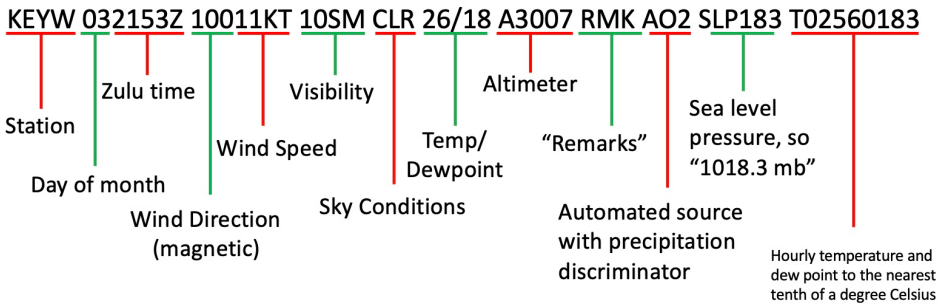
ACS Cheat Sheet: Task C. Weather (PHAK 12, 13)

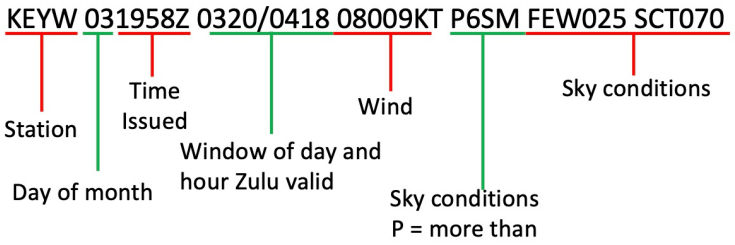
Ground Lesson 3

a. **Sources of weather data (e.g., National Weather Service, Flight Service) for flight planning purposes.**

1. **METAR (Meteorological Aerodrome Report)** – Surface aviation weather observations; compilation of elements of the current weather at individual ground stations across the United States; updated hourly
2. **Example**



3. **TAF (Terminal Aerodrome Forecast)** – Forecast for the five-statute mile radius around an airport. TAF reports are usually given for larger airports. Each TAF is valid for a 24 or 30-hour time period and is updated four times a day
   i. **Example**



Sky Cover	Contraction
Less than ⅛ (Clear)	SKC, CLR, FEW
⅛–⅜ (Few)	FEW
⅜–⅝ (Scattered)	SCT
⅝–⅞ (Broken)	BKN
⅜ or (Overcast)	OVC

Figure 13-6. *Reportable contractions for sky condition.*

Qualifier		Weather Phenomena		
Intensity or Proximity 1	Descriptor 2	Precipitation 3	Obscuration 4	Other 5
– Light	**MI** Shallow	**DZ** Drizzle	**BR** Mist	**PO** Dust/sand whirls
Moderate (no qualifier)	**BC** Patches	**RA** Rain	**FG** Fog	**SQ** Squalls
+ Heavy	**DR** Low drifting	**SN** Snow	**FU** Smoke	**FC** Funnel cloud
VC in the vicinity	**BL** Blowing	**SG** Snow grains	**DU** Dust	**+FC** Tornado or waterspout
	SH Showers	**IC** Ice crystals (diamond dust)	**SA** Sand	**SS** Sandstorm
	TS Thunderstorms	**PL** Ice pellets	**HZ** Haze	**DS** Dust storm
	FZ Freezing	**GR** Hail	**PY** Spray	
	PR Partial	**GS** Small hail or snow pellets	**VA** Volcanic ash	
		UP *Unknown precipitation		

The weather groups are constructed by considering columns 1–5 in this table in sequence:
intensity, followed by descriptor, followed by weather phenomena (e.g., heavy rain showers(s) is coded as +SHRA).
* Automated stations only

Figure 13-5. *Descriptors and weather phenomena used in a typical METAR.*

4. **Automated Terminal Information Service (ATIS)** – Voice recording of current conditions
5. **AWOS (Automated Weather Observing System) and ASOS (Automated Surface Observing Systems)** – Automated equivalents of the ATIS
6. **www.aviationweather.gov** – Website with official aviation weather resources
7. **www.1800wxbrief.com** – Website version of the weather briefing phone-number

b. **Acceptable weather products and resources required for preflight planning, current and forecast weather for departure, en route, and arrival phases of flight.**
    1. **Preflight Planning** – Days in advance, the Prognostic Charts from www.aviationweather.gov will show you pressure trends and expected storms several days out; you can also call 1800wxbrief to obtain and outlook briefing if departure is scheduled for six or more hours later; you can then request a standard weather briefing from them when withing the 6 hour window (see the Cross Country Planning lesson for more information). The TAFs are also useful for forecasts in the near future.
    2. **Current and Forecast Weather** – The METAR is a great source of current weather information and the TAF can give you forecasts for the destination at your time of arrival. Also consider using the Graphical Forecasts for Aviation (GFA) tool for current and near-future information on cloud cover, turbulence, and icing.
    3. **En Route** – While enroute you can listen to the ATIS along the route. You can also ask Flight service stations (FSS) by radio for pilot reports (PIREPS) and other enroute weather observations.
    4. **Arrival** – The ATIS at your destination will give you the current weather there.
c. **Meteorology applicable to the departure, en route, alternate, and destination under VFR in Visual Meteorological Conditions (VMC) to include expected climate and hazardous conditions such as:**
    1. **Atmospheric composition and stability**
        i. **Composition** – 78% Nitrogen and 21% Oxygen
        ii. **Stability** – The ability of the atmosphere to resist vertical motion. As air ascends through the atmosphere, the average rate of temperature change is 2 °C (3.5 °F) per 1,000 feet.
        iii. **Stable Atmosphere** – When the lapse rate is such that the temperature chages little throughout the atmosphere it is considered stable.
            I. Expect stratus clouds, steady rain, smooth air, and poor visibility (atmospheric contaminants are stationary and not being cleared)
        iv. **Unstable Atmosphere** – When the lapse rate is less than the dry adiabatic lapse rate (unsaturated air) of 3 °C (5.4 °F) per 1,000 feet the atmosphere is unstable.
            I. Expect cumulus clouds, showery rain, rough air, and good visibility.
    2. **Wind (e.g., crosswind, tailwind, windshear, mountain wave, etc.)**
        i. **Crosswind** – The horizontal component of the wind, calculated by $V \times \sin(\theta)$; airplanes have a published crosswind component limitation.
        ii. **Tailwind** – Wind from behind the aircraft, this will significantly impact landing and takeoff performance.
        iii. **Windshear** – Drastic change in wind speed and/or direction over a very small area; thick can result in updrafts, downdrafts, or sudden change in airspeed.
        iv. **Mountain Wave** – As wind passes over a mountain, the other side will experience turbulence that pilots should be aware of, sometimes rotor currents can form over mountains and produce the very characteristic lenticular clouds. These represent extreme turbulence.
    3. **Temperature**
        i. The temperature generally decreases as you ascend through the atmosphere. Sometimes, the temperature can actually increase during ascent, this is called a temperature inversion. It's important to be aware of these because the wind and atmospheric conditions can change when crossing an inversion.
    4. **Moisture/precipitation** – If air reaches the saturation point while temperature and dew point are close together, it is highly likely that fog, low clouds, and precipitation will form.

5. **Weather system formation, including air masses and fronts**
    i. **Air masses** are large bodies of air that take on the characteristics of the surrounding area or source region.
        I. **Continental Polar Air Mass** – A continental polar air mass forms over a polar region and brings cool, dry air with it.
        II. **Maritime Tropical Air Mass** – Maritime tropical air masses form over warm tropical waters like the Caribbean Sea and bring warm, moist air.
    ii. **Fronts** – The boundary layer between two types of air masses is known as a front.
        I. **Warm Front** – A warm front occurs when a warm mass of air advances and replaces a body of colder air.
            a. Warm fronts move slowly
            b. Warm fronts contain warm air that often has very high humidity
        II. **Cold Front** – A cold front occurs when a mass of cold, dense, and stable air advances and replaces a body of warmer air. Associated with thunderstorms. A continuous line of thunderstorms, or squall line, may form along or ahead of the front.
            a. Cold fronts move more rapidly than warm fronts
            b. It is so dense, it stays close to the ground and acts like a snowplow, sliding under the warmer air and forcing the less dense air aloft.
        III. **Stationary Front** – When the forces of two air masses are relatively equal, the boundary or front that separates them remains stationary and influences the local weather for days.
        IV. **Occluded Front** – A cold front occlusion occurs when a fast moving cold front is colder than the air ahead of the slow moving warm front. A warm front occlusion occurs when the air ahead of the warm front is colder than the air of the cold front. When this is the case, the cold front rides up and over the warm front.

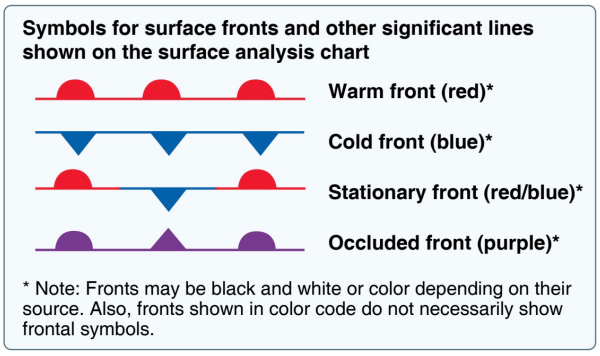
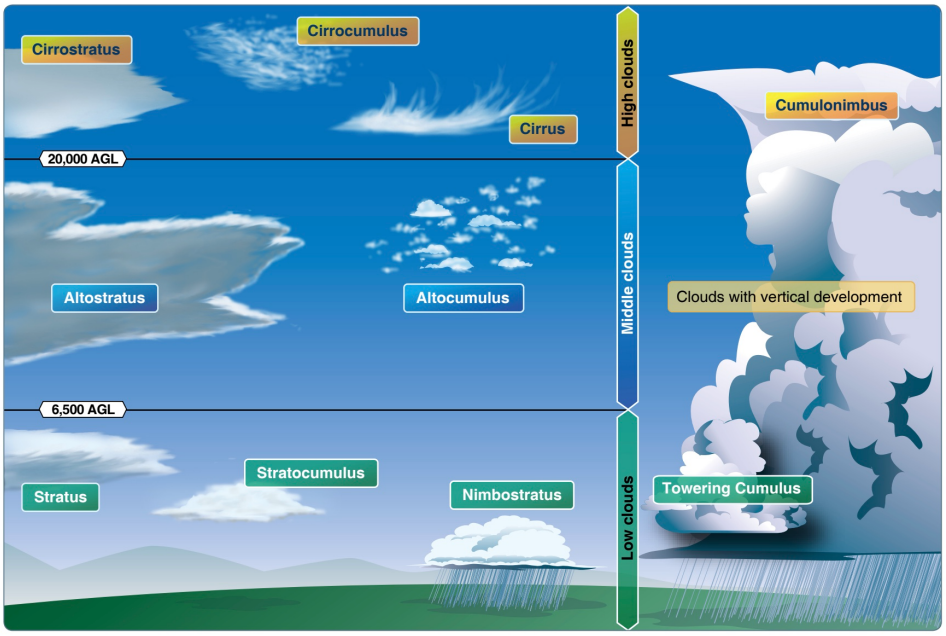


Figure 12-24. *Common chart symbology to depict weather front location.*

        V.
6. **Clouds** – For clouds to form, there must be adequate water vapor and condensation nuclei, as well as a method by which the air can be cooled. When the air cools and reaches its saturation point, the invisible water vapor changes into a visible state. Cumulonimbus clouds pose the greatest threat to pilots.
    i. **Cumulus** — Heaped or piled clouds
    ii. **Stratus** — Formed in layers
    iii. **Cirrus** — Ringlets, fibrous clouds, also high-level clouds above 20,000 feet
    iv. **Castellanus** — Common base with separate vertical development, castle-like
    v. **Lenticularus** — Lens-shaped, formed over mountains in strong winds

vi. **Nimbus** — Rain-bearing clouds
vii. **Fracto** — Ragged or broken
viii. **Alto** — Middle level clouds existing at 5,000 to 20,000 feet



ix. **Figure 12-22.** *Basic cloud types.*

7. **Turbulence** – Turbulence can be caused by ground obstructions, mountains, and varying surface conditions.
8. **Thunderstorms and microbursts**
    i. **Thunderstorms** – For thunderstorms to form, the air must have sufficient water vapor, an unstable lapse rate, and an initial lifting action to start the storm process. A thunderstorm has three stages:
        I. **Cumulus Stage** – The lifting action of the air begins; clouds continue to increase in vertical height. *Updrafts* prevent rain from falling.
        II. **Mature Stage** – Precipitation (rain or hail) begins; there are updrafts and downdrafts. Avoid cells by 20 miles or more.
        III. **Dissipating Stage** – Downdrafts spread out and replace the updrafts needed to sustain the storm.
    ii. **Microbursts** – The most severe type of low-level wind shear; the lifespan of a microburst is about 5–15 minutes during which time it can produce downdrafts of up to 6,000 FPM and headwind losses of 30–90 knots with severe turbulence.
9. **Icing and freezing level information**
    i. **Icing** – Icing can be encountered during thunderstorms or whenever the temperature approaches freezing and there is visible moisture.
        I. **Carb icing** – Carburetor ice is most likely to occur when temperatures are below 70 degrees Fahrenheit (°F) or 21 degrees Celsius (°C) and the relative humidity is above 80 percent. Due to the sudden cooling that takes place in the carburetor, icing can occur even in outside air temperatures as high as 100 °F (38 °C) and humidity as low as 50 percent.
    ii. **Freezing Level** – The freezing level is estimated by taking the current temperature at field elevation and subtracting 2° C per 1,000 feet (average lapse rate). Add AGL of the field elevation and this is the freezing level in MSL.

10. **Fog/mist**
    i. **Radiation Fog** – On clear nights, with little wind, the ground cools rapidly and the surrounding air temperature reaches the dew point. This occurs in valleys and low areas.
    ii. **Advection Fog** – When moist air moves over a cold surface (like San Francisco).
    iii. **Upslope Fog** – stable air is forced up sloping land features like a mountain range.
    iv. **Steam Fog** – When cold, dry air moves over warm water, the water evaporates and saturates the air. This occurs over bodies of water during cold times of the year.
    v. **Ice Fog** – When the temperature is much below freezing and water vapor forms directly into ice crystals, like radiation fog except in arctic climates.
11. **Frost** – When the temperature is below freezing, dew freezes into frost. This can significantly disrupt airflow over a wing and drastically reduce lift production.
12. **Obstructions to visibility (e.g., smoke, haze, volcanic ash, etc.)**
    i. Low visibility is an extreme hazard to all pilots, especially those not trained to fly by reference to instruments. Even rain can significantly reduce visibility.

d. **Flight deck displays of digital weather and aeronautical information**
1. **FIS-B** – Flight Information Services – Broadcast automatically transmits a wide range of weather products with national and regional focus to all ADS-B equipped aircraft.
    i. **NEXRAD** – Time-delayed radar imagery, displays rain cells but it's important to remember the image in the cockpit may be 12-14 minutes old. It's not meant to be used to weave between cells.