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# Safety Study

## Risk Factors Associated with Weather-Related General Aviation Accidents

# Aviation Safety - Regional Staff

Jeff Guzzetti, Deputy Director Regional Operations

Kurt Anderson
Jill Andrews
David Bowling
John Brannen
Nicole Charnon
Tealeye Cornejo
Steve Demko
Debra Eckrote
Todd Fox
Catherine Gagne
Mitch Gallo
Bob Gretz
Bob Hancock
Dennis Hogenson
Clint Johnson
Patrick Jones
Alex Lemishko
Larry Lewis
Tom Little
Ed Malinowski
Steve McCreary
Frank McGill
Van McKenny
Tim Monville
George Petterson
Howard Plagens
Wayne Pollack
Arnold Scott
Jim Silliman
Corky Smith
Tim Sorensen
Jim Struhsaker
Pam Sullivan
Butch Wilson
Leah Yeager
Al Yurman

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# Staff

## Study Managers

Loren Groff
Jana Price

## Meteorology

Jim Skeen
Greg Salottolo
Kevin Petty
Don Eick

## Air Traffic Control

Barbara Zimmermann
Bill English
Scott Dunham

## Editor

Sally Bennett

## Communication Center

Grant Bell
John Taylor
Brian Huddleston
Grady Goodman
Dan Maas
Chris Mason
Richard Chancellor
Malcolm Brown
Randy Rodriguez
Russell Sottile

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# Background

# General Aviation (GA)

- Operations conducted under 14 CFR Part 91
- Does not include air carrier, air taxi, or air tour operations
- 1,614 GA accidents in 2004 represented 94% of all U.S. civil aviation accidents

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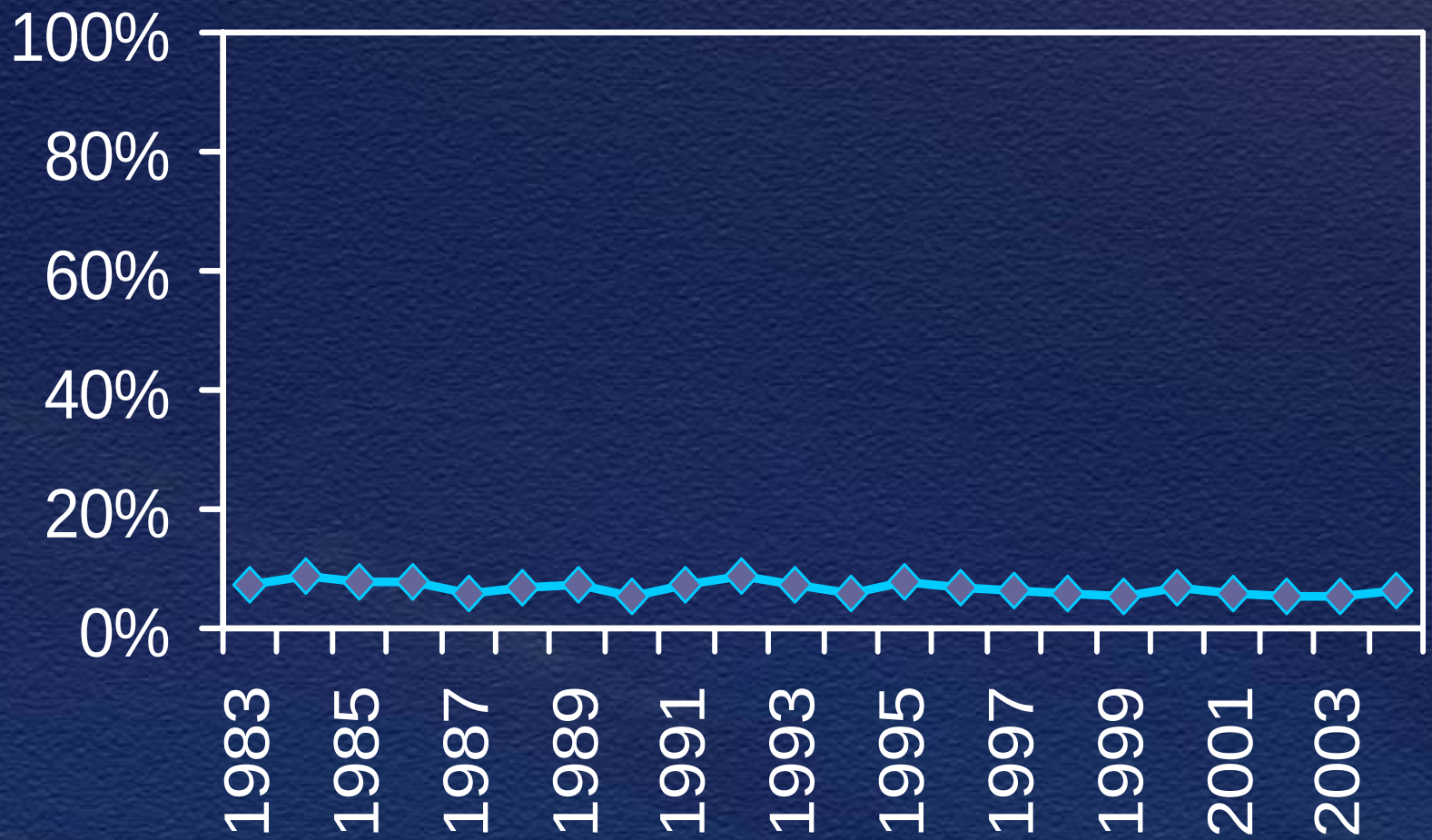
# General Aviation (GA) Accidents in IMC

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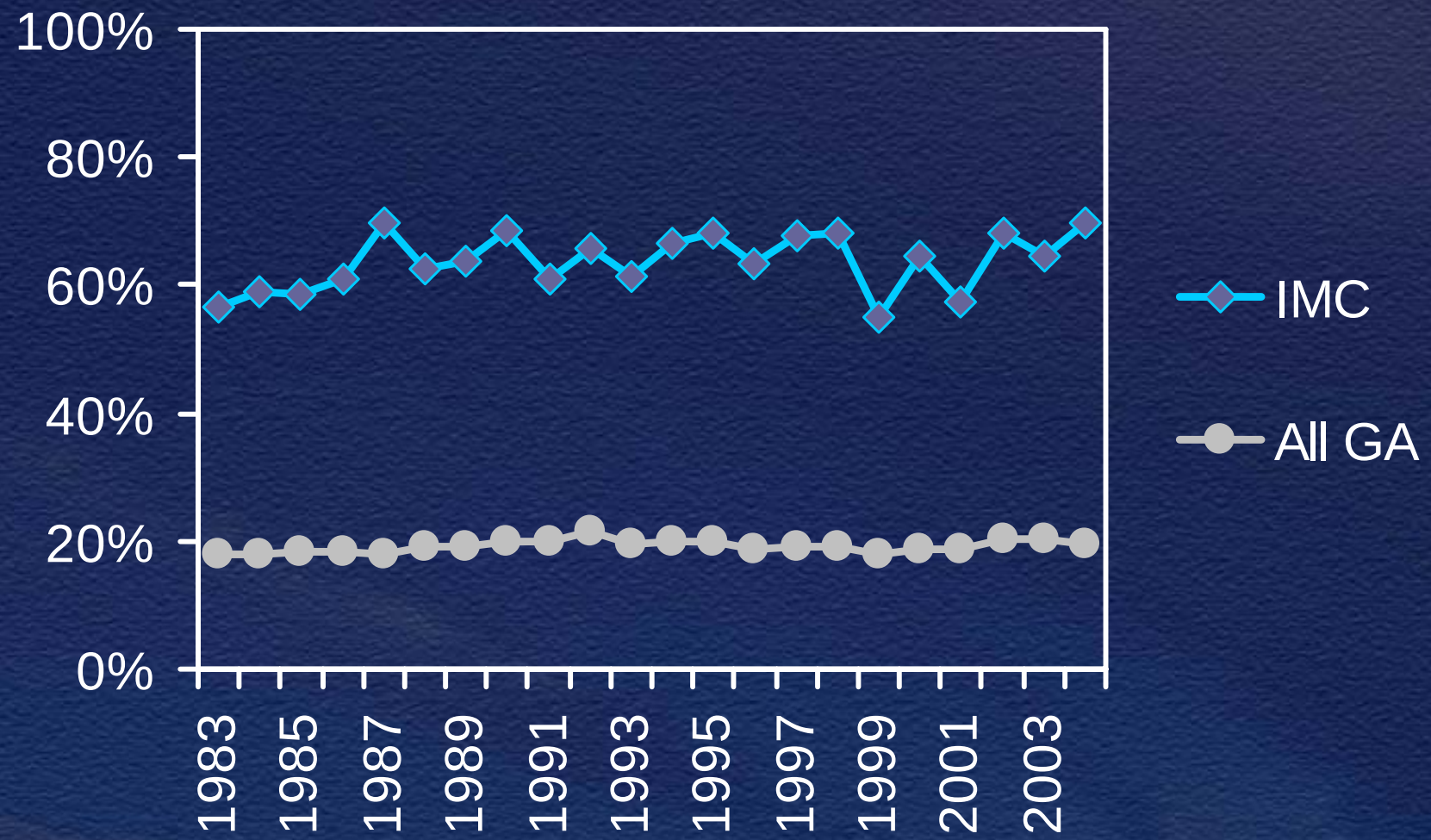
# GA Accidents that Result in Fatality

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# Previous Safety Board Studies

- 1968: Weather-involved accidents in 1966
- 1974: Fatal weather-involved accidents over a 9-year period
- 1976:  Nonfatal weather-involved accidents over an 11-year period
- 1989: VFR-into-IMC accidents over a 5-year period

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# Previous Safety Board Recommendations

- Collection and dissemination of weather information
- Pilot training and operations
- Air traffic control

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# Study Method and Procedures

# Weather-related Accidents

Defined as: “Accidents that occur in weather conditions characterized by instrument meteorological conditions (IMC) or poor visibility.”

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# Case Control Methodology

- Epidemiological approach frequently used in public health research
- Used to identify factors that increase a pilot's risk of being involved in a weather-related GA accident
  - **Cases**: weather-related GA accidents
  - **Controls**: "nonaccident" GA flights that occurred under similar circumstances

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# Selection of Study Variables

- Variable selection was guided by:
  - Previous research findings
  - Investigator expertise
  - Practical constraints
- Variables included information about pilots, flights, and aircraft

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# Accident Inclusion Criteria

- GA airplane operation and
- IMC or marginal VMC at the time and location of the accident
- Other accidents potentially involving lack of visual reference

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# Study Procedure

- Data collection: August 2003 – April 2004
- Regional ASIs notified study managers if accidents met study inclusion criteria
- Staff monitored FAA daily accident reports
- Study managers identified and collected data from matching nonaccident flights

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# Matching Nonaccident Flights

- Weather conditions
- Location (within 30 miles)
- Time (within 30 minutes)
- Rules of flight
- Number of engines
- Engine type

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# Identifying Nonaccident Pilots

| Flight Plan | Method |
| --- | --- |
| IFR | Flight tracking software used to obtain registration numbers of matching flights |

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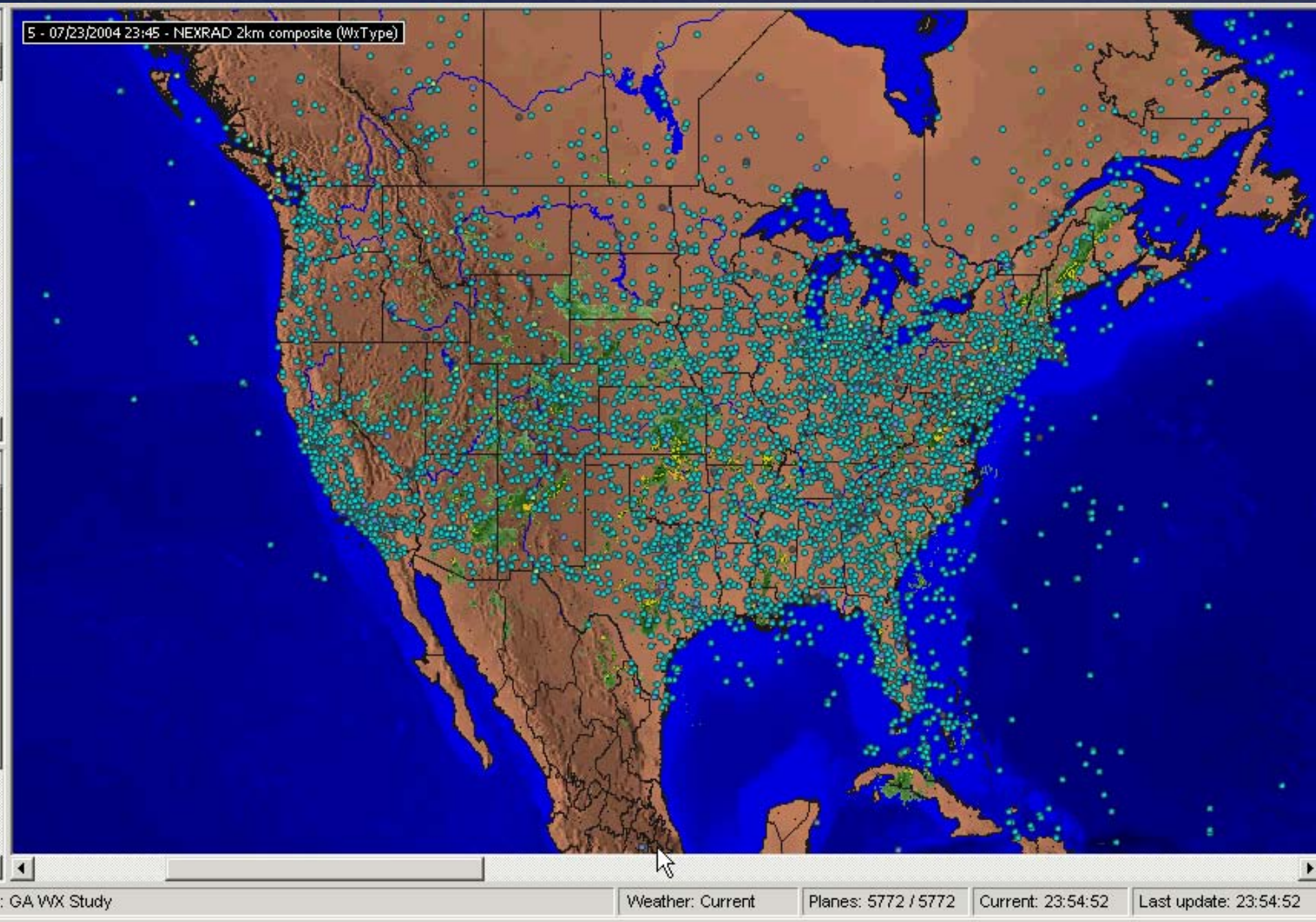
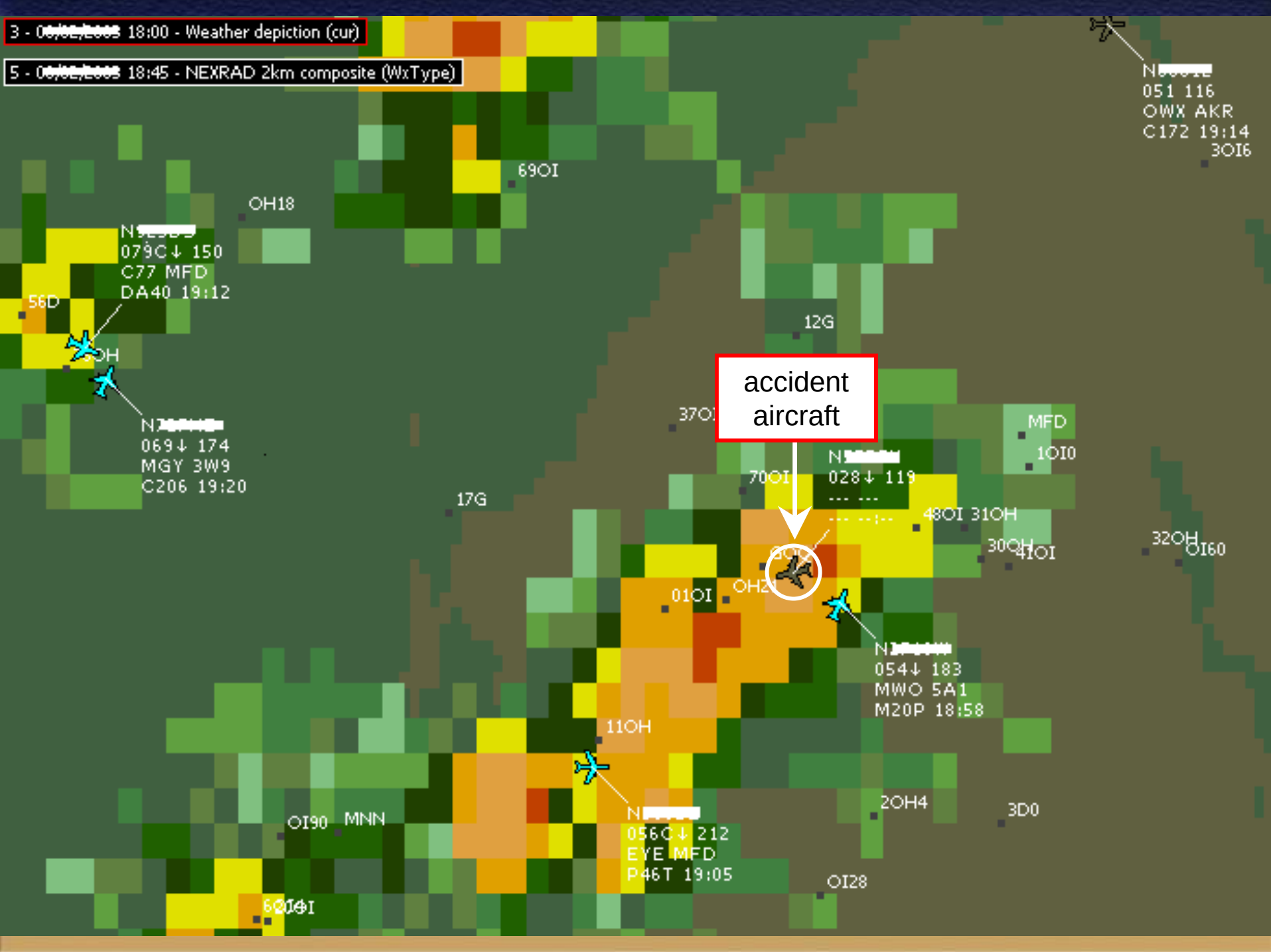



: GA WX Study | Weather: Current | Planes: 5772 / 5772 | Current: 23:54:52 | Last update: 23:54:52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C172 19:14
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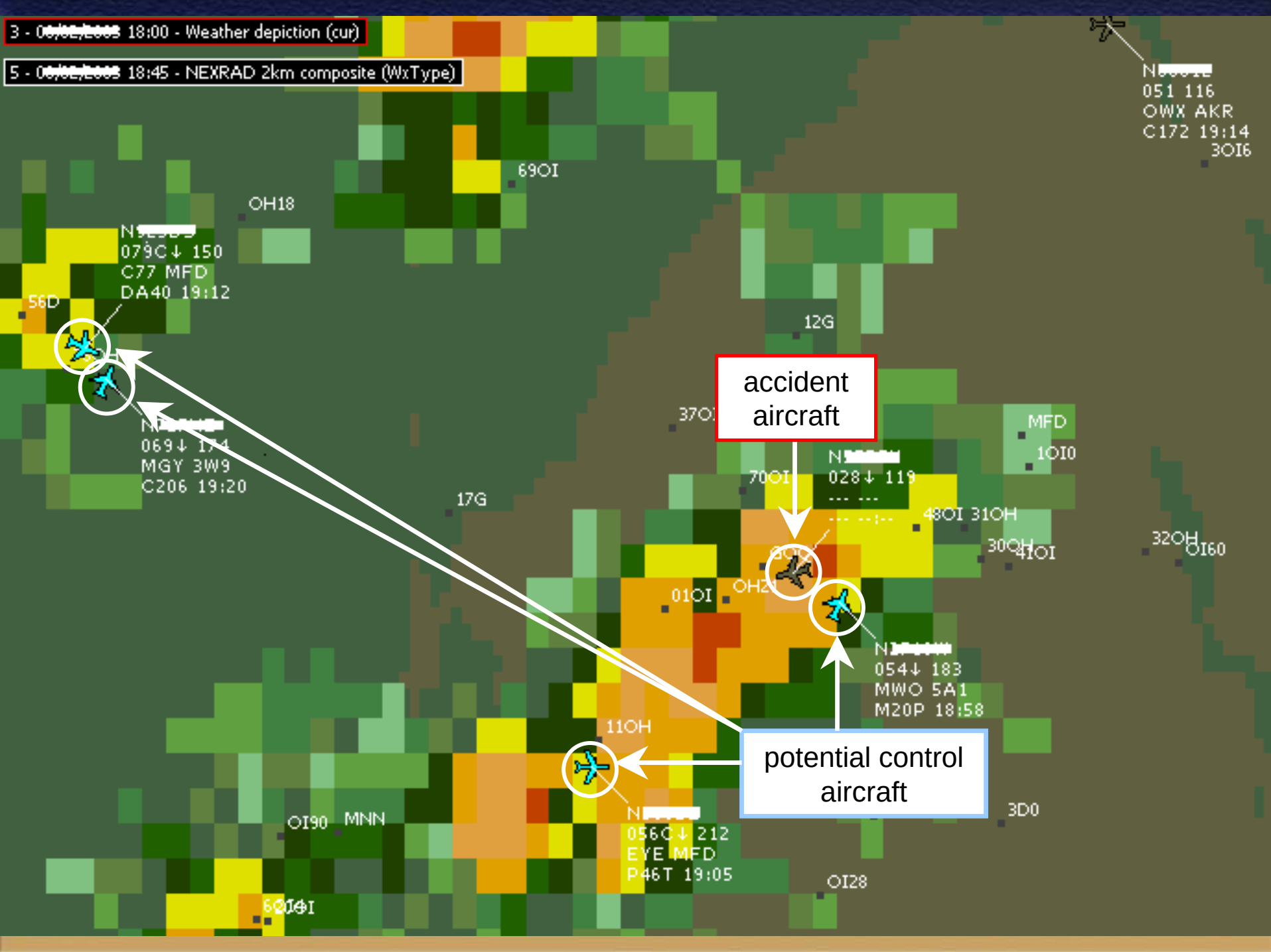
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potential control aircraft
3D0
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P46T 19:05
OI28
60I4I

# Identifying Nonaccident Pilots

| Flight Plan | Method |
|---|---|
| IFR | Flight tracking software used to obtain registration numbers of matching flights |
| VFR or None | FBOs and airports within 30 miles of accident and along route of flight were contacted to identify matching flights and pilots |

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# Data Gathering

- Accident flights
  - Regional accident investigations
  - Supplemental data form
- Nonaccident flights
  - Study managers interviewed pilots
  - 100% of pilots contacted participated
  - Most interviews conducted within 72 hours of accident flight

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# Additional Study Data

- Previous aviation accidents, incidents, and violations
- FAA knowledge and practical test records
- Forecast and actual weather conditions

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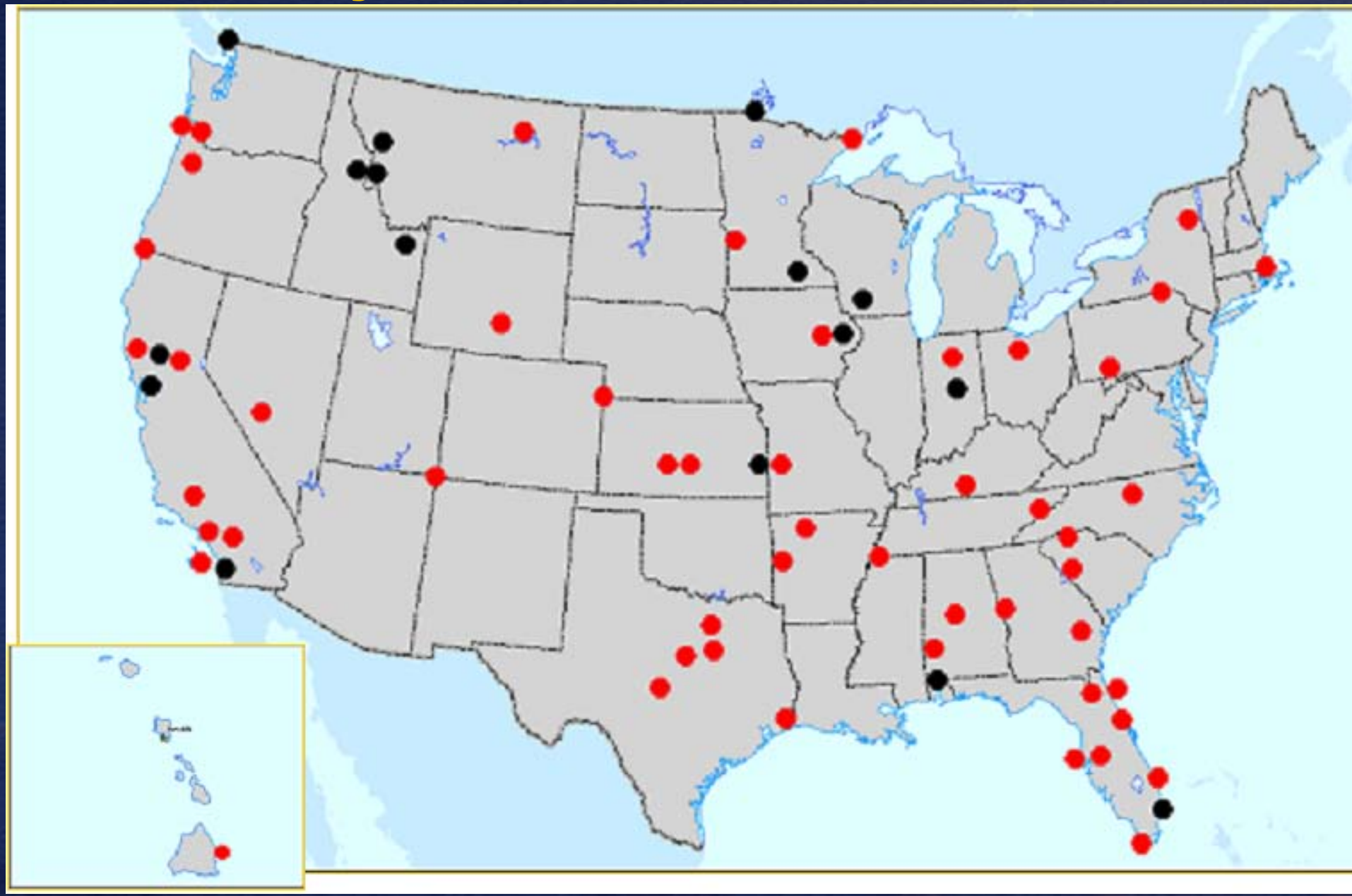
# Statistical Results

# 72 Study Accidents

# 72 Study Accidents



# Study Groups

- 72 accidents, representative of all weather-related GA accidents
- 135 matching nonaccident flights

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# Individual Comparisons

- Chi-square ($\chi^2$) tests used to measure group differences
- Comparisons included
  - Pilot information
  - Aircraft and flight information

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# Pilot-Related Variables

- Instrument rating
- Pilot certification level
- Total flight hours
- Age at accident
- Years as pilot
- Age at initial certification
- FAA knowledge and practical test performance
- Accident/incident history

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# Aircraft and Flight-Related Variables

- Aircraft ownership
- Purpose of flight
- Planned flight length

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# Significant Differences

- Instrument rating
- Pilot certification level
- Age at accident
- Age at initial certification
- FAA test performance
- Accident/incident history
- Aircraft ownership and purpose of flight
- Planned flight length

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# Logistic Regression

- Binary logistic regression used to predict accident involvement
- Also provides estimates of relative risk

# Logistic Regression Model

- Instrument rating
- Pilot flight hours
- Age at first certificate
- Aircraft ownership
- Prior accident or incident
- Highest pilot certification
- Practical test pass rate
- Purpose of flight
- Planned flight length

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# Logistic Regression Model

| | Wald | Sig. |
|---|---|---|
| Instrument rating | 9.55 | .002 |
| Pilot flight hours | 1.06 | .788 |
| Age at first certificate | 13.52 | .004 |
| Aircraft ownership | 2.55 | .279 |
| Prior accident or incident | 4.76 | .029 |
| Highest pilot certification | .389 | .533 |
| Practical test pass rate | 1.86 | .173 |
| Purpose of flight | 2.06 | .152 |
| Planned flight length | 7.87 | .049 |

$\chi^2 = 57.45, p < .001$

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# Logistic Regression Model

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# Analysis of Results

# Issue Areas

- Pilot training and proficiency differences
- Testing, accident, and incident history
- Weather briefing sources and methods

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# Analysis of Results

Pilot Training and
Proficiency Differences

# Pilot Differences

- Pilots who learned to fly prior to age 25 at lowest risk

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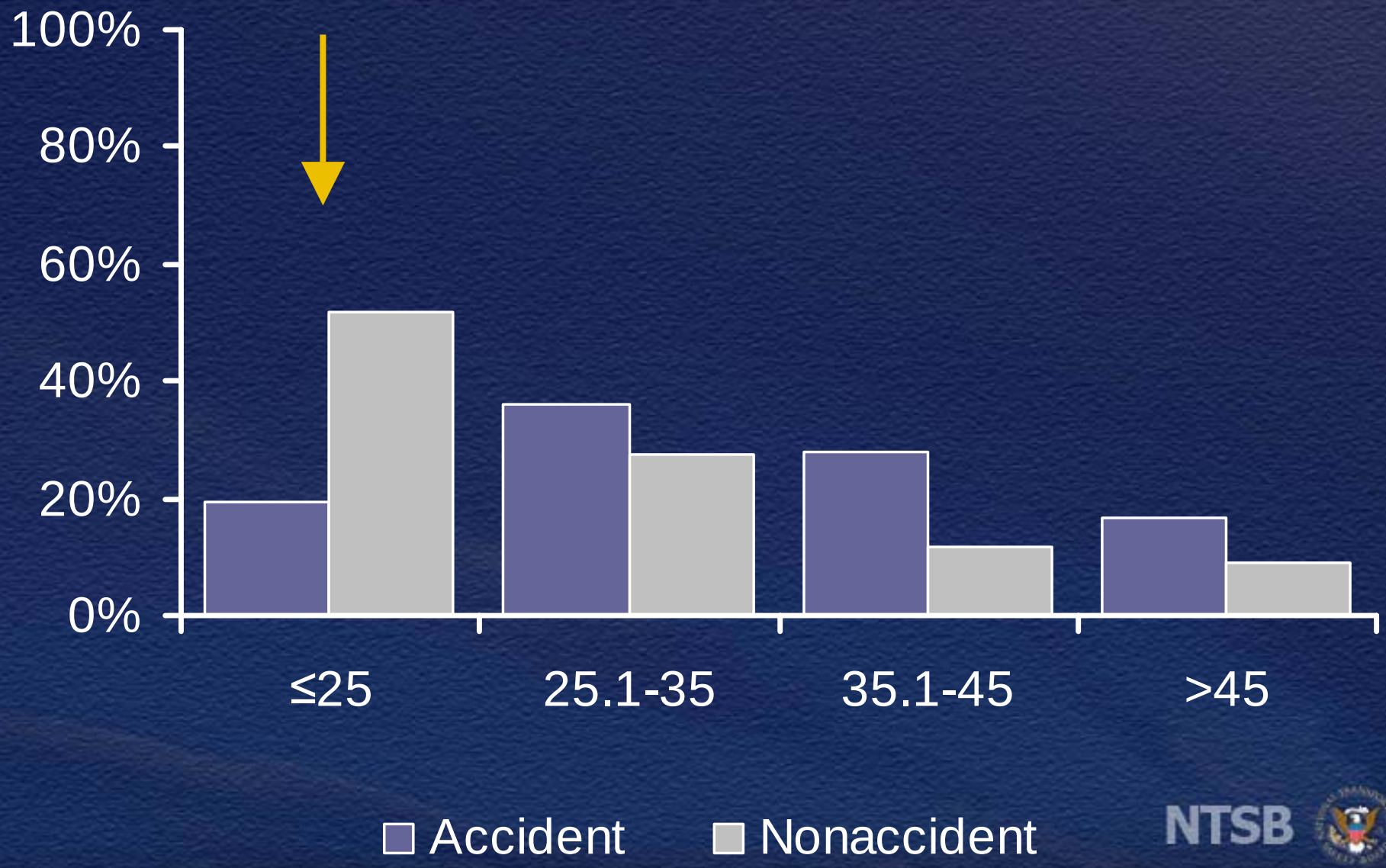
# Age at Initial Certification



# Pilot Differences

- Pilots who learned to fly prior to age 25 at lowest risk
  - Accident risk 3.4x to 4.8x greater for other pilots
- Differences not likely the result of age-related effects

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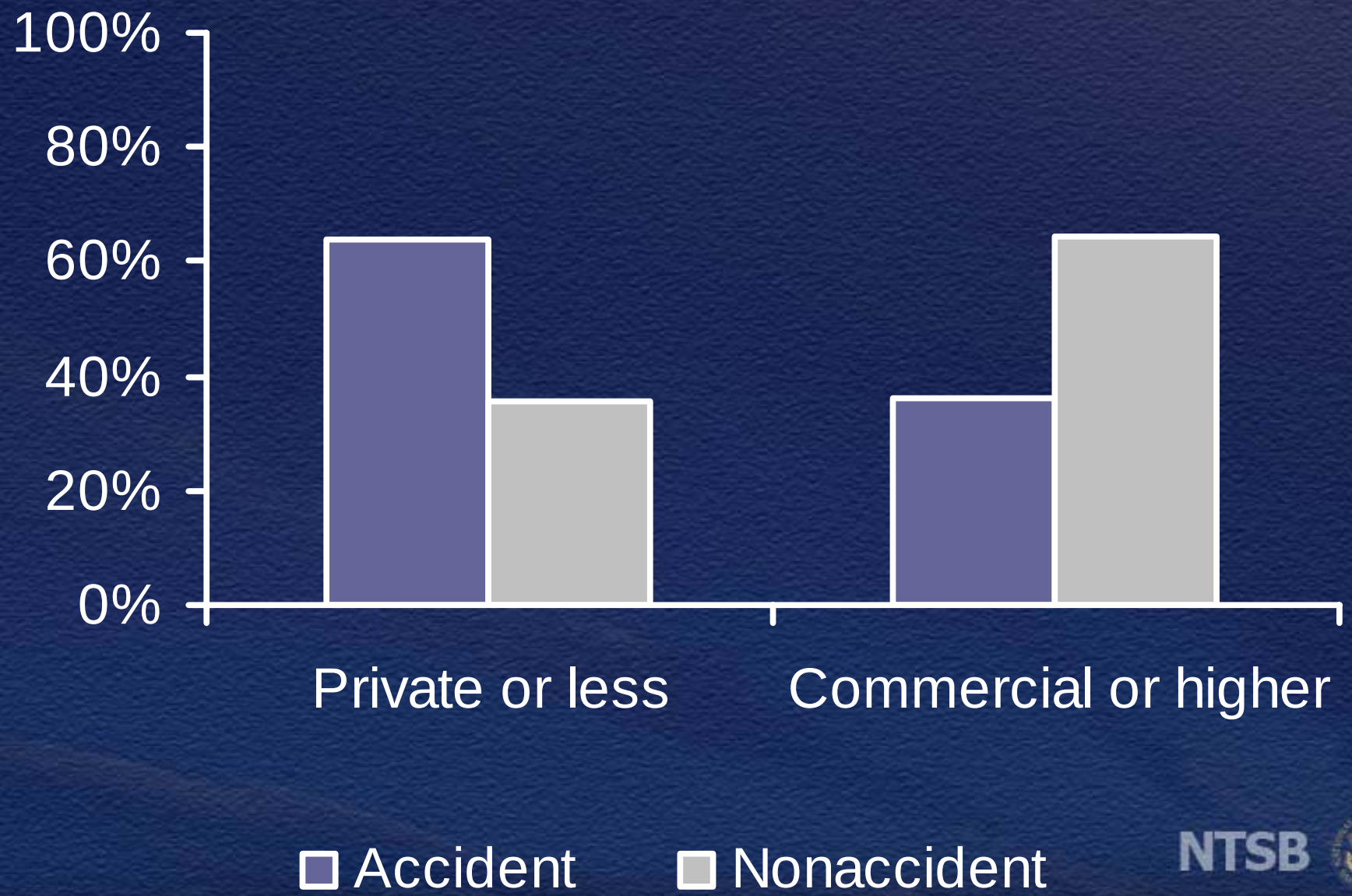
# Highest Pilot Certification Level

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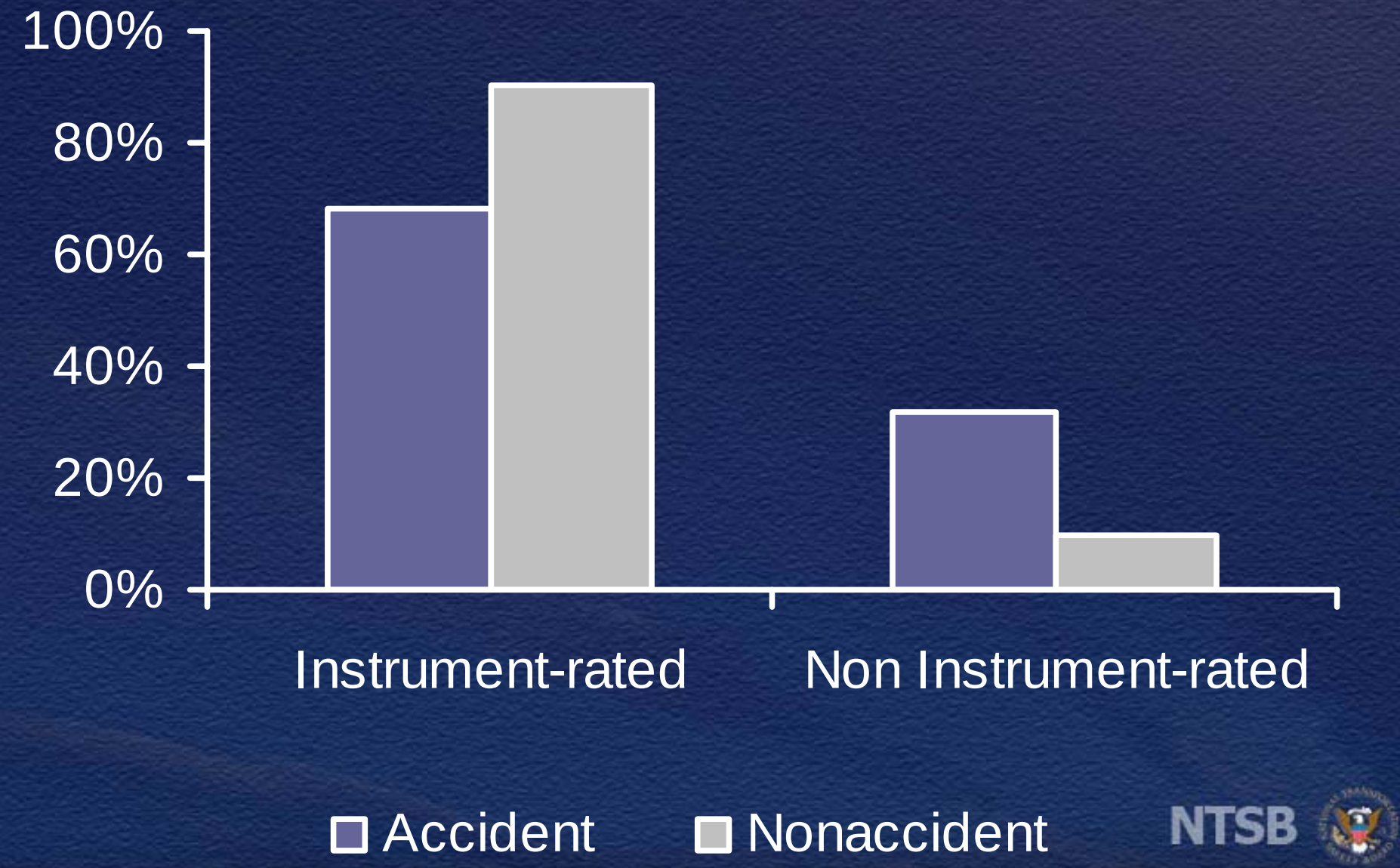
# Instrument Rating

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# Pilot Differences

- Pilots who learned to fly prior to age 25 at lowest risk
- Nonaccident pilots had higher levels of certificate and rating

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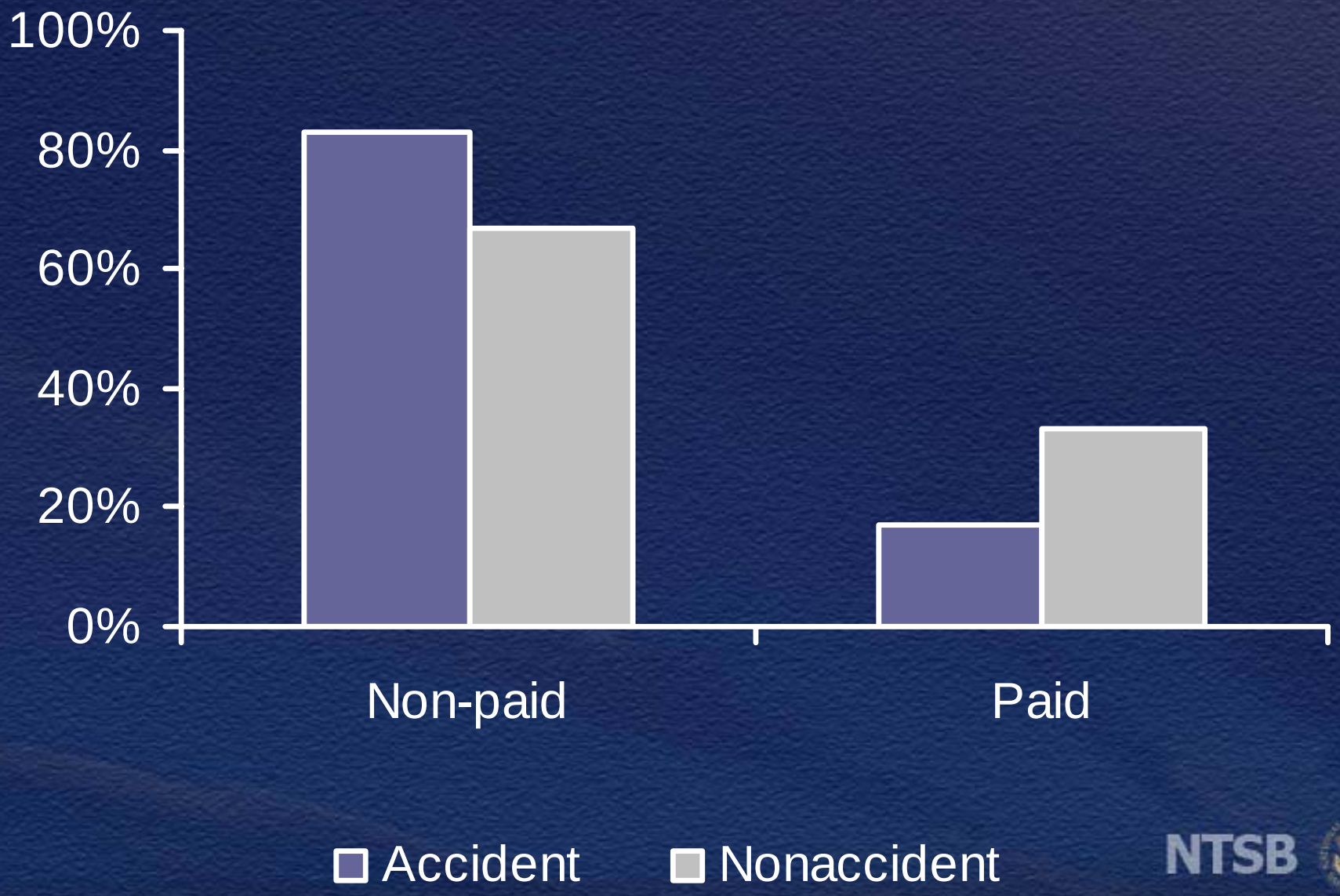
# Purpose of Flight

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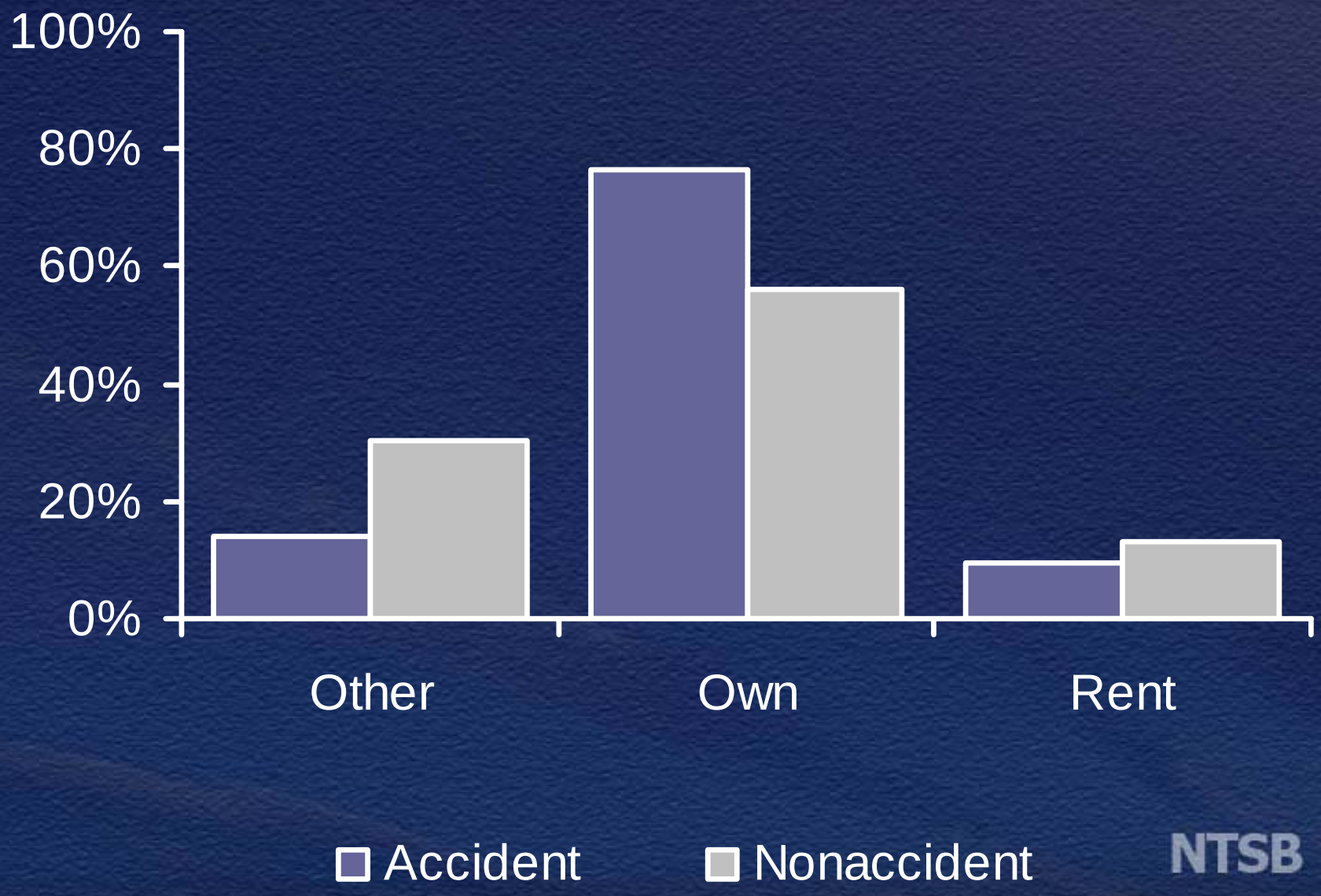
# Aircraft Ownership

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# Pilot Differences

- Pilots who learned to fly prior to age 25 at lowest risk
- Nonaccident pilots had higher levels of certificate and rating
- Nonaccident flights were more likely to be conducting paid operations
- Career pilots subject to more training and oversight

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# Initial Requirements

- All levels of pilot certificate require specific weather knowledge training
- All certificate levels above private require demonstration of instrument flight performance

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# Recurrent Requirements

- Instrument flight proficiency required for instrument-rated pilots
- Flight review currently required for all pilots
  - Every 24 months
  - 1 hour flight/1 hour ground instruction
  - General knowledge, rules, procedures

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# Maintaining Proficiency

Periodic training and evaluation help maintain and improve knowledge and skills

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# Analysis of Results

Testing, Accident and Incident History

# Test Performance and Accident Risk

- FAA knowledge and practical tests required for certification
- Cumulative pass-rates developed using private, commercial and instrument tests
  - "High" pass rate: ≥70%
  - "Low" pass rate: <70%

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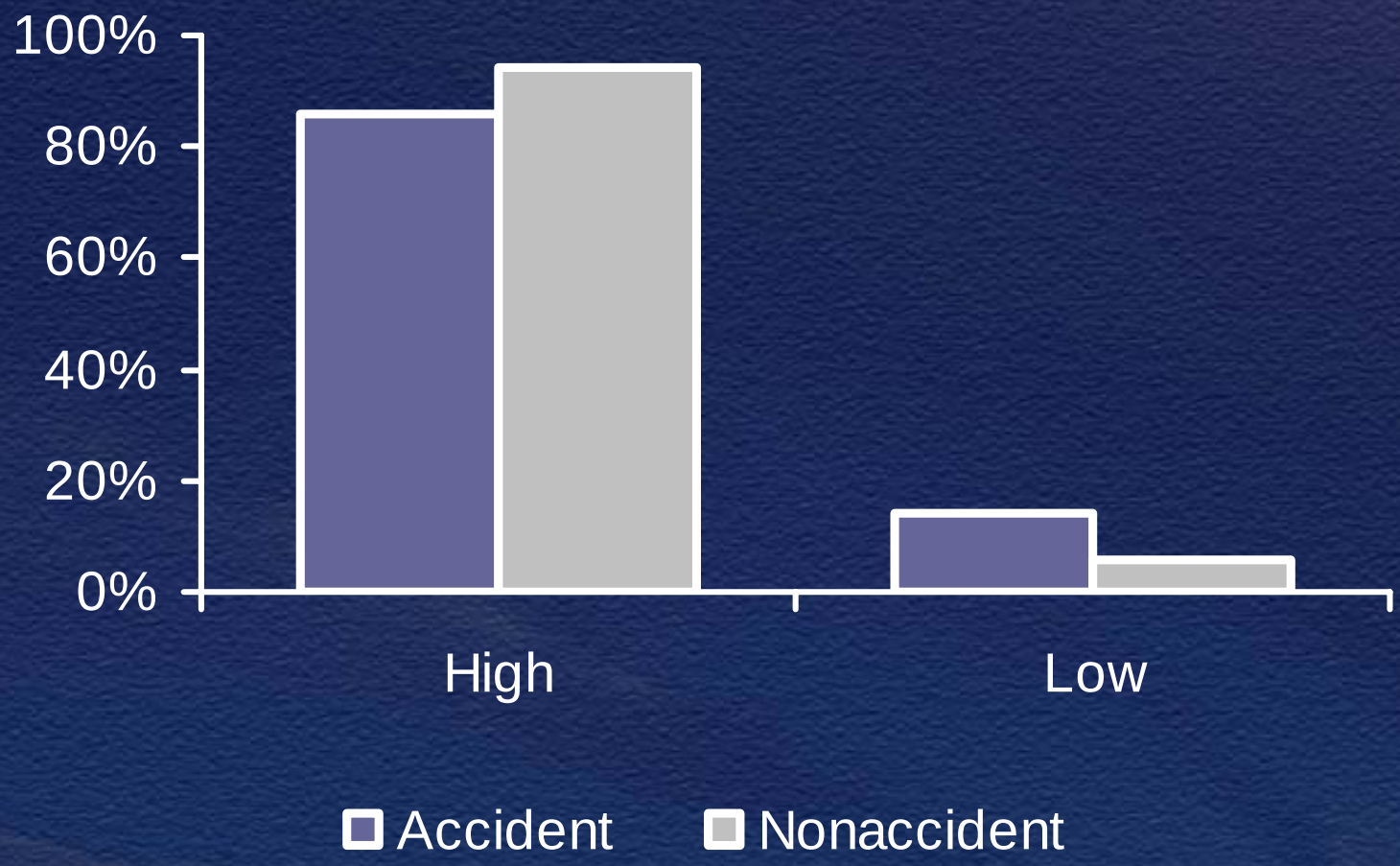
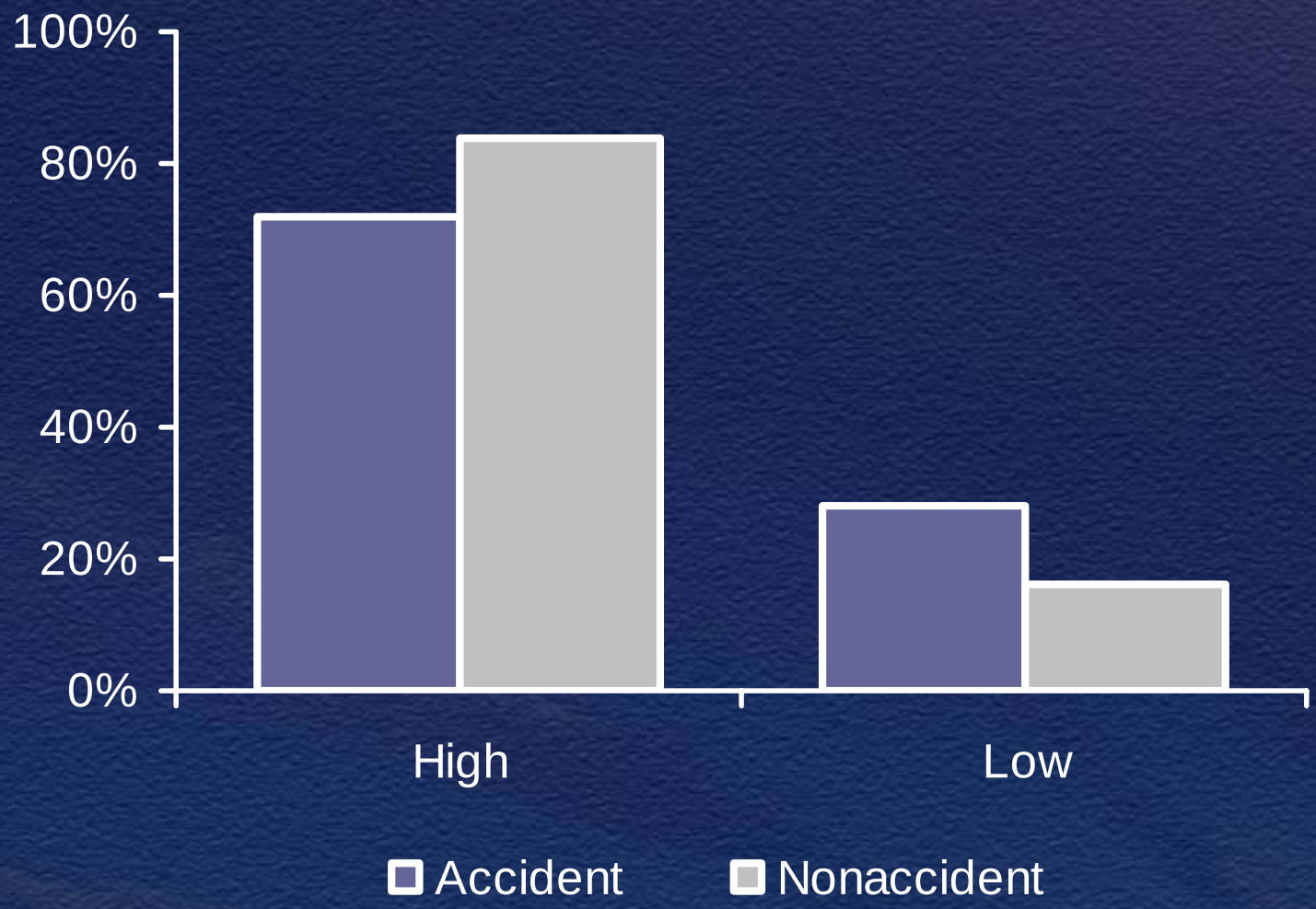
# Knowledge Test Performance



# Practical Test Performance

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# Test Performance and Accident Risk

- Analysis linked high test failure rates to accident involvement
- Currently there are no failure limits on knowledge or practical tests

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# Air Sunshine Accident July 13, 2003

- Over 15-year period, pilot failed 9 practical tests
- Recommendation A-05-02
  - Study whether existing system for post-failure remediation is adequate
  - Based on study, establish failure limits as necessary

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# FAA Knowledge Tests

- Applicants who miss all weather questions may still pass test
- No minimum requirements within knowledge areas

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# Accident/Incident History

- Previous research has linked prior accidents to future accident risk
- Accident/incident history data obtained from FAA

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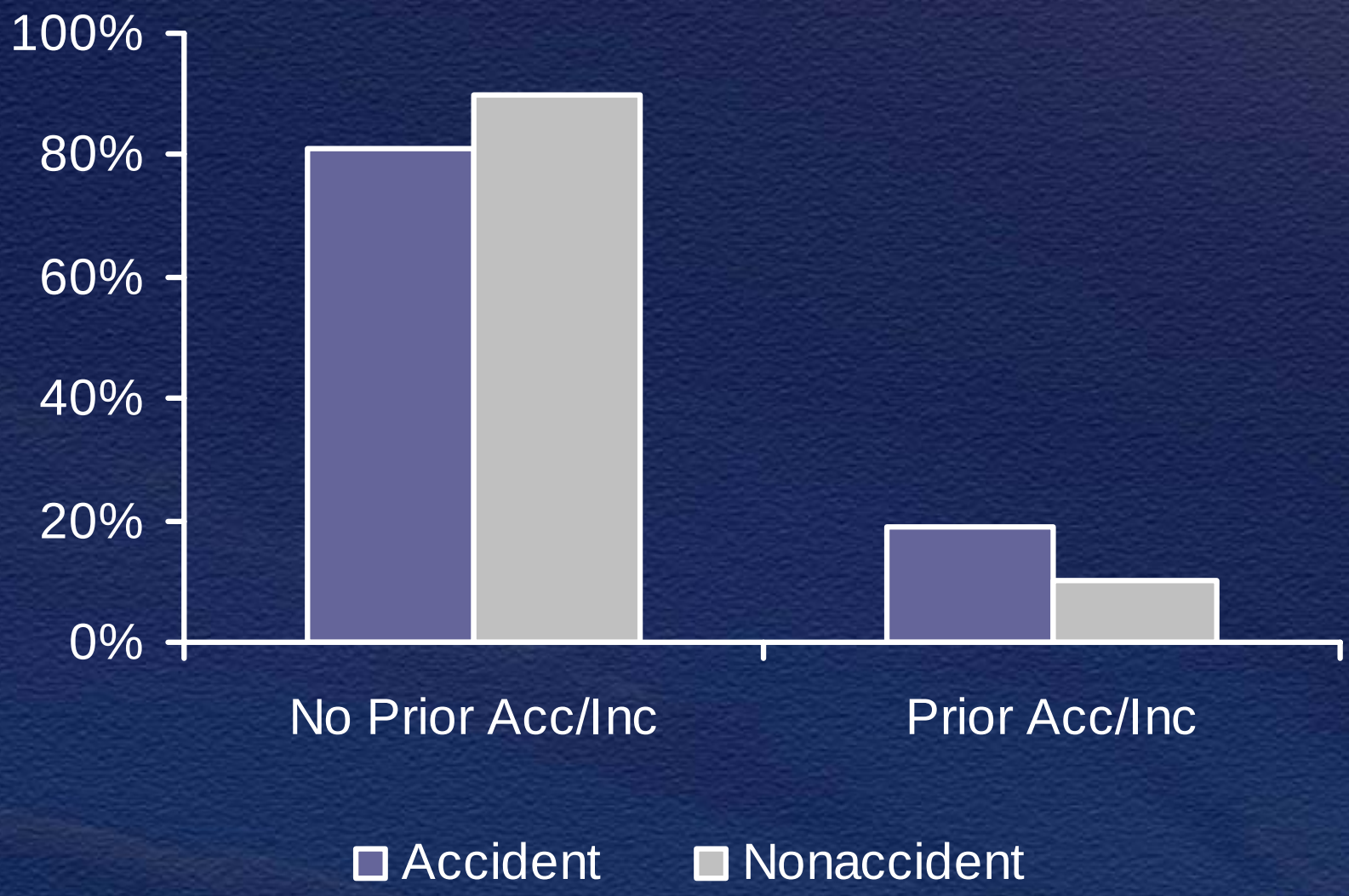
# Pilot Accident/Incident History

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# Accident/Incident History

- Accident/incident history associated with 3.1x greater accident risk
  - Average of 1 in 330 active pilots in U.S. involved in accident annually
  - Most pilots survive and continue to fly after the event
- Existing records could be used to identify pilots at heightened risk

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# Analysis of Results

Weather Briefing
Sources and Methods

# Pilots' Use of Preflight Weather

- Accident pilots
  - Investigators checked documented briefings or interviewed surviving pilots
- Nonaccident pilots
  - Study managers interviewed pilots, usually within 72 hours of flight

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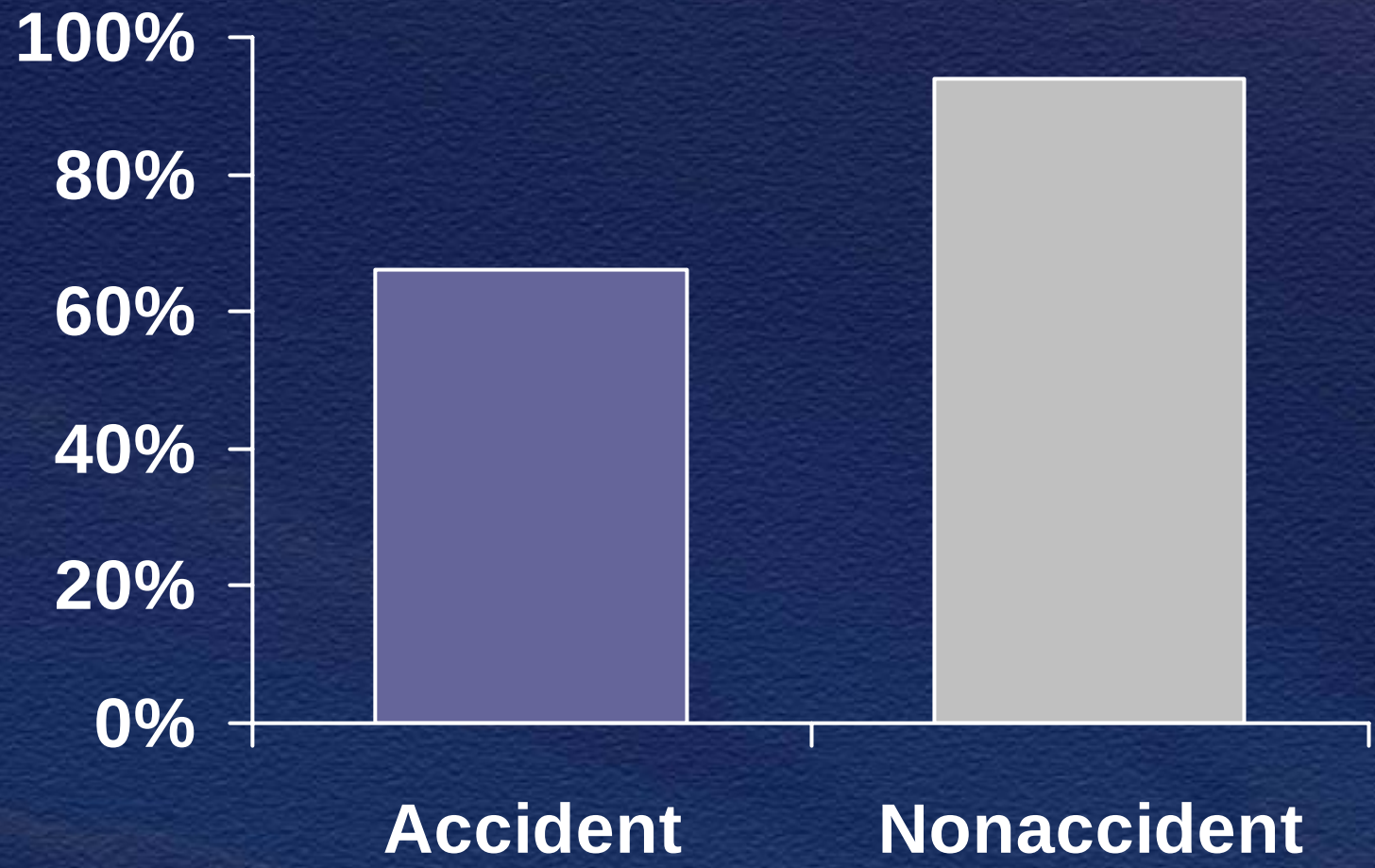
# Pilots Who Obtained Preflight Weather Information

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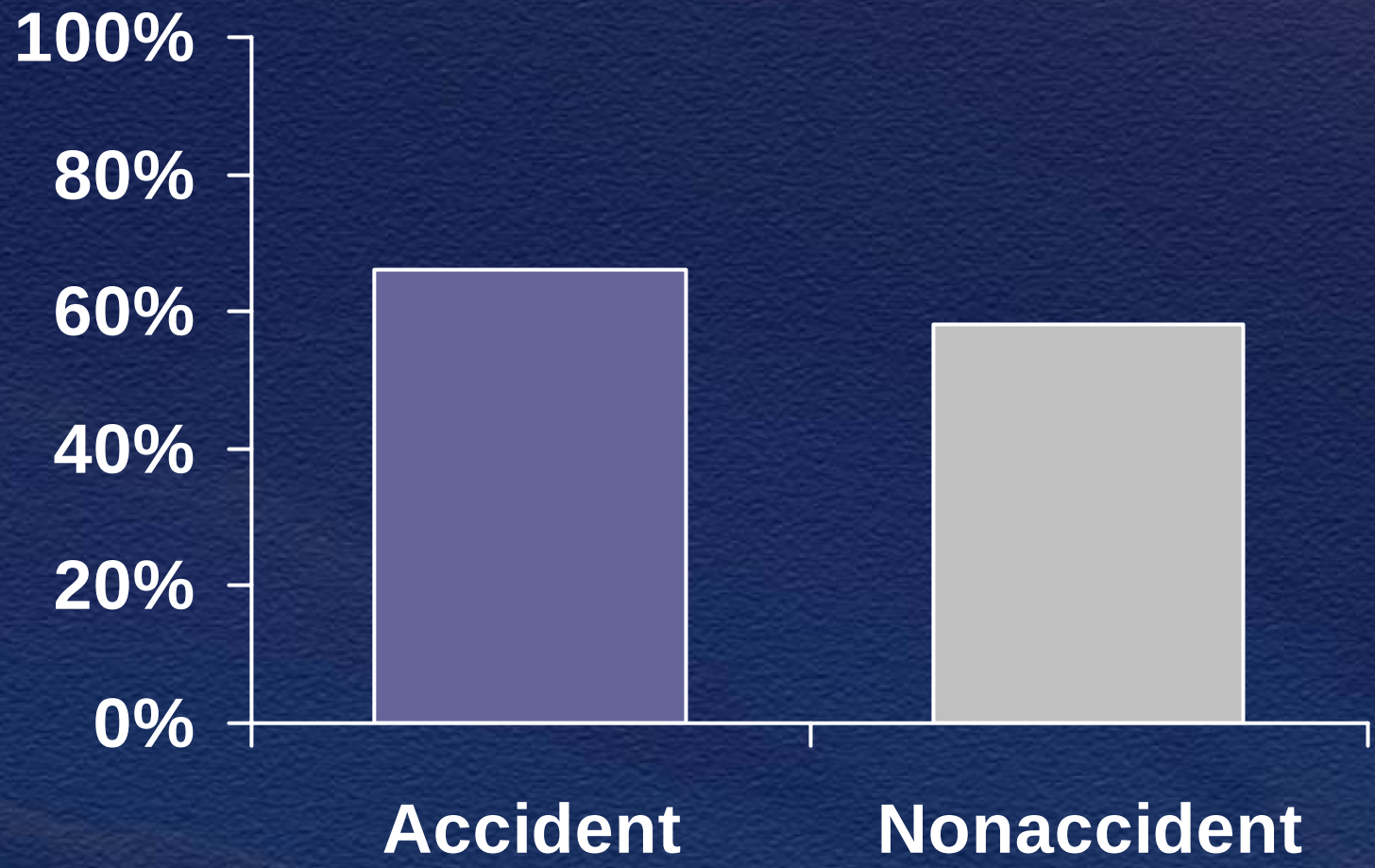
# Pilots Who Obtained Documented Preflight Weather Information

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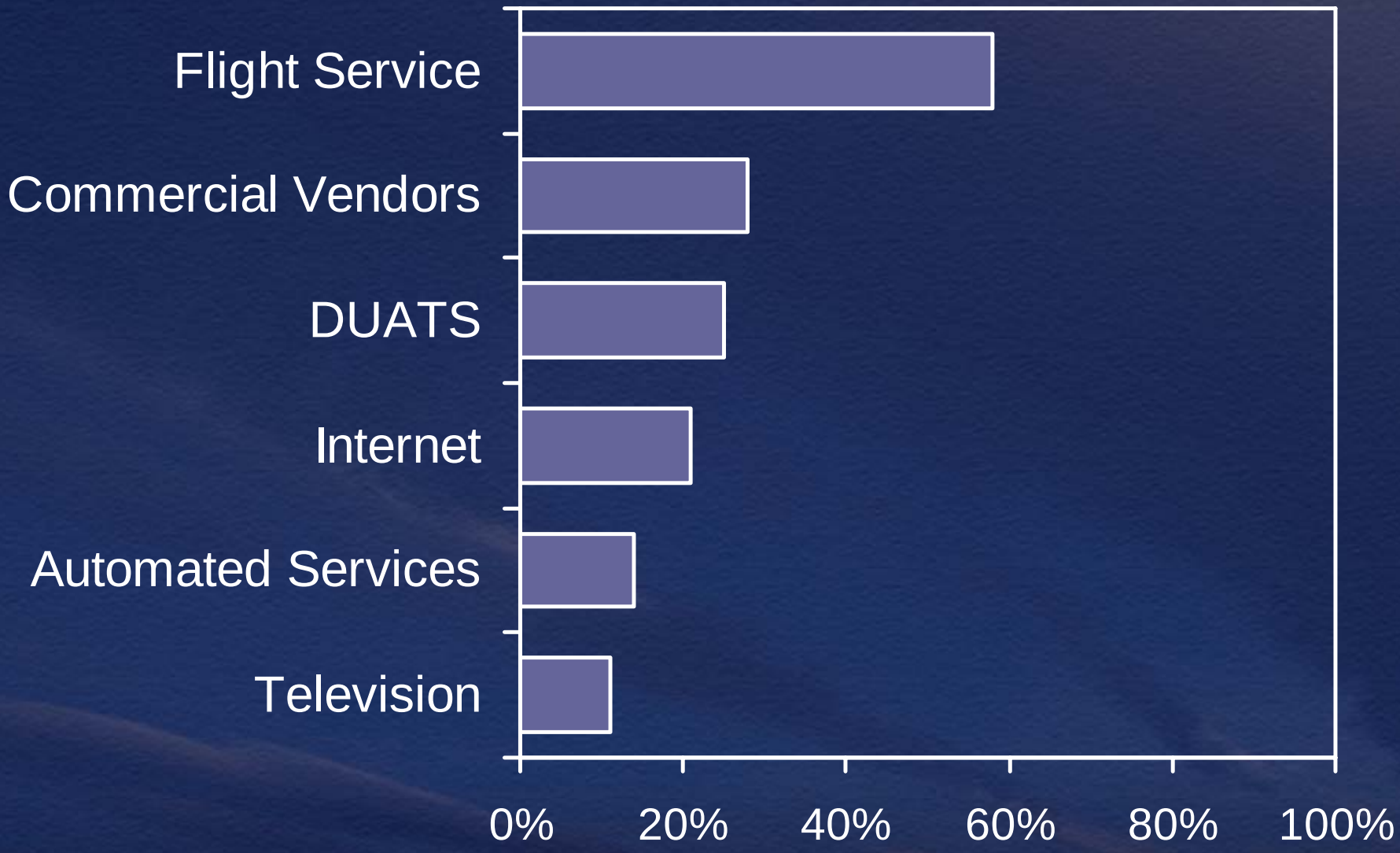
# Weather Information Sources Used by Nonaccident Pilots



# Weather Information Sources Used by Nonaccident Pilots

- Majority of accident and nonaccident pilots used flight service (FSS)
- Nonaccident pilots reported supplementing FSS briefings with Internet or other services
  - Graphical images
  - Interactive tools

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# Flight Service Stations

- February 2005: FAA announced new operator for FSS system
- Transition to new operation: late 2005
- Opportunity to consider incorporating additional information in briefings

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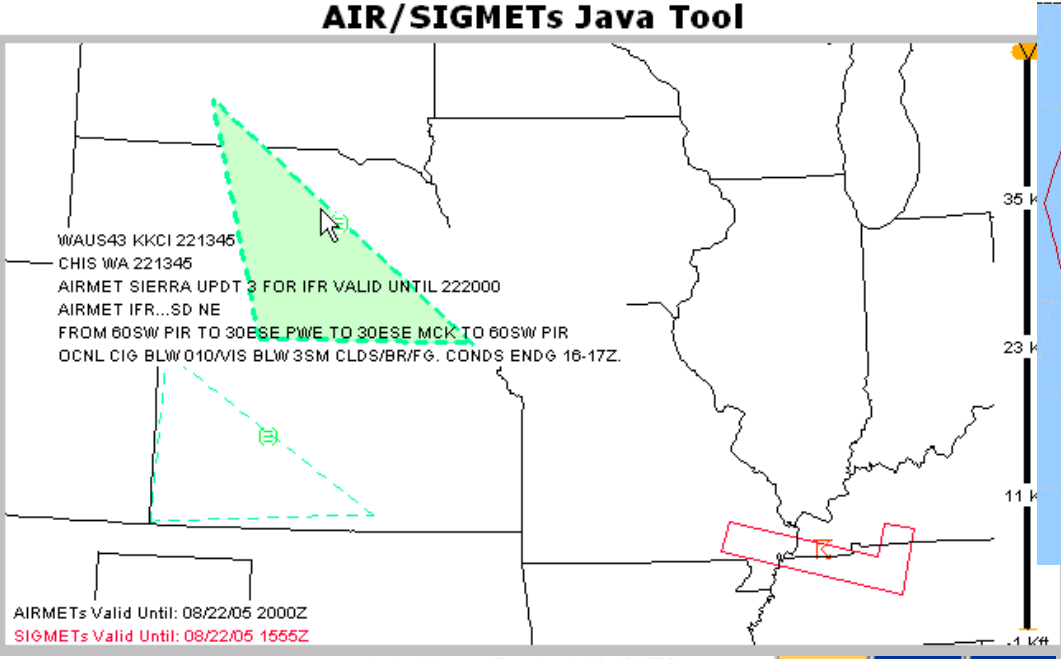
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CHIS WA 221345
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SIGMETs Valid Until: 08/22/05 1555Z


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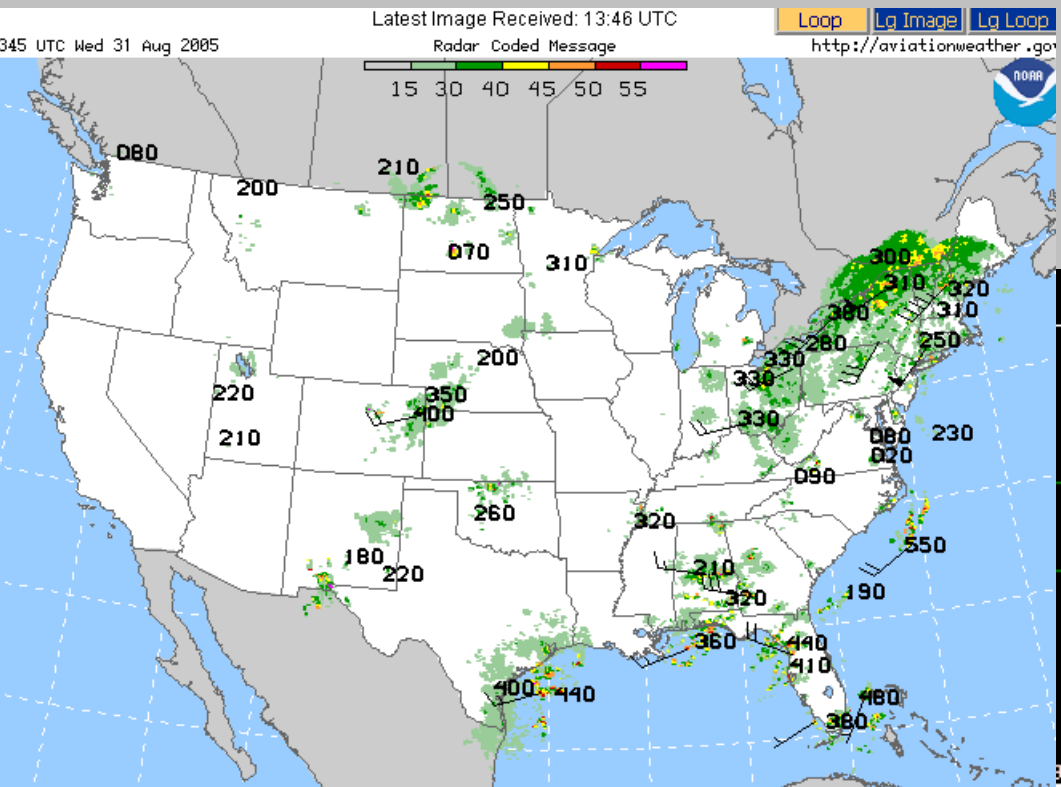
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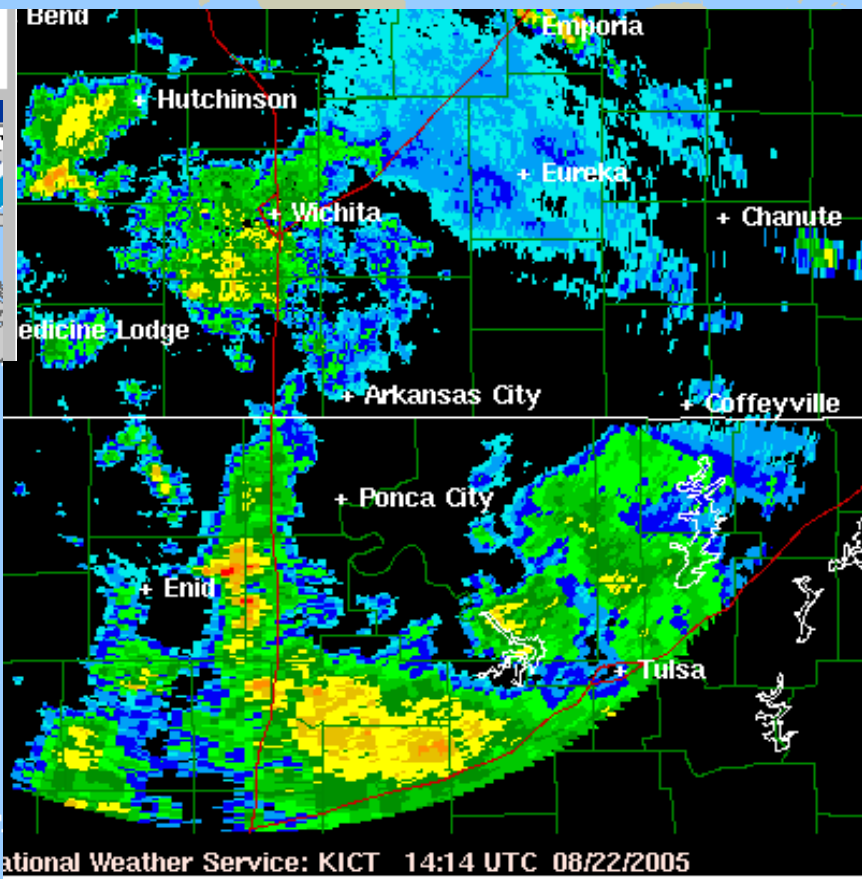
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# FAA Guidance to GA Pilots on Weather Information

- Guidance in FAA advisory circular limited to FSS and DUATS

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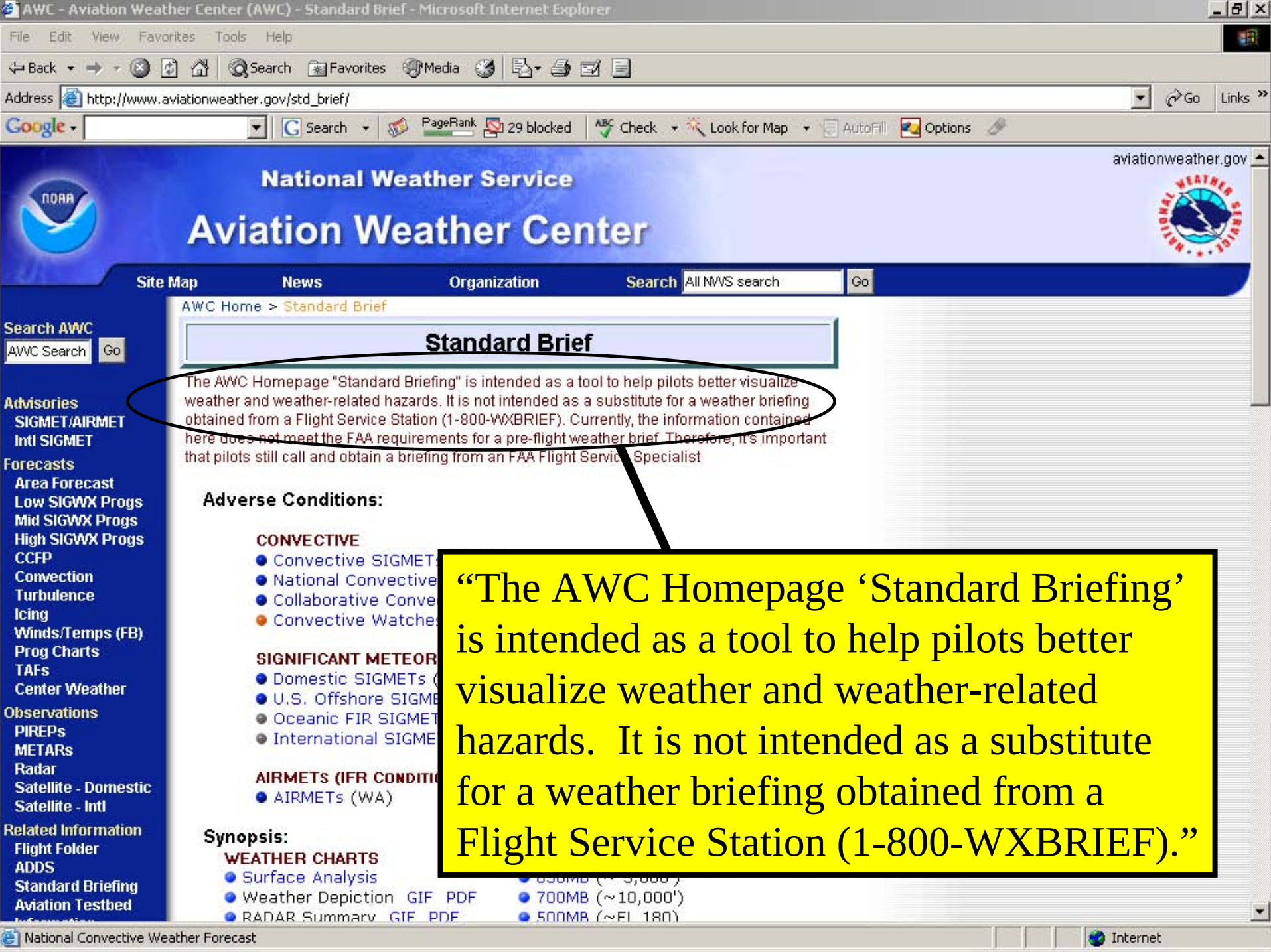
AWC - Aviation Weather Center (AWC) - Standard Brief - Microsoft Internet Explorer
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National Weather Service
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CCFP
Convection
Turbulence
Icing
Winds/Temps (FB)
Prog Charts
TAFs
Center Weather
Observations
PIREPs
METARs
Radar
Satellite - Domestic
Satellite - Intl
Related Information
Flight Folder
ADDS
Standard Briefing
Aviation Testbed
Standard Brief
The AWC Homepage "Standard Briefing" is intended as a tool to help pilots better visualize weather and weather-related hazards. It is not intended as a substitute for a weather briefing obtained from a Flight Service Station (1-800-WXBRIEF). Currently, the information contained here does not meet the FAA requirements for a pre-flight weather brief. Therefore, it's important that pilots still call and obtain a briefing from an FAA Flight Service Specialist
Adverse Conditions:
CONVECTIVE
Convective SIGMET
National Convective
Collaborative Conve
Convective Watche
SIGNIFICANT METEOR
Domestic SIGMETs
U.S. Offshore SIGME
Oceanic FIR SIGMET
International SIGME
AIRMETS (IFR CONDITI
AIRMETs (WA)
Synopsis:
WEATHER CHARTS
Surface Analysis
Weather Depiction GIF PDF
700MB (~10,000')
RADAR Summary GIF PDF
500MB (~FL 180)
"The AWC Homepage 'Standard Briefing' is intended as a tool to help pilots better visualize weather and weather-related hazards. It is not intended as a substitute for a weather briefing obtained from a Flight Service Station (1-800-WXBRIEF)."
National Convective Weather Forecast
Internet


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