NATIONAL ASSOCIATION OF FLIGHT INSTRUCTORS

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Welcome!

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Weather Training in the Cockpit Spring/Summer Focus




Presented by FAA Aviation Weather Division staff (left to right):

Jennifer Colavito, Ceiling and Visibility Project Lead

Gary Pokodner, Weather Technology in the Cockpit Program Manager

Jason Baker, Research Meteorologist

Randall Bass, Weather Research Branch Manager

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Tonight's Host – Jennifer Colavito

FAA Ceiling and Visibility Project Lead

- BS in Aerospace Engineering from Virginia Polytechnic Institute and State University
- Worked for U.S. Army in the process of airworthiness certifications for military helicopters.
- Since Jan 2009, engineer and project manager for the FAA

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Course Objectives

- Inform flight instructors of gaps in pilot weather knowledge and adverse weather avoidance decision-making
- Inform flight instructors of the availability of weather training materials and training aids funded by the FAA (current and near term)
- Highlight features, potential use-errors, and limitations of weather products and information used to avoid summer adverse weather
- Obtain feedback on issues and needs to improve pilot weather decision-making and knowledge

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Question for Viewers

What do you estimate your students would score on an aviation-focused weather exam after successfully completing their flight training?

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Gary Pokodner

Weather Technology in the Cockpit Program Manager

- BS in Electrical Engineering from Lehigh University
- With ARINC for 25 years on military avionics acquisition programs
- Since 2011 FAA's NextGen Weather Technology in the Cockpit (WTIC) Program Manager

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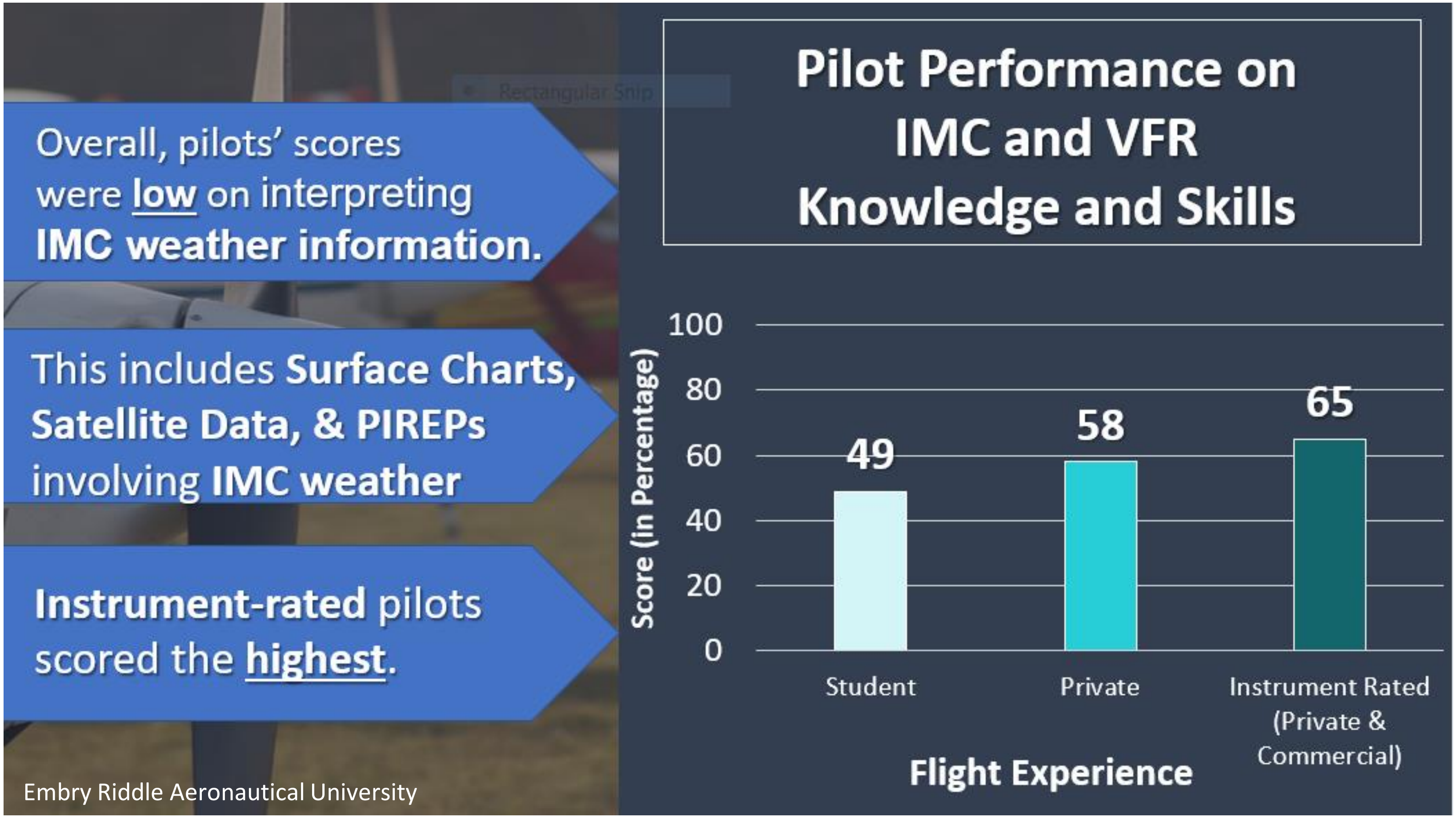
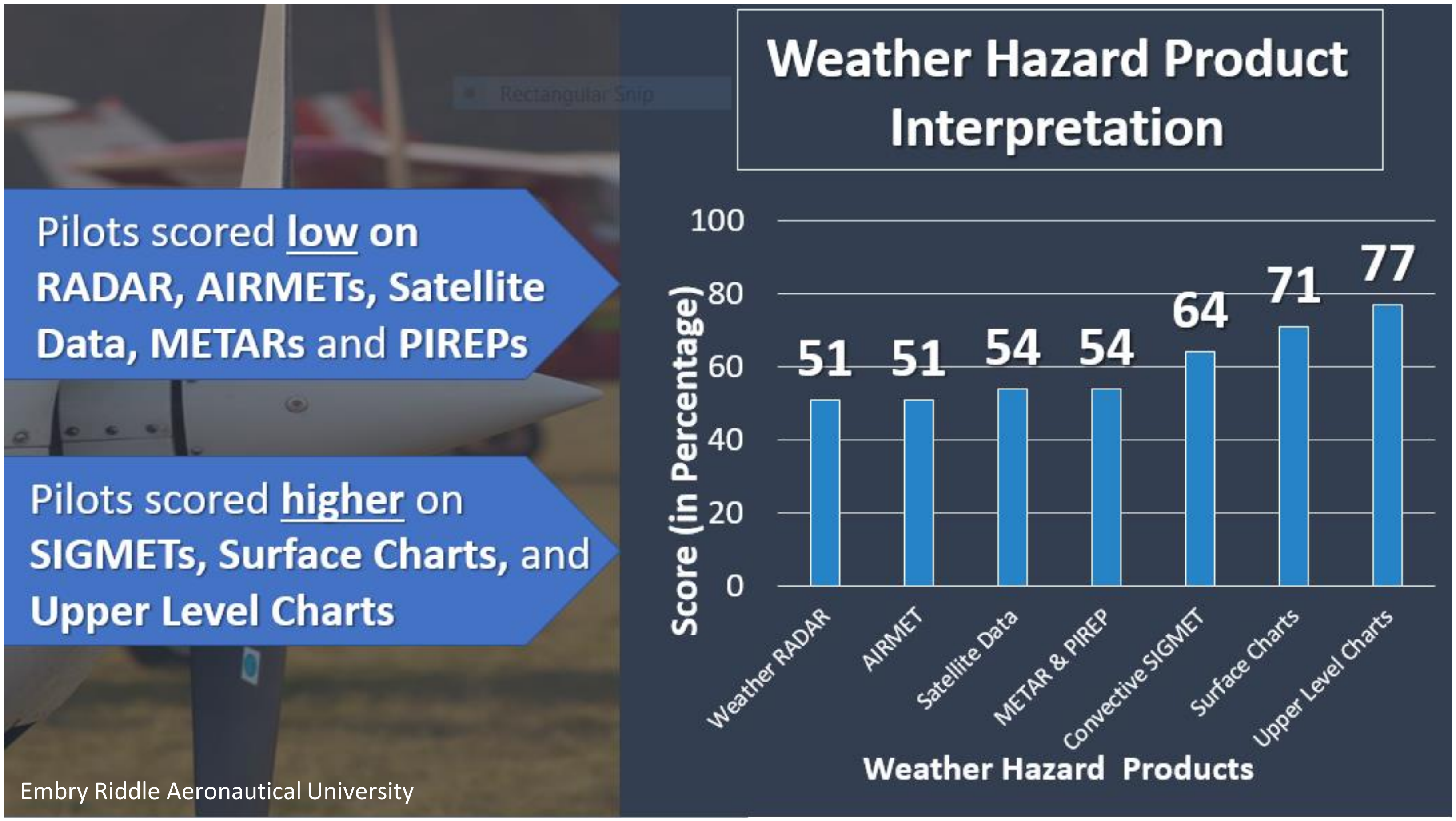
Gaps in Pilot Weather Knowledge



LIVE Link to ERAU report: https://commons.erau.edu/ga-wx-display-interpretation/13/

Gaps in Pilot Weather Knowledge



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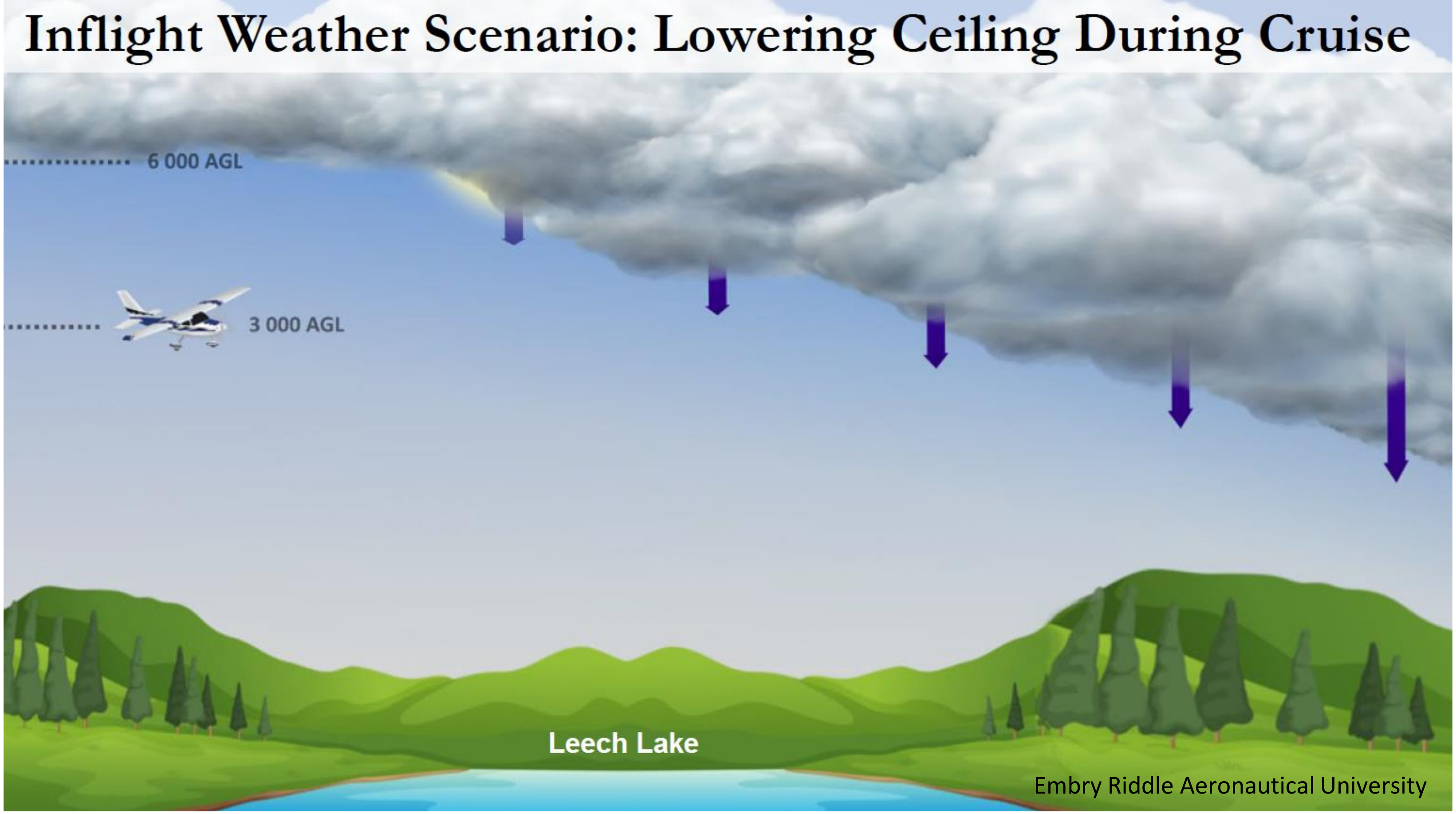
Gaps in Pilot Weather Knowledge



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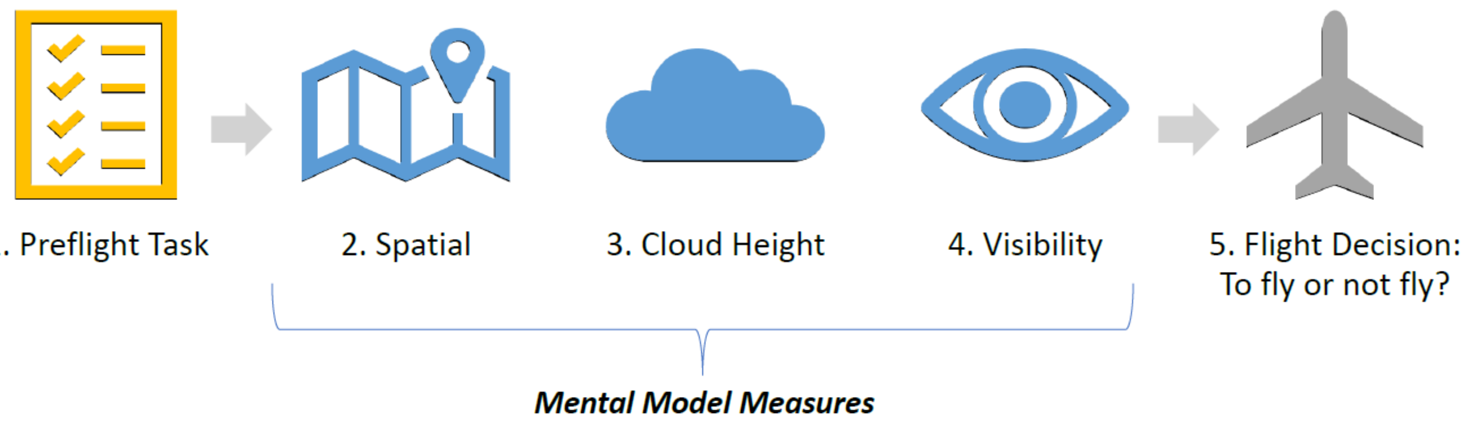
Gaps in Pilot Weather Knowledge



- **High Fidelity Preflight Scenario**
  - Closely mimic real preflight tasks and processes.
- Pilots developed a weather briefing based on “current” and “forecasted” weather products
- WX data captured from the Aviation Weather Center (AWC, 2017)
  - Slightly modified
- Formatted to match AWC website
- Mockup website created using Wix.com

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Gaps in Pilot Weather Knowledge

Preflight Results: Products Accessed

	n products	Private *n* = 24 M (SD)	Private w/ Instrument *n* = 20 M (SD)	Commercial w/ Instrument *n* = 20 M (SD)	CFI/CFII *n* = 20 M (SD)	Total *n* = 84 **M (SD)**
Observation	6	2.04 (.81)	3.05 (1.16)	2.70 (1.46)	2.95 (1.39)	**2.65 (1.26)**
Analysis	3	.33 (.57)	1.10 (.70)	1.05 (.83)	.84 (.83)	**.81 (.78)**
Forecast	16	4.13 (2.88)	6.33 (2.92)	5.30 (3.80)	5.89 (3.28)	**5.36 (3.28)**
Total	**25**	**6.24 (3.68)**	**9.57 (4.82)**	**8.23 (5.58)**	**9.20 (5.19)**	**8.23 (4.93)**

- **Private accessed** significantly ***less products*** than **private w/ instrument**, $F(3, 71.79) = 3.81$, $p = .013$, partial eta squared = .13
- No sig. difference between other ratings

Products Accessed	f (n = 84)
Observation	
METAR	82
RADAR	57
Satellite Images	35
Analysis	
CVA	39
Surface Analysis	25
Forecast	
TAF	51
Area Forecast *(Discontinued)*	57
Wind Aloft	79
Convective SIGMET	29
Low-Level Sig WX Chart	32
GAIRMET 3hr	42
GAIRMET Sierra (C & V)	7

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Gaps in Pilot Weather Knowledge

RESULTS

Frequency of Estimated Ceiling Correct by Region

	Private $n = 24$	Private w/ Instrument $n = 20$	Commercial w/ Instrument $n = 20$	CFI/CFII $n = 20$	Total $n = 84$
	f	*f*	*f*	*f*	***f***
Region 1	8	7	6	6	**27**
Region 2	0	2	8	1	**11**
Region 3	1	5	2	3	**11**
Region 4	1	3	2	5	**11**
Region 5	2	2	4	1	**9**
All regions	0	0	0	0	**0**

Frequency of Estimated Visibility Correct by Region

	Private $n = 24$	Private w/ Instrument $n = 20$	Commercial w/ Instrument $n = 20$	CFI/CFII $n = 20$	Total $n = 84$
	f	*f*	*f*	*f*	***f***
Region 1	21	20	17	20	**78**
Region 2	21	17	12	18	**68**
Region 3	3	4	11	3	**21**
Region 4	4	5	9	6	**24**
Region 5	4	6	7	2	**19**
All Regions	0	1	2	0	**3**

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Gaps in Pilot Weather Knowledge

- **SUMMARY**
  - Pilots struggled at depicting weather along the route
  - Held incorrect weather expectations for most of the route and at the destination airport
    - Depicted destination weather as Visual Flight Rules (VFR) whereas conditions were much lower
  - Pilots may not be assessing enough forecast products to gain a better mental model of what weather to expect along the route
    - Relying on observation information (e.g. METARs) for destination instead of the appropriate forecast products

Gaps in Pilot Weather Knowledge

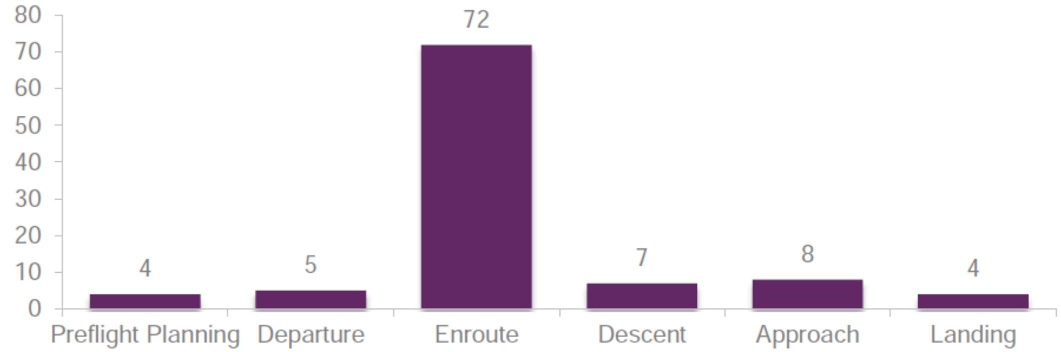
- **RECOMMENDATIONS**
  - Use study as a training tool to determine if trainees are interpreting and applying weather information correctly to a flight route
  - Use high fidelity preflight weather scenarios as practice in assessing weather along a route.
  - Pilots **may not be**:
    - Accessing the correct issued/valid times for forecast weather products
    - Calculating weather condition heights correctly
    - Reading weather information in its entirety (e.g. sky conditions on a METAR)
  - Link to presentation (file is h-ortiz-yolanda-final.pdf):

    https://ral.ucar.edu/events/2018/friends-and-partners-in-aviation-weather-0

Gaps in Pilot Weather Knowledge

NASA Aviation Safety Reporting System (ASRS) Study

Figure 3. Phase of Flight during which reported safety incident occurred *(n=100)*



In 72 of 100 reports analyzed the incident occurred enroute

Table 2. Weather Encountered *(n=100)*

	Better Than	Same As	Worse
Departure	3	95	2
Enroute	3	55	42
Destination	5	68	27

Encountered weather versus preflight assessment (100 reports)

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Representative Accident

Date: March 25, 2018

Accident Location: Hydro, Oklahoma

Intended route: Odessa, TX to El Reno, OK

Circumstances:

- Night VFR flight
- Pilot called FS for weather briefing
- FS provided forecast of IFR conditions at destination
- No evidence pilot IFR current
- Pilot could not identify destination airport(s)

Weather Study Results:

- Conditions 7 miles NW of accident site
  - Overcast at 800’, 7 mile vis
- Conditions 27 miles E of accident site
  - Overcast at 800’, 7 mile vis
- Conditions SW of accident site
  - VFR conditions

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Jason Baker

Research Meteorologist

- B.S in Meteorology minoring in Forecasting and Broadcasting from Penn State in 2004
- 2007 with the National Weather Service as an Aviation Meteorologist
- Manages FAA Convective Weather Research Program

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Convective Weather Overview

- **Why do we have convective weather?**
  - The earth trying to find balance results in convective activity. Ultimately, a transports of warm air from low to high altitudes. When air becomes moist and there's instability and/or other triggers convective weather can occur
- **Is convective weather important?**
  - Yes, thunderstorms are the leading cause of delays in the NAS. They are also cited frequently as a direct or indirect cause in aircraft accidents
- **When does convective weather occur?**
  - Convective weather can occur at any time of the day, however, early afternoon through evening (local time) are the most common as afternoon heating provides additional instability to the atmosphere
- **Where does convective weather occur?**
  - Thunderstorms occur in all 50 states, however, they are most common in the Southern United States, particularly from early March to late October
- **Are "popcorn thunderstorms" dangerous?**
  - Yes, the term "popcorn thunderstorms" refers to the storms appearance on radar. They usually form quickly in the early afternoon as clusters and last a few hours past sunset (local time), They are also known to move slowly and/or be erratic which makes prediction difficult

Preflight Product and Tools

- Terminal Aerodrome Forecast (TAFs)

Time	1653Z	08/18Z	08/19Z	08/20Z	08/21Z	08/22Z	08/23Z	09/00Z	09/01Z	09/02Z	09/03Z	09/04Z	09/05Z
Type	OBS	PRVL	PRVL	PRVL	PRVL	PRVL [TEMP]	PRVL [TEMP]	PRVL	PRVL	PRVL	PRVL	PRVL	PRVL
VIS	10	>6	>6	>6	>6	5 [2]	5 [2]	5	>6	>6	>6	>6	>6
CIG	250	250	250	--	--	35 [15]	35 [15]	35	30	30	30	30	30
Cover	BKN	BKN	BKN	SCT	SCT	BKN [OVC]	BKN [OVC]	BKN	BKN	BKN	BKN	BKN	BKN
FltCat	VFR	VFR	VFR	VFR	VFR	MVFR [IFR]	MVFR [IFR]	MVFR	MVFR	MVFR	MVFR	MVFR	MVFR
WX	--	--	--	VCTS	VCTS	TSRA [TSRA]	TSRA [TSRA]	TSRA	VCSH	VCSH	VCSH	VCSH	VCSH
WDir	230	190	190	210	210	240 [VRB]	240 [VRB]	240	350	350	350	350	350
WSpd	10	15	15	16	16	15 [25]	15 [25]	15	11	11	11	11	11
WGst	18	--	--	24	24	25 [40]	25 [40]	25	20	20	20	20	20

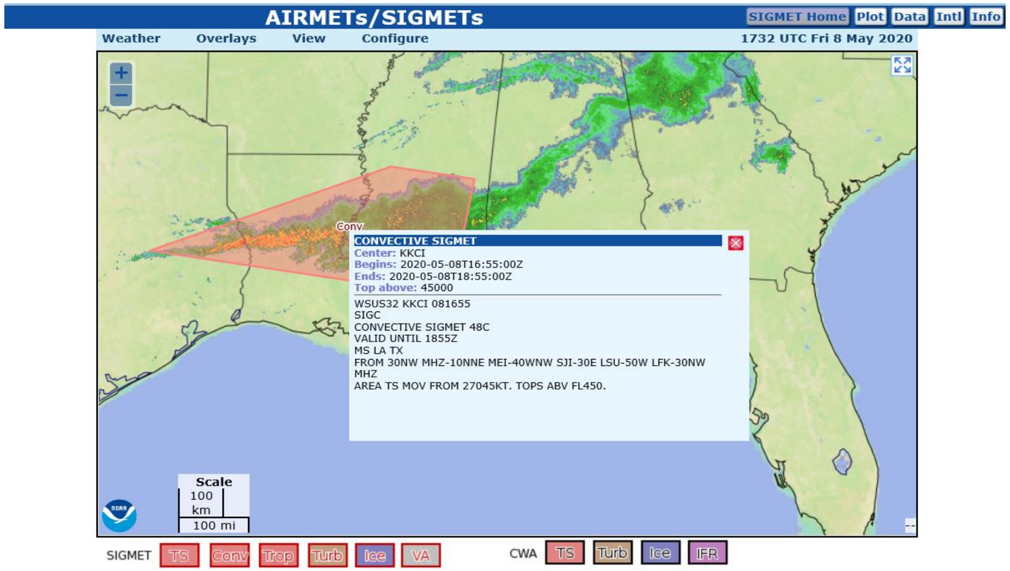
TDA Impact Legend

	None	Marginal	Slight	Moderate	High
Visibility (sm)	>5	3≤X≤5	1≤X<3	0.5≤X<1	<0.5
Ceiling (100 ft)	>30	10≤X≤30	4≤X<10	2≤X<4	<2
Wind Speed (kt)	<15	15≤X<25	25≤X<30	≥30	
Wind Gust (kt)	<15	15≤X<25	25≤X<35	≥35	
Weather	No Wx Reported	VCTS	-TS,-FZRA	TS,FZRA	+TS,+FZRA

TAF

```
KMSY 081205Z 0812/0918 18005KT P6SM SKC
   FM081400 19015KT P6SM SCT030 BKN250
   FM082000 21016G24KT P6SM VCTS SCT040CB
   FM082200 24015G25KT 5SM TSRA SCT015CB BKN035
   TEMPO 0822/0824 VRB25G40KT 2SM TSRA OVC015CB
   FM090100 35011G20KT P6SM VCSH BKN030
   FM090600 04020G28KT P6SM BKN150
```

- Significant Meteorological Information (SIGMETs)



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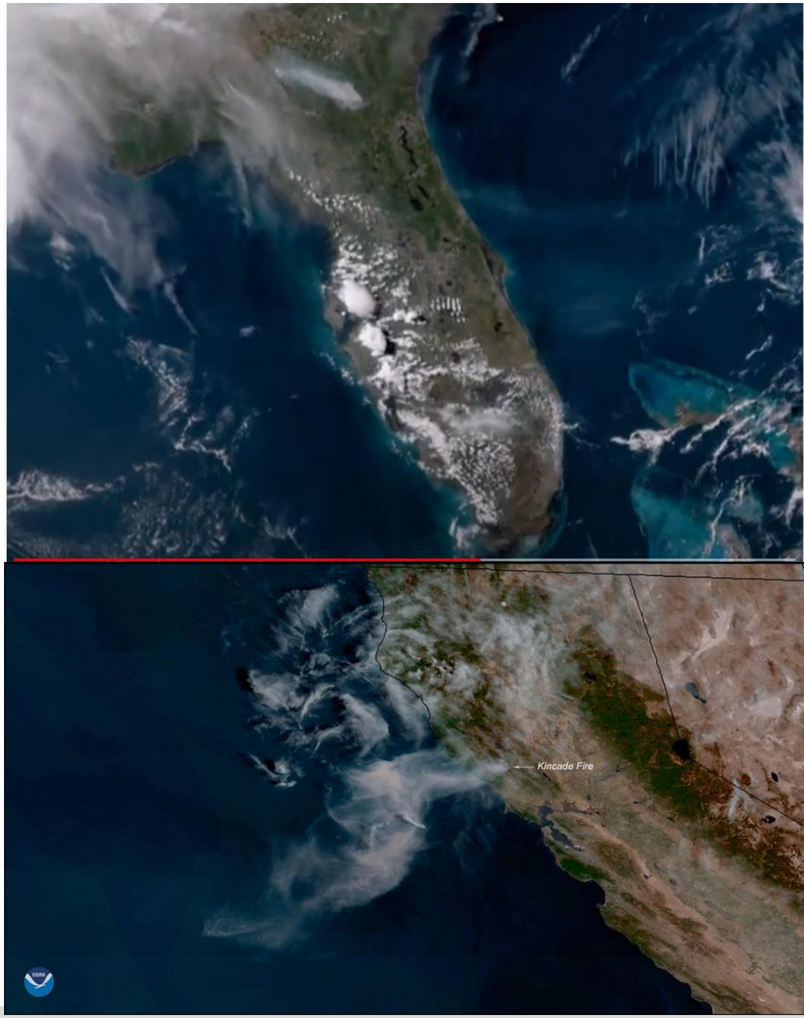
Satellite Technology Improving

- New! Fourth Generation Geostationary Operational Environmental Satellites (GOES) information is now available
  - This imagery is the highest quality data yet
  - Able to pinpoint locations of fires/smoke, volcanic ash, fog, low clouds, lightning and developing convective weather
  - Can update every 30 seconds



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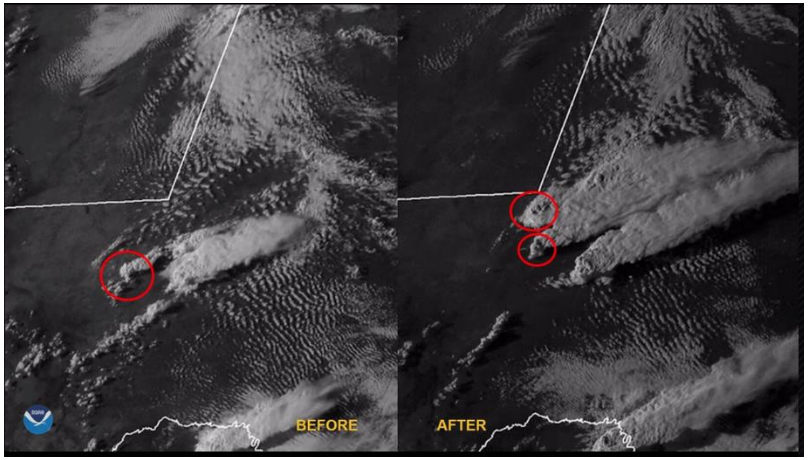
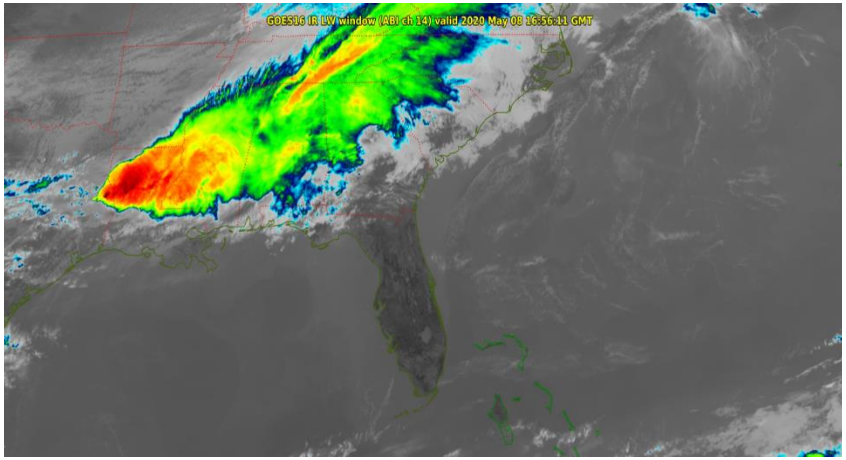
- Satellites provide a wealth of information
  - For aviation, the most frequently used information feeds are visible and infrared
    - Visible – what the satellites "sees" during the daylight hours similar to a human eye, not useful at night
    - Infrared – detects heat energy in various wavelengths, provides useful information 24 hours a day





- Always check the key/legend when looking at infrared satellite information. Frequently, cooler temperatures (which are normally associated with higher clouds tops) will have warmer colors
- The latest generation of satellites provides excellent information, but it's not perfect
  - Not recommended for estimating cloud bases
  - Not recommended for estimating cloud tops without additional supplementary data
- To ensure you are understanding the satellite data consult with flight services or a meteorologist when possible
- Taking supplemental satellite training through providers like COMET is encouraged

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Link to COMET: https://www.meted.ucar.edu/index.php

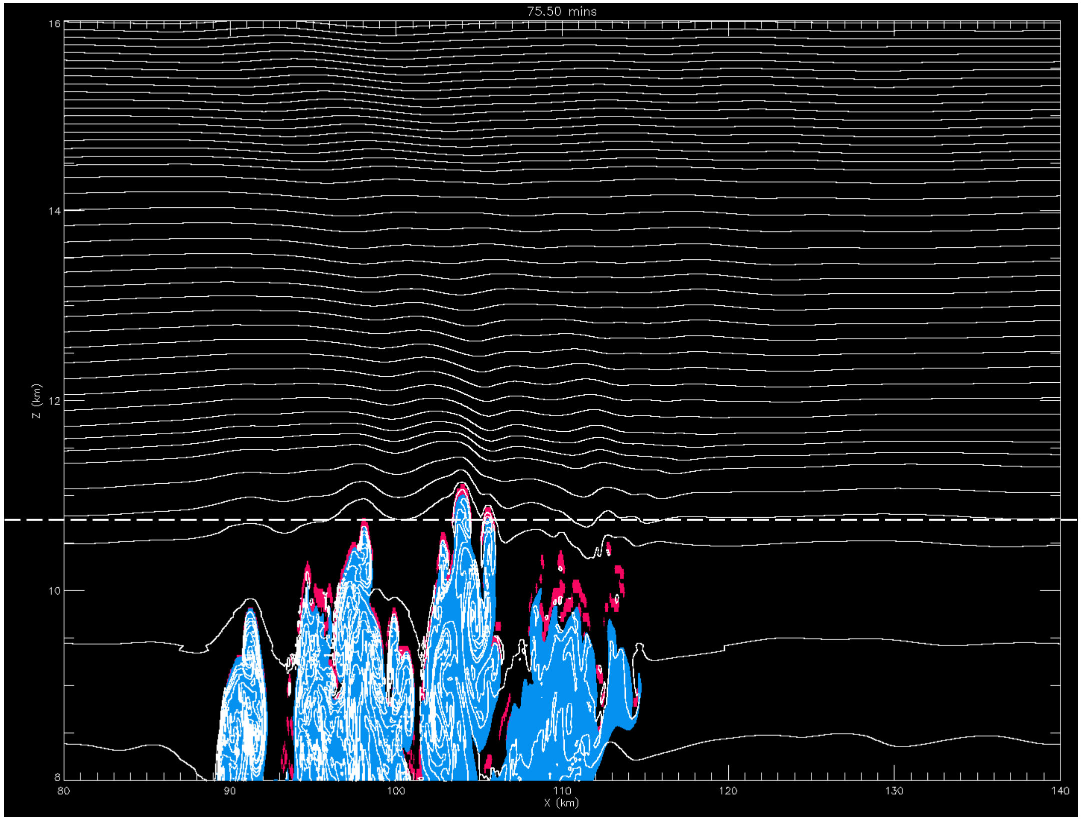
Product Suggestions

- What do I use?
- Weather information can be obtained in various forms and formats, there's not a one-size fits all approach as needs, equipment and purpose vary
- NWS provides information intended to enhance safety and efficiency during all phases of flight by providing various products and data sets to the public
  - Vendors repackage information and tailor it for specific user consumption
    - A few vendors provide additional data to add value to existing NWS data (example: privately owned radar)
    - These additional data sources can be valuable when used properly, but can also induce new risks

Convectively-induced turbulence (CIT)

Some turbulence occurs in clear air near clouds (CIT)

- FAA avoidance guidelines are a starting point
- Blue = cloud
- Red = turbulence
- Turbulence exceeds cloud height by ~2km (~6,500 ft)



Courtesy Todd Lane, U. Melbourne

Lane and Sharman, JAMC 2008

Example

- 10 July 1997 near Dickinson, ND (En-route Seattle to JFK)
- Boeing 757 encountered severe turbulence while flying above and between developing thunderstorms
- FL370 (approx 11 km)
- 22 injuries
- +1 to -1.7 g's in 10 sec

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Randy Bass

Weather Research Branch Manager

- MS in Meteorology from Texas A&M University
- 20-year Air Force veteran serving as a weather officer, half of military career supporting Intelligence
- Manager, Aviation Weather Research Branch overseeing budget and transition from research to operations

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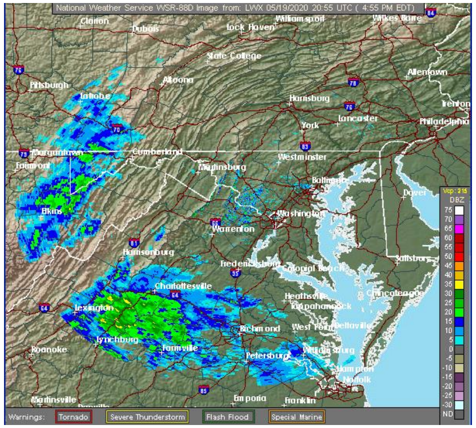
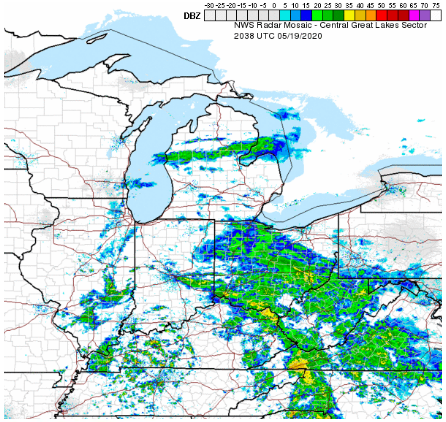
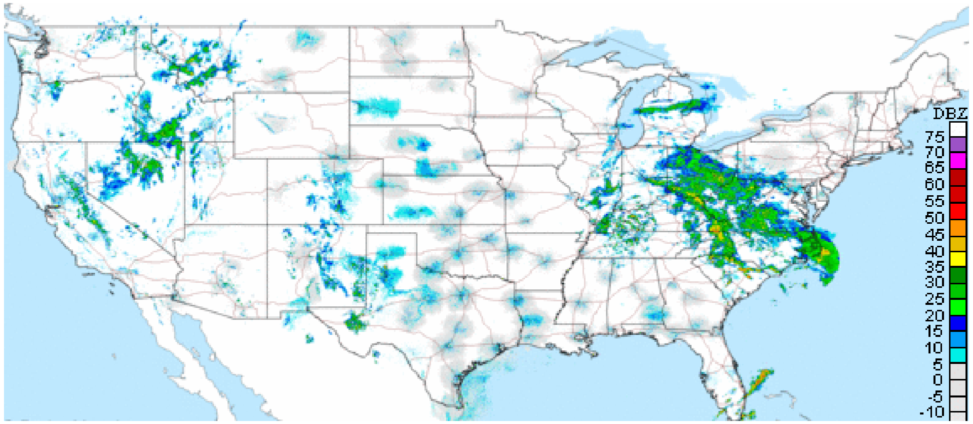
Weather Radar

- Weather radar is one of the most important tools a pilot can use
- Pilots should understand and interpret radar data correctly before and during flight
- Radar images may be from one radar or mosaicked into regional or national displays







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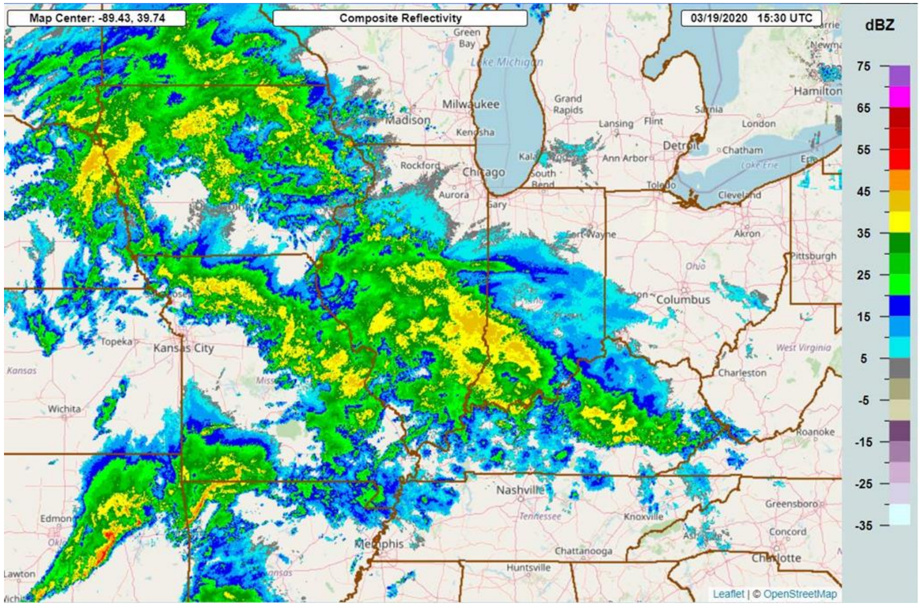
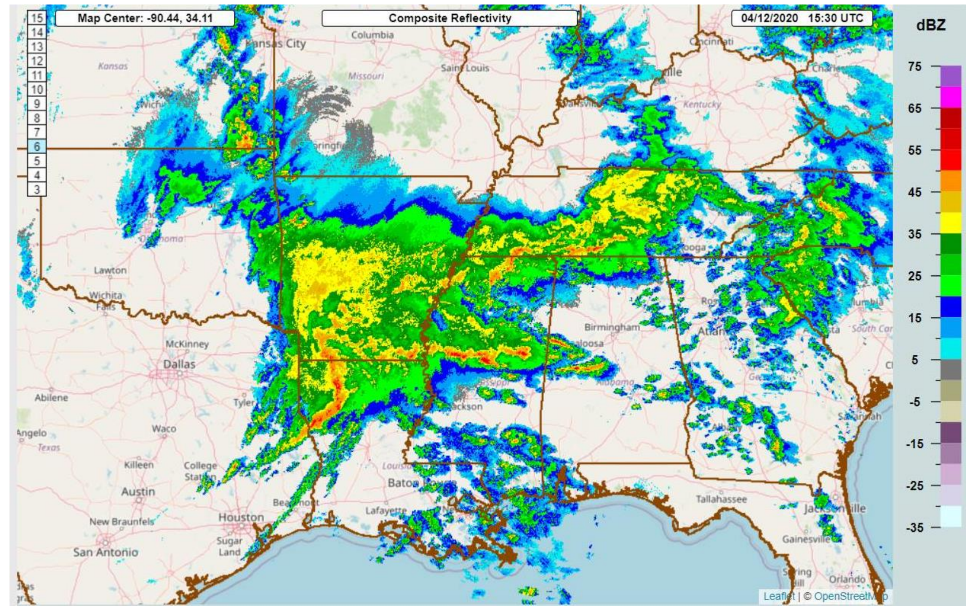
Weather Radar

March 19, 2020



April 12, 2020



- Composite reflectivities (CREF) of two different storm systems on two different dates – March 19, 2020 on the left and April 12, 2020 on the right
- CREF is a measure of the intensity of the radar echo returns throughout the column of atmosphere; yellows, reds and purple are strongest returns
- **Is there a difference in the storms? Can pilots fly through or over them?**

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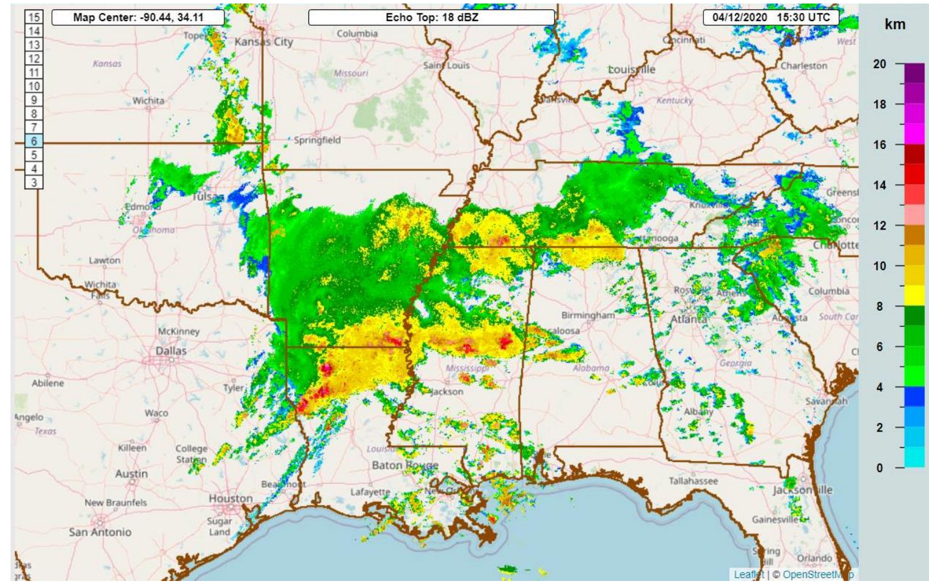
Weather Radar

March 19, 2020

April 12, 2020



- Same storms as in the previous slide, except images depict Echo Tops, or cloud tops of the same two storm events
- The image on the left generally has cloud tops around 5-7 km (16-23 kft)
- The image on the right has cloud tops of 8-14 km (26-45 kft)

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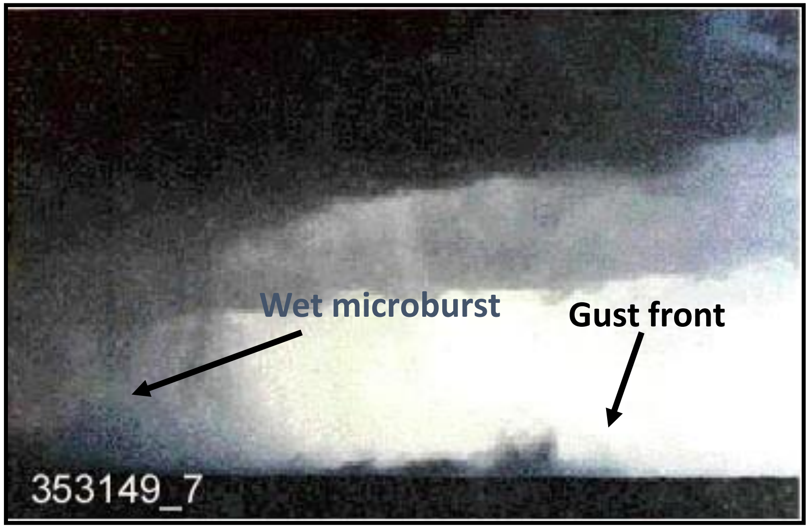
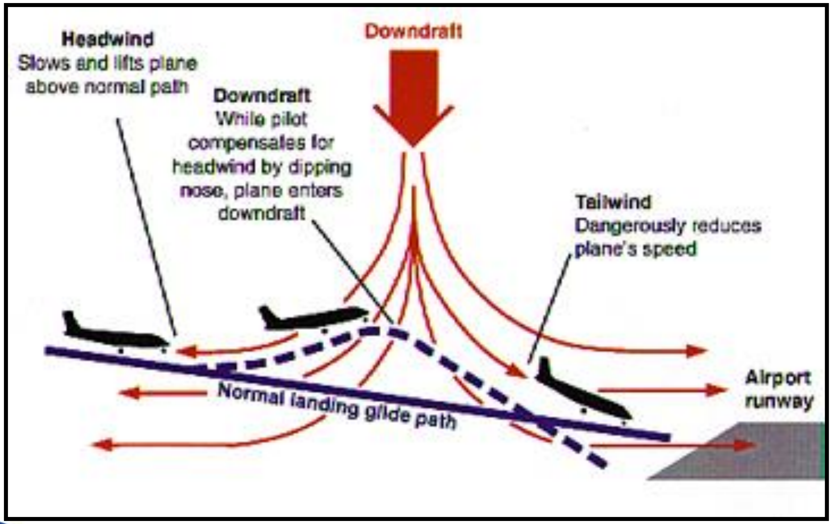
Weather Radar

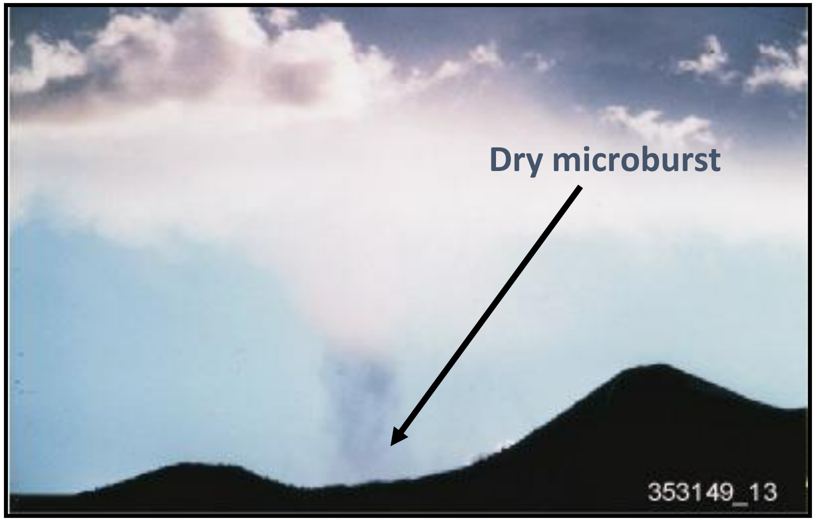
- The March event was a winter storm that produced a lot of sleet; ice has very high reflectivity
- The April event was a severe thunderstorm outbreak
- Avoid flying through or near high radar reflectivity echos
- Some high reflectivity areas can be flown over with caution
- While radar imagery is a good tool for determining current weather conditions, one image isn’t enough to review
- Additionally, radar imagery alone isn’t enough to make flight planning decisions; it must be used in conjunction with other information such as turbulence and icing forecasts
- Radar can, however, be used to locate hazards that might otherwise be missed in other products…

Wind Shear - Microburst & Gust Front

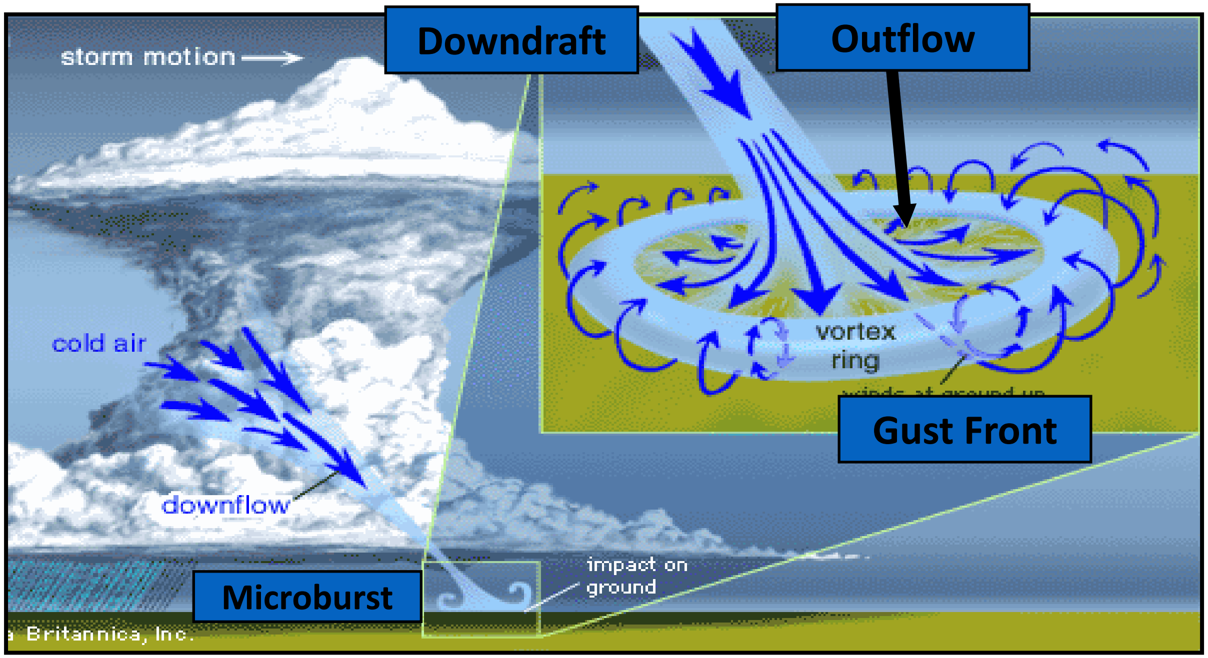
- Microbursts, downdrafts, gust fronts and outflows are phenomena typically associated with convection that are extremely hazardous to aviation
- Particularly dangerous during arrival and landing phase of flight but can affect low flying aircraft en route







Wind Shear Accidents



Dallas, TX 1985

Phuket, Thailand Sep 2007

Air Carrier Wind Shear Accidents at US Airports

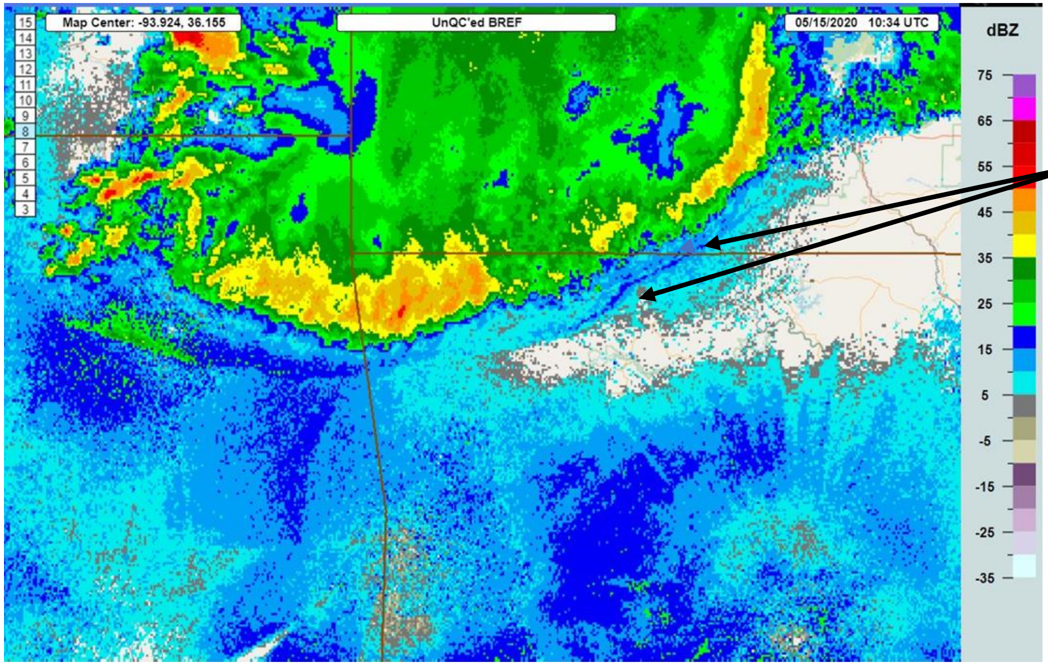
	1975-1994	After 1994
Accidents	15	2*
Fatalities	489	1*

*0 for airports equipped with wind shear sensors

NTSB: Outside of US, air carrier wind shear accidents continue at an unabated rate

Radar and Gust Fronts

- Weather radar can be used to detect gust fronts and thunderstorm outflows away from convective activity
- Instruments and sensors near major airports detect microbursts and wind shear
- Small airports and en route areas do not have detectors so it's up to the pilot to be aware of these phenomena



Outflow boundary well ahead of thunderstorm line

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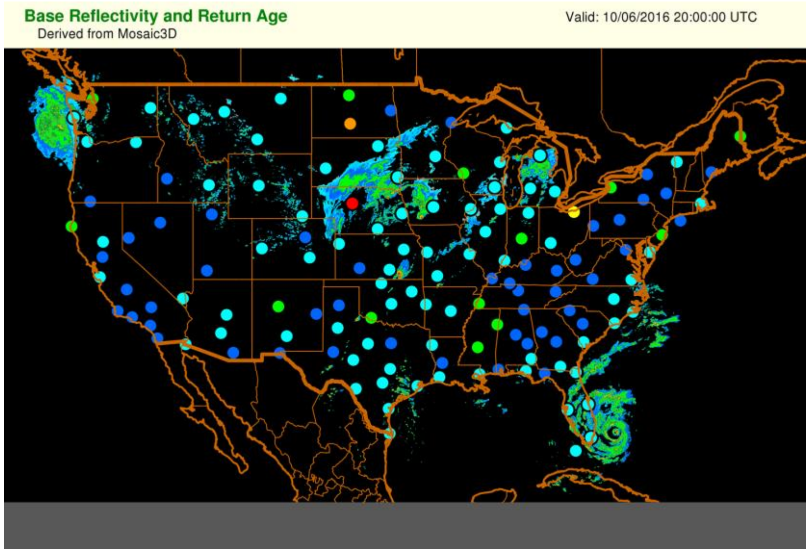
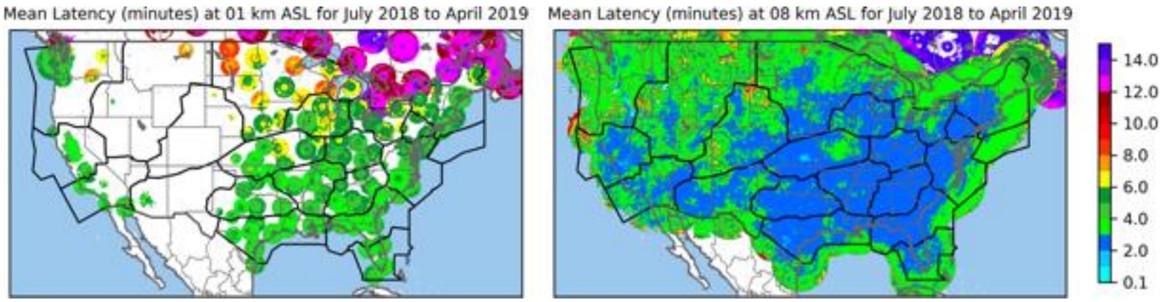
Weather Radar Data Age and Latency

- All users of weather radar data, including pilots, should understand that data age and data latency affect the quality of the images used in operational decision making
- Even when a radar image is first transmitted to the public, the data within the image may still be several minutes old
- Three primary reasons





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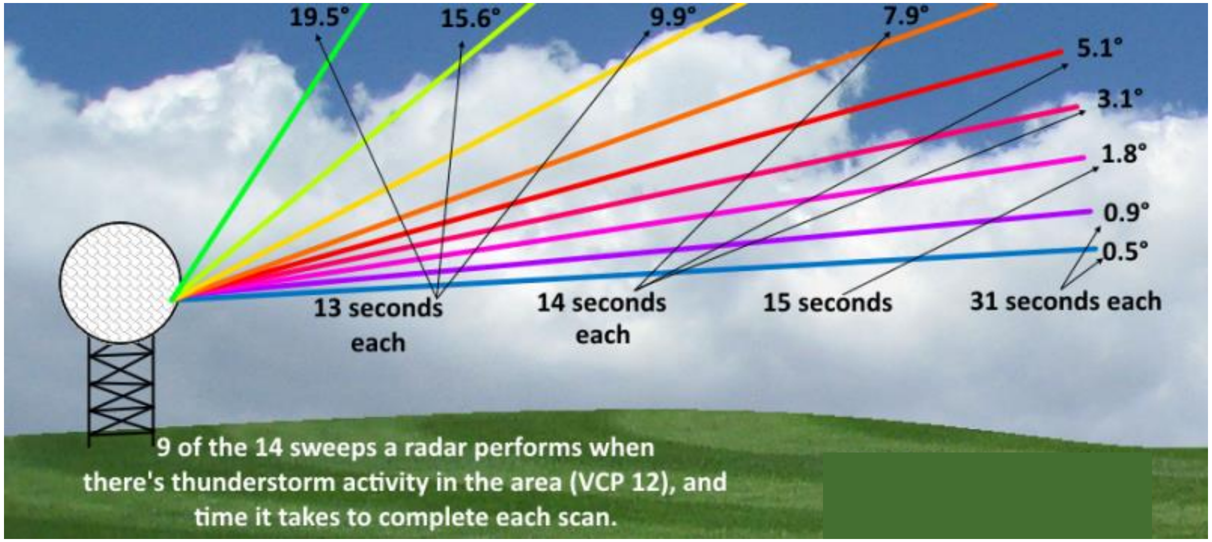
Sources of Latency in Radar Reflectivity Mosaics

Reason #1: The volume scan mode



The primary influence on radar data latency is the time it takes to complete a full volume scan (between 4 and 7 minutes)

Observations included in a composite reflectivity mosaic can be anywhere from 0 to 7 minutes old during thunderstorm activity and up to 14 minutes for winter weather

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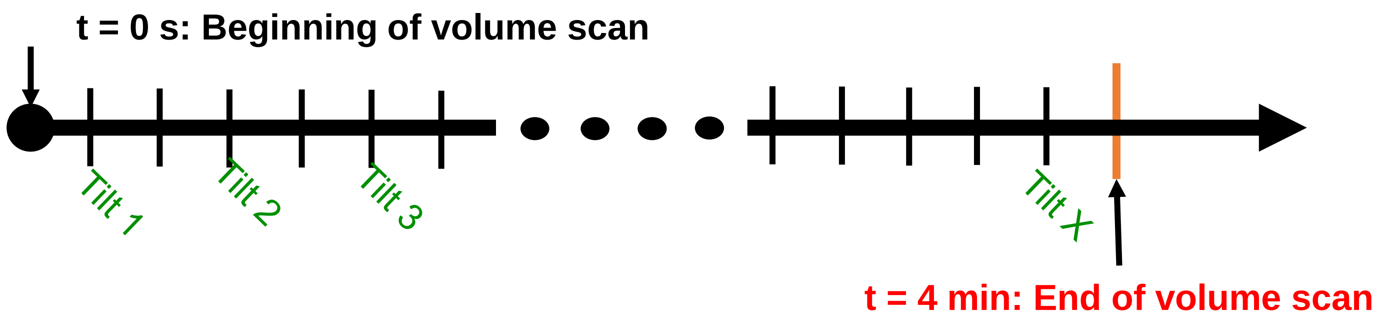
Sources of Latency in Radar Reflectivity Mosaics

Reason #2: The method of data transmission (Level 2 versus Level 3)



Level 2: Minimizes latency
- Available at the completion of each tilt
- Full resolution (0.16 mi)
- Not free (ongoing subscription)
- Requires significant bandwidth
- Requires significant code development to integrate into mosaic

Level 3: Maximizes latency
- Produced only at end of volume scan
- Coarse resolution (2.5 v 0.16 mi)
- Free
- Only way to stream real time observations until recently
- Still used by several vendors

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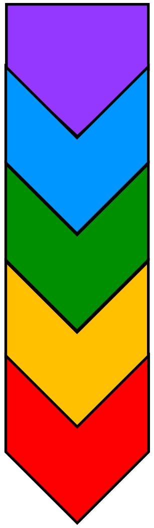
Sources of Latency in Radar Reflectivity Mosaics

Reason #3: Computational time required to produce mosaic

Dependent on…

- The amount of hardware available
- Computational efficiency of the software
- The amount of weather in the volume

The Multi-Radar Multi-Sensor (MRMS) mosaics produced by the NWS are produced every 2 min and have a requirement that the processing time for data transmission, Quality Control (QC), and the mosaicking of the data not exceed 90 seconds



t = 0 s: Data is collected by radar

t = 0 - 30 s: Data is transmitted to NOAA

t = 15 - 60 s: Data is quality controlled

t = 30 - 90 s: Data is mosaicked

t = 30 - 90 s: Publicly disseminated

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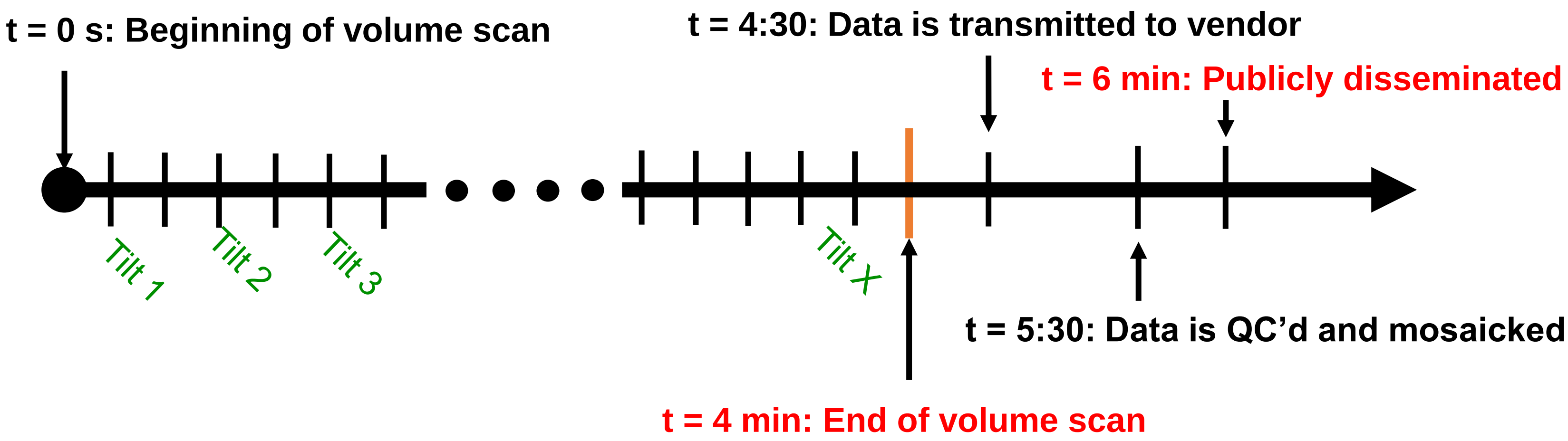
Sources of Latency in Radar Reflectivity Mosaics

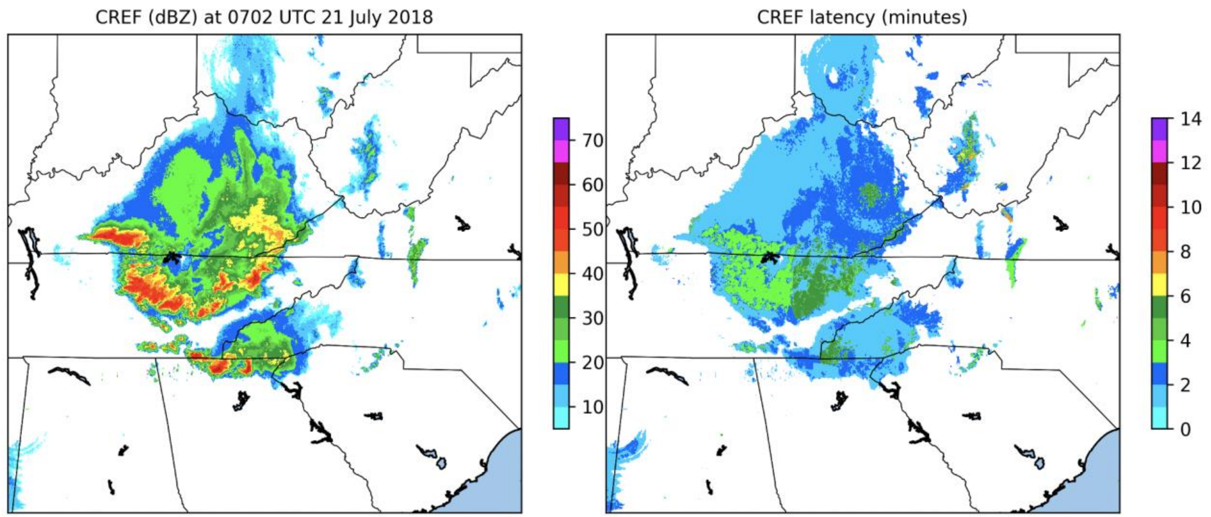
Best case timeline for radar scan to product



- Even in the best case scenario some radar data may be at least 6 minutes old when a mosaic is disseminated to the public
- Using a level 3 approach with the longest volume scan can result in an echo that is up to 20 minutes old by the time it is available publicly

Effects of Latency in Radar Reflectivity Mosaics

Why should a pilot care?



- Users currently only have access to the CREF image on the left; the image on the right is a depiction of data age inside the mosaic, and is still in the developmental stage
- In this example, the storm cells shown moving through eastern TN are almost 6 minutes old
- If the cells are moving 30 mph, they could be at least 3 miles from where they are depicted at the time stamp of the image
- If a pilot references the image only 4 minutes later, the cells could be at least 5 miles away from what's shown and where they may assume the storm is at

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- For pilots with onboard weather radar, this latency is a major reason why what you see and what Air Traffic Control sees on their scope can be so different

Case Study

Date: December 19, 2011

Accident Location: Bryan, Texas

Intended route: Hampton, Ga to Waco, Tx

Circumstances:

- Flight encountered areas of severe weather
- Controller providing guidance
- Pilot referring to NEXRAD display
- Numerous un-announced heading changes
- Pilot last reported *"in some bad weather, I'm trying to get out of it"*

Weather Study Results:

- Outflow boundary northwest of the accident site
- Unstable environment favorable for formation of clouds and precipitation

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Training Aids – A Proposed Taxonomy

- Organizes GA pilot weather education and training materials
- Three main knowledge categories
  - Weather phenomena
  - Weather hazard products
  - Weather hazard product sources and their application
- Categorization links meteorological concepts and hazards to their application to make correct aeronautical decisions about weather in flight
- Products and applications do not teach pilots about weather so taxonomy creates the links

Training Aids – A Proposed Taxonomy

Taxonomy Version 1.0 (Top Level View)

Tier	**Weather Phenomena**	**Number of Topics**
1000	Basic meteorological knowledge	14
1100	Knowledge of how meteorological phenomena affect flight performance	14
1200	Knowledge of aviation meteorological hazards	8
	Total	**36**
Tier	**Weather Hazard Products**	**Number of Topics**
2000	Knowledge of official weather hazard products	27*
2100	Analysis and interpretation of different hazard products	8
	Total	**35**
Tier	**Weather Hazard Product Sources and Application**	**Number of Topics**
3000	Knowledge of approved product sources	7
3100	Knowledge of differences between vendor products	1
3200	Knowledge of how/when to use different product sources during different flight phases	5
	Total	**13**

* Includes aviation-weather-specific and general meteorological products.

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https://doi.org/10.15394/jaaer.2020.1815

Training Aids

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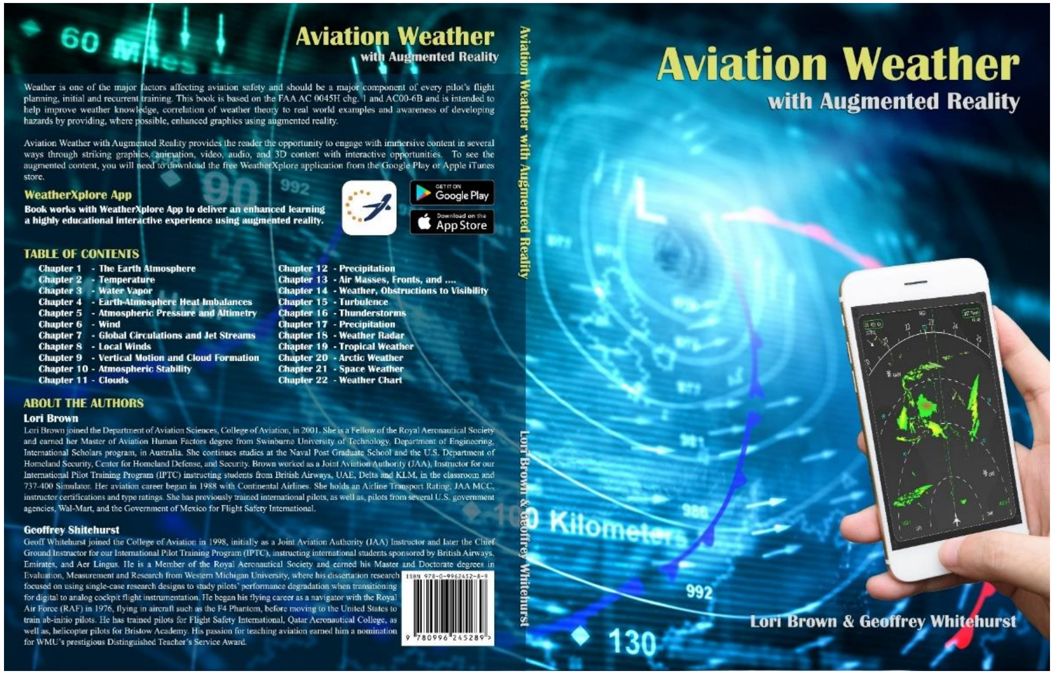
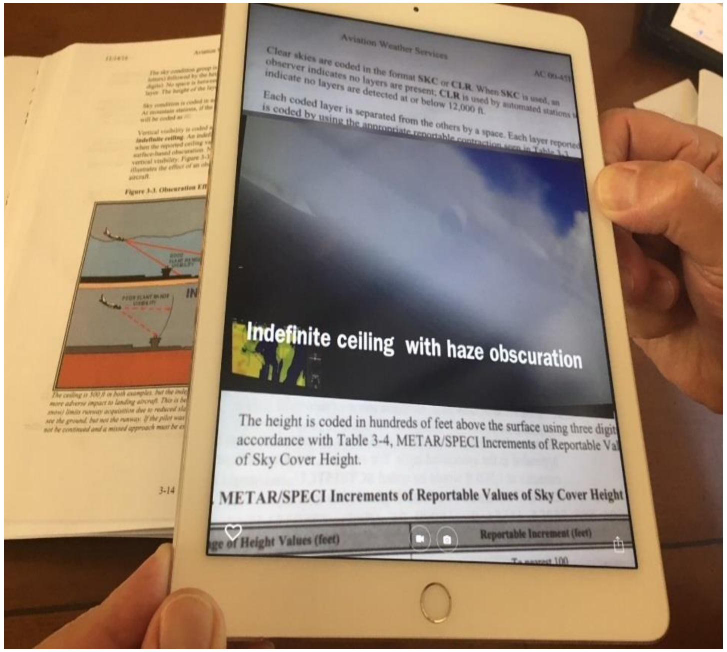
WeatherXplore Augmented Reality APP

- Digital training content over any printed material (checklist, approach plates, sectional charts books)
- Currently in demonstration mode with AC 00-45H chg. 1 and AC 00-6B- **Full App available June 2020**
- Free Download from iTunes or Google Play- WeatherXplore APP – Works with tablet or phone
- **Lets pilots see what the actual weather looks like to enhance correlation of knowledge**





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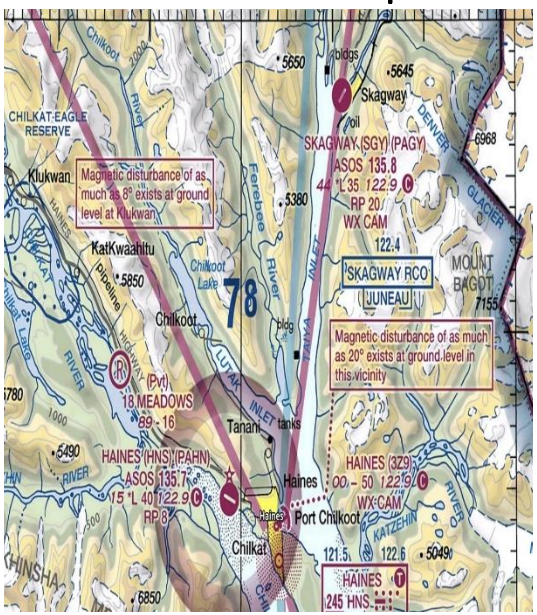
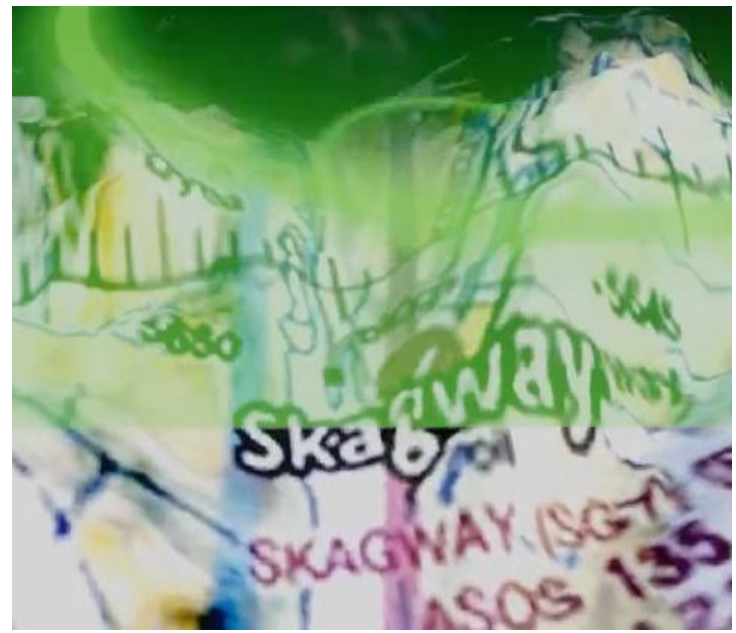
Training Aids – WeatherXplore App

Create a 3D Virtual Reality experience from any sectional chart which can be viewed through Google cardboard with a phone to view difficult areas before flying



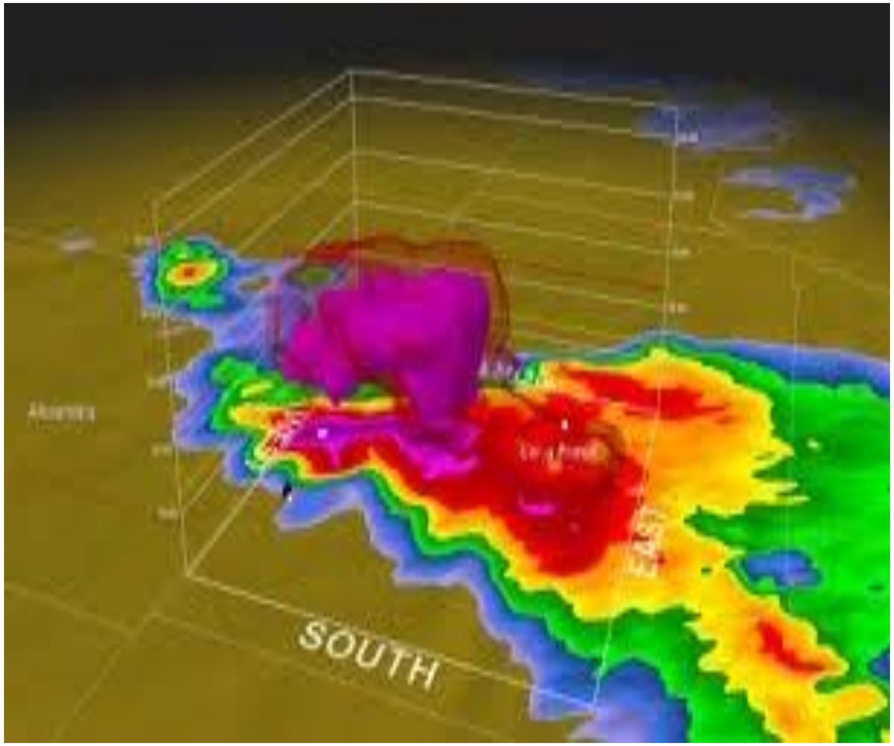
Skagway, Alaska VFR Sectional Chart



3D sectional chart viewed through virtual realty headset

WeatherXplore Mini Video Lessons

1. Thunderstorm Lifecycle
2. Low Ceiling/Mountain Obscuration
3. Variable Wind / Sudden Wind Shift
4. Density Altitude
5. Temperature / Dewpoint spread
6. Carburetor Icing
7. GFA Tool (graphic forecast area)
8. PIREP and AIRREP
9. Graphical Airmet (G-Airmet)
10. Center Weather Advisory

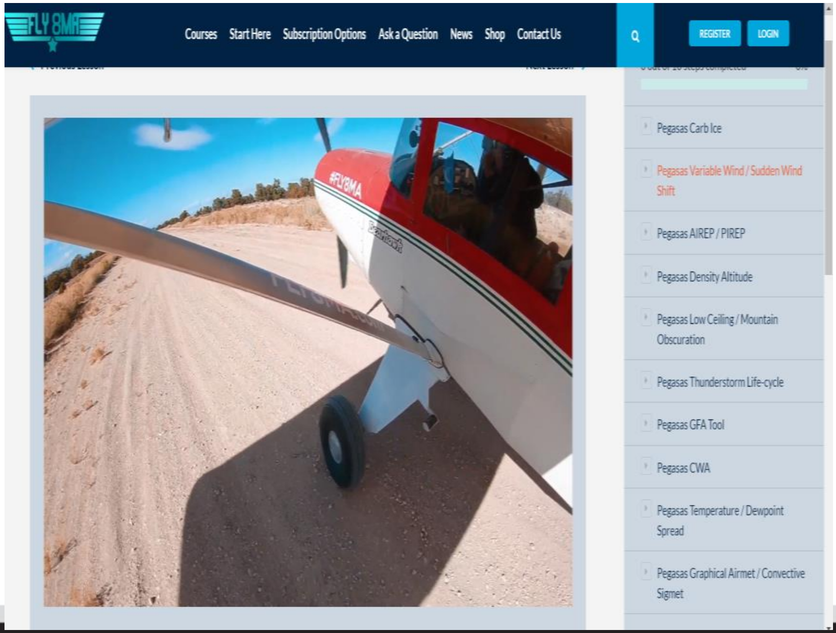


https://fly8ma.com/courses/weatherxplore-course/

WeatherXplore Mini Video Lessons

- 10 Free weather lessons (early June 2020 completion)
- Quiz and completion certificates for instructor use
- Hosted by FLY8MA Ground schools
- Will be linked to FAASAFETY.gov for Wings credit

https://fly8ma.com/courses/weatherxplore-course/



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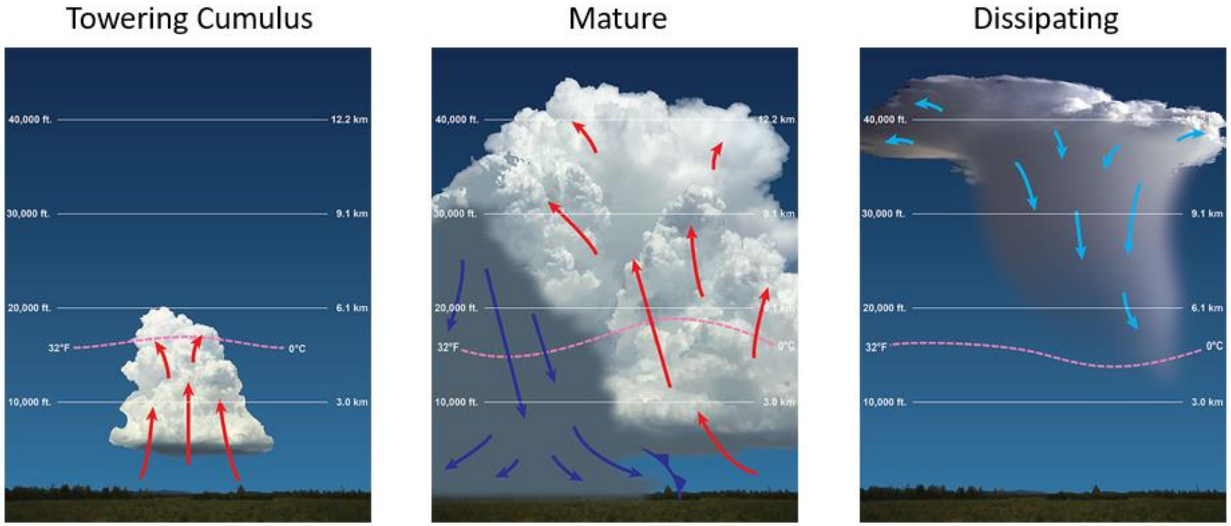
Training Aids – Mini Courses

- Thunderstorm Lifecycle is first course and will include augmented reality and 3-D virtual reality for assessment
  - Target completion is Fall 2020
  - Plan to perform experiment on effectiveness of the course
  - Feedback from flight instructors will be solicited



Images source: NWS Jetstream, https://www.weather.gov/jetstream/life

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Training Aids – Mini Courses

Learning Plan for an Individual (draft)

Student Learning Factors

The learners are motivated to pilot aircraft.

They have not yet developed a pilot's regard for the effects of weather on flight.

Their experience on the ground predisposes them toward thinking that wind velocity as 2D instead of 3D and the atmosphere is more stable than it is (Whitehurst).

Learning Experiences

- Read text on thunderstorm cell and cell stages (towering cumulus, mature, dissipating)
- Observe model on thunderstorm cell and cell stages (towering cumulus, mature, dissipating)
- Read text on cell formations (single, multi-cluster, multi-line, super)
- Observe model on cell formations (single, multi-cluster, multi-line, super)
- Read text on thunderstorm motion (advection, propagation)
- Observe model on thunderstorm motion (advection, prorogation)
- Read text on hazards and effects (lightening, wind, downbursts, turbulence, icing, hail, pressure, static electricity, tornado)
- Observe model on hazards and effects (lightening, wind, downbursts, turbulence, icing, hail, pressure, static electricity, tornado)
- Read text on best practices for decision making in response to a thunderstorm
- Observe scenarios of in-flight decision making in response to a thunderstorm

Proficiencies

- Recognize linguistic labels and visual cues of cell stages
- Recognize linguistic labels and visual cues of cell formations
- Recognize linguistic labels and visual cues of thunderstorm motion
- Recognize linguistic labels and visual cues of hazards. Understand their potential effects.
- Recognize linguistic, visual, and logical aspects of decision making in response to a

Formative Assessment

- Quiz about thunderstorm knowledge
- Quiz about thunderstorm hazards kowledge
- Quiz about best practices for in-flight decision making about thunderstorms

Summative Assessment

In augmented reality in-flight scenarios, students will be able to:
- correlate linguistic and visual information about the storm
- predict the storm's potential hazards
- estimate the effect of the hazards on the flight
- display safe attitudes towards the hazard
- execute best practices for decision making

Learning Outcomes

Each student can recognize a thunderstorm cell, cell stages, thunderstorm types, and thunderstorm movement. (1,5)

Each student can describe the possible effects of a thunderstorm on an airplane in flight in multiple positions relative to the thunderstorm. (4)

Each student can execute best practices for thunderstorm-related decision making in a variety of given situations. (3,6)

Each student displays safe attitudes towards thunderstorm-related hazards in flight.

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Training Aids - Experiential Education

- Experiential Education is learning by "doing"
- WTIC interactive training modules focus on "doing" visibility estimations and experiencing weather information latency
  - Introduction
  - Training
  - Practice
  - Test
- Visibility and latency modules available at (use Chrome):

https://www.faa.gov/nextgen/programs/weather/wtic/

VFR Not Recommended (VNR)

Gaps / Motivation

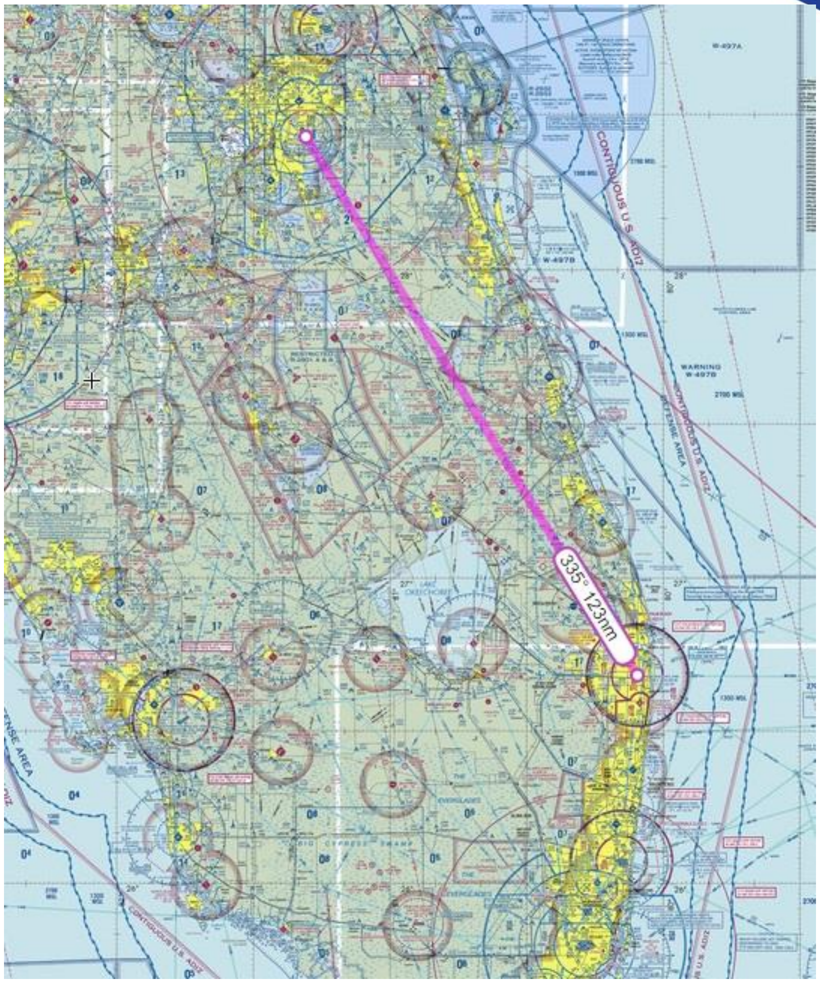
- Digital, automated services lack a meaningful way to provide a VFR Not Recommended (VNR) statement
- The VNR statement is sometimes perceived to be overused or too subjective
- The VNR recommendation is specifically given when "current or forecast conditions, surface or aloft, would make flight under visual flight rules doubtful"
- The FSS includes a brief statement describing the type, location, and movement of weather systems and/or masses which might affect the route or the area
- *Assessment of the Visual Flight Rules Not Recommended Statement study – 2018*
  - FSS and GA pilots evaluated a range of weather scenarios and made determinations regarding VFR vs VNR conditions
    - Inconsistency among the FSS specialists in their recommendation (for some scenarios) and a lack of a procedure for how to use the weather products before making a recommendation indicates a need for procedure standardization
    - Recommendation for further research to help define a standardized procedural method and training for evaluating weather products to achieve a more consistent determination of flight visibility and to develop an automated version of the VNR service

VNR Study – Scenario A

- **Scenario Description**
  - Departure and destination airports show current and forecasted VFR conditions
  - Thunderstorms are present to the west, moving north and parallel to the route
  - Enroute weather shows only a minor possibility of small, localized areas of precipitation

- **Condition Assessment Results**

	VFR	VNR
FSS	17	3
PILOT	9	11



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VNR Study – Notional Display

Enter Flight Plan Information

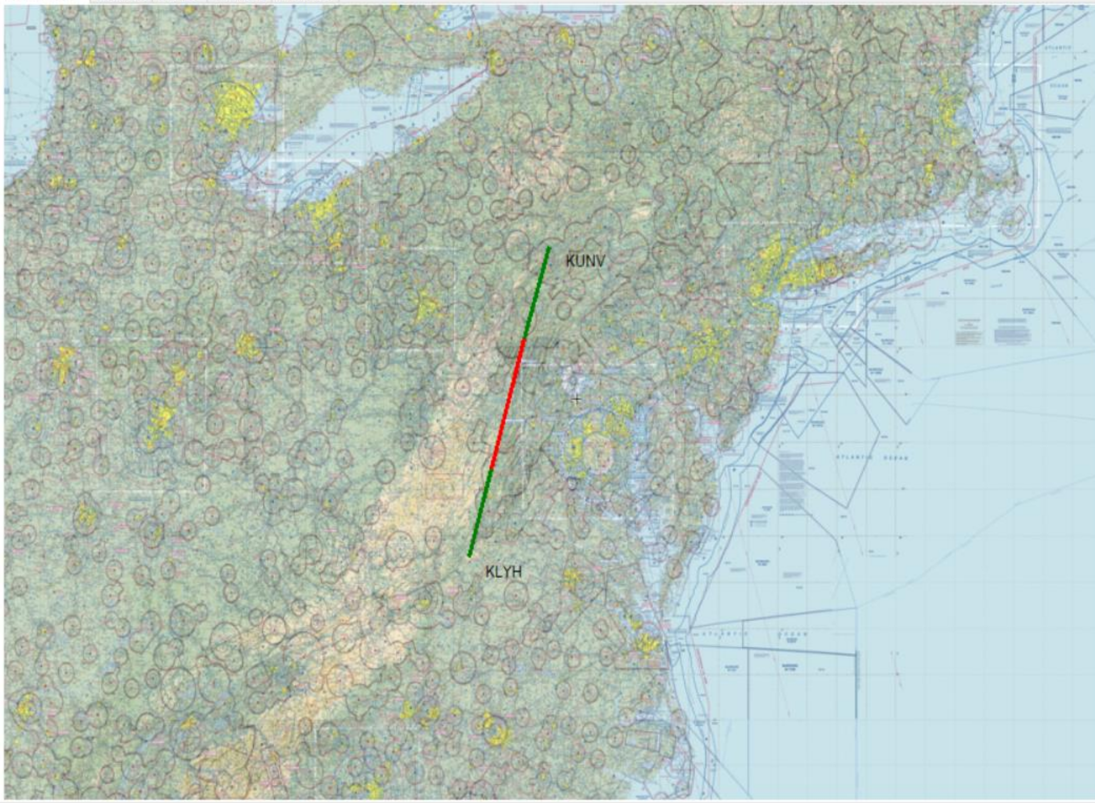
1. Type	2. Aircraft Ident	3. Aircraft Type	4. True Airspeed	5. Departure Point	6. Departure Time (Z)	7. Cruising Alt	9. Destination	10. Est Time En Route	11. Remarks	12. Fuel on Board	13. Alternate Airports
☑ VFR ☐ IFR ☐ DVFR	123	C172	150 KTS	KLYH	Proposed 1500 / Actual	12000 ft	KUNV	Hours 1 / Minutes 40		Hours 3 / Minutes 00	

8. Route of Flight

Evaluate

Reset Fields

Flight Route | Satellite | Radar | PIREPs | AIRMET



Evaluation Status:	VNR Statement
☐ VFR ☑ VNR	

VNR Due to:	Affected Portion of Flight
☐ Low Visibility ☑ Low Ceiling	☐ Departure ☑ En Route ☐ Arrival

Wx Product Status	TAF
METAR Satellite Radar PIREPS AIRMET SIERRA TAF	KUNV 111151Z 1112/1212 VRB04KT P6SM SCT200 FM111300 21003KT P6SM BKN050 FM111700 16005KT P6SM OVC015 FM112100 16006KT P6SM VCSH OVC008 WS012/19040KT FM120000 17006KT 4SM -RA BR OVC004 WS012/19045KT

Alternative	
☑ Time ☐ Altitude ☐ Route	Forecast improving: Delaying your departure time by 1 hour may increase conditions at your departure point.

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Why are PIREPs Important?

"Making a PIREP is the most direct way that you can help another pilot." NASA

- Valuable only if made available to others in the NAS
- PIREPs play a vital role in GA safety
- Pilots use PIREPs during pre-flight planning and during flight to get first-hand direct observations of weather
- Weather forecasters use PIREPs in developing, updating, and improving weather forecast / model accuracy
- Pilots, dispatchers and ATC need PIREPs for strategic and tactical planning (long and short term actions)
- FSS uses PIREPs in their briefings, inflight advisories and WX avoidance procedures
- "A single PIREP may influence a weather forecaster's decision to issue or discontinue a hazardous weather advisory such as an AIRMET or SIGMET, and/or change its area."

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https://aircrafticing.grc.nasa.gov/1_1_5_11.html
https://www.ntsb.gov/safety/safety-alerts/Documents/SA_064.pdf

Barriers to Pilots Submitting PIREPs?

- Unaware that all weather conditions are important – as forecasted or not as forecasted*
- Lack of confidence in ability to accurately assess weather conditions*
- Lack of consistent guidance and criteria for WX reporting*
- Low proficiency or comfort level with PIREP submission methods*
- Belief that their PIREP will not be disseminated to others*
- Submitting a PIREP in-flight for GA pilots may mean switching the radio to FSS or talking to a controller for extended periods of time**
- GA pilots may be busy flying when the WX event occurs and may have to report several minutes later and rely on best estimates of altitude and location

*https://www.ntsb.gov/safety/safety-alerts/Documents/SA_064.pdf

** https://ntsb.gov/safety/safety-studies/Documents/SIR1702.pdf

How to Provide Better PIREP Information*

- Provide PIREPs when workload permits
- Report accurate time and location
- Become more familiar with PIREP formats and submission methods
- Provide complete or standard terminology/codes to significantly improve a PIREPs effectiveness

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*https://www.ntsb.gov/safety/safety-alerts/Documents/SA_064.pdf

Help us…Help you!

- PIREPs are important not just to you and your fellow pilots, but also aviation weather forecasters
  - PIREPs are feedback to the forecaster and serve as an observation (aka "ground truth") for computer models
  - The more accurate data computers have on the state of the atmosphere the better computers can help predict it
  - Don't forget null reports: Knowing where aviation weather hazards are not occurring is important too; helps forecasters and computer models target areas to improve temporal, horizontal and vertical product resolutions

Wrap Up
Feedback to Briefers Encouraged

- Interested in Flight Instructor Perspectives On:
  - This course
  - Training materials presented
  - Interest in participating in research activities and product evaluations
  - Challenges to teaching weather
  - Issues related to weather information and products
  - Perspectives on weather related accidents/incidents
  - Future Mentor Live weather topics or specific areas of weather focus (winter weather tentatively Oct 2020)

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Additional Information

- Contact:
  - Randy Bass – Randy.Bass@faa.gov
  - Jason Baker – Jason.M.Baker@faa.gov
  - Gary Pokodner – Gary.Pokodner@faa.gov
  - Jenny Colavito – Jenny.Colavito@faa.gov

Additional Information

Links Summary:

- Pilot Knowledge Test Report
  - https://commons.erau.edu/ga-wx-display-interpretation/13/
- Preflight Mental Model Experiment Briefing
  - https://ral.ucar.edu/events/2018/friends-and-partners-in-aviation-weather-0
- Link to Comet
  - https://www.meted.ucar.edu/index.php
- Taxonomy Information
  - https://doi.org/10.15394/jaaer.2020.1815
- WTIC Research Reports and Experiential Education Modules
  - https://www.faa.gov/nextgen/programs/weather/wtic/
- FAA Safety Website
  - FAASafety.gov
- PIREP Information from NTSB
  - https://www.ntsb.gov/safety/safety-alerts/Documents/SA_064.pdf
  - https://ntsb.gov/safety/safety-studies/Documents/SIR1702.pdf
- 10 Mini Weather Courses
  - https://fly8ma.com/courses/weatherxplore-course/

Weather Training in the Cockpit Spring/Summer Focus




Presented by FAA Aviation Weather Division staff (left to right):

Jennifer Colavito, Ceiling and Visibility Project Lead

Gary Pokodner, Weather Technology in the Cockpit Program Manager

Jason Baker, Research Meteorologist

Randall Bass, Weather Research Branch Manager

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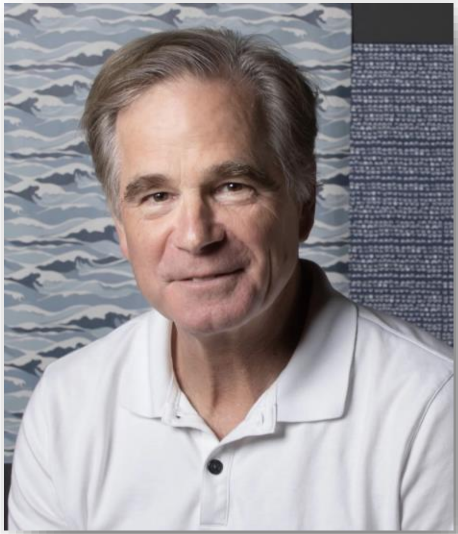
Save the Date!

Join us for next month's MentorLIVE, July 15th at 8:00 p.m. ET



Scenario-based Simulation Training for the Rest of Us

Presented by William "Billy" Winburn, founder Community Aviation

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Thanks for Watching!

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