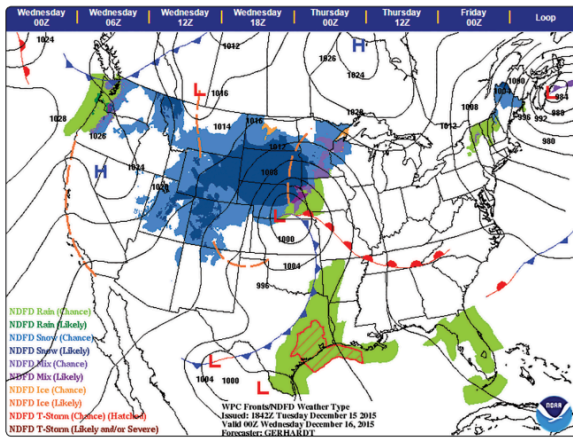


Weather Information

Objective	
<p>To ensure the applicant learns the various sources of aviation weather and the factors that contribute to weather go/no-go decision making.</p>	
Purpose	
<p>Weather can be one of the most hazardous aspects of flying, especially for VFR-only pilots. This lesson introduces pilots to the various sources of aviation weather observations, forecasts, and charts. It will illustrate the importance of obtaining a thorough weather briefing before every flight, and evaluating the weather situation in terms of their own proficiency and airplane capabilities.</p>	
Schedule	Equipment
<ul style="list-style-type: none"> ● Ground Lesson: 30 minutes ● Student Q&A: 10 minutes 	<ul style="list-style-type: none"> ● Sample Aviation Weather Products ● Tablet / EFB Software (optional) ● Whiteboard / Markers (optional)
Student Actions	Instructor Actions
<ul style="list-style-type: none"> ● Ask any questions, receive study material for the next lesson. ● Watch linked video. ● Review listed references. 	<ul style="list-style-type: none"> ● Deliver the ground lesson (below). ● Request a Standard Weather Briefing from FSS. ● Answer student questions. ● Pose a weather and flight planning scenario to the student.
Completion Standards	
<ul style="list-style-type: none"> ● Student can explain the following concepts: <ul style="list-style-type: none"> ● The types of weather briefings available to pilots and how to obtain one. ● METARs, TAFs, Winds Aloft, and how to decode them. ● The types of weather charts available to pilots. ● The sources of in-flight weather information available to pilots. ● Common aviation weather hazards, including windshear, thunderstorms, and icing. ● Personal weather minimums, and factors influencing weather-related go/no-go decisions. ● For a cross-country flight scenario provided by the instructor, student demonstrates: <ul style="list-style-type: none"> ● Use all available weather resources to obtain an adequate weather briefing. ● Analyze the implications of at least three of the weather hazards or concepts listed in this lesson in conditions specified by the instructor. ● Correlates weather information to make a go/no-go decision for the scenario flight. 	

References

- FLY8MA.com Flight Training - "GS: How to Decode METARs and TAFs | Part 1 | The Simple Stuff"
 - YouTube - <https://www.youtube.com/watch?v=bqXIMwp-yQY>
- FAA-H-8083-25C (Pilot's Handbook of Aeronautical Knowledge) - Chapter 13, Page 2-4 [Observations], Chapter 13, Page 4-5 [Service Outlets], Chapter 13, Page 5 [Weather Briefings], Chapter 13, Page 5-8 [Aviation Weather Reports], Chapter 13, Page 9-13 [Aviation Forecasts], Chapter 13, Page 13-16 [Weather Charts], Chapter 13, Page 16-18 [ATC Radar Weather Displays], Chapter 13, Page 18-23 [EFD/MFD/Datalink Weather]
- FAA-H-8083-28 (Aviation Weather Handbook)
- FAA-S-ACS-6C (Private Pilot ACS) - Area I Task C
- FAA-S-ACS-7B (Commercial Pilot ACS) - Area I Task C
- FAA-S-ACS-25 (CFI ACS) - Area III Task C

Ground Lesson Outline

- Importance of Weather Briefings
 - How to Get/Sources - FSS/National Weather Service
 - Standard Briefing - Adverse conditions, VFR not rec'd, Current conditions., forecasts, NOTAMs, etc.
 - Abbreviated Briefing - Changes to previous briefing
 - Outlook Briefing - More than 6 hours from departure, forecasted conditions
- Aviation Weather Products
 - Observations
 - METAR (Hourly or as-needed by SPECI), PIREPs
 - NEXRAD
 - Weather Depiction/Ceiling-Visibility Charts - Derived from METARs, every 3 hours, IFR/VFR/MVFR
 - Surface Analysis/METAR Plot Charts - Every 3 hours, fronts/systems, temps/dew points, wind dir/speed, sky cover
 - Forecasts
 - TAF (24/30 hours, every 6 hours), GFA Tool, Winds/Temperatures Aloft (Twice daily)
 - Convective Outlook (AC)
 - AIRMET - Every 6 Hours, Sierra (IFR/Mtn Obscuration), Tango (Turbulence/Winds/LLWS), Zulu (Icing and Freezing Levels)
 - SIGMET - Unscheduled, Valid 4 Hours, Issued under Alphabetic ID, Non-Convective
 - Convective SIGMETs - Unscheduled, Valid 2 hours, Sequentially Numbered, Dangerous Conv.
 - Significant Weather Prog Charts - 12/24 hour or 36/48 hour. Shows large forecasted areas of IFR, turbulence, etc.
- In-Flight Weather Sources
 - ATC - Weather Avoidance Assistance
 - AIRMET/SIGMET/Center Weather Advisories
 - ATC Radar Limitations - Light/Moderate/Heavy/Extreme
 - FSS - Communicate directly or by VORs
 - Datalink Weather - Limitations (Time Delay, Doesn't Show Developing Storms), Flight Deck Displays
- Aviation Concepts and Weather Hazards
 - Atmospheric Stability, Frontal Systems, Wind Shear, Thunderstorms/Microbursts, Turbulence
 - Low Cloud Ceilings, Low Visibility (Mist, Smoke, Haze, Ash, Fog)
 - Precipitation, Frost, Icing
 - Temperature and heat exchange, Density Altitude
- Scenario-Based Training - Discuss Aviation Weather Hazards for a Scenario
 - Use of Real-time Weather Reports, Forecast, and Charts
 - Factors in making Go/No-Go Decisions
 - Personal Weather Minimums

Ground Lesson Content

- **Importance of Weather Briefings**
 - **How to Get** - FSS (1-800-WX-BRIEF)
 - **Standard Briefing** - Adverse conditions, when VFR not recommended, current conditions, forecasts, NOTAMs, etc.
 - **Abbreviated Briefing** - Changes to previous briefing
 - **Outlook Briefing** - More than 6 hours from departure, forecasted conditions
- **Aviation Weather Products** - Primarily provided by the National Weather Service
 - **Observations** - Wind directions are referenced to *true north*.
 - **METAR** - Textual (coded) observation. Issued hourly or as-needed by SPECI. Contains Wind Direction, Speed, Temperature, Dew Point, Altimeter setting, Cloud Cover, Precipitation/Obscuration, etc.
 - METAR KGGG 161753Z AUTO 14021G26KT 3/4SM +TSRA BR BKN008 OVC012CB 18/17 A2970 RMK PRESFR

Sky Cover	Contraction
Less than 1/8 (Clear)	SKC, CLR, FEW
1/8-2/8 (Few)	FEW
3/8-4/8 (Scattered)	SCT
5/8-7/8 (Broken)	BKN
8/8 or (Overcast)	OVC

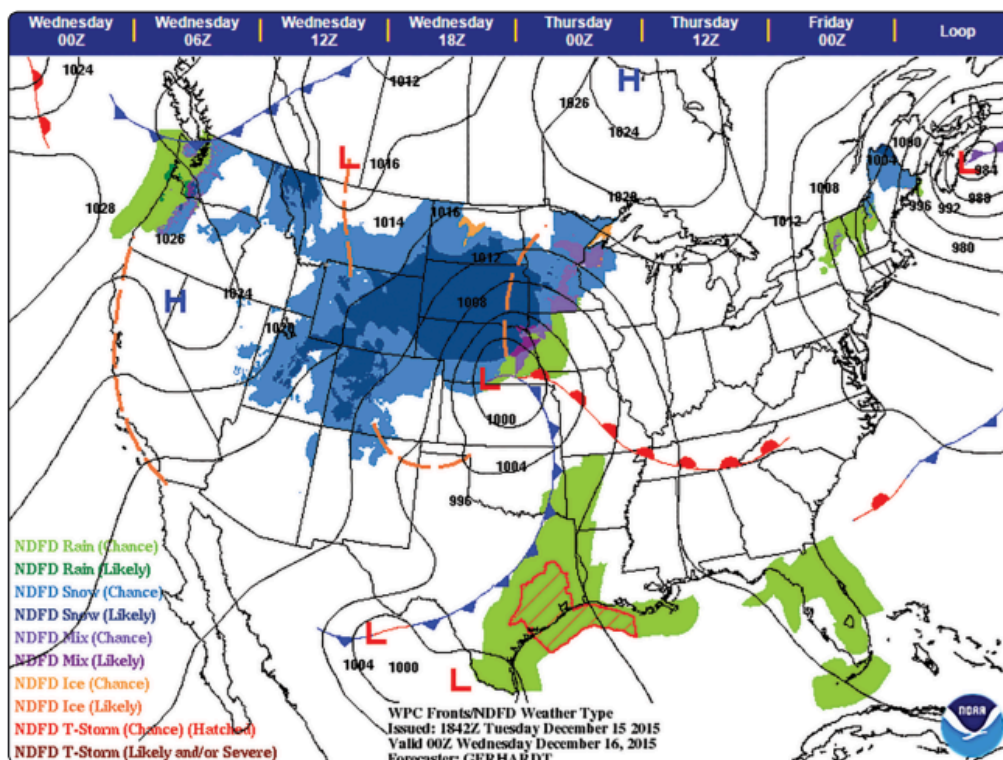
Qualifier		Weather Phenomena		
Intensity or Proximity 1	Descriptor 2	Precipitation 3	Obscuration 4	Other 5
- Light	MI Shallow	DZ Drizzle	BR Mist	PO Dust/sand whirfs
Moderate (no qualifier)	BC Patches	RA Rain	FG Fog	SQ Squalls
+ Heavy	DR Low drifting	SN Snow	FU Smoke	FC Funnel cloud
VC in the vicinity	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		

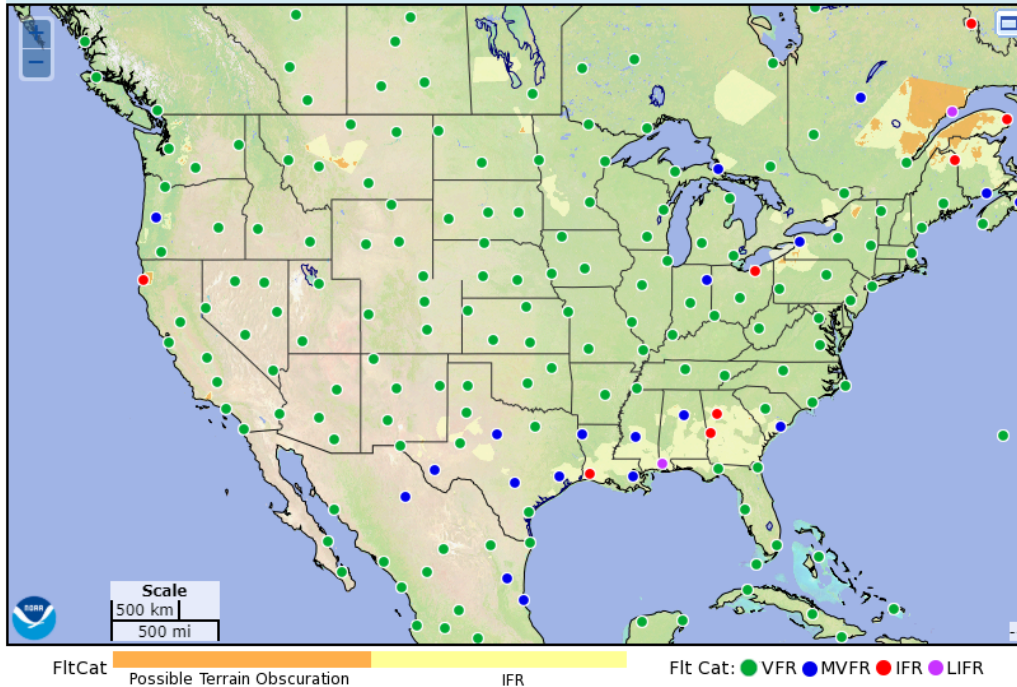
The weather groups are constructed by considering columns 1-5 in this table in sequence: intensity, followed by descriptor, followed by weather phenomena (e.g., heavy rain showers(s) is coded as +SHRA).
* Automated stations only

- **PIREPs** - Pilot reports. Submitted by pilots describing in flight conditions at a certain location. Winds, temperatures, cloud layers, turbulence, etc.
 - UA/OV GGG 090025/TM 1450/FL 060/TP C182/SK 080 OVC/WX FV04SM RA/TA 05/WV 270030KT/TB LGT/RM HVY RAIN

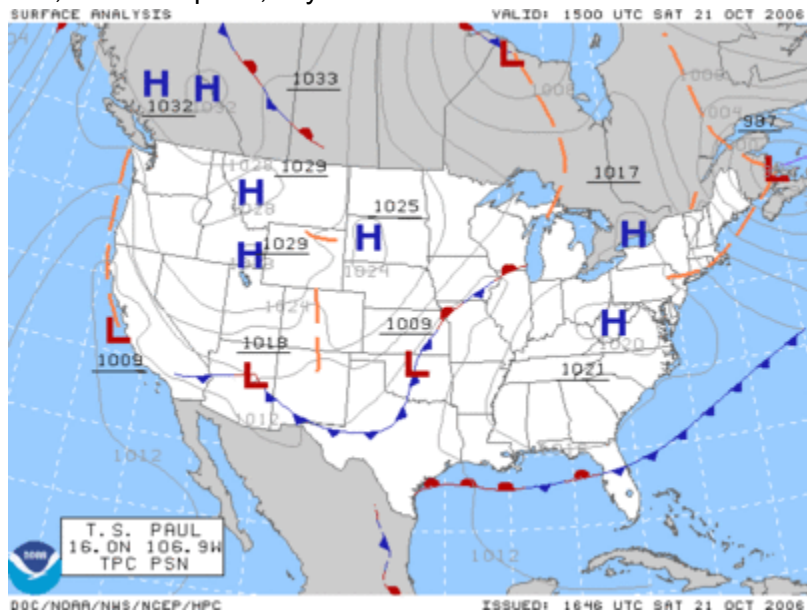
Encoding Pilot Weather Reports (PIREPS)			
1	XXX	3-letter station identifier	Nearest weather reporting location to the reported phenomenon
2	UA	Routine PIREP, UUA-Urgent PIREP.	
3	/OV	Location	Use 3-letter NAVAID identifi only. a. Fix: /OV ABC, /OV ABC 090025. b. Fix: /OV ABC 045020-DEF, /OV ABC-DEF-GHI
4	/TM	Time	4 digits in UTC: /TM 0915.
5	/FL	Altitude/flight level	3 digits for hundreds of feet. If not known, use UNKN: /FL095, /FL310, /FLUNKN.
6	/TP	Type aircraft	4 digits maximum. If not known, use UNKN: /TP L329, /TP B727, /TP UNKN.
7	/SK	Sky cover/cloud layers	Describe as follows: a. Height of cloud base in hundreds of feet. If unknown, use UNKN. b. Cloud cover symbol. c. Height of cloud tops in hundreds of feet.
8	/WX	Weather	Flight visibility reported first: Use standard weather symbols: /WX FV02SM RA HZ, /WX FV01SM TSRA.
9	/TA	Air temperature in celsius (C)	If below zero, prefix with a hyphen: /TA 15, /TA M06.
10	/WV	Wind	Direction in degrees magnetic north and speed in six digits: /WV270045KT, WV 280110KT.
11	/TB	Turbulence	Use standard contractions for intensity and type (use CAT or CHOP when appropriate). Include altitude only if different from /FL, /TB EXTRM, /TB LGT-MOD BLO 090.
12	/IC	Icing	Describe using standard intensity and type contractions. Include altitude only if different than /FL: /IC LGT-MOD RIME, /IC SEV CLR 028-045.
13	/RM	Remarks	Use free form to clarify the report and type hazardous elements first: /RM LLWS -15KT SFC-030 DURC RY22 JFK.

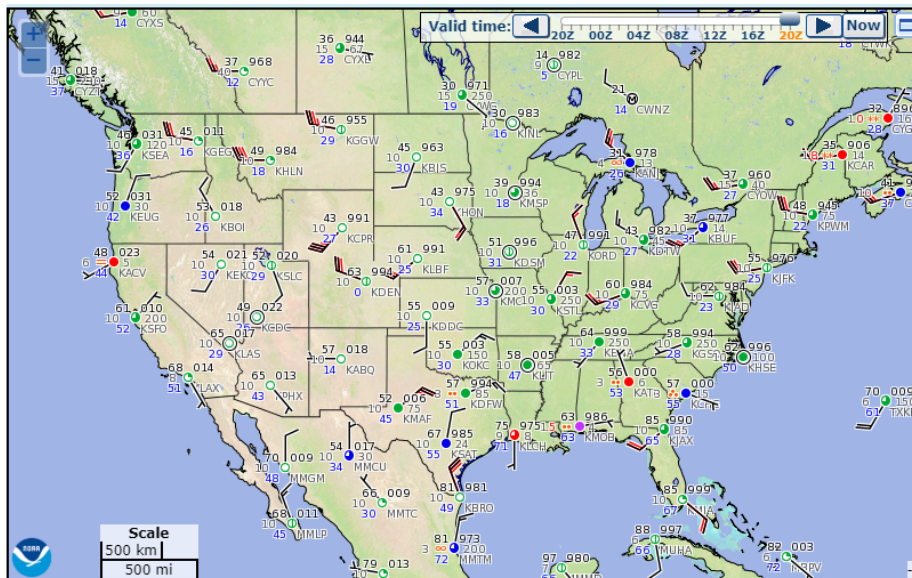
- **NEXRAD** - Composite image of radar (precipitation) from around the country.
- **Weather Depiction/Ceiling Visibility Charts** - Derived from METARs, every 3 hours, depicts areas of IFR / VFR / MVFR weather.





- **Surface Analysis/METAR Plot Charts** - Every 3 hours, fronts/systems, temps/dew points, wind dir/speed, sky cover





T — 26 966 — ALTM
 VIS — 0.5 — 17 — CIG
 Wx — 19 — KRFD — Id
 DP — Wind G
 Wind © Calm 15kt 60kt 25G30kt
 Flt Cat: ● MVFR ● IFR ● LIFR

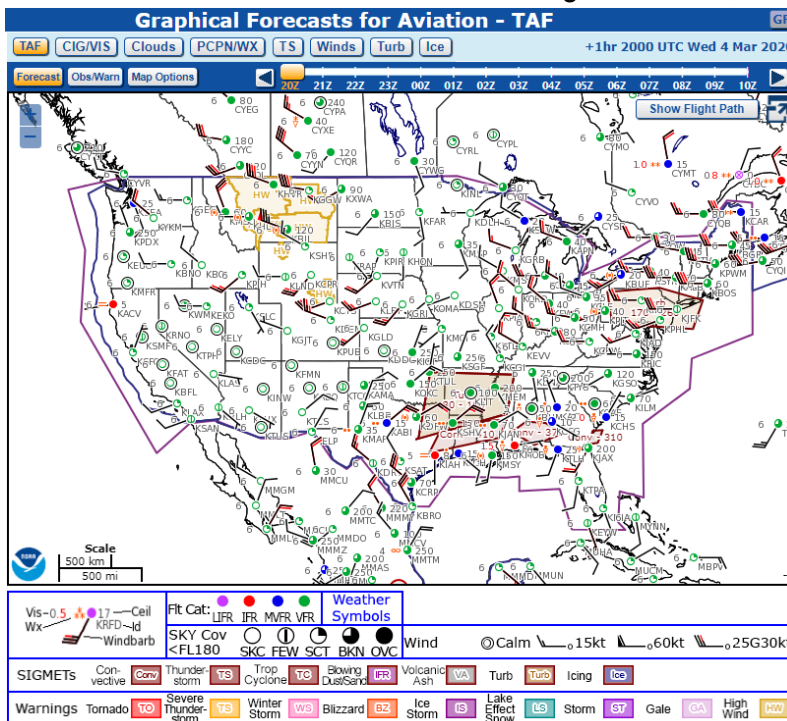
○ **Forecasts**

- **TAF - Terminal Aerodrome Forecast**, a textual forecast, similar in format to a METAR. Covers an area 5 statute miles around the field. Valid for 24/30 hours, issued every 6 hours.

Data at: 1954 UTC 05 Mar 2020

```
MCO 051728Z 0518/0624 21016G24KT P6SM SCT035 BKN250
FM052100 22018G25KT P6SM VCTS SCT050CB BKN250
FM060000 23010KT P6SM VCSH SCT020 BKN040
FM060800 26012KT P6SM OVC015
FM061200 32011KT P6SM BKN020
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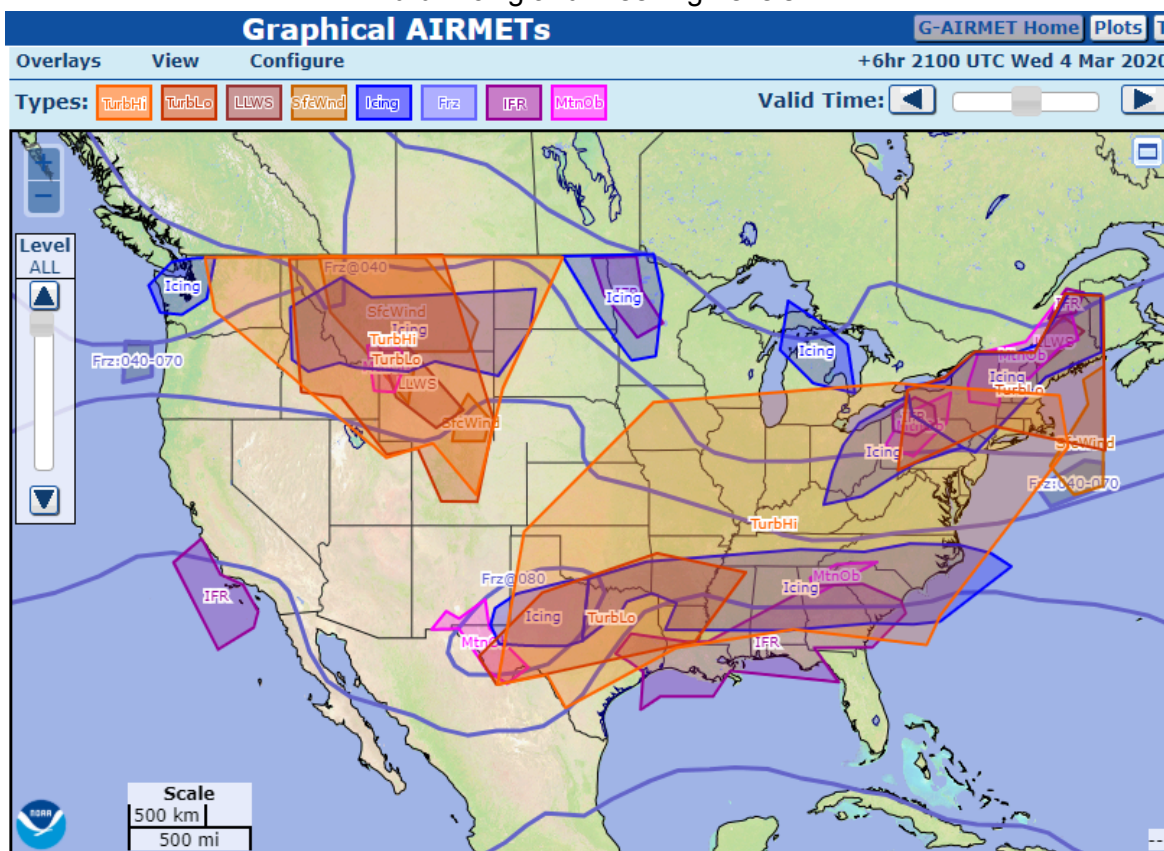
- **GFA Tool - Textual Area Forecasts** are no longer available, but there is a Graphical tool:



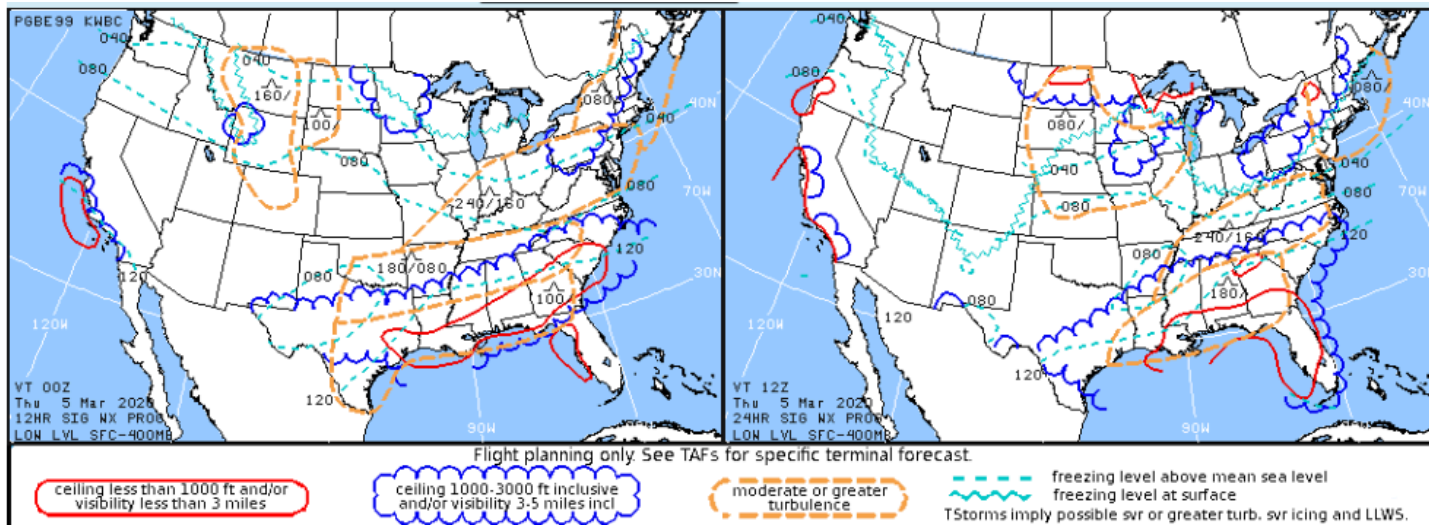
- **Winds/Temperatures Aloft** - Issued twice daily, give winds and temps aloft at various altitudes.
 - Add 50 to Bearing = Wind > 99 knots, Less than 199 knots, >200 knots = 99
 - Calm (< 5 knots) = 9900

FB KWBC 151640 DATA BASED ON 151200Z VALID 151800Z FOR USE 1400-2100Z TEMPS NEGATIVE ABV 24000							
FB	3000	6000	9000	12000	18000	24000	30000
AMA		2714	2725+00	2625-04	2531-15	2542-27	265842
DEN			2321-04	2532-08	2434-19	2441-31	235347

- **AIRMET** - Issued every 6 Hours. Three Types:
 - **AIRMET Sierra** - Areas of IFR Weather/Mountain Obscuration
 - **AIRMET Tango** - Turbulence/Winds/Low-Level Wind Shear
 - **AIRMET Zulu** - Icing and Freezing Levels



- **SIGMET** - Unscheduled, Valid 4 Hours, Issued under Alphabetic ID, Non-Convective
- **Convective SIGMETs** - Unscheduled, Valid 2 hours, Sequentially Numbered, Dangerous Conv.
- **Significant Weather Prog Charts** - 12/24 hour or 36/48 hour. Shows large forecasted areas of IFR, turbulence, etc.



● In-Flight Weather Sources

- **ATC Weather Avoidance Assistance** - ATC can offer vectors around weather, or relay certain weather information, such as:
 - **AIRMET/SIGMETs**
 - **Center Weather Advisories** - Often broadcast over ATC Center frequencies
 - **ATC Radar Limitations** - ATC Radar is not designed for weather surveillance, and is limited in its capability. **It cannot be used for tactical weather avoidance.**
 - ATC Radar can generally only indicate areas of Light, Moderate, Heavy, or Extreme precipitation.
- **FSS** - Communicate directly or by VORs
- **ATIS/AWOS** - Recorded weather observations, either human (ATC/ATIS) created, or automatically generated (AWOS). Wind directions are given relative to *magnetic north*.
- **Datalink Weather** - ADS-B (FIS-B) data or XM WX (Satellite) data can provide displays in the cockpit of METARs, TAFs, or even NEXRAD mosaic imagery.
 - **Limitations** - Major limitation is that it **can be delayed by several minutes**, and this can create dangerous conditions in rapidly changing weather conditions. (e.g. Thunderstorms)
 - **Flight Deck Displays of Weather** - Many aircraft now have an opportunity for pilots to connect their EFBs to display weather data on their personal device. Also, many common avionics packages will display NEXRAD weather, METARs, and other data.



A Garmin G3X Touch displaying NEXRAD data in-flight.

- **Aviation Concepts and Weather Hazards** - At a fundamental level, weather is created by the unequal distribution of heat on Earth's surface. Below are some important concepts and hazards pilots should be aware of:
 - **Atmospheric (In)Stability** - Air columns that cool rapidly with increasing altitude are called unstable, because air parcels that are displaced vertically become positively buoyant. For this reason, unstable air is associated with vertical air movement (convection) and is very likely to produce turbulence or thunderstorms.
 - **Frontal Systems** - Often produce dangerous wind shear and turbulence.
 - **Wind Shear** - Large change in wind direction over a small range of altitudes. Can be extremely dangerous and create turbulence.
 - **Thunderstorms/Microbursts** - Extremely dangerous, **strong updrafts and downdrafts create extreme turbulence and can damage/crash aircraft!**
 - **Turbulence** - Can cause discomfort for pilots and passengers or even damage aircraft, making them difficult to control.
 - **Precipitation** - When air cools to its dew point, and condensation nuclei are present, moisture falls out of the air as precipitation. All forms of precipitation are hazards to VFR pilots, as they impede visibility.
 - **Low Cloud Ceilings** - Areas of IFR weather are dangerous to VFR-only pilots since they may be unable to descend.
 - **Low Visibility (Mist, Smoke, Haze, Ash, Fog)** - VFR pilots should avoid flying when Fog and Mist are possible (temperature and dew point spread is small). Smoke and Ash can be dangerous to airplanes!
 - **Frost/Icing** - Frost and Icing degrades the aerodynamic properties of a wing and causes them to stall at an unpredictable angle of attack. **Frost is especially insidious as it seems minor but can cause disastrous results!**
 - **High Temperature/Density Altitude** - High density altitude reduces airplane performance.
- **Scenario-Based Training** - Discuss Aviation Weather Hazards for a Scenario. Instructors should provide real-world scenario-based training on weather decisions, emphasizing go/no-go decision making skills.
 - **Use of Real-time Weather Reports, Forecast, and Charts** - The best scenarios involve real weather reports and a real cross-country plan.
 - **Factors in making Go/No-Go Decisions** - Pilots must consider their own skill and proficiency (VFR only, or IFR capable), plus the presence of aviation weather hazards.
 - **Personal Weather Minimums** - Every pilot should develop personal weather minimums tailored to their own skill level, such as:
 - "I will not fly with a wind speed greater than 20 knots."
 - "I will not fly when the crosswind component is greater than 10 knots."
 - "I will not fly within 20 miles of thunderstorm activity."
 - "I will not depart with a density altitude of over 5,000 ft."
 - "I will not fly when the cloud ceilings are lower than 3,000 ft."