

Weather Products

Objective

To understand the standard aviation weather products, and apply them in a flight planning scenarios.

Motivation

Checking weather is a part of every flight and there is a large variety of weather information available to pilots. Pilots need to parse weather information, determine what information is pertinent to their flight, and what limitations the weather products contain.

Overview

- Talk about standard weather products
 - METARs
 - TAFs
 - Winds Aloft
 - Prog Charts
- Flight planning exercise in ForeFlight
- In-airplane weather products

Weather Data Sources

- EFBs: ForeFlight, Garmin Pilot
- AviationWeather.gov
- 1800wxbrief.com (Leidos Flight Service)
- In-cockpit weather

● Marginal VFR

36m ago

METAR KSEA 201753Z 12004KT 10SM FEW007
SCT011 OVC020 09/07 A3023 RMK AO2 SLP245
60005 T00890067 10089 20072 50000

Time 10:53 AM PDT

Wind 120° at 4 kts

Visibility 10 sm

Clouds (AGL) Few 700'
Scattered 1,100'
Overcast 2,000'

Temperature 9°C (48°F)

Dewpoint 7°C (45°F)

Altimeter 30.23 inHg

Humidity 87%

Density Altitude -391'

Aviation Routine Weather Report (METAR)

- Observation of current surface weather reported in a standard international format
- Update on a regular interval, often once per hour
- SPECI reports can be issued in between scheduled reports

Aviation Routine Weather Report (METAR)

```
METAR KGGG 161753Z AUTO 14021G26KT 3/4SM  
+TSRA BR BKN008 OVC012CB 18/17 A2970 RMK  
PRESFR
```

- Type of report: METAR or SPECI
- Station: ICAO code of the airport or station identifier
- Time of report: 1753Z time on the 16th of the month
- AUTO: Means automatic reporting station
 - AO1: No precipitation discriminator
 - AO2: Precipitation discriminator
- Wind: 140 ° *True* at 21 knots, with peak gusts of 26 knots
 - Variable wind reported as VRB

Aviation Routine Weather Report (METAR, cont.)

```
METAR KGGG 161753Z AUTO 14021G26KT 3/4SM  
+TSRA BR BKN008 OVC012CB 18/17 A2970 RMK  
PRESFR
```

- Visibility:
 - May also report runway visual range (RVR): R17L/1400FT
- Weather: Made up of qualifiers and descriptors
 - (-): Light, (): Moderate, (+): Heavy
 - VC means "in vicinity of", 5-10 miles from the airport

Aviation Routine Weather Report (METAR): Weather Descriptors

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

Aviation Routine Weather Report (METAR): Sky Condition

```
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

- Broken at 800' *AGL*
- Overcast at 1,200 ft. *AGL*, cumulonimbus
 - Can also be **TCU** : Towering cumulonimbus
- **vv003** : Vertical visibility 300 ft.
 - Sky obscured by ground clouds

Aviation Routine Weather Report (METAR): Altimeter, Temperature

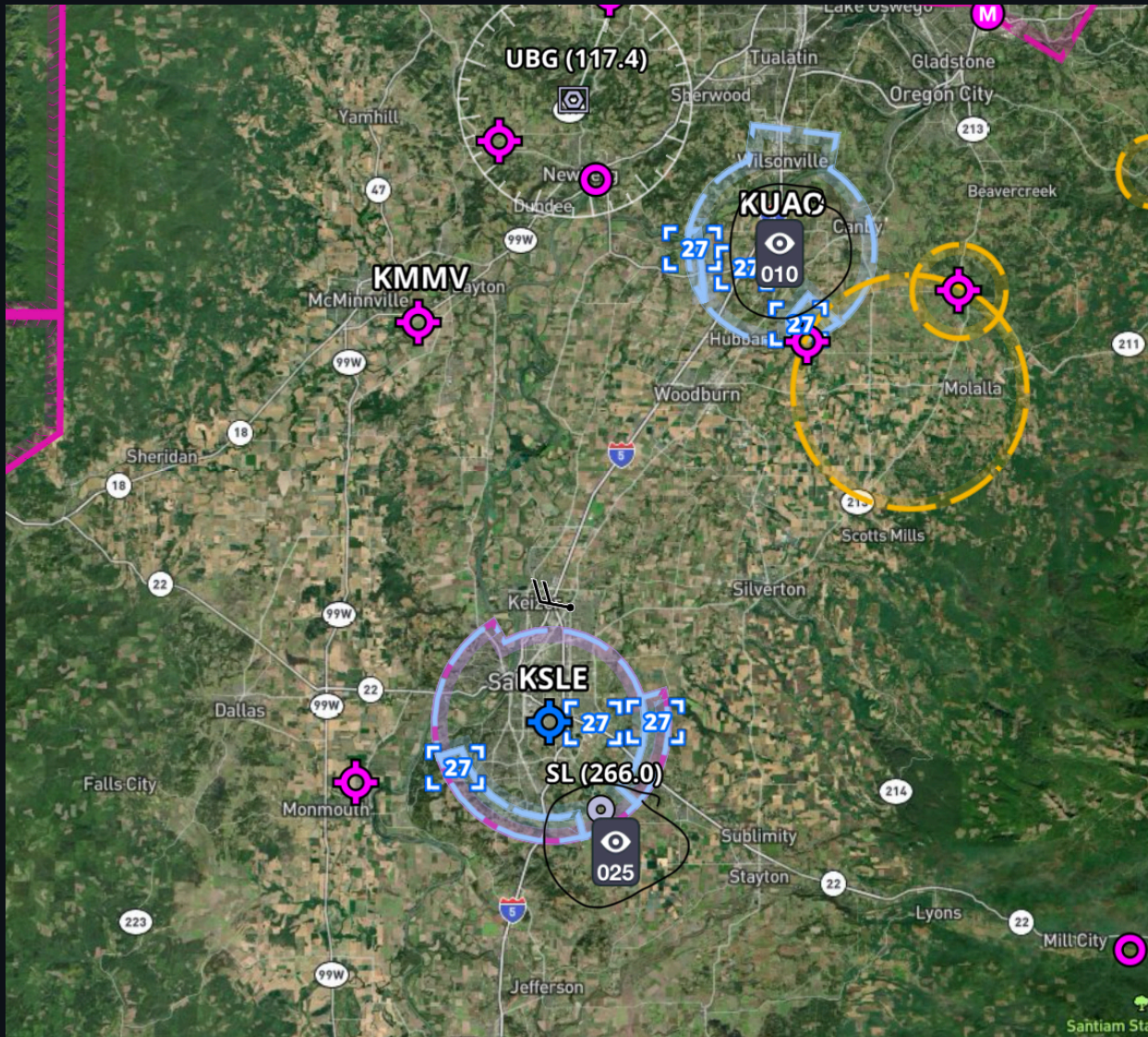
```
METAR KGGG 161753Z AUTO 14021G26KT 3/4SM  
+TSRA BR BKN008 OVC012CB 18/17 A2970 RMK  
PRESFR
```

- Temperature 18° C / Dewpoint 17° C
- Altimeter setting: 29.70" Hg
- **PRESFR** - Pressure falling
- **PRESRR** - Pressure rising

METAR LIFR / IFR / MVFR / VFR

Category	Ceiling		Visibility
Visual Flight Rules VFR (green sky symbol)	greater than 3,000 feet AGL	and	greater than 5 miles
Marginal Visual Flight Rules MVFR (blue sky symbol)	1,000 to 3,000 feet AGL	and/or	3 to 5 miles
Instrument Flight Rules IFR (red sky symbol)	500 to below 1,000 feet AGL	and/or	1 mile to less than 3 miles
Low Instrument Flight Rules LIFR (magenta sky symbol)	below 500 feet AGL	and/or	less than 1 mile

Pilot Report (PIREPS)



- Reports from other airplanes aloft
- Can report
 - Cloud ceilings
 - Turbulence
 - Icing
 - Precipitation
- If ceiling is below 5,000', ATC will solicit PIREPs from pilots
- Take note of the aircraft type making the report

Pilot Report (PIREPS): Required Components

UA/OV GGG 090025/TM 1450/FL 060

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 idents 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.

Pilot Report (PIREPS): Weather Conditions

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

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.

Pilot Report (PIREPS): Sample

```
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
```

- Routine report (UA)
- Location 25nm on the Greg County (GGG) VOR
- Time 1450Z
- Altitude 6000 ft.
- Aircraft Cessna 182
- Sky condition 8000' overcast
- Flight visibility 4s.m. in rain
- Temperature 5°C
- Wind 270°T at 30 knots
- Light turbulence
- Remarks: Heavy rain

201723Z 2018/2124 15007KT P6SM VCSH
FEW015 OVC020
FM202000 21007KT P6SM VCSH OVC030
FM202300 28008KT P6SM -SHRA OVC035
FM210200 06010KT P6SM -SHRA OVC035
FM210600 20009KT P6SM VCSH OVC035
FM211100 19010KT P6SM OVC025

 Forecast Discussion

11:00 AM PDT (CURRENT)

● Marginal VFR

Wind 150° at 7 kts

Visibility 6+ sm

Clouds (AGL) Few 1,500'
Overcast 2,000'

Weather Showers In Vicinity

Expires 1:00 PM PDT

1:00 PM PDT

● Marginal VFR

Wind 210° at 7 kts

Visibility 6+ sm

Clouds (AGL) Overcast 3,000'

Weather Showers In Vicinity

Terminal Aerodrome Forecasts (TAF)

- Report for the 5sm area around an airport
- Valid for a 24 or 30-hour time period
- Updated four times a day at 0000Z, 0600Z, 1200Z, and 1800Z

Terminal Aerodrome Forecasts (TAF)

```
KORD 201814Z 2018/2124 09014G20KT 6SM -SHRA SCT040 OVC060  
  TEMPO 2019/2020 3SM TSRA OVC040CB  
  FM202100 10015G23KT P6SM OVC050  
  FM210200 13015G23KT P6SM VCSH OVC040  
    TEMPO 2105/2108 3SM SHRA BKN025 OVC040  
  FM211800 27018G30KT P6SM OVC025
```

- Station identifier: KORD
- Time: 20th day of the month, 1814Z
- Valid from: 1800Z on the 20th to 2400Z on the 21st
- Wind: 90° T @ 14 knots, peak gusts 20 knots
- Visibility 6 s.m., light rain showers
- Scattered at 4000 ft. AGL, overcast 6000 ft. AGL

Terminal Aerodrome Forecasts (TAF) - cont.

```
KORD 201814Z 2018/2124 09014G20KT 6SM -SHRA SCT040 OVC060  
FM202100 10015G23KT P6SM OVC050  
FM210200 13015G23KT P6SM VCSH OVC040  
TEMPO 2105/2108 3SM SHRA BKN025 OVC040  
FM211800 27018G30KT P6SM OVC025
```

- From 2100Z on the 20th:
 - Wind 100°T gusting 23 knots, visibility +6sm, overcast 5000 ft.
- TEMPO: Temporarily from 0500Z on the 21st to 0800Z on the 21st:
 - Visibility 3sm, rain showers, broken 2500 ft., overcast 4000 ft.



Winds and Temperature Aloft Forecast (FB)

- Based on the radiosonde (weather balloon) soundings
- Winds are always in true north

Winds and Temperature Aloft Forecast (FB): Sample

FD1US1

DATA BASED ON 201200Z

VALID 201800Z FOR USE 1400-2100Z. TEMPS NEG ABV 24000

FT	3000	6000	9000	12000	18000	24000	30000	34000	39000
PDX	2711	3117-03	3016-06	2922-12	2830-23	2841-37	276249	286854	274855
GEG		9900-01	2611-08	2819-14	2627-25	2638-37	254753	264854	273852
SEA	2311	2409-03	2813-08	2820-14	2828-26	2834-38	273852	284553	274252
YKM	2807	2607-01	2509-07	2817-13	2825-25	2735-37	275151	275353	274554

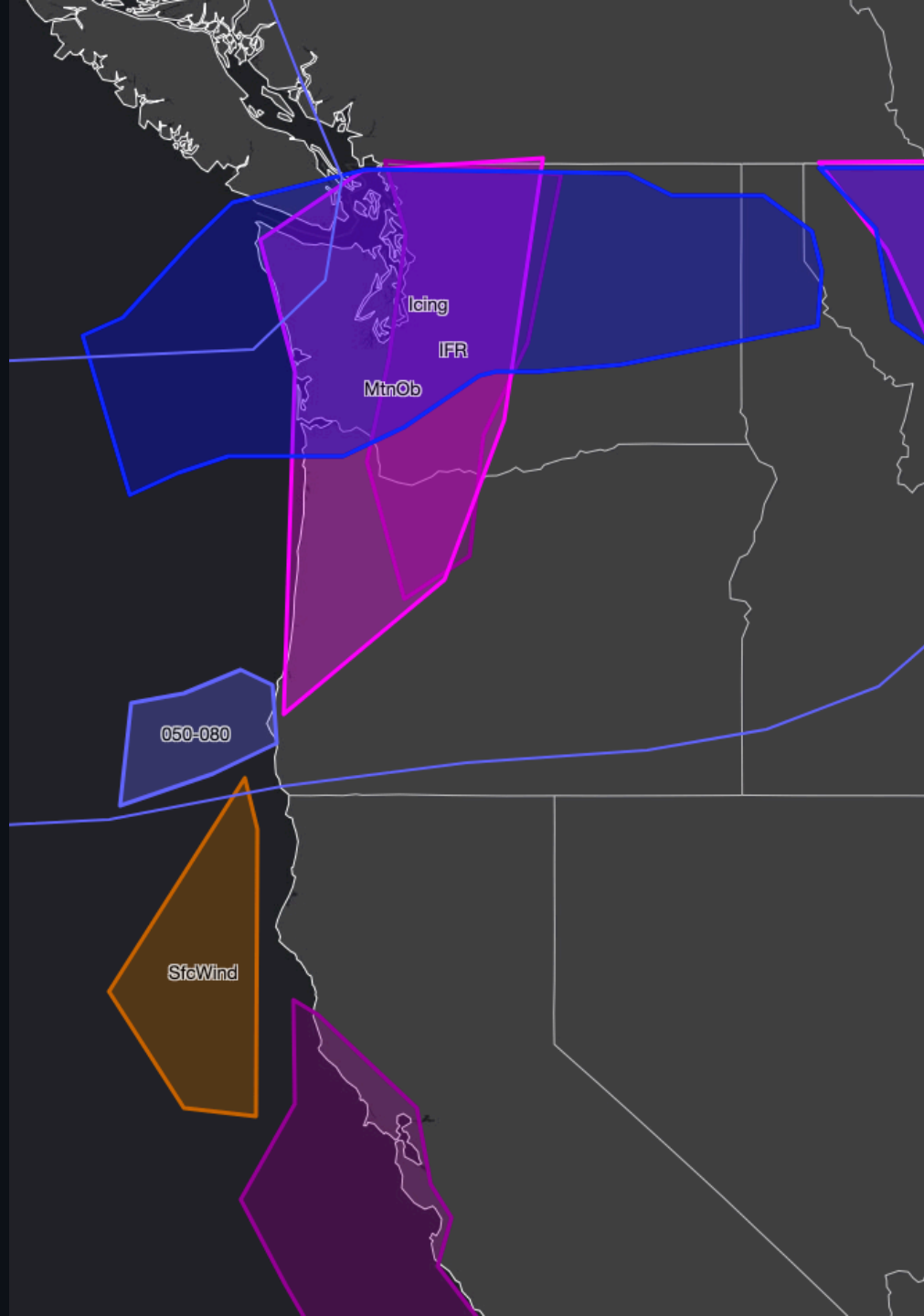
Winds and Temperature Aloft Forecast (FB): Sample

FT	3000	6000	9000	12000	18000	24000	30000	34000	39000
YKM	2807	2607-01	2509-07	2817-13	2825-25	2735-37	275151	275353	274554

- 3000' MSL: Wind 280° T at 7 knots
- 6000' MSL: Wind 260° T at 7 knots, temperature -7 °C
- Above 24,000' temperatures are assumed to be negative

Winds and Temperature Aloft Forecast (FB): Other Cases

- 9900 : Winds are calm (< 5 knots)
- 731960 : Winds are great than >100 knots
 - Encoding add 50° to the direction, subtracts 100 from the wind speed
 - Wind direction: $73 - 50 = 23$, 230° T
 - Wind velocity: $100 + 19 = 119$ knots
 - Temperature -60°C

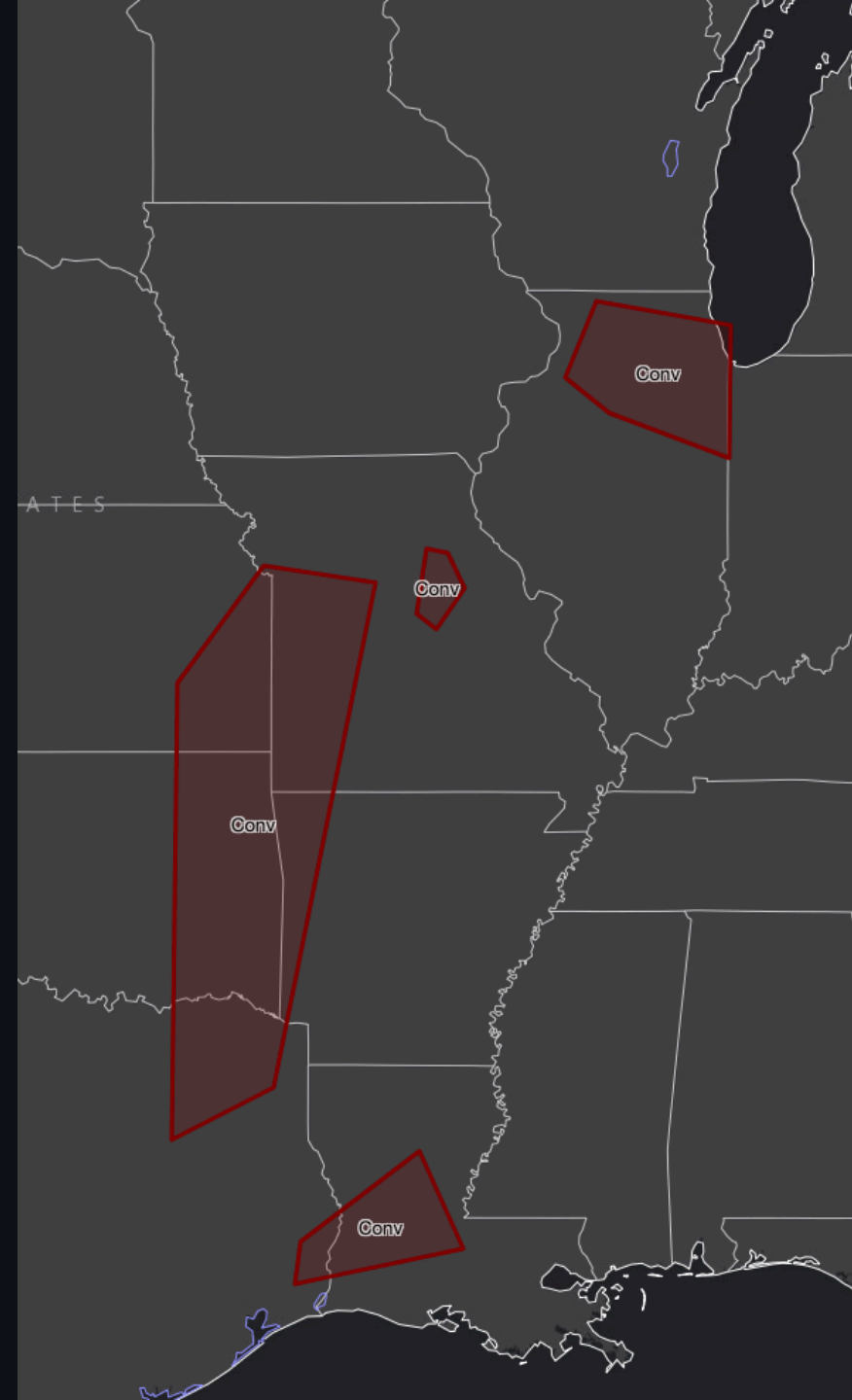


AIRMETs and Graphical AIRMETs

- In-flight weather advisories for these conditions:
 - Airmet **Zulu**: Moderate icing
 - Airmet **Tango**: Moderate turbulence
 - Also sustained surface winds ≥ 30 knots
 - Airmet **Sierra**: Widespread areas where conditions are less than basic VFR
 - Extensive mountain obscuration

SIGMETs

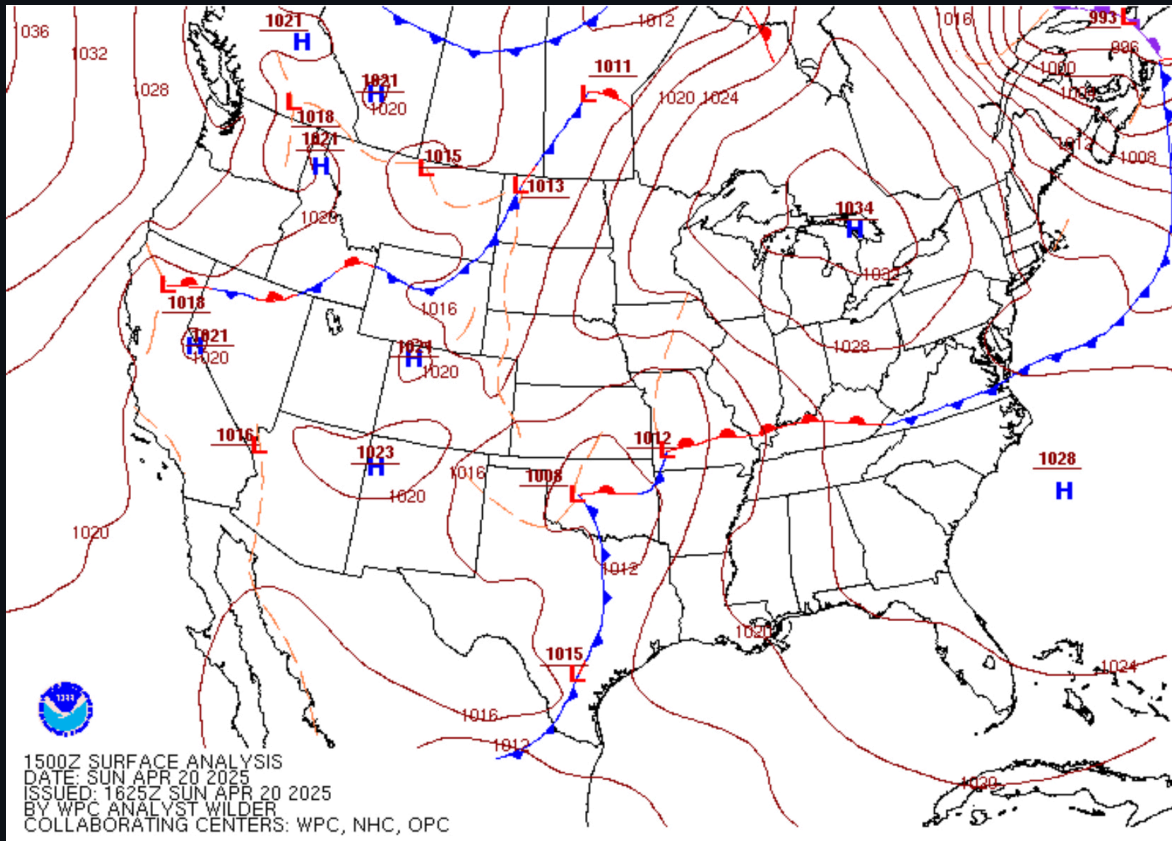
- Stands for **SIG**nificant **MET**eorological Information
- Issued for the following non-convective weather phenomena:
 - Heavy hail (greater than 3/4" diameter)
 - Severe turbulence (also clear air turbulence, CAT)
 - Icing (severe or moderate with severe icing)
 - Widespread duststorm or sandstorm reducing visibility to < 3 miles
 - Volcanic ash
- Valid for 4 hours



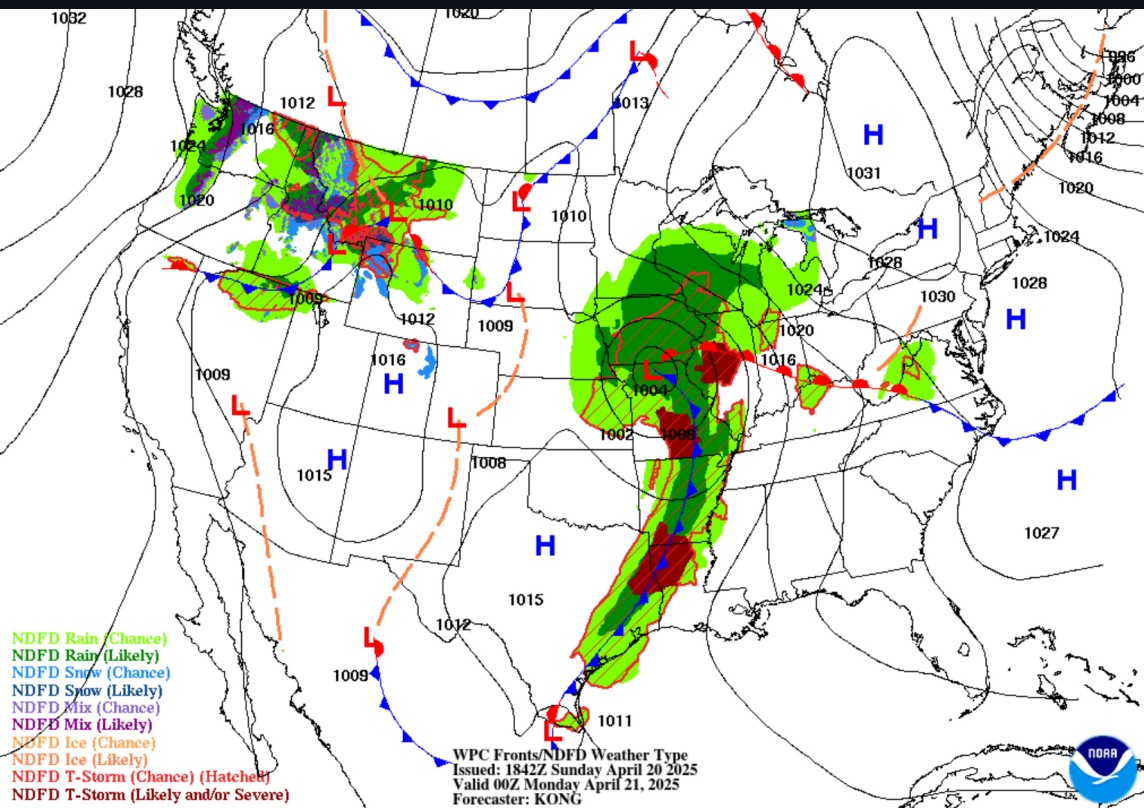
Convective SIGMETs

- Condition that
- Pertains to severe thunderstorms (surface winds > 50 knots)
- Hail larger than 3/4" in diameter
- Tornadoes

Surface Analysis Charts



- Issued every 3 hours
- Based on surface pressure observations

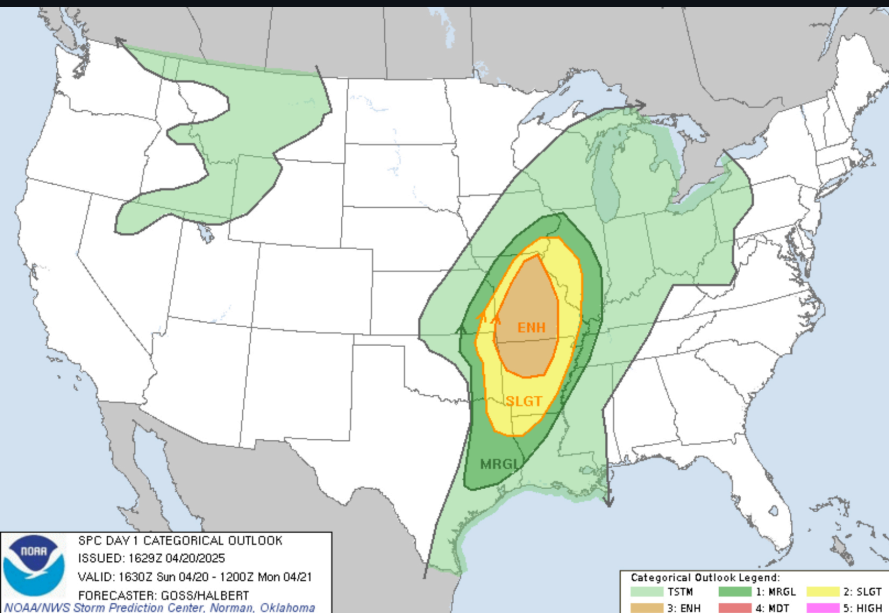


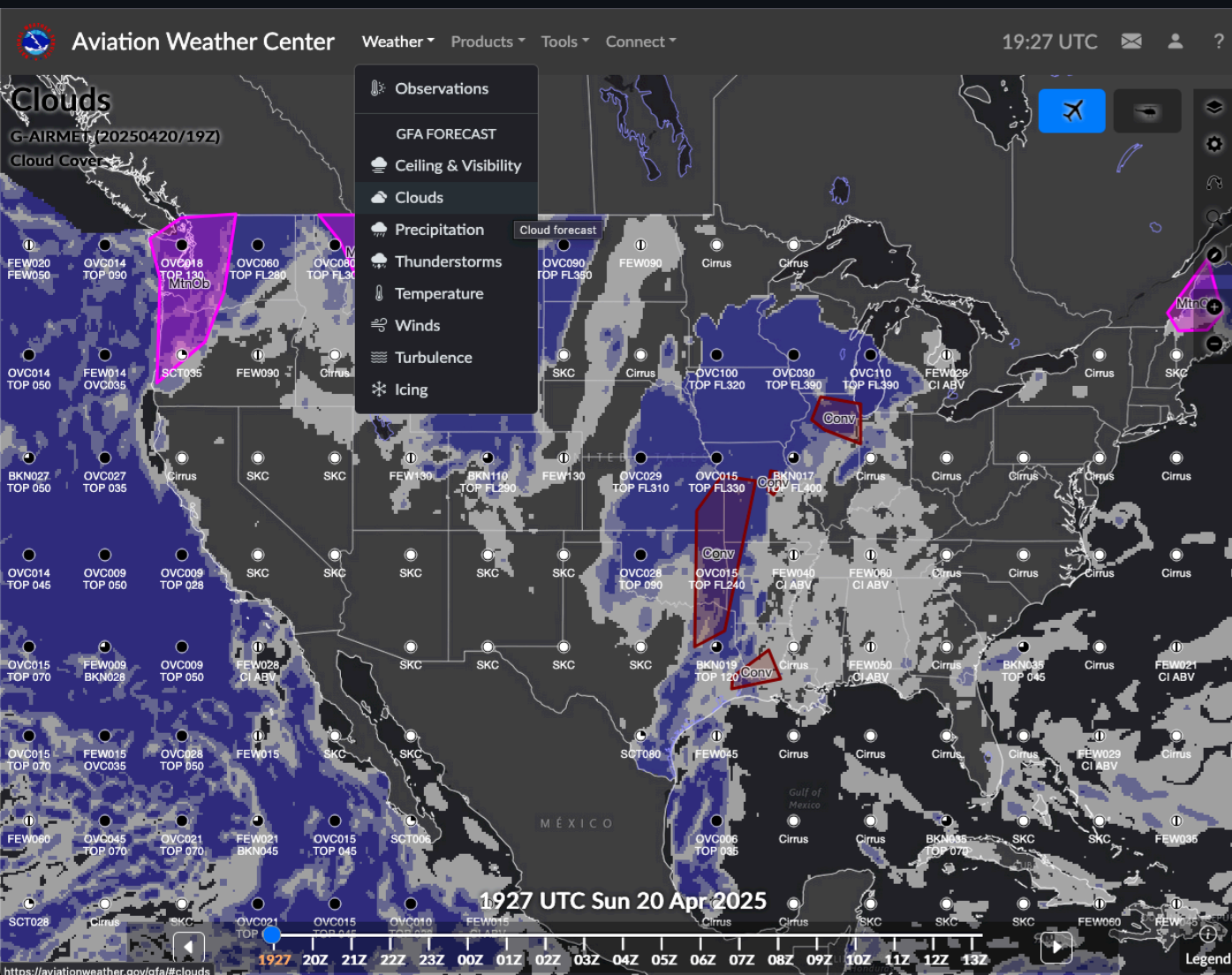
Weather Depiction Chart (Prognostic Charts)

- Surface-analysis forecasts
- Shows high/low/frontal positions
- Show precipitation, IFR/VFR conditions

Convective Outlook

- Shows likelihood of severe thunderstorms forming
 - TSTM: 10% or higher probability of thunderstorms is forecast
 - SLGT: Slight risk, organized severe storms, limited coverage/intensity
 - ENH: Enhanced risk, severe thunderstorms, varying levels of intensity
 - MDT: Moderate risk, widespread severe weather, several tornadoes and/or severe thunderstorms
 - HIGH: High risk, severe weather outbreak, hurricane force winds, numerous

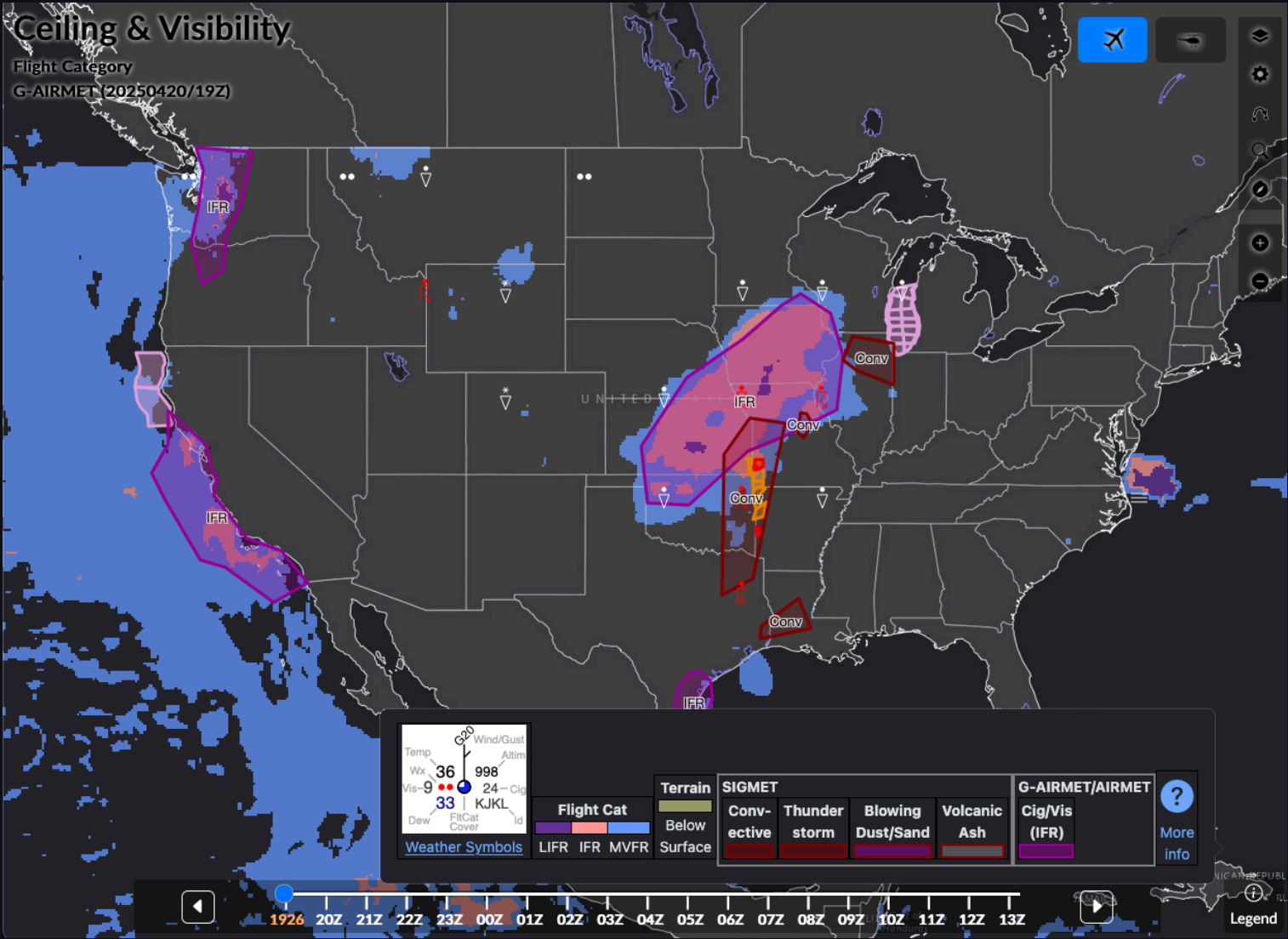




Graphical Forecast for Aviation

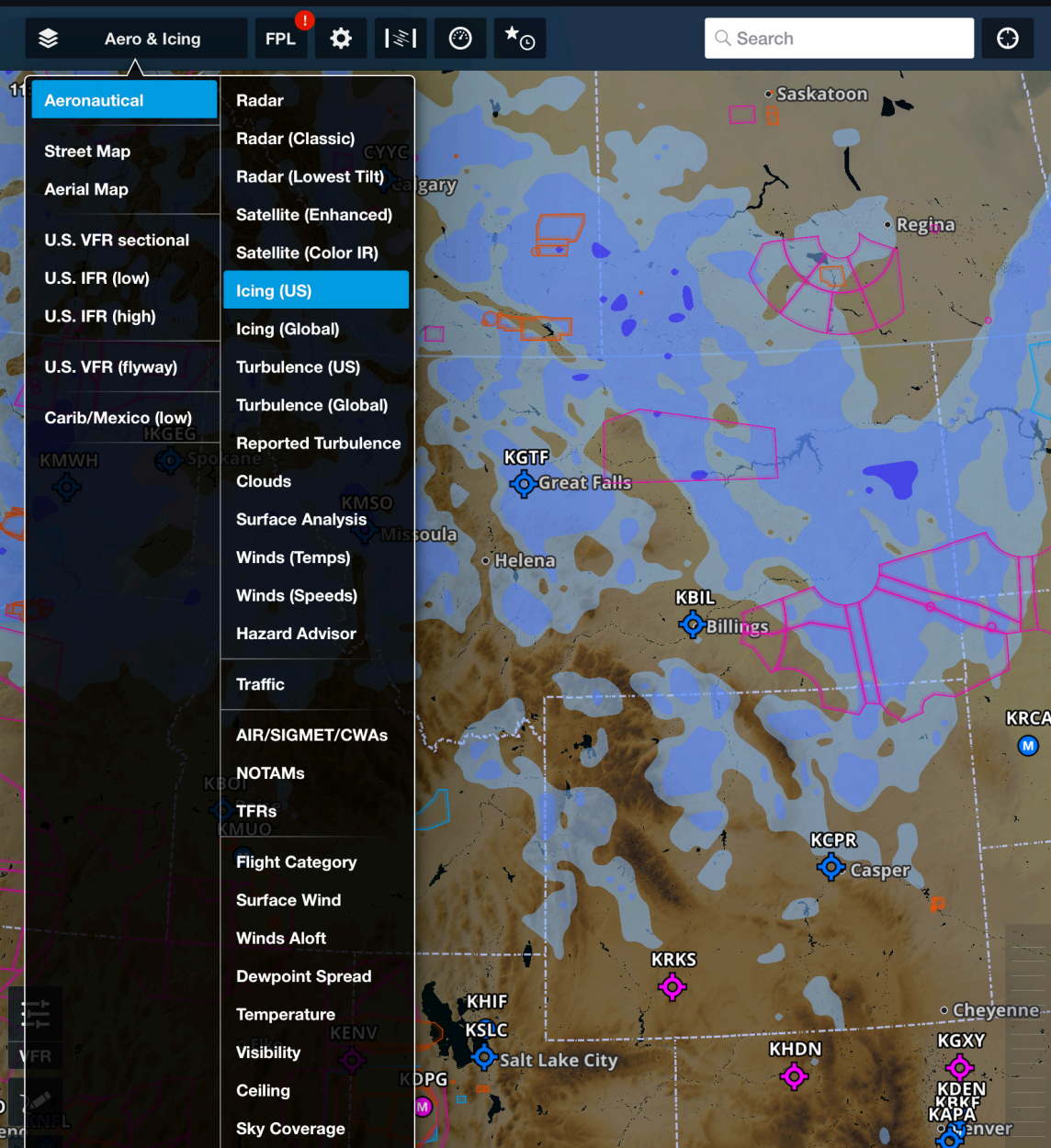
- Series of map-based products
- Replaces the legacy text-based area forecasts

GFA: Ceiling and Visibility Chart



In-Cockpit Weather Systems

- ADS-B in weather products:
 - FIS-B, Flight Information Service: METARs, TAFs
 - TIS-B, Traffic Information Service: Real-time traffic



Flight Information Service (FIS-B)

- METARs/SPECIs/TAFs
- PIREPs
- AIRMETs/SIGMETs
- Graphical AIRMETs
- Icing
- Lightning
- NEXRAD (CONUS and Regional)
- NOTAMS
- Center Weather Advisories
- Winds and temperatures aloft
- Turbulence

Cautions of Using NEXRAD

- NEXRAD display depicts where the weather WAS, not where it IS
- Several fatal accidents have occurred where pilot attempt to fly around severe weather using NEXRAD displays
- Always reference the publish date of the imagery
- Know whether your system is regularly receiving updates

Summary

- Aviation Routine Weather Report (METAR)
- Pilot Report (PIREPS)
- Terminal Aerodrome Forecasts (TAF)
- Winds and Temperature Aloft Forecast (FB)
- AIRMETs and Graphical AIRMETs: IFR, turbulence, icing
- SIGMETs and Convective SIGMETs: Thunderstorms, severe turbulence, severe icing
- Surface Analysis and Weather Depiction Charts: Fronts, Highs/Lows
- Convective Outlook
- Graphical Forecast for Aviation
- GFA: Ceiling and Visibility Chart