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Welcome!

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Enhanced Winter Weather Training

Presented by the FAA Weather Research Branch

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Tonight's Host – Jennifer Colavito

FAA Engineer

- FAA Aviation Weather Research Program (AWRP), leads Ceiling and Visibility Research
- 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.

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Dr. Ian Johnson

FAA Engineering Psychologist

- FAA Weather Technology in the Cockpit program, Human Factors Lead and General Aviation expert
- Over 20 years' experience in Human Factors Engineering and System Safety of various cockpit display systems and user interfaces.
- 3 Degrees Embry Riddle Aeronautical University
  - BS in Human Factors Psychology
  - Masters in Human Factors in Aviation Systems and
  - Masters in Aviation/Aerospace Safety Systems
- Ph.D. in Psychology with an emphasis in Cognition and Instruction from Grand Canyon University.
- Single and Multi-Engine Airplane pilot.

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Danny Sims

FAA Physical Scientist

- FAA AWRP, leads Inflight Icing and the Model Development and Enhancement weather research
- Led sustainment of the FAA Traffic Flow Management System (TFMS) at the FAA Air Traffic Control System Command Center.
- Led TFMS Weather Integration efforts, HQ
- Led test and evaluation of aviation weather products at the FAA William J. Hughes Technical Center.
- US Air Force weather officer
- BA in Environmental Science from the University of Virginia and a BS and MS in Meteorology from the Pennsylvania State University

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Winter Weather Flight Scenario

- **Ian walks us through flight planning**
  - Ian makes errors that research and accident investigations have identified as recurring
  - Take mental notes: How many errors do you notice?
- **Danny reviews the scenario**
  - What Ian did right
  - What Ian did wrong
  - What else Ian could have done
  - How to help your students avoid these recurring mistakes

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Meet the pilot

"Hi, my name is Ian. I love flying and the feeling it gives me. I recently completed pilot training and obtained my pilot's license. I am a small business owner, and because of my success I have recently purchased my own aircraft. Therefore, I am taking my family on a weekend getaway for some rest and relaxation. We'll be flying a VFR flight from Fort Collins, Colorado to Moab, Utah in my Cessna 172."

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Flight Plan

- Flight Date: 15 September
- Intended Route of Flight
  - Departure: Fort Collins (FNL) CO
  - Destination: Canyonlands Field Airport (CNY), Moab UT
  - About 280 miles (~2 hours flight time)
- Intended Departure Time (D_1): 1530 MDT (2130 UTC)
- Ian is a non-instrumented rated pilot
- VFR flight plan filed & Flight Following
- Intended Flight Altitude: 10,000 – 15,000 feet MSL to clear terrain
- Ian is concerned about the potential of wintry conditions, especially icing, ceiling and visibility, and turbulence

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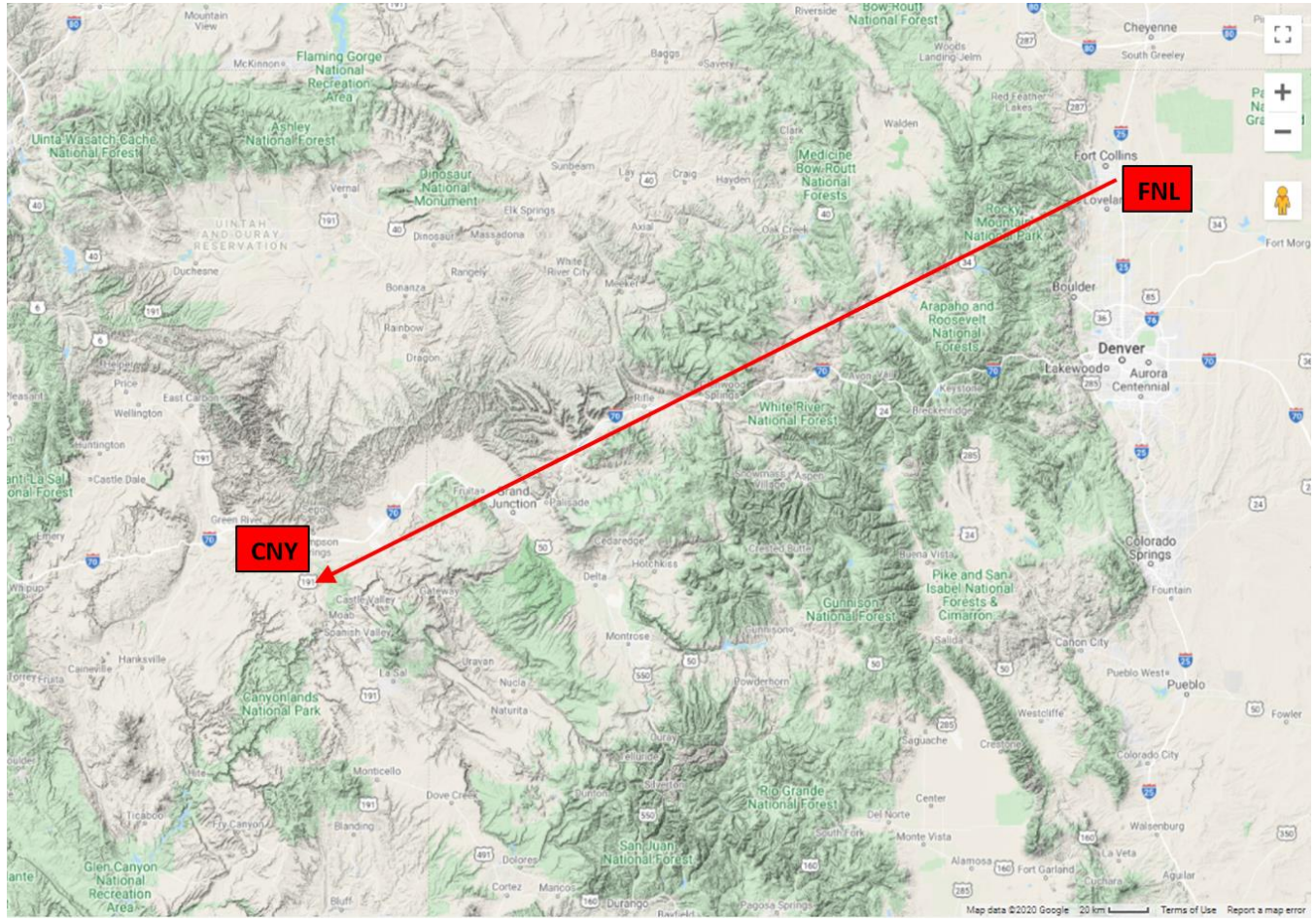

Weather self-briefing

1500 MDT/2100 UTC
D_1-30 minutes

- **FNL METAR**
  - KFNL 152056Z AUTO VRB03KT 10SM SCT110 27/04 A2979 RMK AO2 SLP025 T02720039 58006
- **CNY METAR and TAF**
  - KCNY 152053Z AUTO 31020G27KT 10SM CLR 20/11 A2989 RMK AO2 PK WND 30027/2045 SLP086 T02000111 58002
  - KCNY 151740Z 1518/1618 21011G19KT P6SM FEW070 SCT120 \FM152200 24016KT P6SM FEW070 SCT150 \FM160000 28017KT P6SM VCSH FEW070 SCT110 \FM160300 32009KT P6SM BKN070 \FM160600 33006KT P6SM FEW060 SCT200 \FM161700 00000KT P6SM SKC
- **Surface Analysis**
- **Satellite**
- **Radar**
- **AIRMETs and SIGMETs**
- **Looks good to go**

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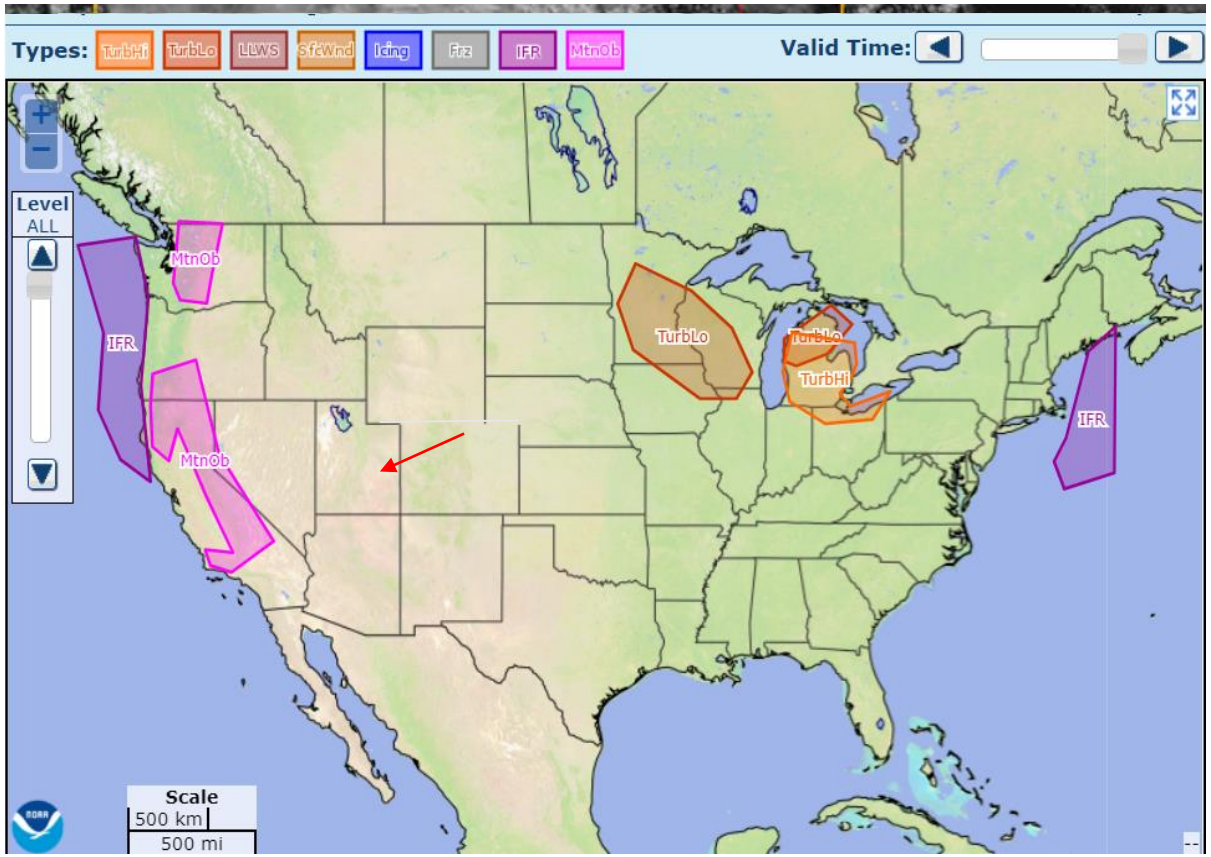

Delayed

1500-1920 MDT
2100-0120 UTC
D_1-30 to D_2

- **Pressing business issue comes up**
- **New departure time (D_2) of 1920 MDT (0120 UTC)**
- **Sun is going down, so it's going to be a night flight**
- **Got to get going; no time for a weather update but how much could the weather have changed?**

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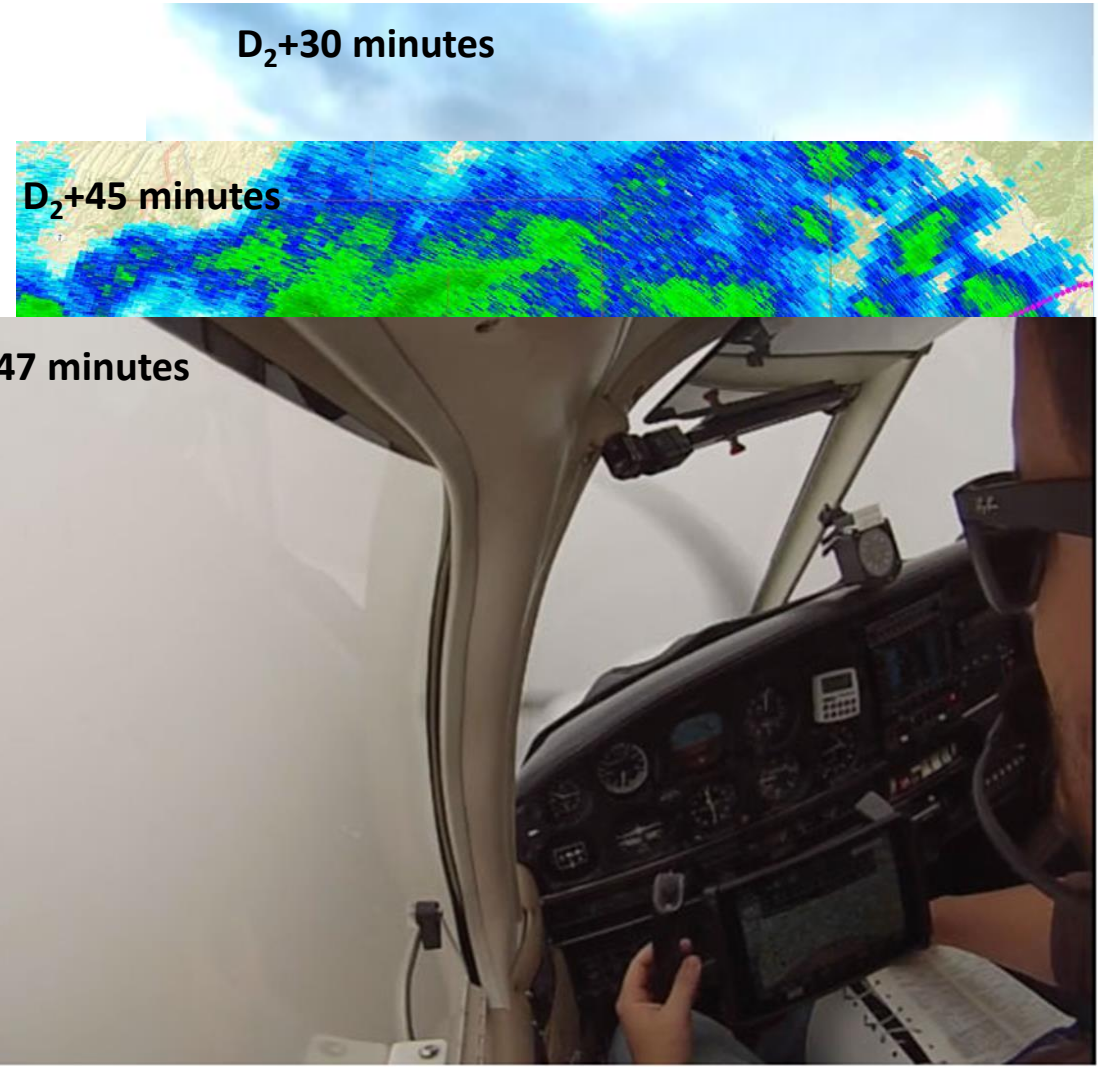
Unexpected Weather

D_2: 1920 MDT (0120 UTC)

- **Encounter intermittent IMC 30 minutes into flight**
- **45 minutes into flight weather radar showing precipitation ahead**
  - Deviate to the Northwest
- **Encounter solid IMC soon after**
- **Encounter inflight icing**
  - "Supercooled water mass" on the windshield
  - Windshield crystalized with ice in about 5 seconds



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Unexpected Icing

2010 MDT/0210 UTC
D_2+50 minutes

Ian to ATC: “I’ve encountered icing conditions and I am in IMC”

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Replay

1500 MDT/2100 UTC
D_1-30 minutes

Ian says “Why didn’t I see the hazards in the weather products? What could I have done differently to avoid the hazards?"

How can you help your students avoid similar mistakes?

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What could change?

1500-1920 MDT
2100-0120 UTC
D_1-30 to D_2

- **What a pilot should consider while building a mental model**
  - What if my departure gets delayed?
  - Radar and satellite changes
  - METAR changes
  - Making sure to check weather enroute . . .
  - When was forecast made . . . is new forecast coming out soon?
  - Time of day . . . sunrise, sunset, sun angle?
  - What if the weather is moving faster/slower than expected?
  - What if its colder than expected?
  - Pilot distractions such as meetings, passengers, delays, maintenance, etc.
- **Don’t assume the best case; but prepare for the worst case**
- **Be prepared for anything that can cause a change in the pilots’ routine**

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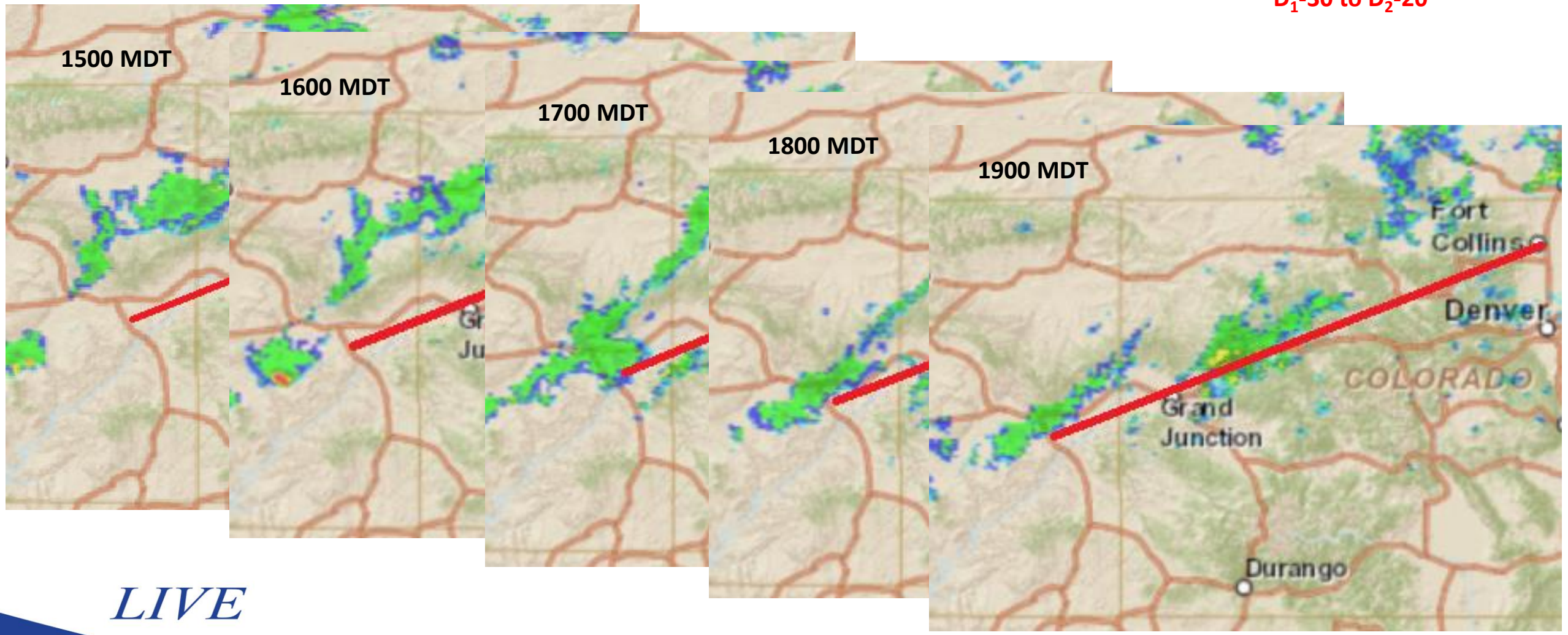
Weather radar changes

1500-1900 MDT
2100-0100 UTC
D_1-30 to D_2-20



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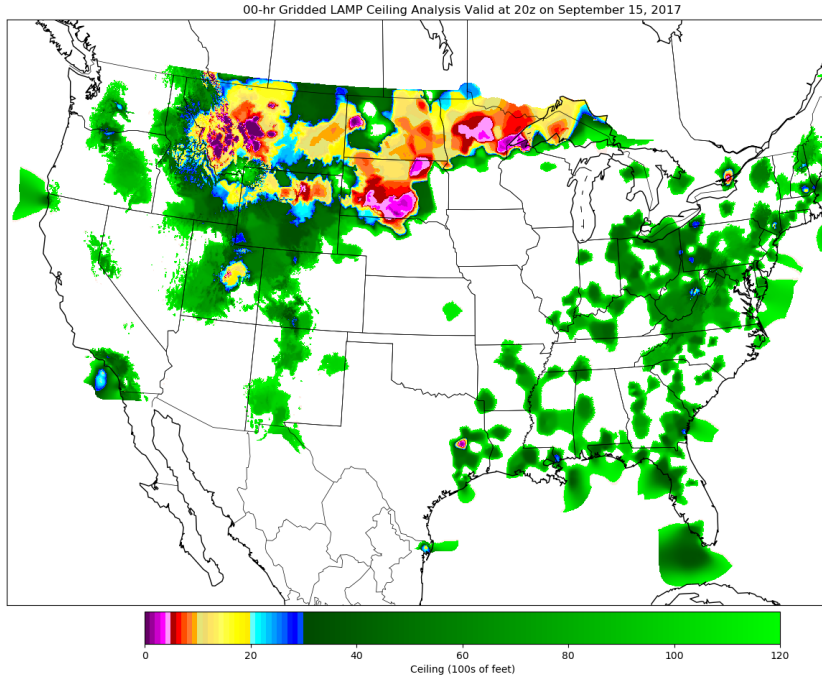
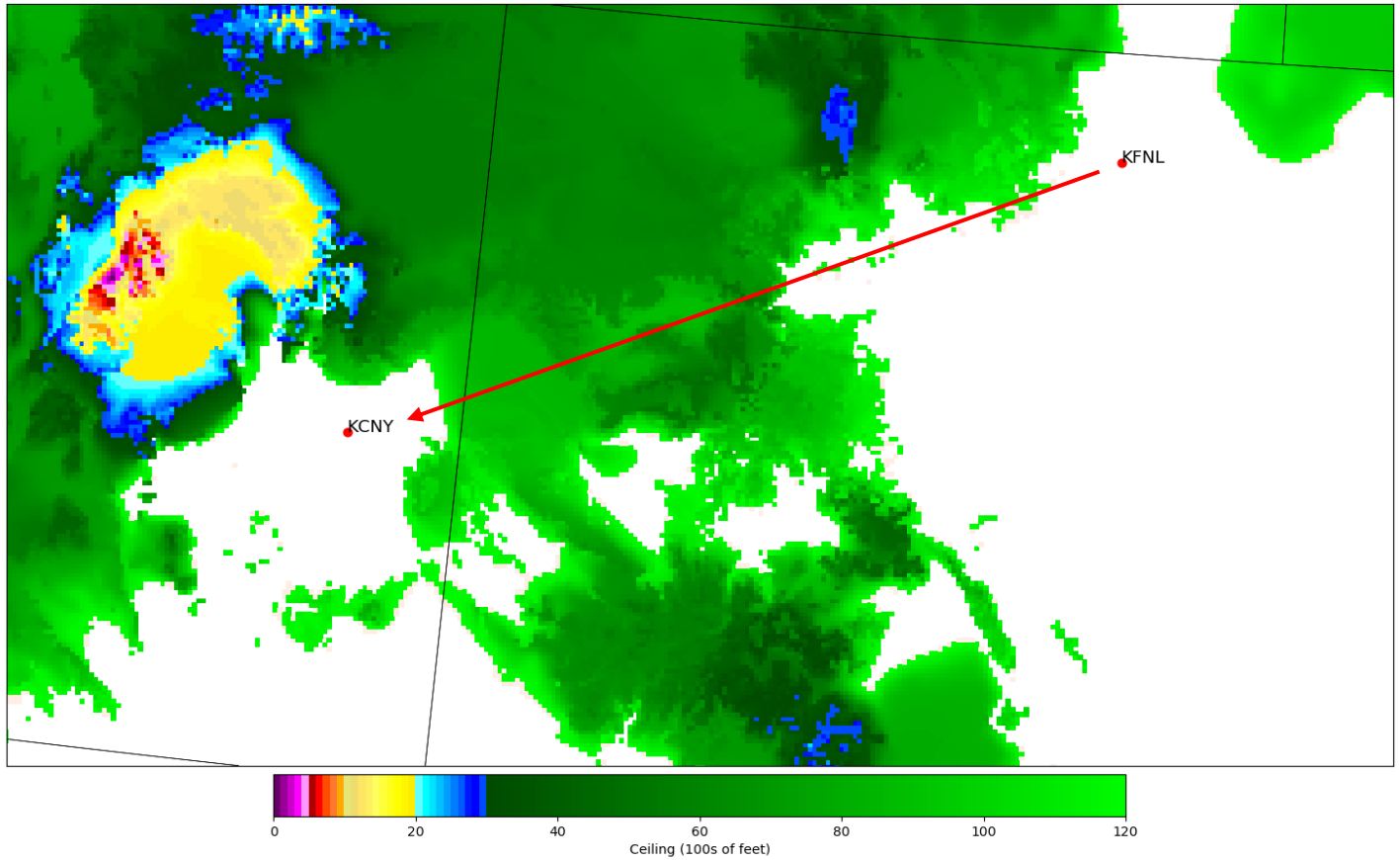
Ceiling Information

1500 MDT/2100 UTC
D_1-30

- Localized Aviation Model Output Statistics (MOS) Product (LAMP) analysis and forecast products





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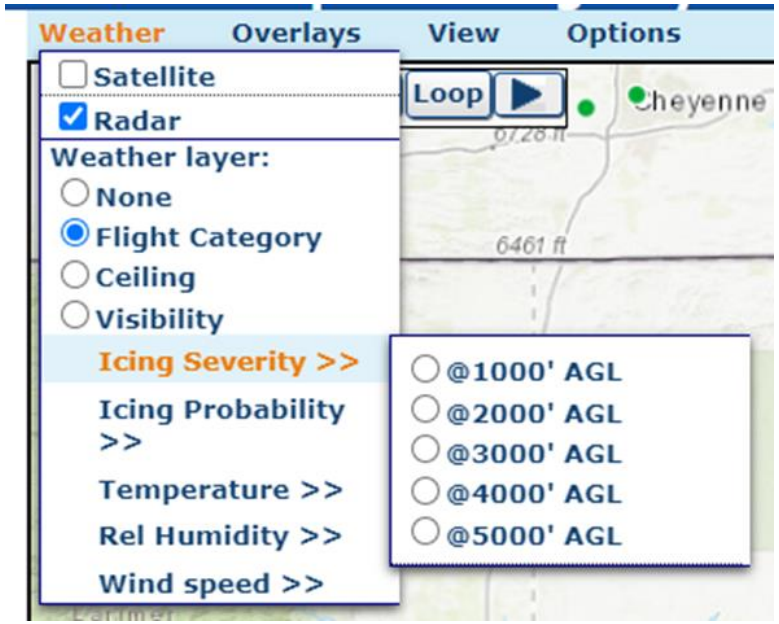
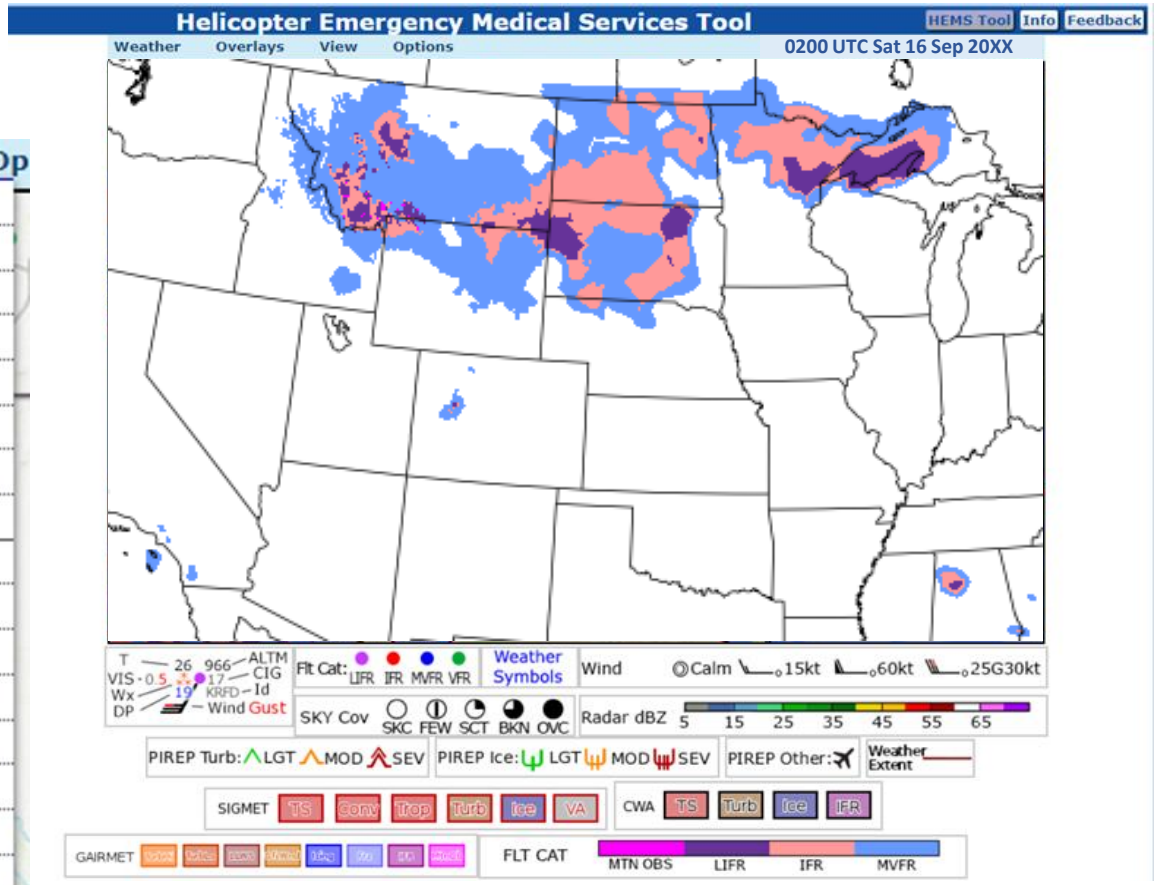
Aviation Weather Center Graphical Tools

2000 MDT/0200 UTC
D_2+40 minutes

- Graphical Forecast for Aviation (GFA)
- HEMS Tool – low altitude





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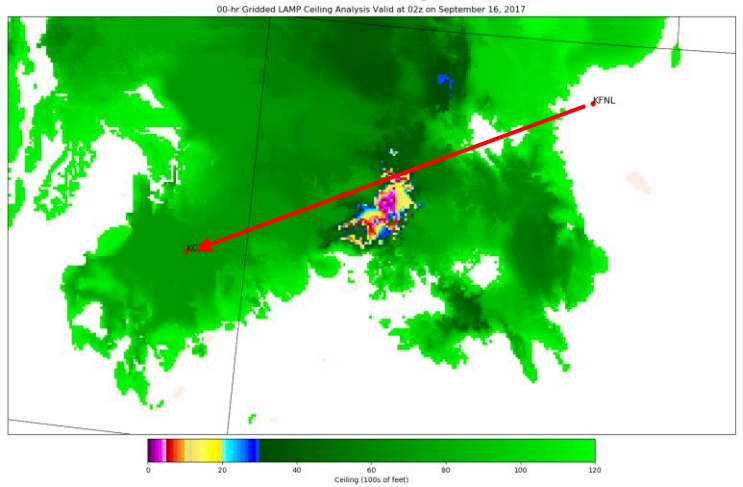
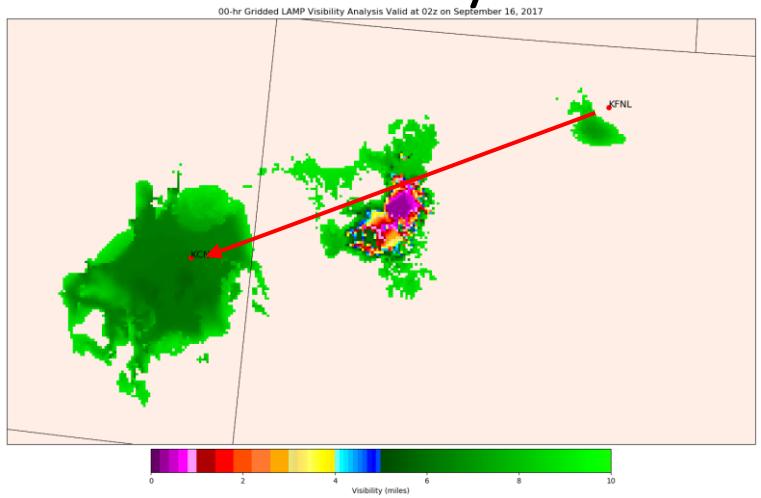
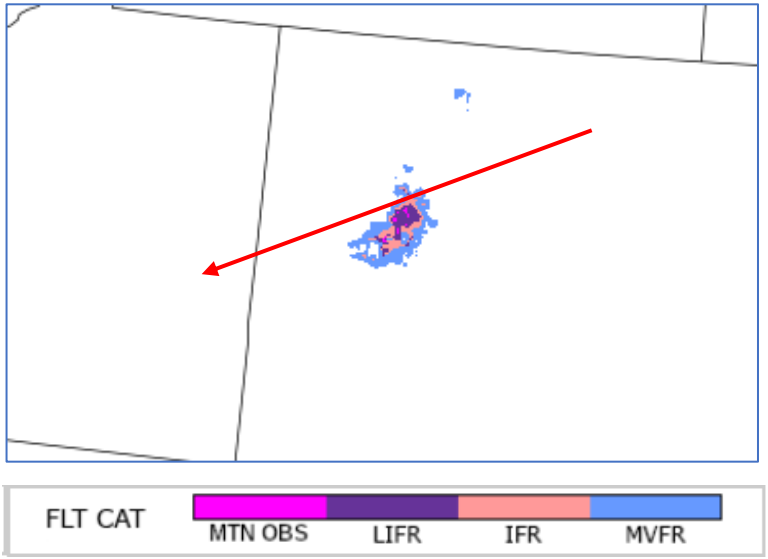
Ceiling



Visibility



Flight Category



2000 MDT/0200 UTC
D_2+40 minutes

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HEMS Tool uses LAMP C&V analysis and forecast

Ceiling And Visibility Definition

Section 1.1 14 CFR Part 1 - Definitions - Federal Air Regulations
FAA Order 7900.5C, the Surface Weather Observing Guide.

Ceiling is the height above the Earth's surface of the lowest layer of clouds or obscuring phenomena that is reported as broken, overcast, or obscuration, and not classified as thin or partial"

Visibility is a measure of the horizontal opacity of the atmosphere at the point of observation and is expressed in terms of the horizontal distance at which a person should be able to see and identify specific objects.

Important Notes:

1. Ceiling is lowest height with broken (BKN) or overcast (OVC) reported; Scattered (SCT) or Few (FEW) don't count
2. Ceiling is measured Above Ground Level (AGL)
3. Visibility is at the surface

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Weather Display Flight Categories

Category*	Ceiling, AGL		Visibility
LIFR (Low IFR)	Less than 500 ft	and/or	Less than 1 mile
IFR	500 ft to less than 1000 ft	and/or	1 to less than 3 miles
MVFR (Marginal VFR)	1000 to 3000 ft	and/or	3 to 5 miles
VFR	Greater than 3000 ft	and	Greater than 5 miles

*These categories are not flight rules and should not be confused with the flight rules provided in Part 91, including those for Basic VFR Weather Minimums. Rather, these categories were created for weather charts as a means to visually enhance the products.

Scenario Intended Flight Altitude: 10,000’ – 15,000’ MSL

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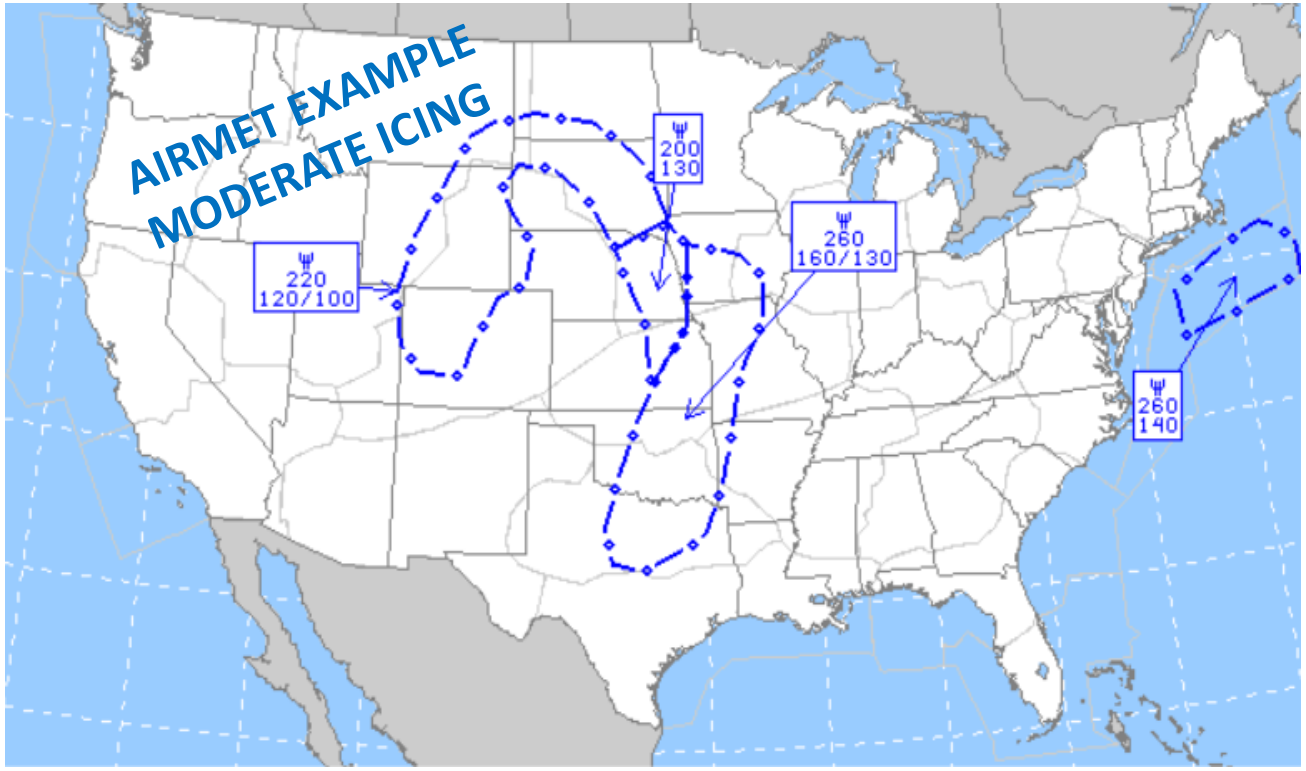
AIRMET and SIGMET

1500 MDT/2100 UTC
D_1-30 minutes

- **Why no AIRMETs and SIGMETs?**
  - AIRMETs are for Moderate icing and turbulence
  - SIGMETs are for Severe icing and turbulence
  - Trace or light icing or light turbulence will not warrant an AIRMET or SIGMET
    - But icing can still be hazardous to an aircraft without anti- or de-icing equipment
  - Note that a Convective SIGMET also implies severe or greater turbulence, severe icing, and low level wind shear



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Icing – CIP and FIP

1900 MDT/0100 UTC
D_2-20 minutes

- Current Icing Product (CIP) and Forecast Icing Product (FIP) are automated icing products to supplement AIRMETs and SIGMETs
  - CIP is a diagnosis or nowcast (0-hour forecast)
  - FIP is a forecast out to 18 hours
- Available pre-departure and via FIS-B while in flight (along with other products)

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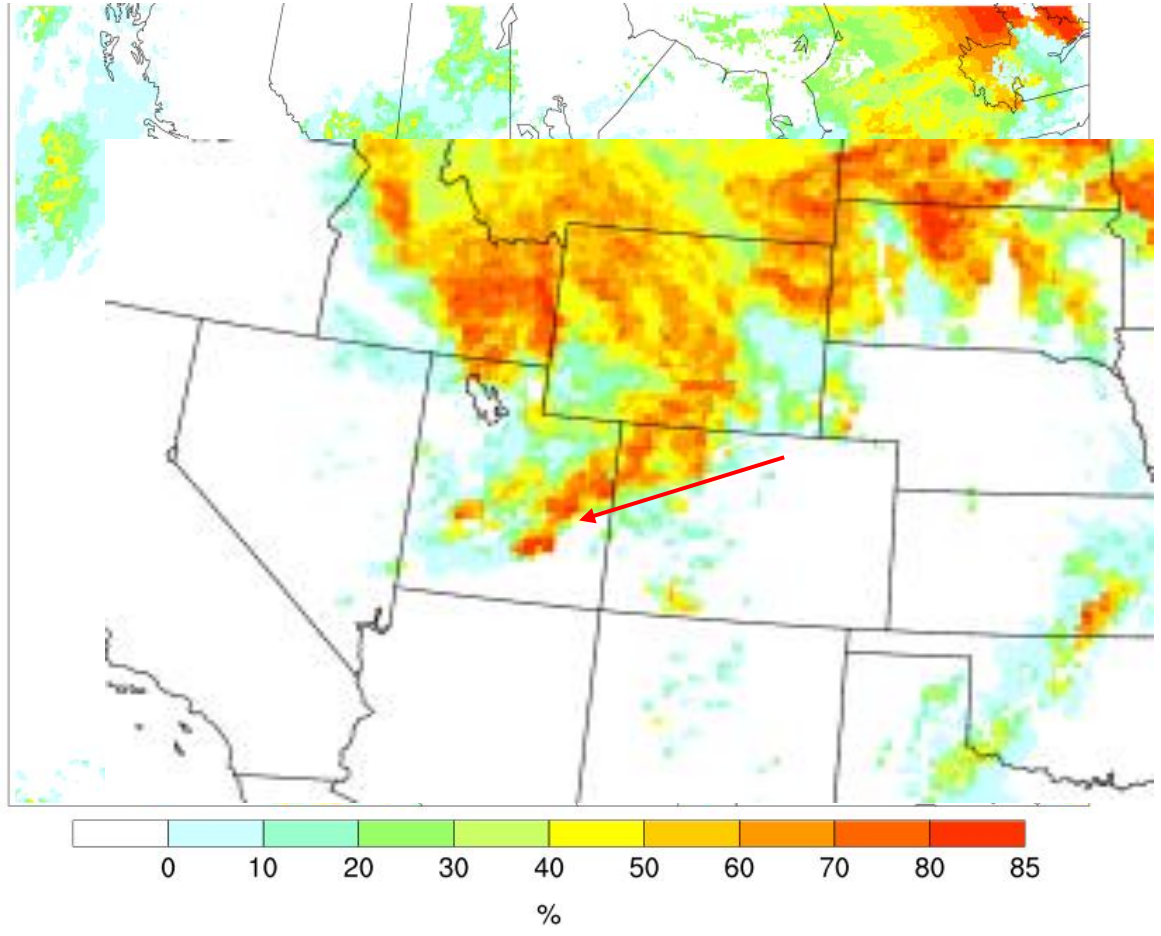
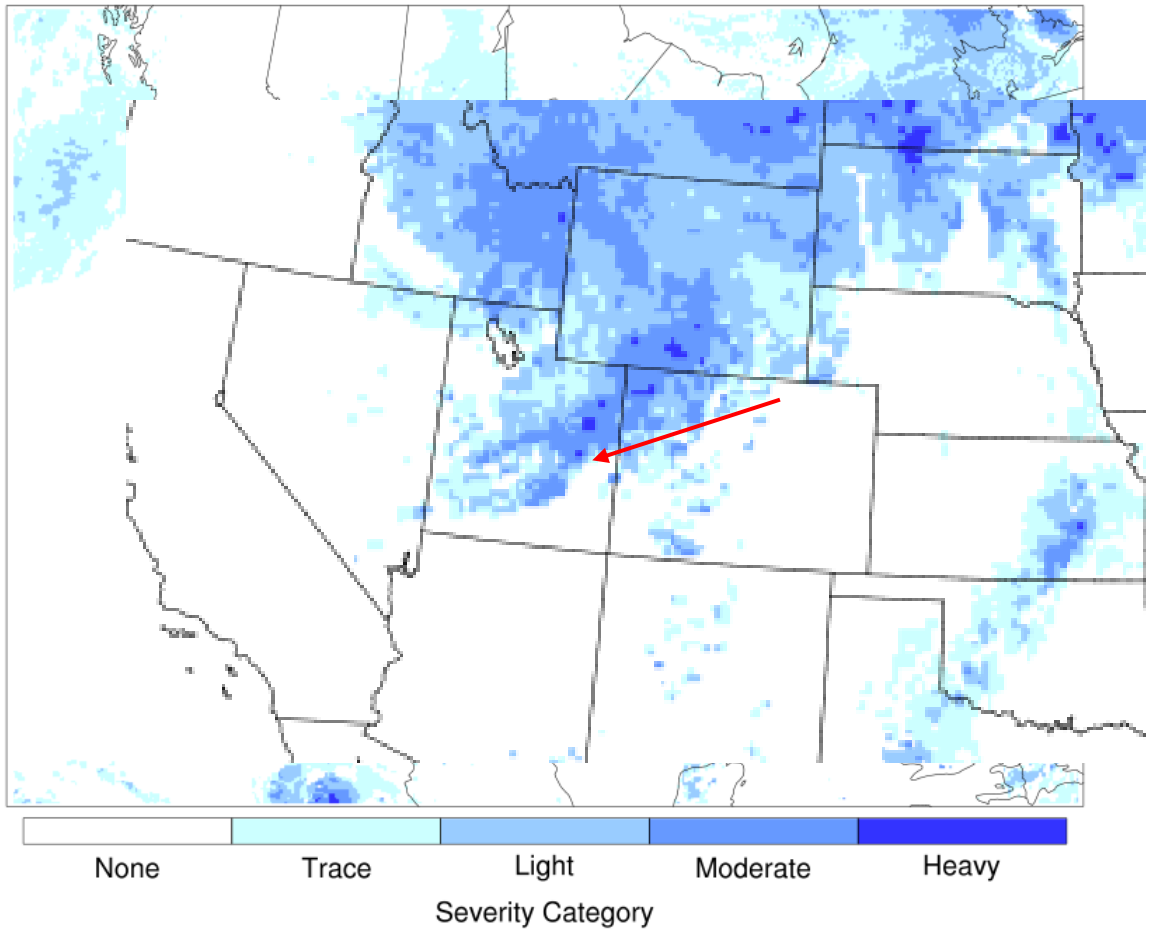
Icing – CIP and FIP

1900 MDT/0100 UTC
D_2-20 minutes

ICING PROBABILITY COMPOSITE



ICING SEVERITY CATEGORY COMPOSITE



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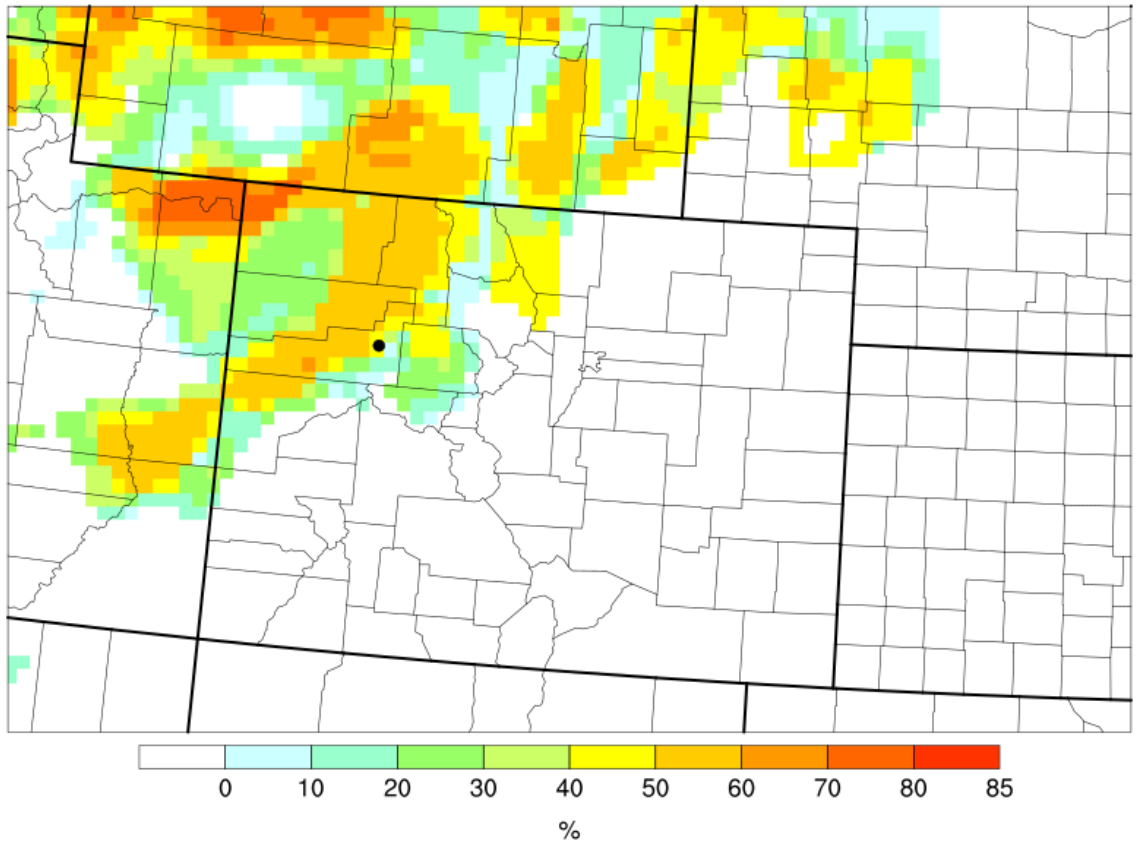
Icing - FIP 2-hour forecast

1900 MDT/0100 UTC
D_2-20 minutes

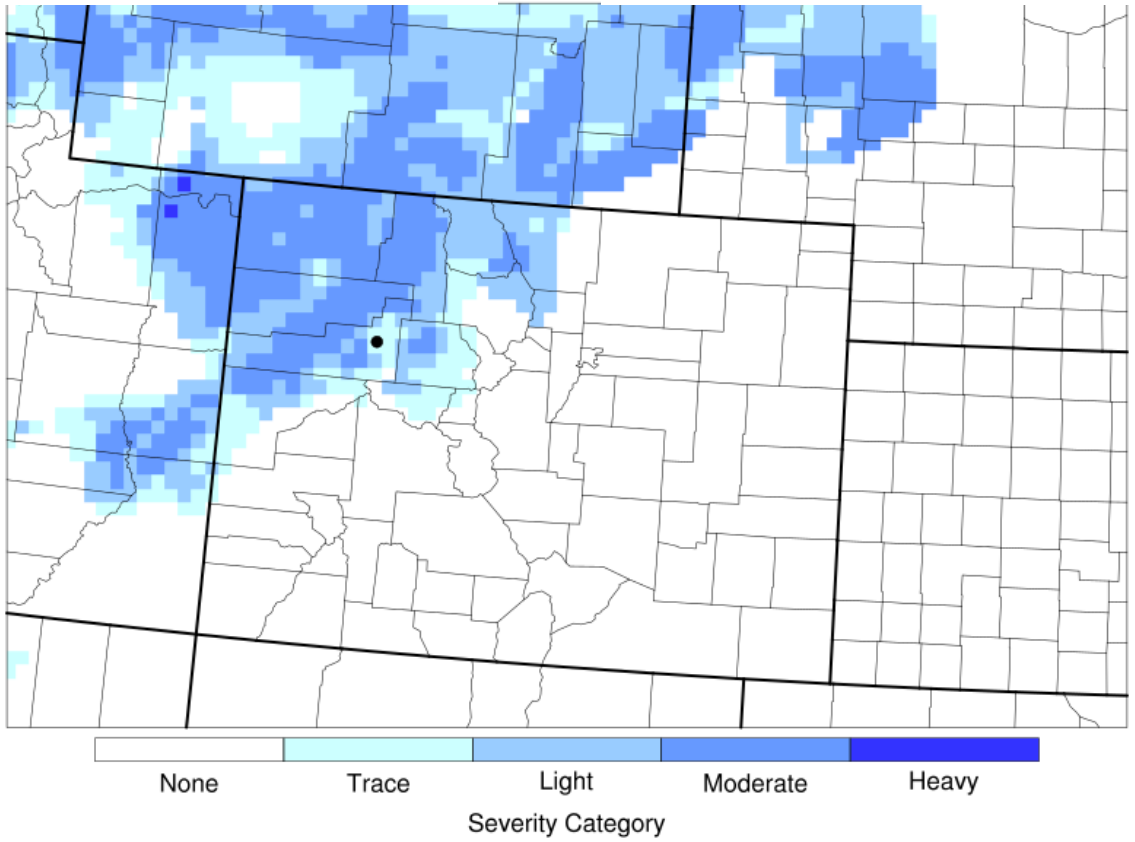
ICING PROBABILITY at FL 130

2 hour forecast valid 9/16 0300 UTC



ICING SEVERITY CATEGORY at FL 130

2 hour forecast valid 9/16 0300 UTC



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Turbulence

- **Recall the satellite image from Ian's initial self-briefing**
  - Notice the wave-like patterns especially in north-central CO but throughout the Rocky Mountains
  - Bands of clouds that resemble waves on weather satellite images are usually a good indicator of turbulence
- **Updated Infrared satellite at night hours**
  - Visible no longer available or usable
- **Supplement with other turbulence-specific products such as the Graphical Turbulence Guidance**

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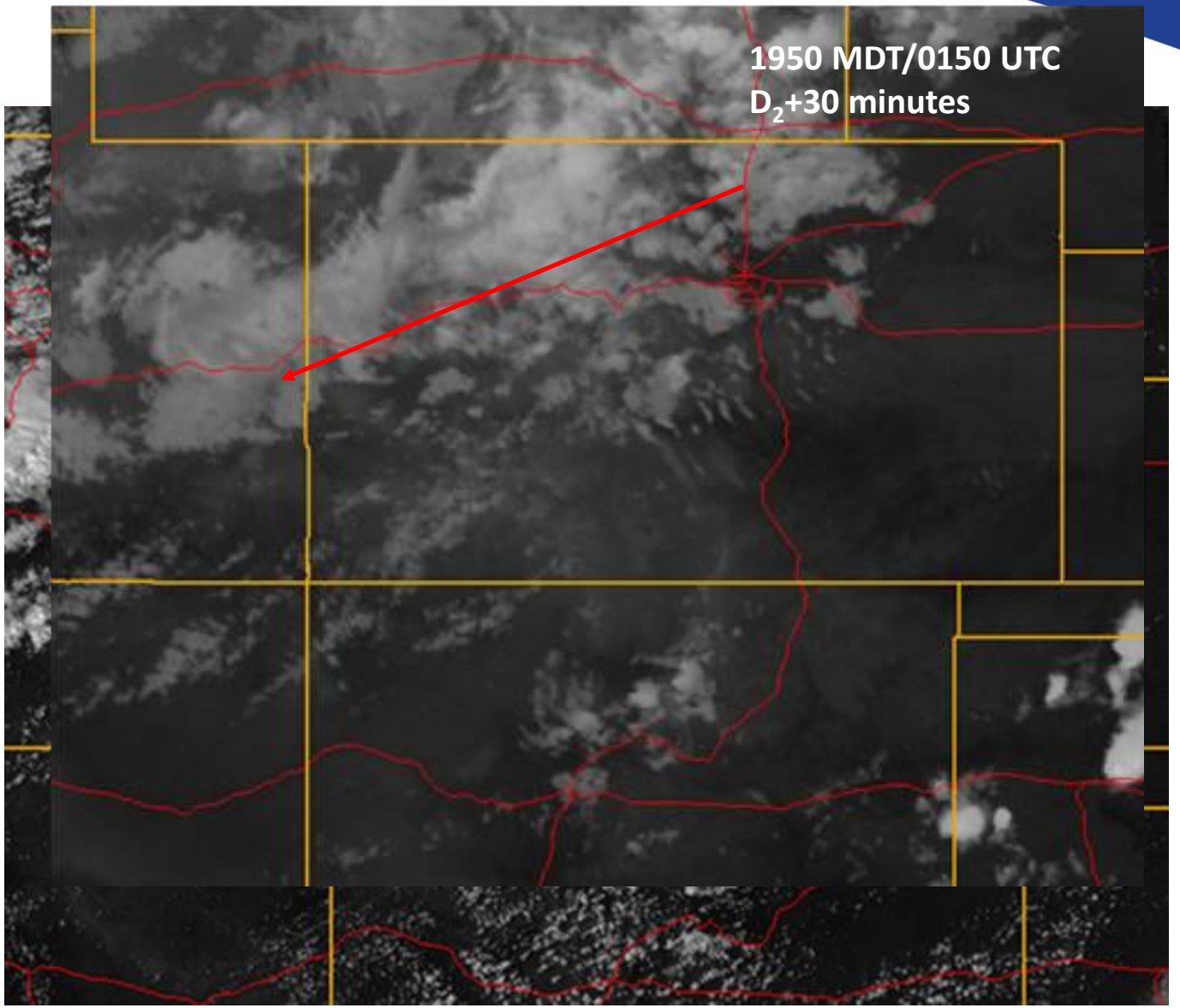
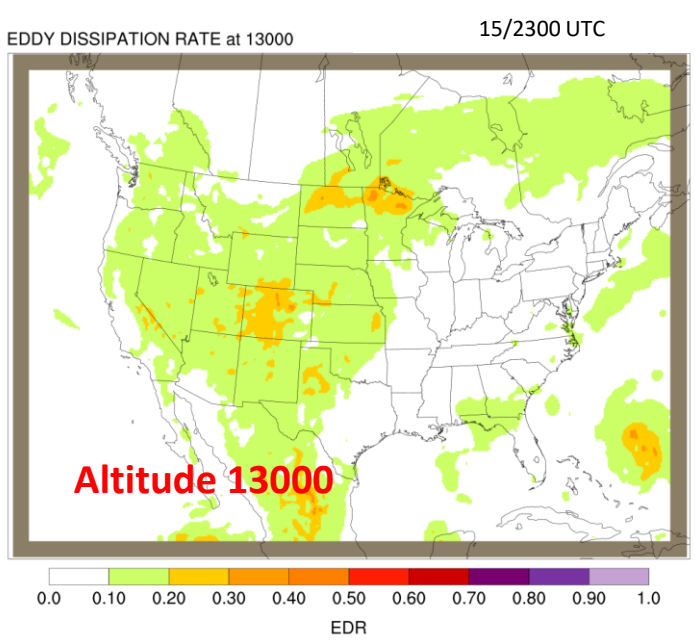
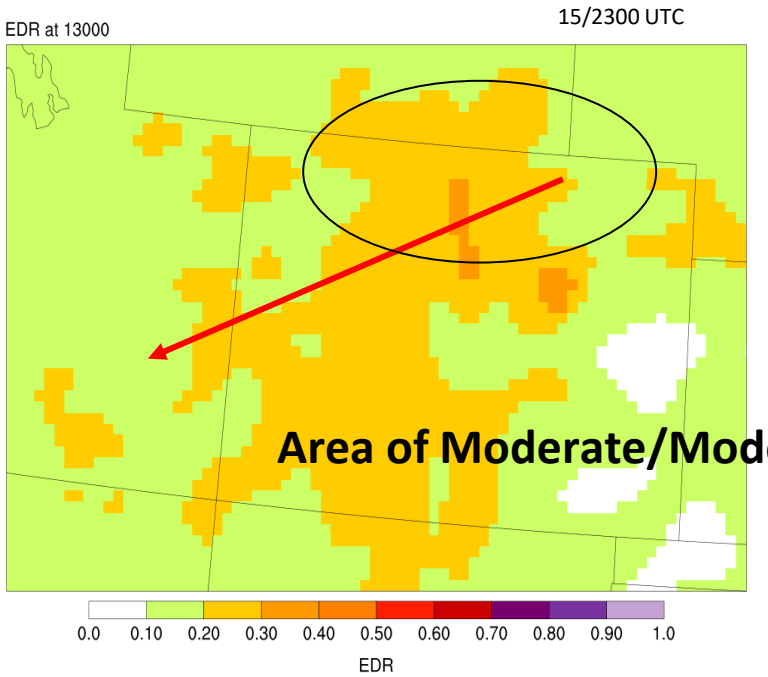


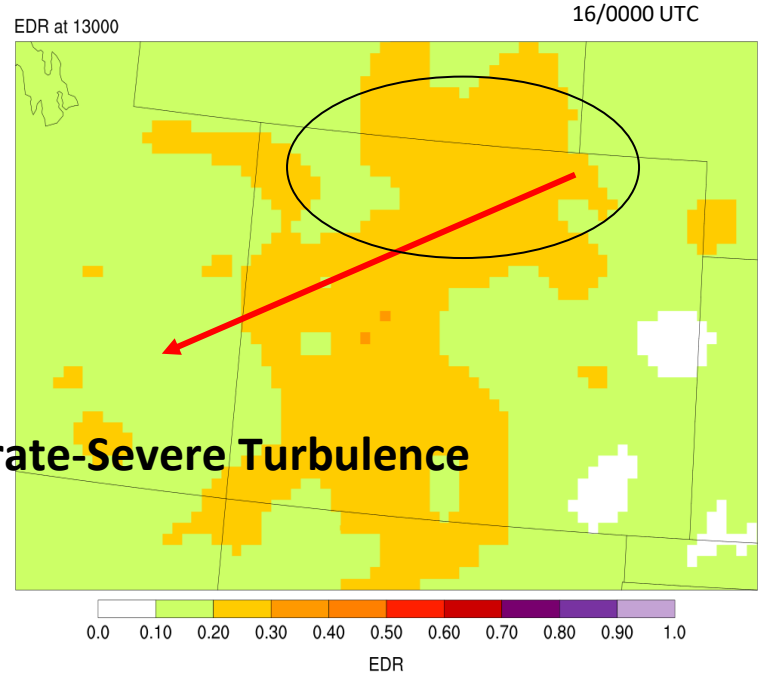
GTG Forecast

1500 MDT/2100 UTC
D_1-30 minutes

Graphical Turbulence Guidance (GTG) is an automated turbulence forecast product available on aviationweather.gov







Eddy Dissipation Rate (EDR) objective values translated to turbulence intensity of light, moderate, severe, and extreme

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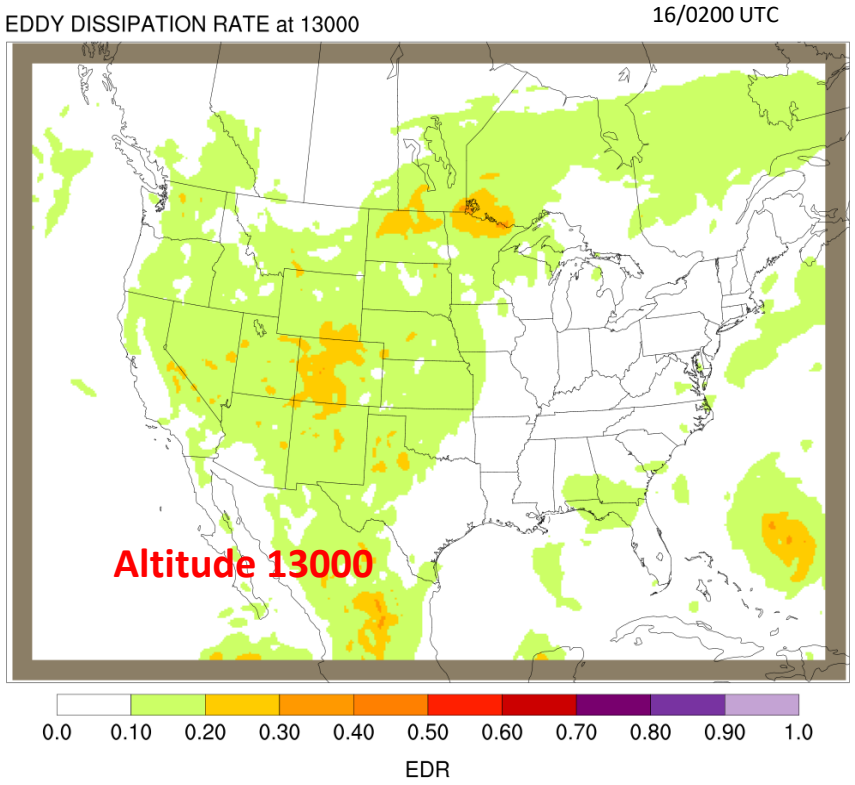
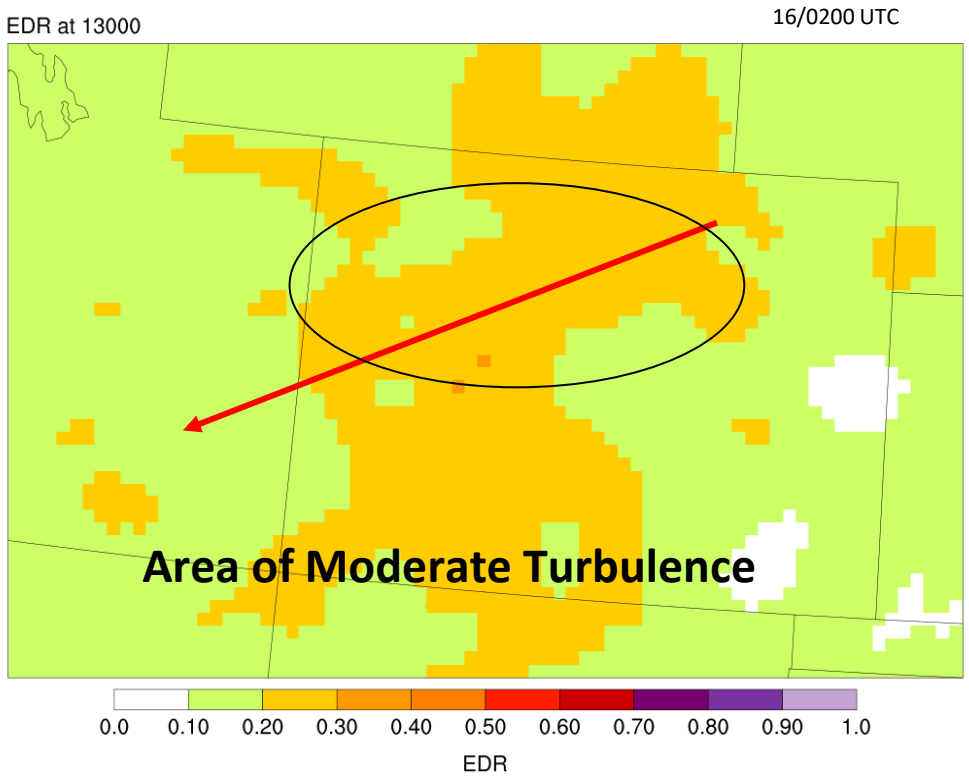
GTG Update

1900 MDT/0100 UTC
D_2-20 minutes





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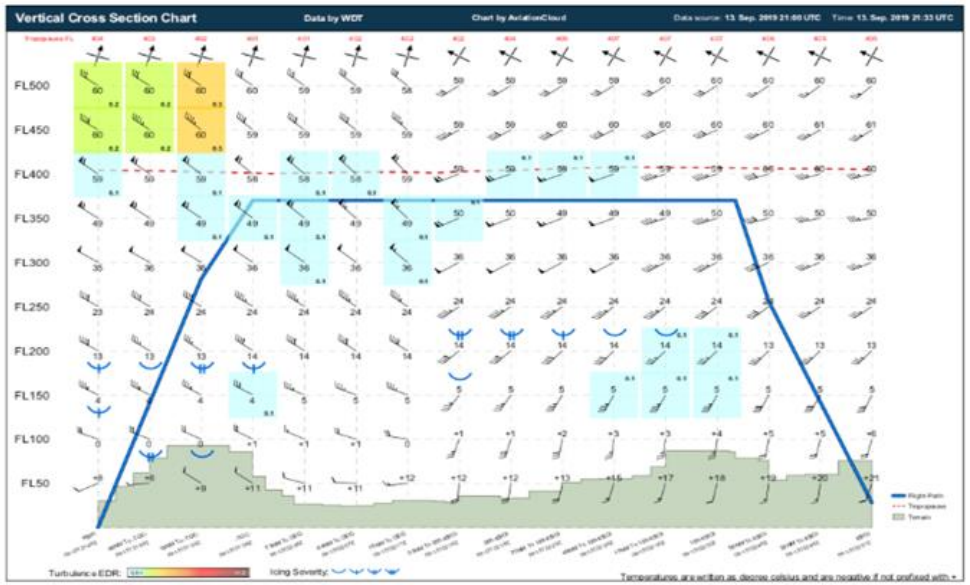
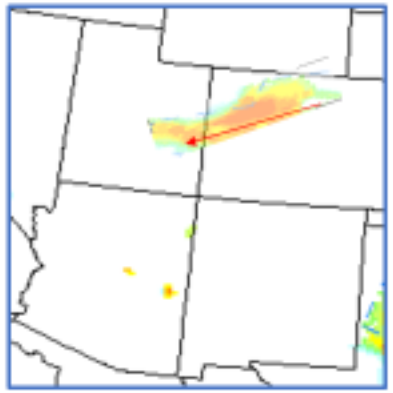
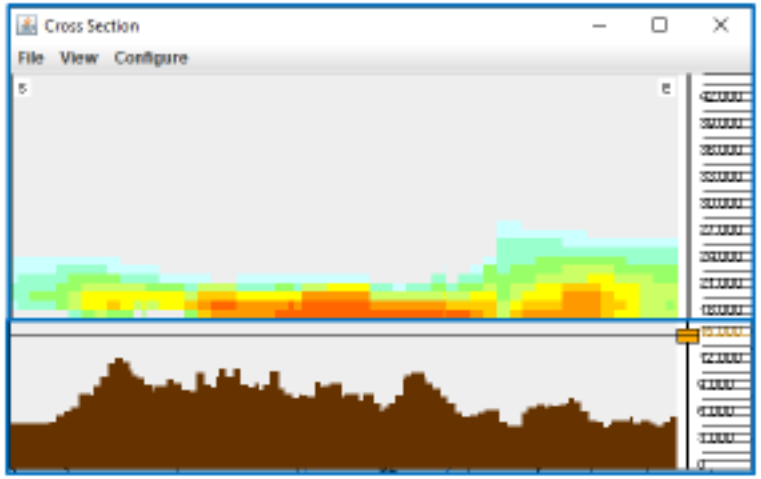
Representative Cross Sections

Flight path cross sections available from government and industry flight planning tools allow pilot to see, at a glance, what altitudes may be impacted by weather







Vertical cross sections do not show the horizontal extent of hazards.
Use in conjunction with plan views

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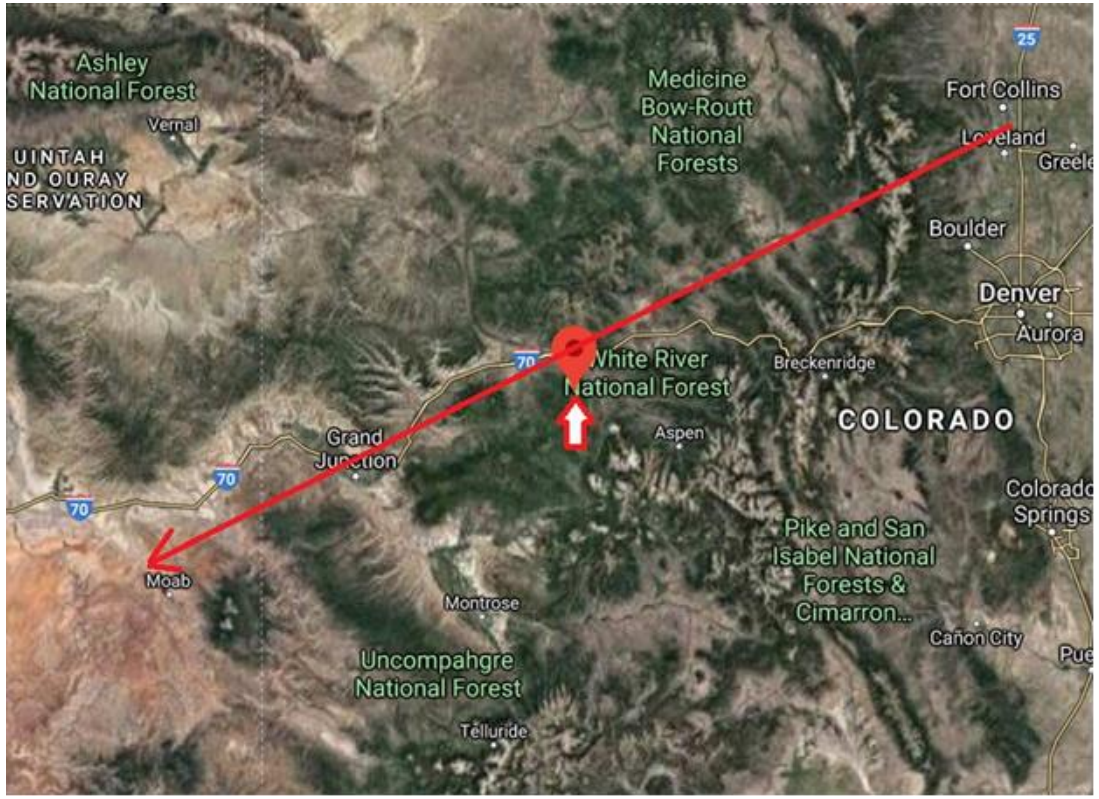
Information from METARs

1829-1910 MDT
0029-0110 UTC
D_2-10 minutes

METARs along route

- Understand the environment factors associated with icing (moisture and sub-freezing temperatures)
- Icing clues from Sunlight Mountain (5SM) AWOS at an elevation of 10,604 feet
  - [1829 MDT] METAR K5SM 160029Z AUTO 26007G20KT 230V030 10SM -TSRA BKN006 BKN047 OVC095 03/01 A3022 RMK AO2 LTG DSNT SW THRU N=
  - [1849 MDT] METAR K5SM 160049Z AUTO 26012G21KT 190V320 1 3/4SM –TSRA OVC002 03/02 A3022 RMK AO2 LTG DSNT W THRU NE=
  - [1910 MDT] METAR K5SM 160110Z AUTO 27014G25KT 230V310 1/4SM -RA OVC002 01/01 A3023 RMK AO2 LTG DSNT NW THRU NE=
  - **This last observation is just prior to the delayed departure time and it shows precipitation, clouds, and near freezing temperatures which provide insight to the likelihood of icing**



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Colorado Webcams with directional images

Also available in Alaska and being installed in Hawaii

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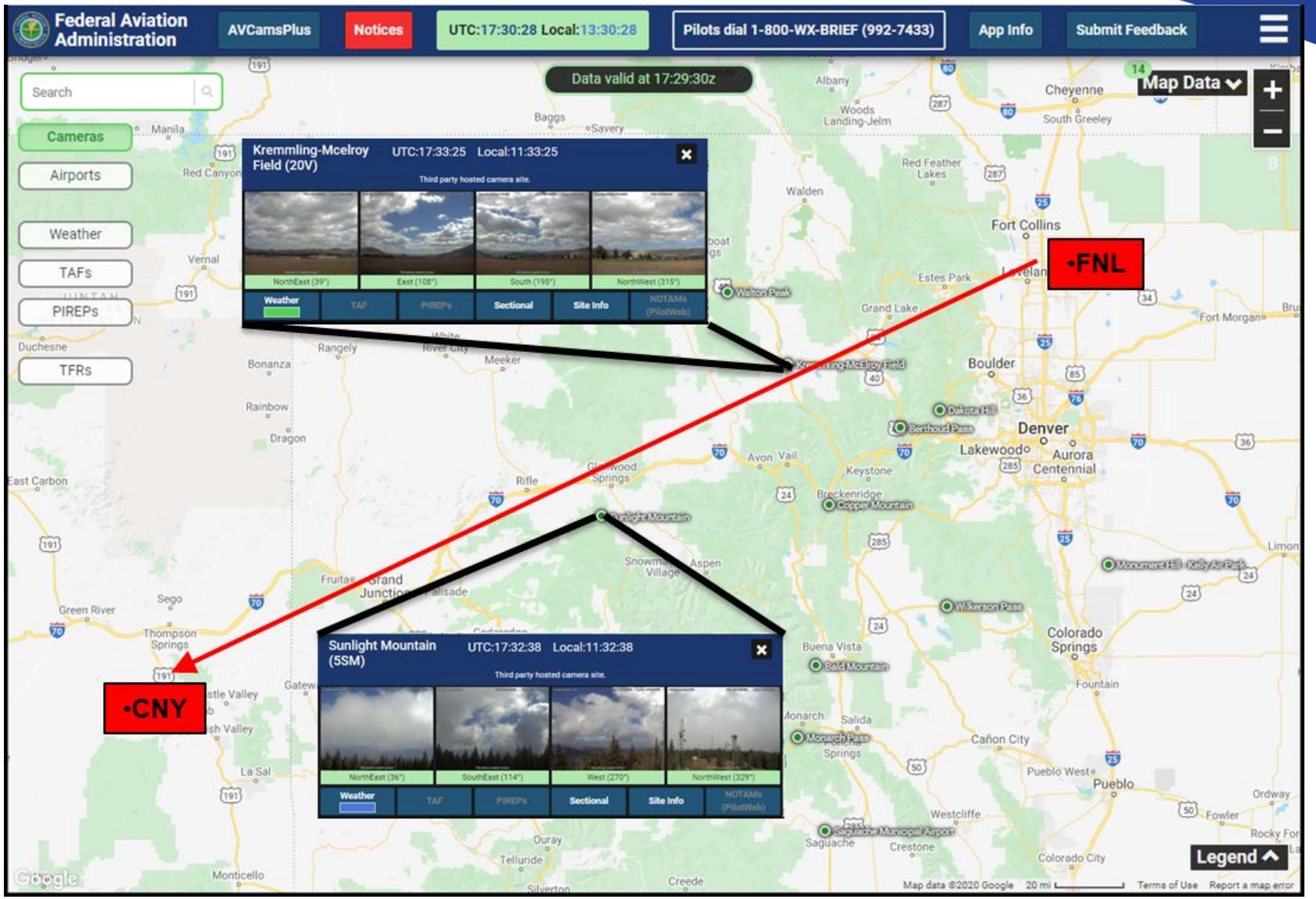
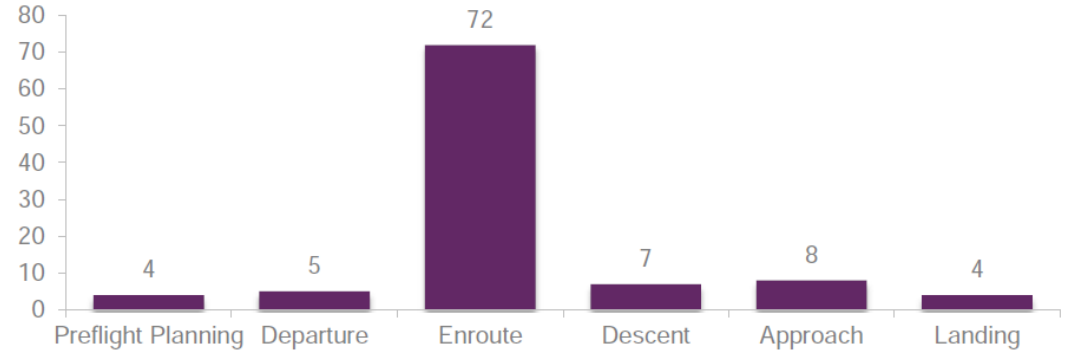


Gaps in Pilot Weather Knowledge

NASA Aviation Safety Reporting System (ASRS) Study

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



Of 100 reports analyzed, 72 indicated that weather-related incidents 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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Gaps in Pilot Weather Knowledge

- **Summary**
  - Pilots struggled at interpreting weather along the route
  - Held incorrect weather expectations for most of the route and at the destination airport
    - Pilot expectation of destination airport weather as Visual Flight Rules (VFR) whereas conditions were much lower (per WTIC research studies)
  - Pilots may not be assessing enough forecast products to gain a better mental model of what weather to expect along the route
    - Pilots relied on observation information (e.g. METARs) for their destination airport instead of considering the appropriate forecast products

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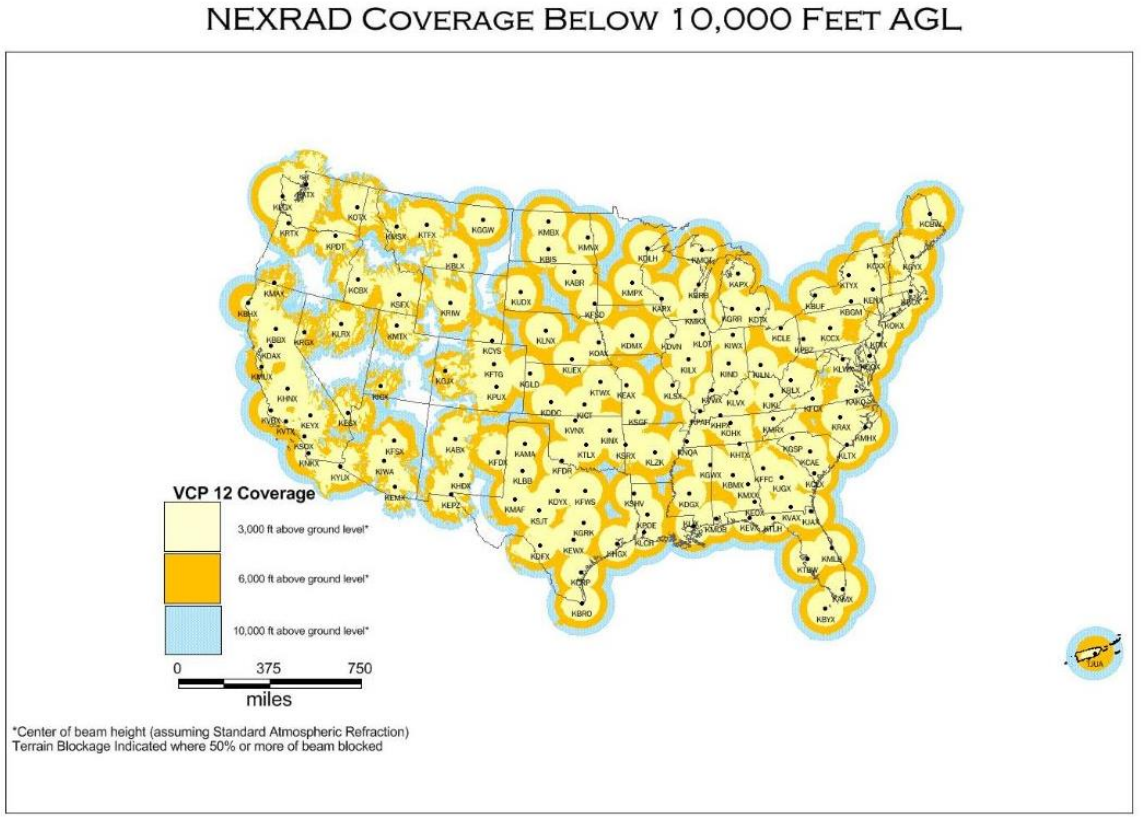
Other Factors

1500-2010 MDT
2100-0210 UTC
D_1-30 to D_2+50

- **The need for an in depth weather brief**
  - More than just departure and arrival and current conditions
  - Include enroute and forecasts
- **Limitation of satellite and radar**
  - Are not a forecast
  - Terrain blockage of radar
- **The need for an updated briefing**
  - Weather is dynamic
- **Inflight updates**
  - FIS-B automated updates
  - ATC
  - PIREPs
- **Develop options beforehand**
  - Exit unsafe conditions
  - Maintain control and contact ATC immediately



Internet Links

- **C&V:** aviationweather.gov/gfa
- **HEMS Tool:** aviationweather.gov/hemst
- **CIP and FIP:** aviationweather.gov/icing
- **GTG:** aviationweather.gov/turbulence
- **METARs:** aviationweather.gov/metar
- **PIREPs:** aviationweather.gov/airep
- **Radar:** aviationweather.gov/radar
- **Satellite:** aviationweather.gov/satellite
- **TAFs:** aviationweather.gov/taf
- **Weather Cameras:** avcams.faa.gov
- **AWRP:** faa.gov/nextgen/programs/weather/awrp/
- **WTIC:** faa.gov/nextgen/programs/weather/wtic/

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Contacts

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- **Ian Johnson: WTIC GA and Human Factors Lead, ian.johnson@faa.gov**
- **Danny Sims: AWRP Icing Project Lead, danny.sims@faa.gov**
- **Gary Pokodner: WTIC Program Manager, gary.pokodner@faa.gov**
- **Randy Bass: Weather Research Branch Manager, randy.bass@faa.gov**

Enhanced Winter Weather Training

Presented by the FAA Weather Research Branch

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Save the Date!

Join us for next month's MentorLIVE,
November 18th at 8:00 p.m. ET

Airman Certification Standards – An Update

Presented by Robert Terry,
FAA Staff Specialist-OPS

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Thanks for Watching!

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