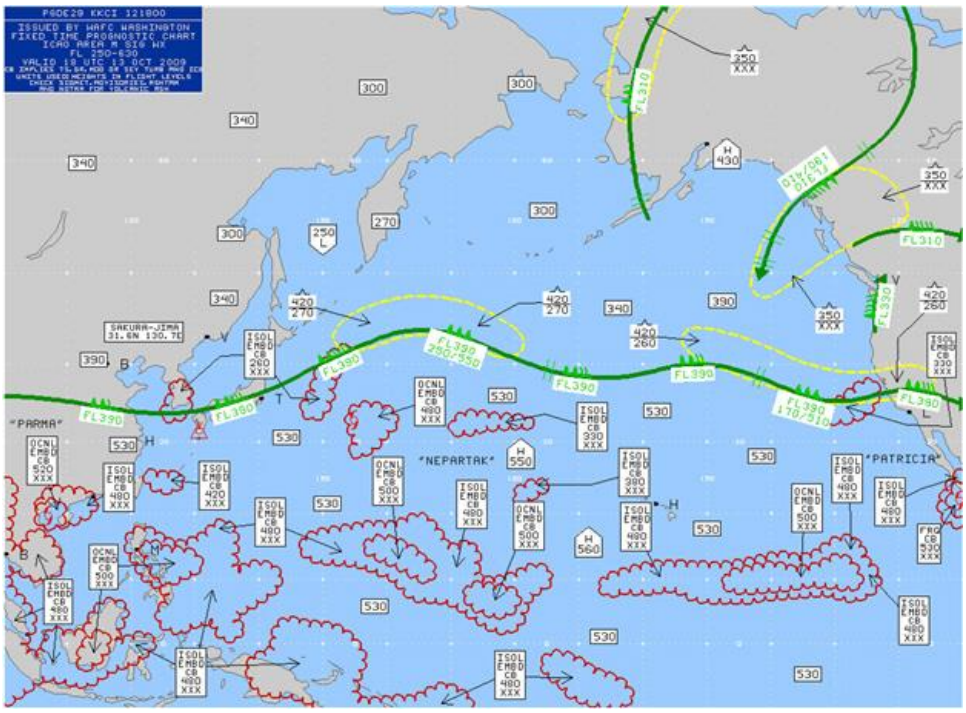
Day 2 forecast of general weather—extension of day 1 low-level prog chart, issued from same observed data base. Issued two times daily (0000Z and 1200Z), charts valid 36/48hrs after observation.
Two panels (36- and 48-hr surface progs) and a forecast discussion. The panels display forecast positions/characteristics of pressure patterns, fronts, and precipitation. Forecast discussion is a discussion of day 1 and day 2 forecast package—identifies weather systems and associated weather conditions portrayed on prog charts.

Use for general weather conditions outlook and to assess the progression of weather through Day 2.



High-level significant weather prog

Day 1 forecast of significant weather covering a large portion of the Northern Hemisphere and a limited portion of the Southern Hemisphere for 24,000 to 60,000 ft. Conditions routinely appearing above the jet streams with cumulonimbus clouds, turbulence, tropopause heights, surface front information.
Tropical cyclones, squall lines, eruptions, sandstorms, dust storms.
Issued 4 times a day, valid time 00Z, 06Z, 12Z, 18Z.



Convective outlook chart

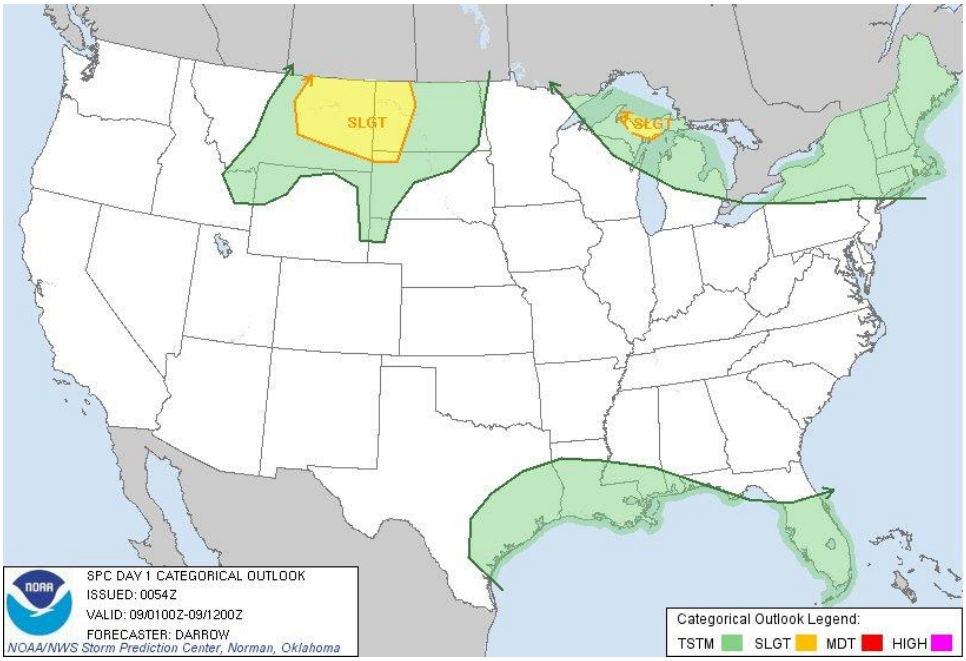
Flight planning tool used to determine forecast areas of thunderstorms. Outlines general thunderstorms and provides risk areas.

Two panels—Day 1 (left) and Day 2 (right) convective outlook.

- Day 1 issued 5 times daily (first issuance at 0600Z, then 1300Z, 1630Z, 2000Z, and 0100Z) all valid until 12Z the next day.
- Day 2 issued 2 times daily (first issuance at 0830Z during standard time, 0730Z during daylight time, updated at 1730Z), valid from 12Z the following day to 12Z the next day.

Risk levels depend on number of severe thunderstorm reports per geographical unit and forecaster confidence

- SEE TEXT used for situations where slight risk is considered but not warranted at the time of forecast
- SLGT describes a high probability of 5-29 reports of >1" hail and/or 3-5 tornadoes, and/or 5-29 wind events. Well-organized severe thunderstorms expected but in small numbers and low coverage.
- MDT describes a high probability of at least 30 reports of >1" hail, 6-19 tornadoes, or numerous wind events. Greater concentration of severe thunderstorms and greater wind magnitude.
- HIGH describes a high probability of at least 20 tornadoes (at least two of them rated F3 or higher) or an extreme derecho causing widespread (> 50) wind events with higher-end winds (> 80 mph) and structure damage reports. A major weather outbreak is expected with great coverage.



Go/No-go decision

Consider weather factors in relation to the equipment available. Can the plane handle the flight?
Think about thunderstorms, especially embedded, fast-moving fronts or squall lines, moderate or greater turbulence, icing, and fog or other visual obscurations.

The pilot's physical and mental condition can also affect the decision, as well as recent flight experience.

ASOS

Automated Surface Observing System

Continuous minute by minute observations that are used to generate a METAR and provide information. Transmits SPECI report whenever it detects a significant change in conditions.

Contains
- Cloud height indicator
- Visibility sensor
- Precipitation identification sensor
- Freezing rain sensor (at select sites)
  Designated A01 without liquid/frozen precipitation discriminator, A02 with
- Pressure sensors
- Ambient temperature and dew point temperature sensors
- Anemometer for wind direction and speed
- Rainfall accumulation sensor
- Lightning detection equipment installed at selected sites

	Cannot distinguish between stratus/cumulonimbus clouds. Limited ability to identify visibility restrictions (prevailing, sector, tower visibility) without input from human observer. ✈ Level A: highest level of service, available at major airports ✈ Level B: has human observers available 24hrs ✈ Level C: at airports with part-time towers (human augmentation ends when tower closes) ✈ Level D: at smaller, non-towered airports (unattended, always AUTO when in METAR)
AWOS	Automated Weather Observing System First widely installed automated weather data gathering system at airports. Available in lesser configurations. AWOS-A: Only reports altimeter setting AWOS-1: Measures and reports wind speed, direction, gusts, temperature, and dew point AWOS-2: Visibility information AWOS-3: Cloud/ceiling data (essentially equivalent to ASOS); may include precipitation discriminators and lightning detection. Difference between ASOS and AWOS—the ability to detect and report significant changes in surface weather. AWOS transmits three reports per hour at fixed intervals and cannot issue a special report as needed.
ATIS	Automated Terminal Information Service Continuous broadcast of recorded non-control information in busier terminal areas. Contains essential information such as weather and active runways and approaches. It is given a letter designation and is updated when there is a significant change. Re-recorded at every update. Data may be entered by hand, from a METAR, or directly from the sensors. Modern systems are fully automated. Arriving/departing aircraft ATIS may be on separate frequencies.
Conclusion	Brief review of the main points.

CFI PTS

Objective: To determine that the applicant:

1. Exhibits instructional knowledge of the elements of airport/seaplane base runway and taxiway signs, markings, and lighting, by describing:
a. Identification and proper interpretation of airport/seaplane base, runway, and taxiway signs and markings, with emphasis on runway incursion avoidance.
b. Identification and proper interpretation of airport/seaplane base, runway, and taxiway lighting, with emphasis on runway incursion avoidance.

2. Exhibits instructional knowledge of common errors related to airport/seaplane base, runway and taxiway signs, markings, and lighting, by describing:
a. Failure to comply with airport/seaplane base runway and taxiway signs and markings.
b. Failure to comply with airport/seaplane base runway and taxiway lighting.
c. Failure to use proper runway incursion avoidance procedures.

3. Demonstrates and simultaneously explains airport/seaplane base runway and taxiway signs, markings, and lighting, from an instructional standpoint.

4. Analyzes and corrects simulated common errors related to airport/seaplane base runway and taxiway signs, markings, and lighting.

PPL/CPL ACS

Objective: To determine that the applicant:

1. Exhibits knowledge of the elements related to airport, runway, and taxiway operations, with emphasis on runway incursion avoidance.
2. Properly identifies and interprets airport/seaplane base, runway, and taxiway signs, markings, and lighting.