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Evaluating GA Pilots' Interpretation of New Automated Weather Products

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Assessing General Aviation Pilots' Interpretation of Weather Products :

Traditional & New Automated Generation Products

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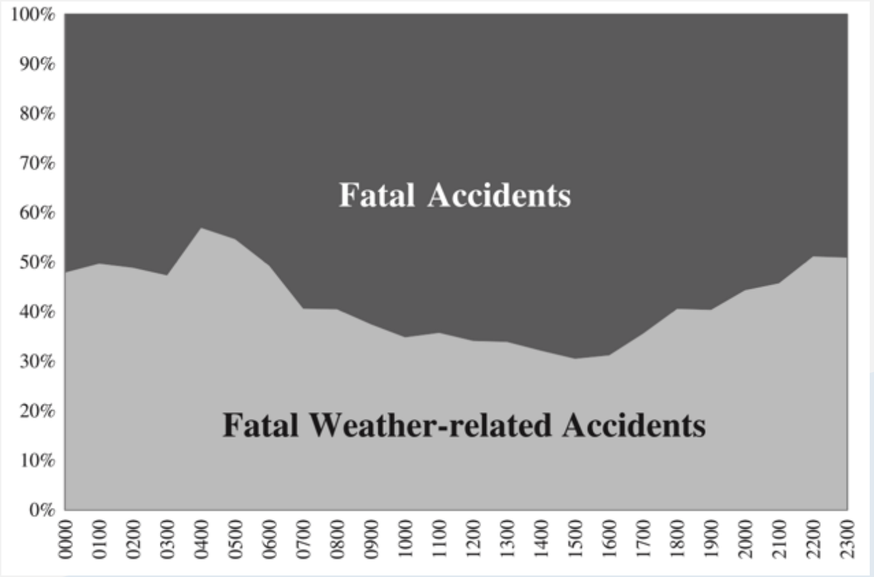
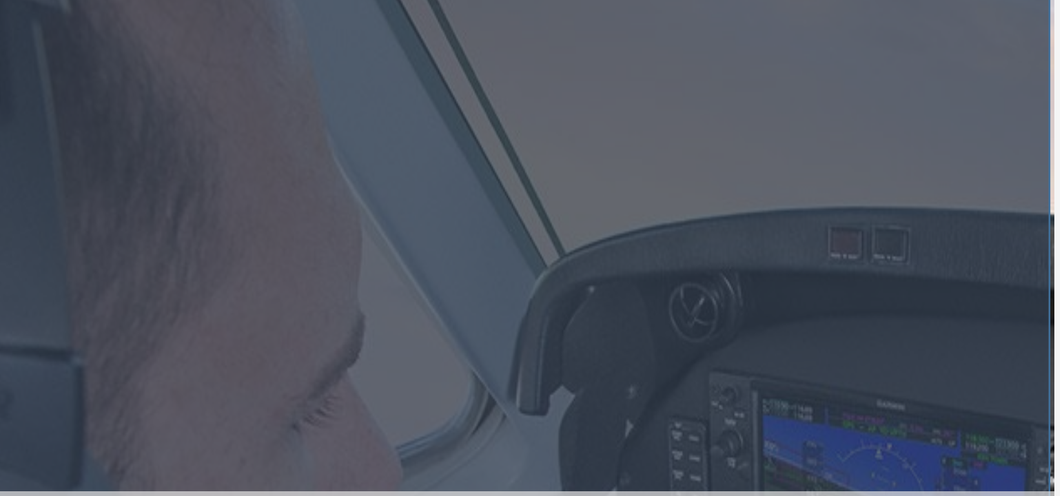
Background

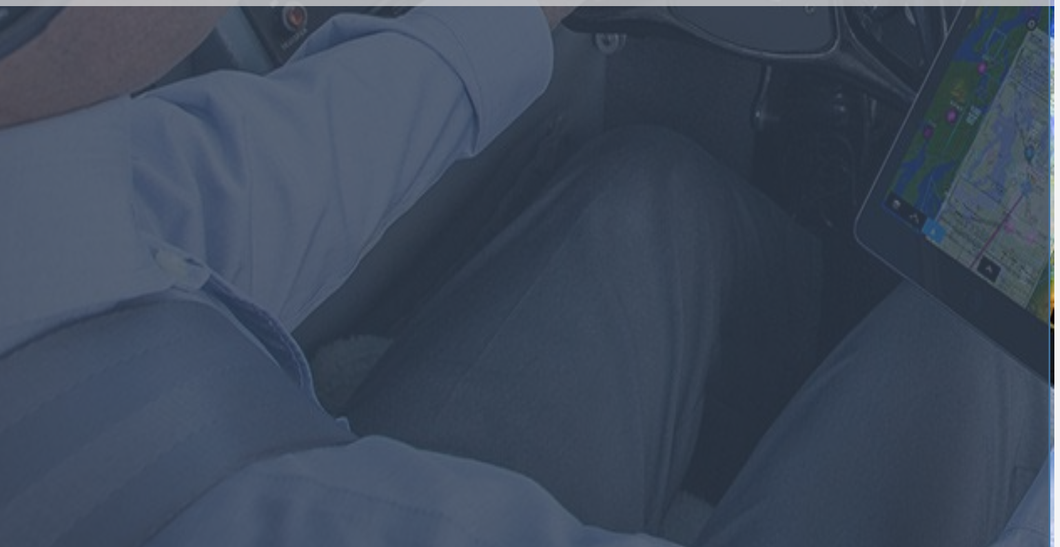
The Aviation Weather Problem

- The rate of weather-related accidents within general aviation (GA) operations has remained relatively stagnant (FAA, 2010).
- Between 2003 and 2007, a total of 1,532 GA accidents were identified as weather related (FAA, 2010).



(Fultz & Ashley, 2016).



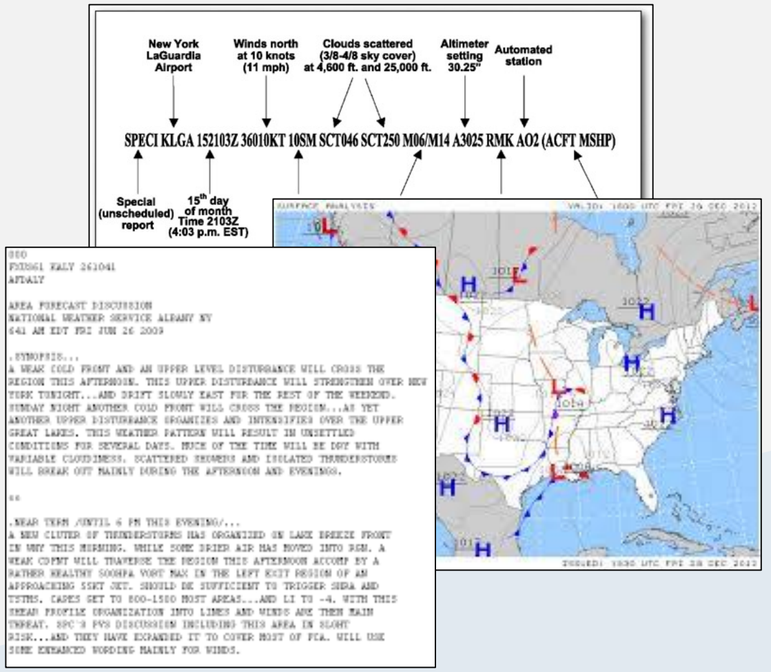


Background

Weather Information

- Currently, there is wide variety of weather information available :

  - METAR
  - Surface Analysis Charts
  - G- AIRMET
  - Area Forecast
  - Radar



Background

Lack of Weather Knowledge

Pilots may have difficulty interpreting this information.

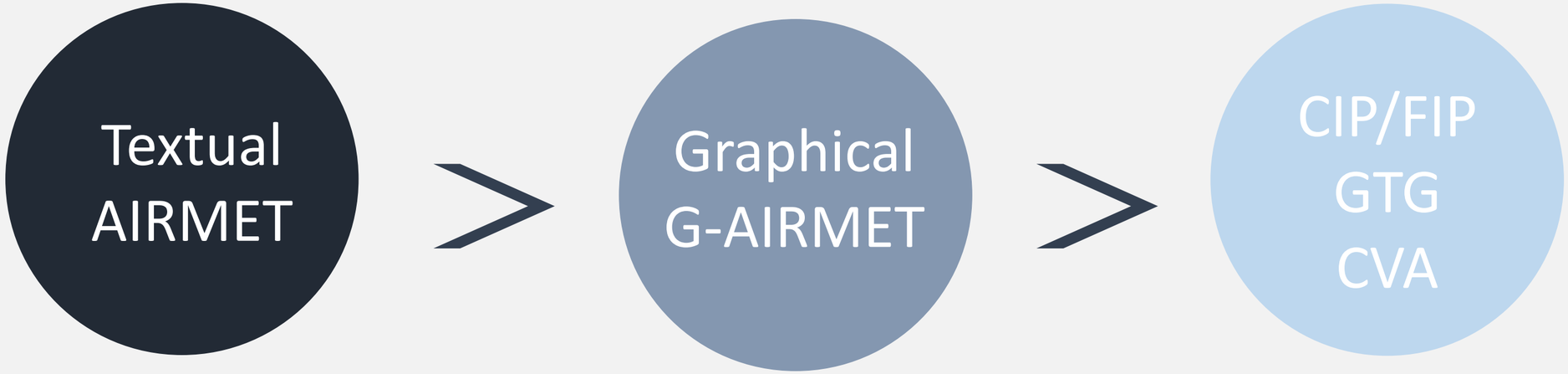
- Weather Products are difficult to interpret
- Poor Weather Products Usability
- Basic Weather Theory is challenging

Usability and Graphics May Improve Pilot Situational Awareness and Decision Making

(Latorella & Chamberlain, 2002).

Evolution of Weather Products

The Aviation Weather Center (AWC) has progressed in their presentation of Meteorological Products.

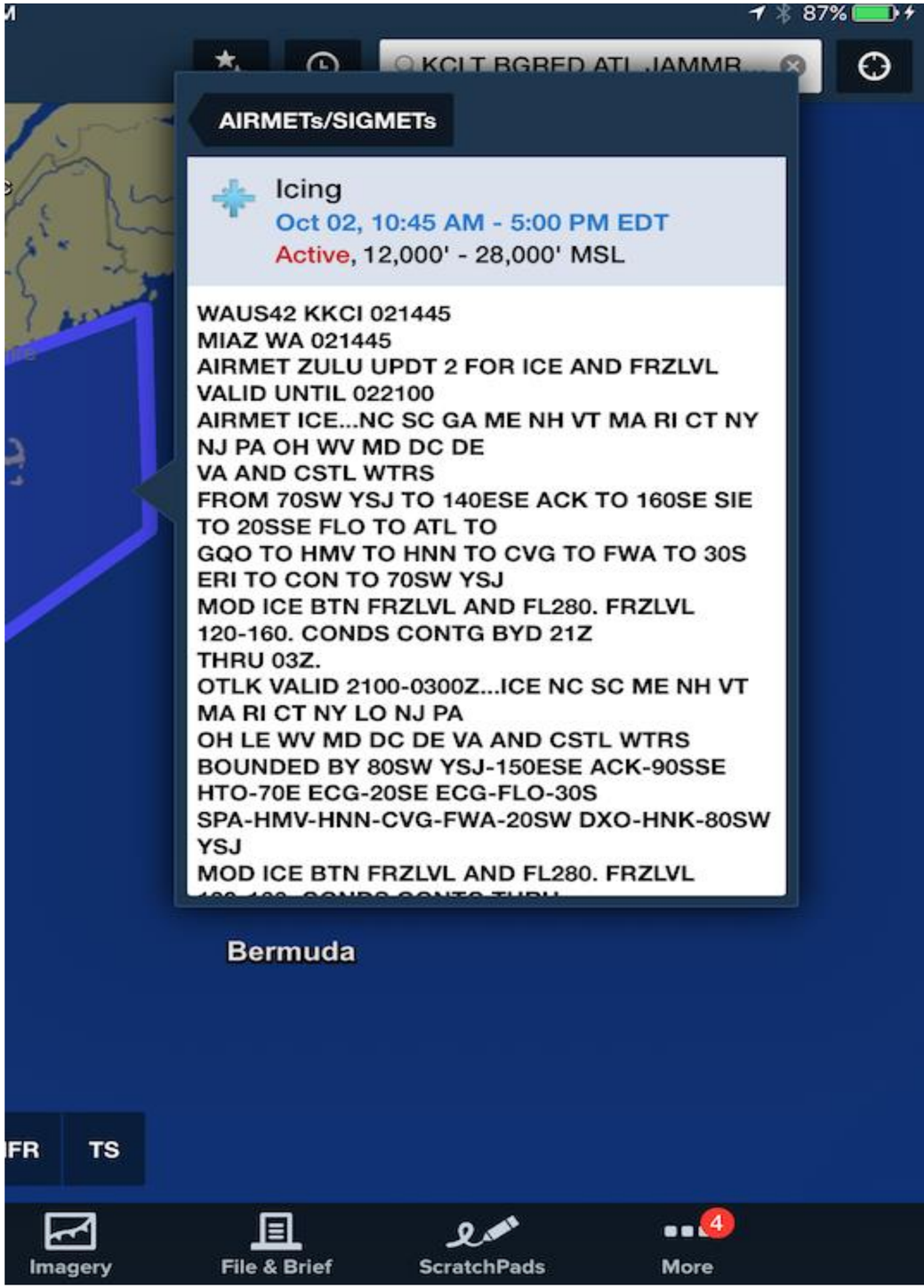


Background

Textual Based AIRMET

The textual based AIRMET products faced several limitations:

- Descriptions of spatial weather phenomena as textual instead of graphical
- Textual presentation may hinder the users' understanding of the information

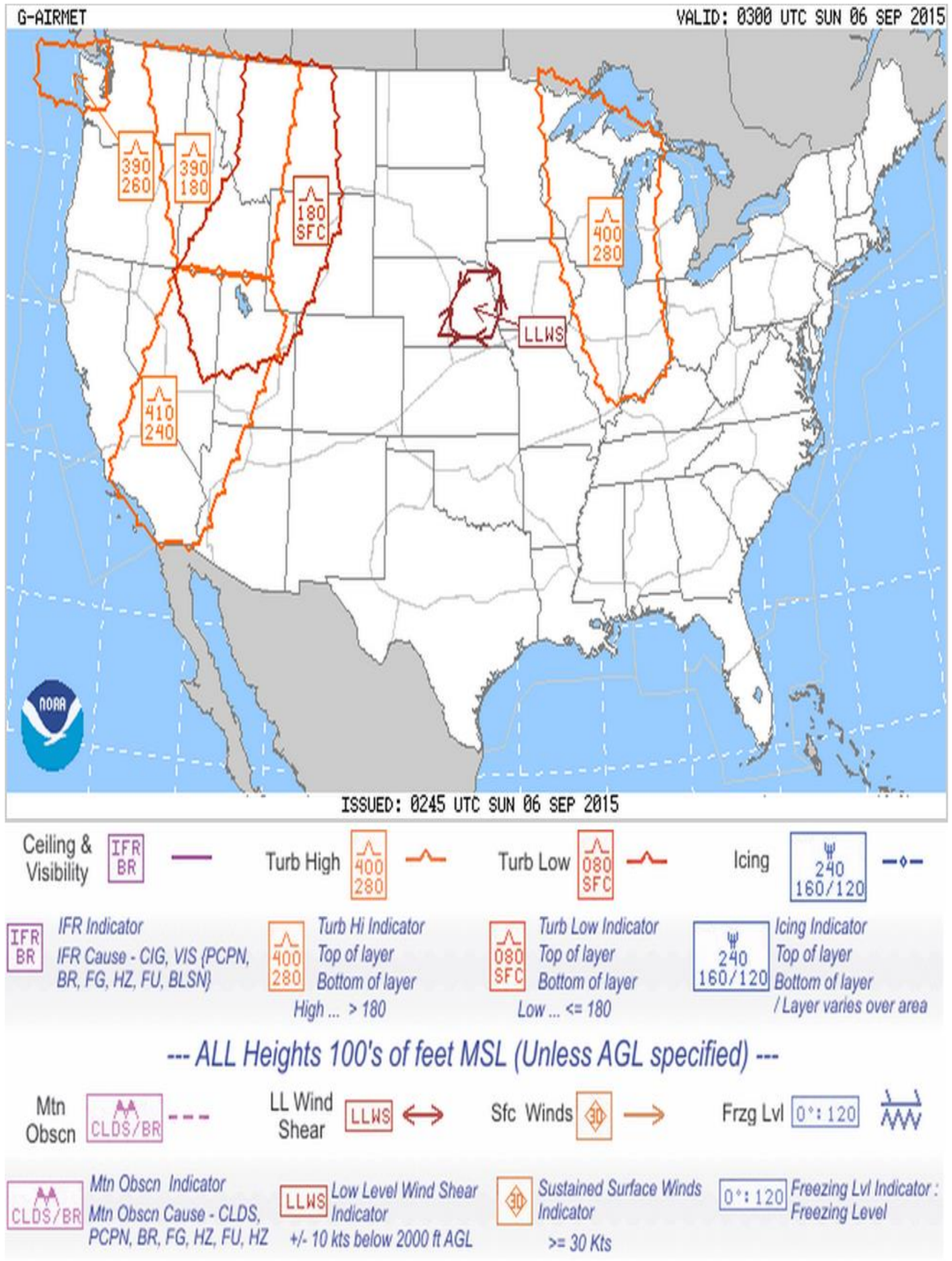


Background

G-AIRMET

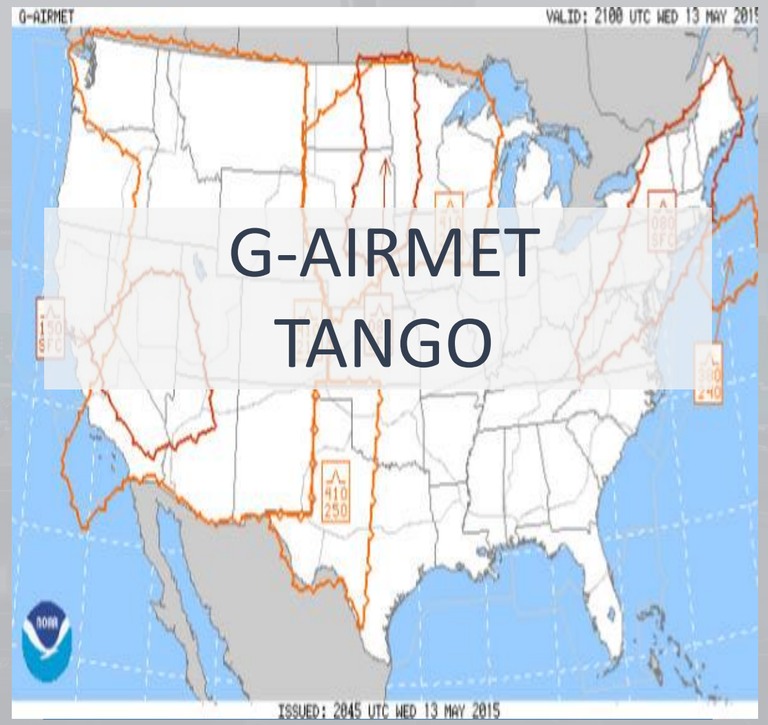
The AWC then developed the graphical AIRMET (G-AIRMET).

- The G-AIRMET is an aviation weather tool providing short time-interval snap-shots of weather
- New design facilitated the graphical display of pertinent aviation weather information
- Products are made with meteorologists in-the-loop

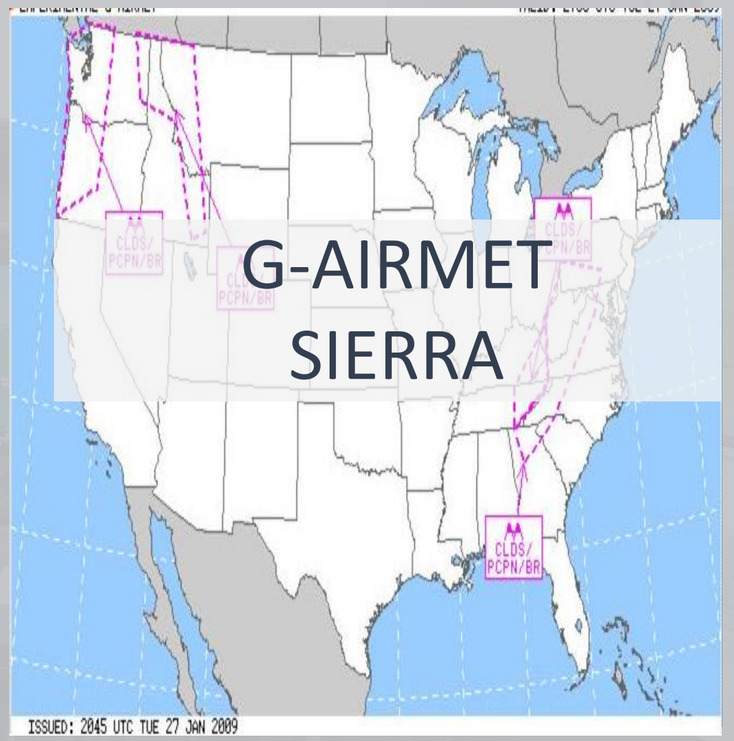


G-AIRMET SUITE

G-AIRMET ICE



G-AIRMET TANGO



G-AIRMET SIERRA

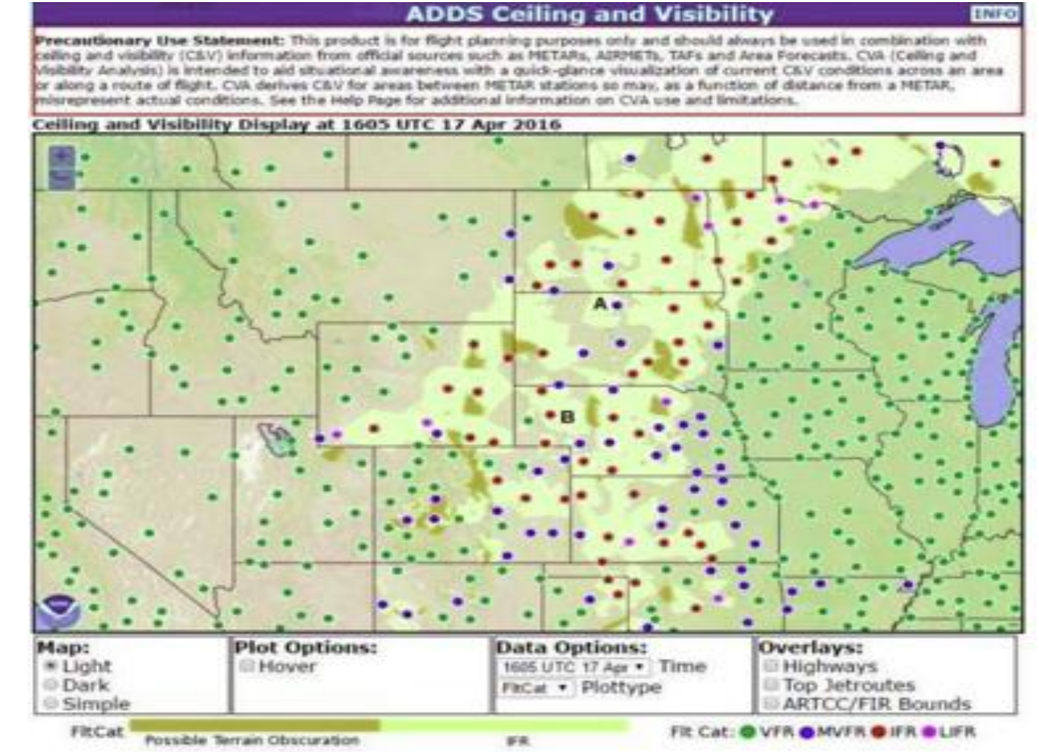
Background

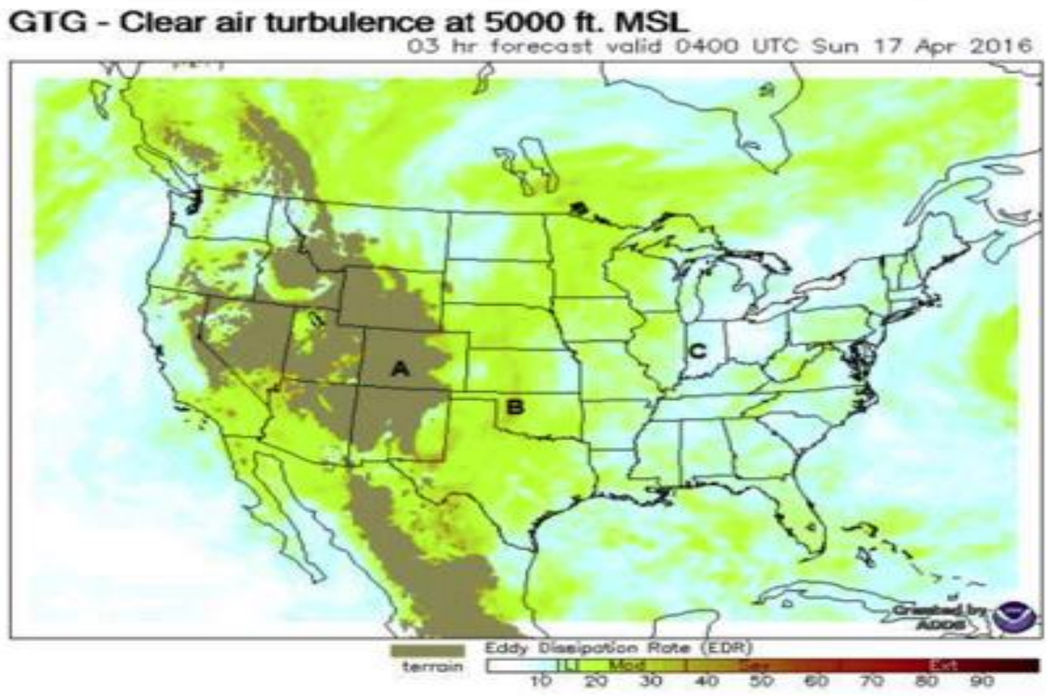
Automated Products

The AWC has developed three new fully automated weather tools:

- Current and Forecast Icing Products (CIP/FIP)
- Graphical Turbulence Guidance (GTG)
- Ceiling and Visibility Analysis (CVA)

Automation = No meteorologist in the loop to generate weather product (FAA, 2016).



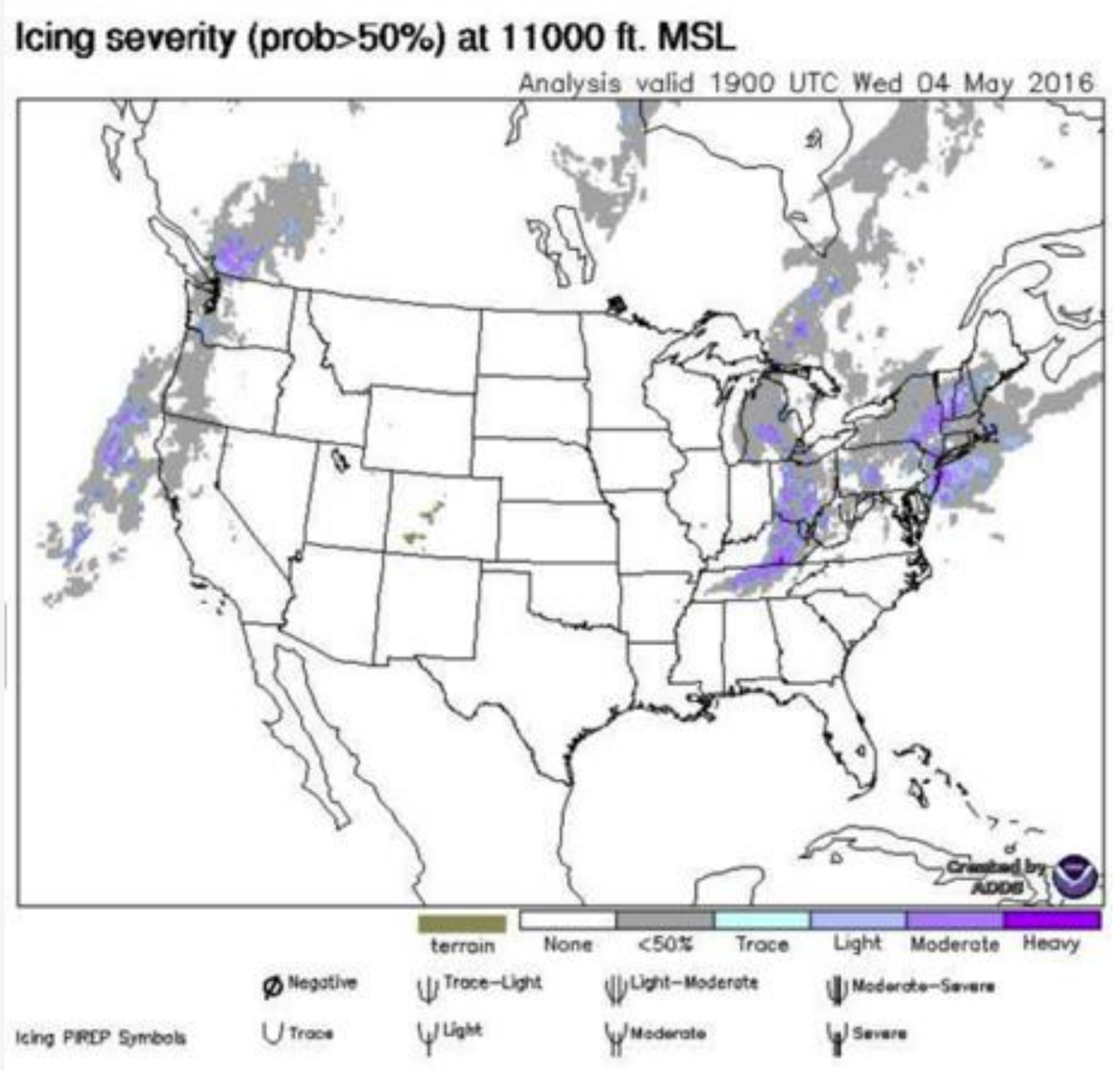


Background

Automated Products

Removing the human in the loop aspect can pose limitations

- May not accurately represent environment affected by weather
- Algorithms may cause errors
- No meteorologist to double check product data



Background

New Product Influence

Does the introduction of graphical and automated products improve pilots understanding of weather?

- Graphical information (in general) may cause pilots' to take more risks
- Products could provide too much information
- If not followed with appropriate training, new products may pose challenges if not followed with appropriate training

Purpose

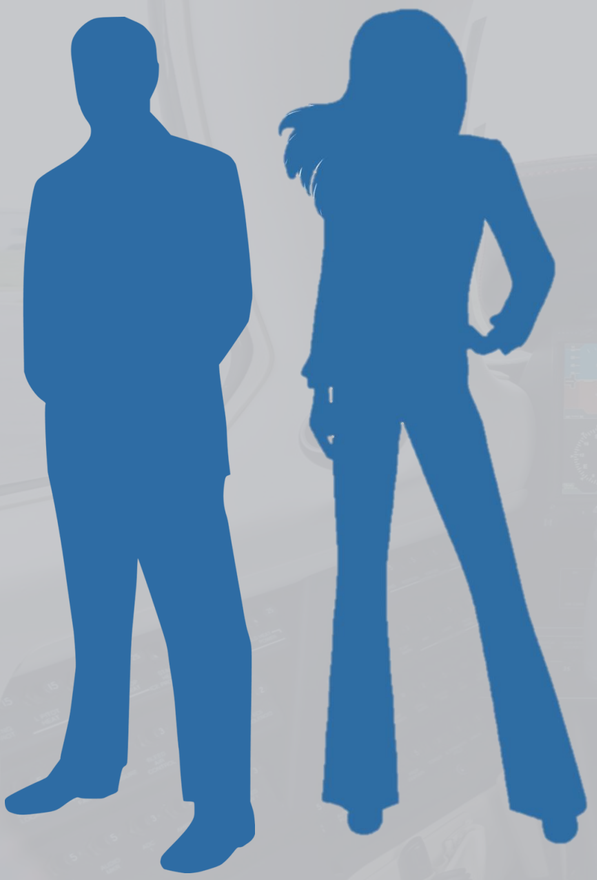
The purpose of this research was to assess and compare pilots' knowledge and interpretation of G-AIRMETs to the fully automated product suite (CVA, CIP, and GTG).

This comparison may help provide a better understanding of pilots' performance with new fully automated weather products and give insight to possible training needs.

METHOD

Method

Participants



Participants were recruited from Embry-Riddle Aeronautical University

Average Age: *M* = 20.70, *SD* = 3.0

Pilot Certificate and/or Rating	Number of Pilots (Total = 131)	Flight Hours *M* (SD)
Student	26	39.92 (33.62)
Private	46	99.35 (40.02)
Private with Instrument	33	173.79 (57.71)
Commercial with Instrument	26	261.52 (92.02

Method

Measures

Two measures were used in this study, a Demographic questionnaire and the Aviation Weather Knowledge Questions.

- Demographic: Questions covered participant age, flight experience, flight training, and weather training.

- Aviation Weather Knowledge Questions: This study used 21 multiple-choice questions pertaining to G-AIRMETs, CVA, CIP/FIP, and GTG product interpretation (Blickensderfer et al ., 2016).

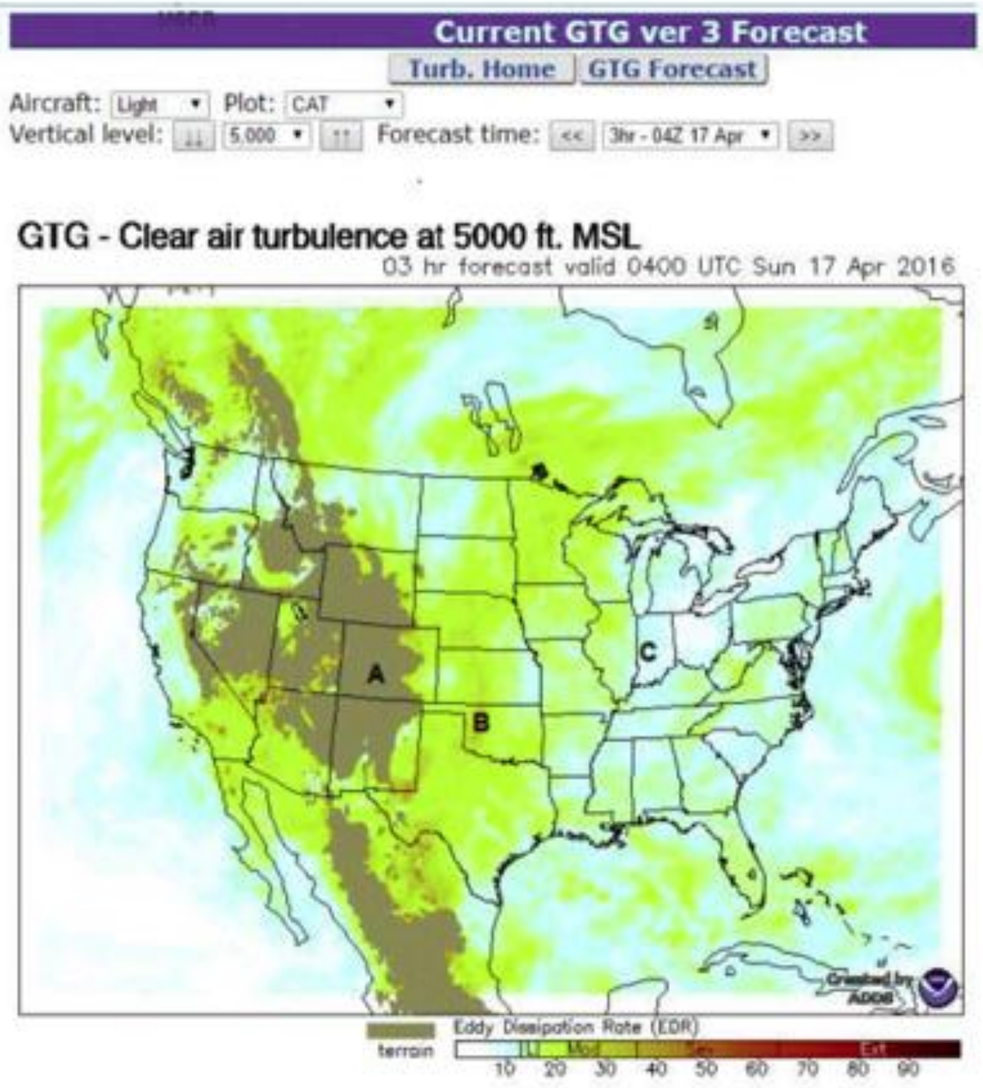
5) **Taxonomy Code: 2005a. 2005b, 2005c**

Examine the four Graphical AIRMETS below, all of which are valid at 06Z. What potential hazards exist on a flight between points A and B below 10,000 feet?

a) Moderate turbulence, moderate icing, IFR conditions.
b) Moderate icing, IFR conditions.
c) Moderate turbulence, IFR conditions.
d) Moderate icing, moderate turbulence

9) Taxonomy Code: 2008

Examine the Graphical Turbulence Guidance (GTG) product below. The product represents the expected conditions for what time?



a) 0300Z

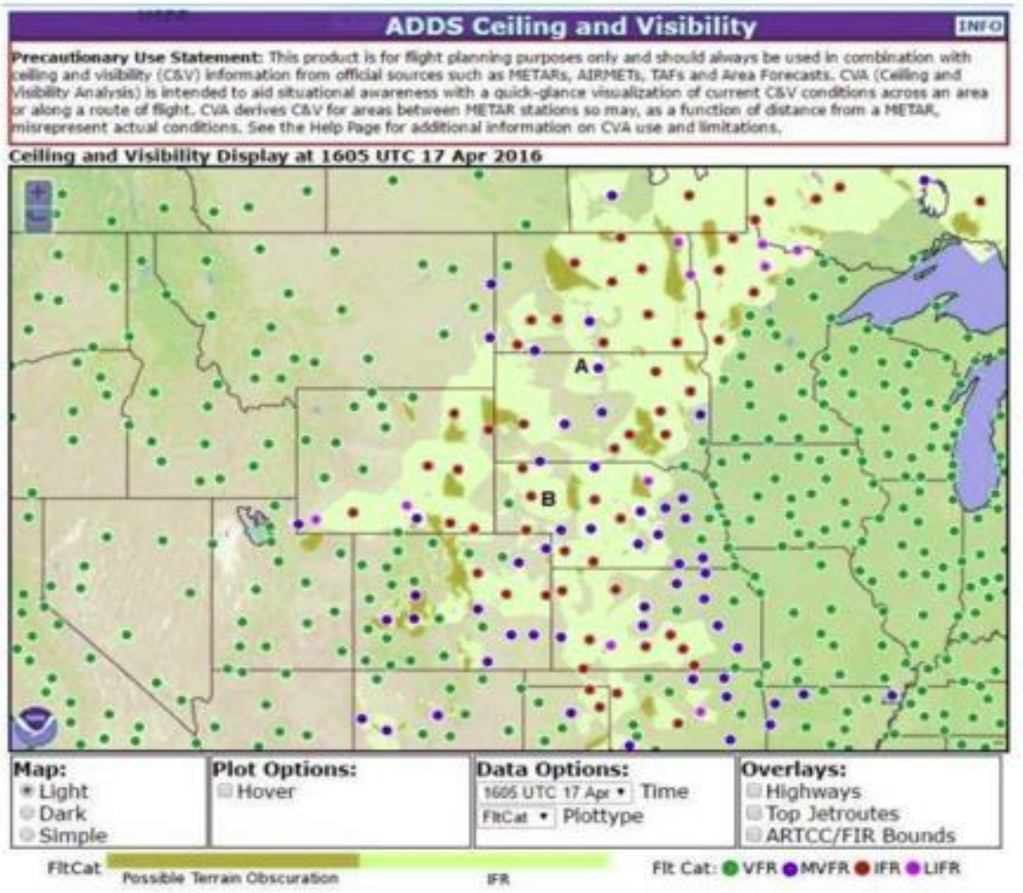
b) 0400Z

c) 0700Z

d) The time period between 03-07Z

61) Taxonomy Code: 1201e, 2014

Examine the Ceiling and Visibility Analysis (CVA) product below valid for at 1605Z. What do we know about the ceiling and visibility conditions for the station with the red dot located to the immediate left of the letter "B" (Alliance Municipal Airport, NE?



a) The ceiling is less than 1000 feet and the visibility is less than 3 miles.

b) Either the ceiling is less than 1,000 feet or the visibility is less than 3 miles.

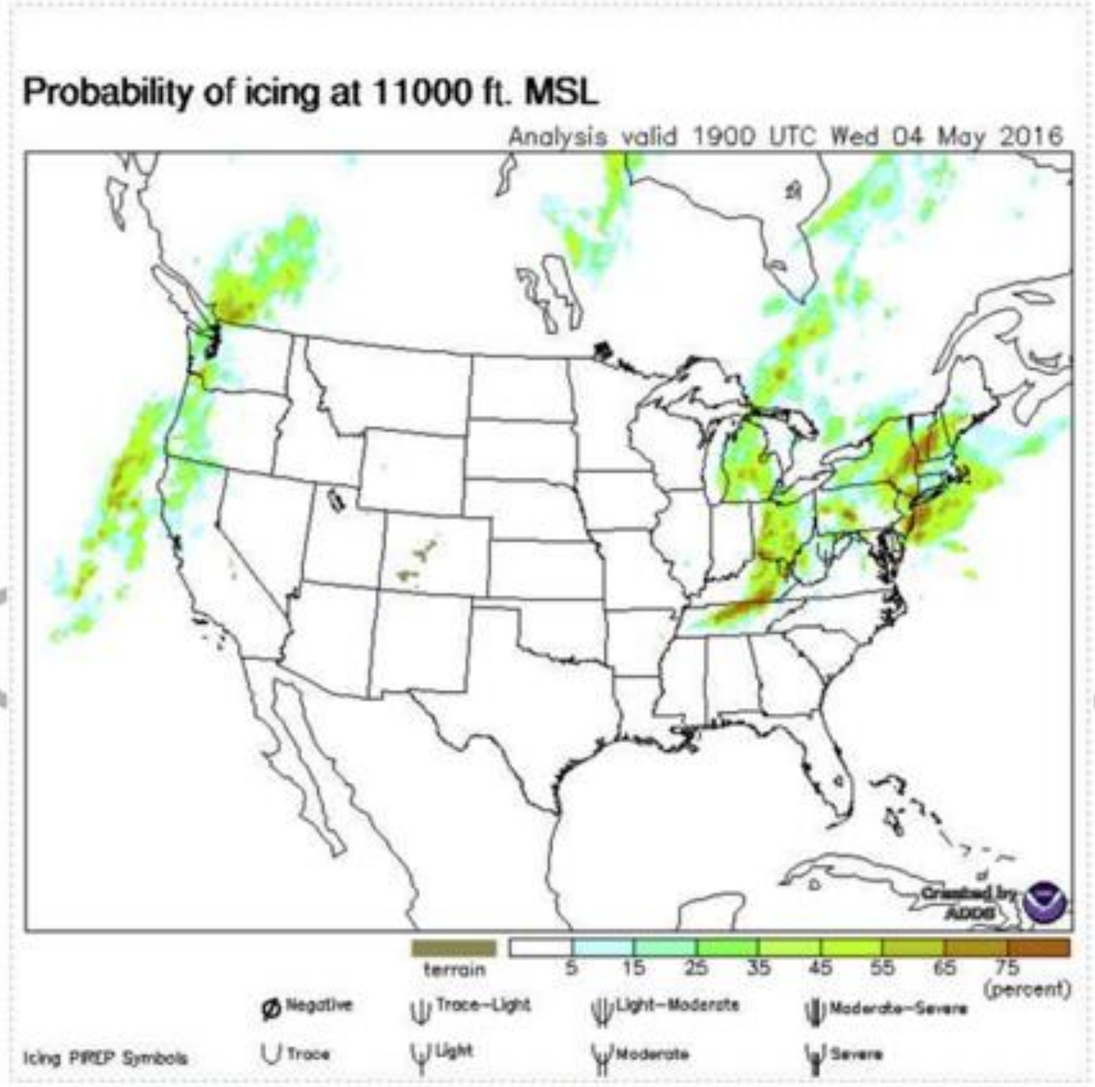
c) The ceiling is less than 1,500 feet and the visibility is less than 2 miles.

d) Either the ceiling is less than 1,500 feet or the visibility is less than 2 miles.

Difficulty Level	Point Biserial	Frequency of Each Distractors			
		A	B	C	D
.6	.322	60	122	10	12

3) **Taxonomy Code: 2006**

The Current Icing Product (CIP) example below provides what useful information for 1900Z on 4 May 2016?



a) The severity of icing at 11,000 feet MSL

b) The probability of encountering moderate or greater icing at 11,000 feet MSL

c) The maximum probability of icing regardless of altitude

d) The probability of encountering any intensity of icing at 11,000 feet MSL

Method

Measures

To assess the participant's product interpretation scores, we calculated percent correct and developed composite scores for the following categories:

Traditional Generation Products
(13 questions)

- **G AIRMET ICE**
  (9 questions) *
- **G AIRMET SIERRA**
  (4 questions)*
- **G AIRMET TANGO**
  (6 questions)*

Automated Generation Products
(8 questions)

- **CIP/FIP**
  (4 questions)
- **GTG**
  (2 questions)
- **CVA**
  (2 questions)

* Groups share overlapping questions

Method

Procedure

Once participants arrived at the data collection site, each participant was briefed and received an informed consent form to sign and review.

Then they completed the following at their own pace:

- **The computer-based online demographic survey.**
- **The computer based aviation-weather knowledge assessment.**

After completing the demographic survey and the knowledge assessment, participants were debriefed and received their compensation. Subset of previous study (Blickensderfer et al ., 2016).

RESULTS


GARMIN
CHARTS
SELECT
ALERTS
KECP
KLSF
KABY
NXRD
Back
MSG
TRAFFIC

Results

Analyses

We conducted four 4 X 2 Mixed ANOVAS. In each analysis we investigated the effect of experience on product interpretation score and the following factors:

1. Effect of Traditional and Automated on Product Interpretation Scores.

Traditional
- G-AIRMET ICE
- G-AIRMET Sierra
- G-AIRMET Tango

Automated
- CIP/FIP
- CVA
- GTG

2. Effect of Icing Product Generation on Product Interpretation scores.

- CIP/FIP
- G-AIRMET ICE

3. Effect of Turbulence Product Generation on Product Interpretation scores.

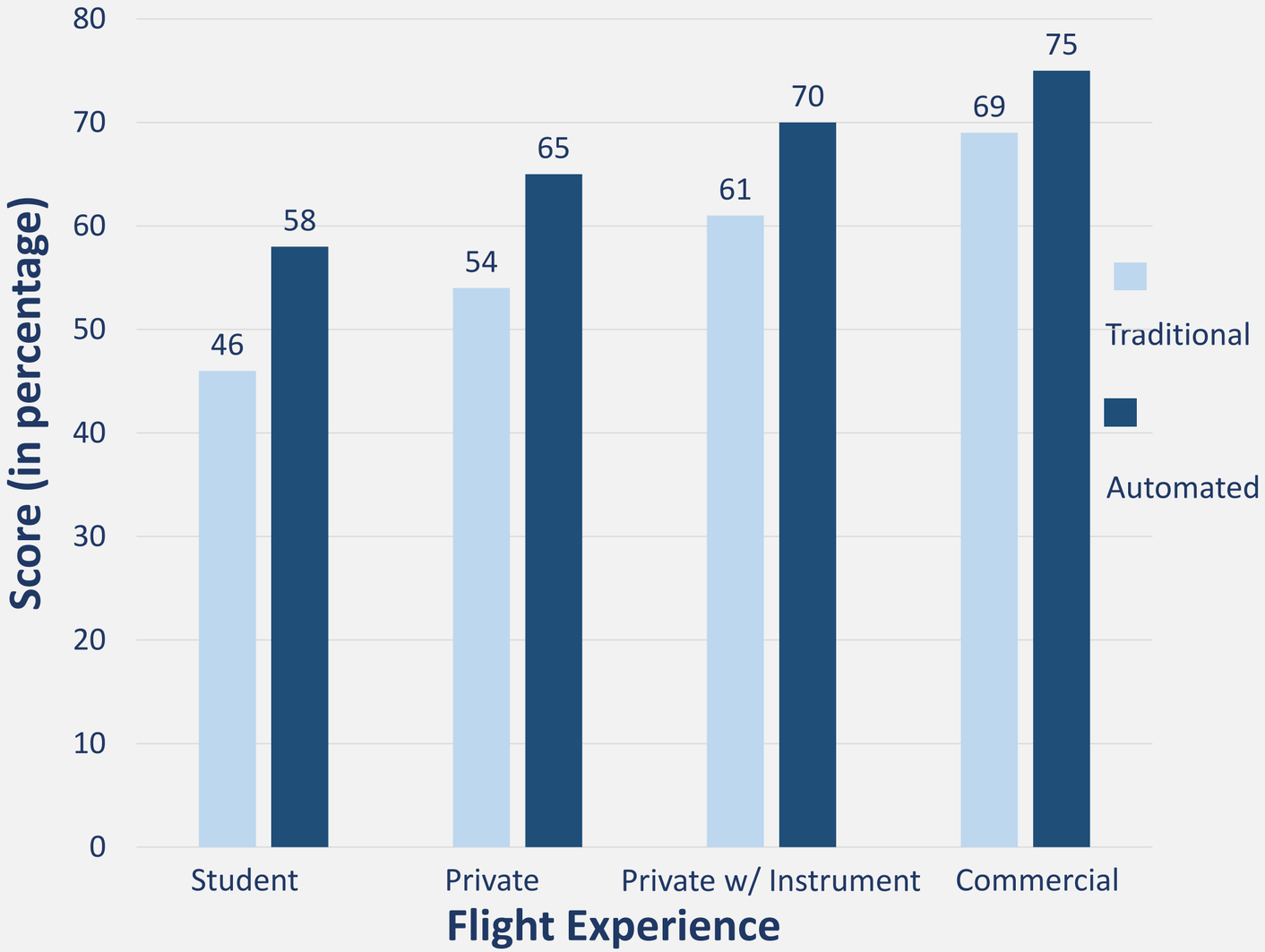
- GTG
- G-AIRMET Tango

4. Effect of Visibility Product Generation on Product Interpretation scores.

- CVA
- G-AIRMET Sierra

Results

Effect of Traditional and Automated on Product Interpretation Scores

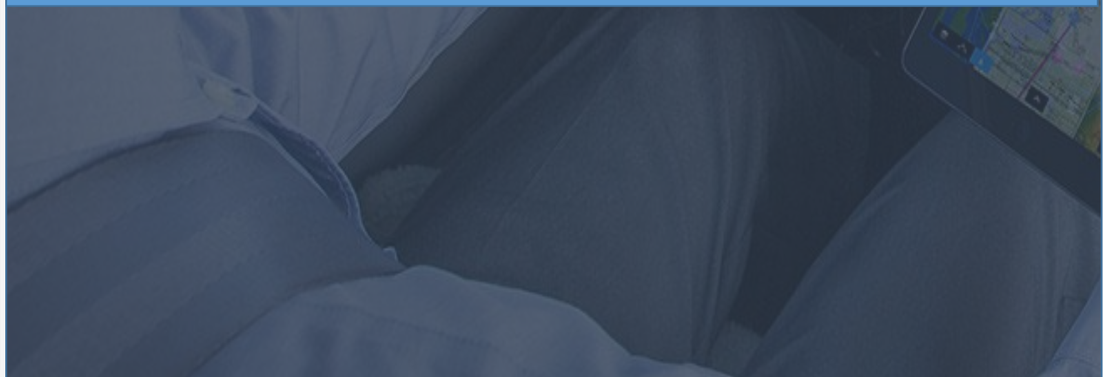


4 x 2 Mixed ANOVA

- Product generation by experience on percentage correct

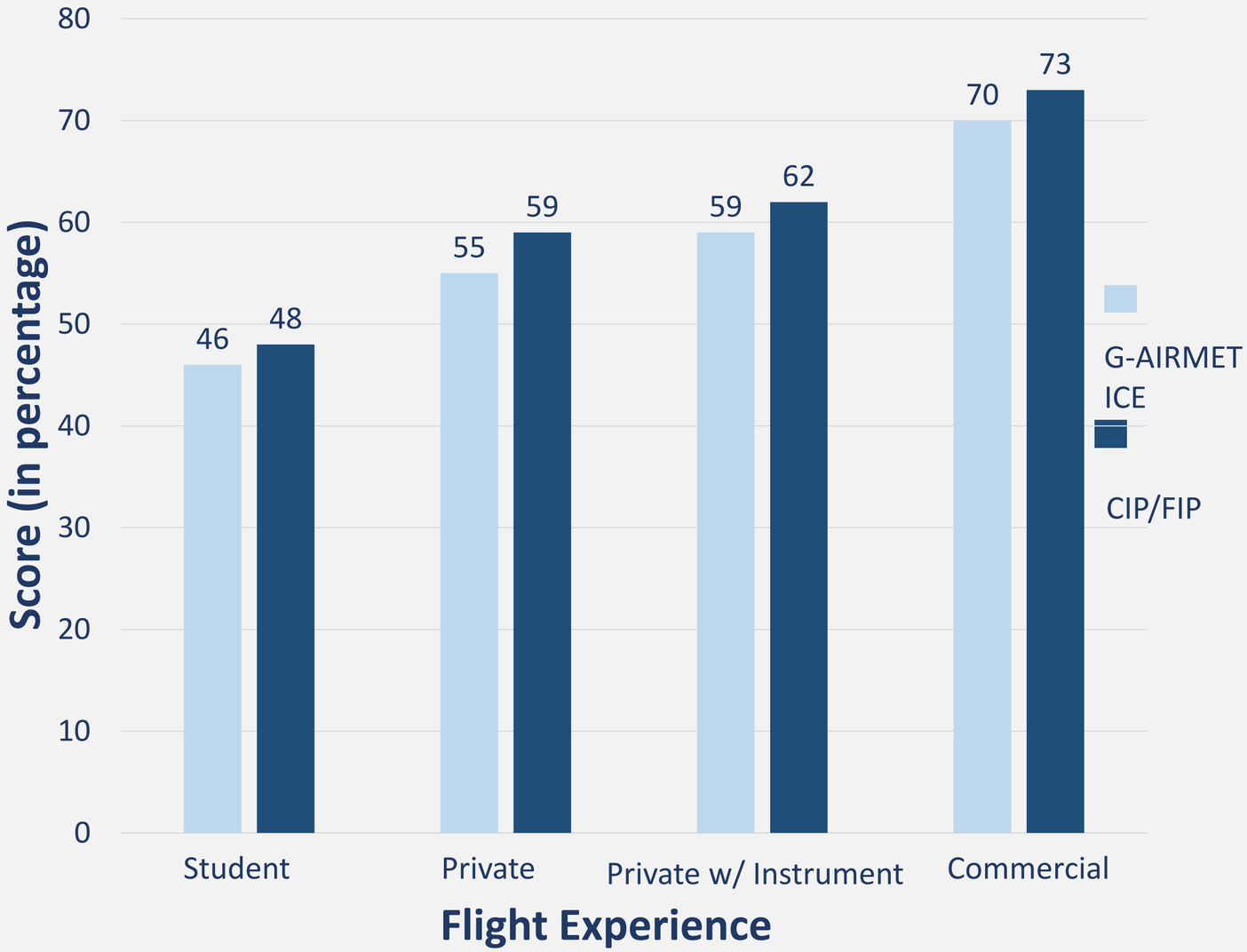
Pilots scored higher on automated weather products questions

Student pilots scored lower than Commercial Pilots



Results

Effect of Icing Product Generation on Product Interpretation scores



4 x 2 Mixed ANOVA

- Icing Product generation by experience on percentage correct

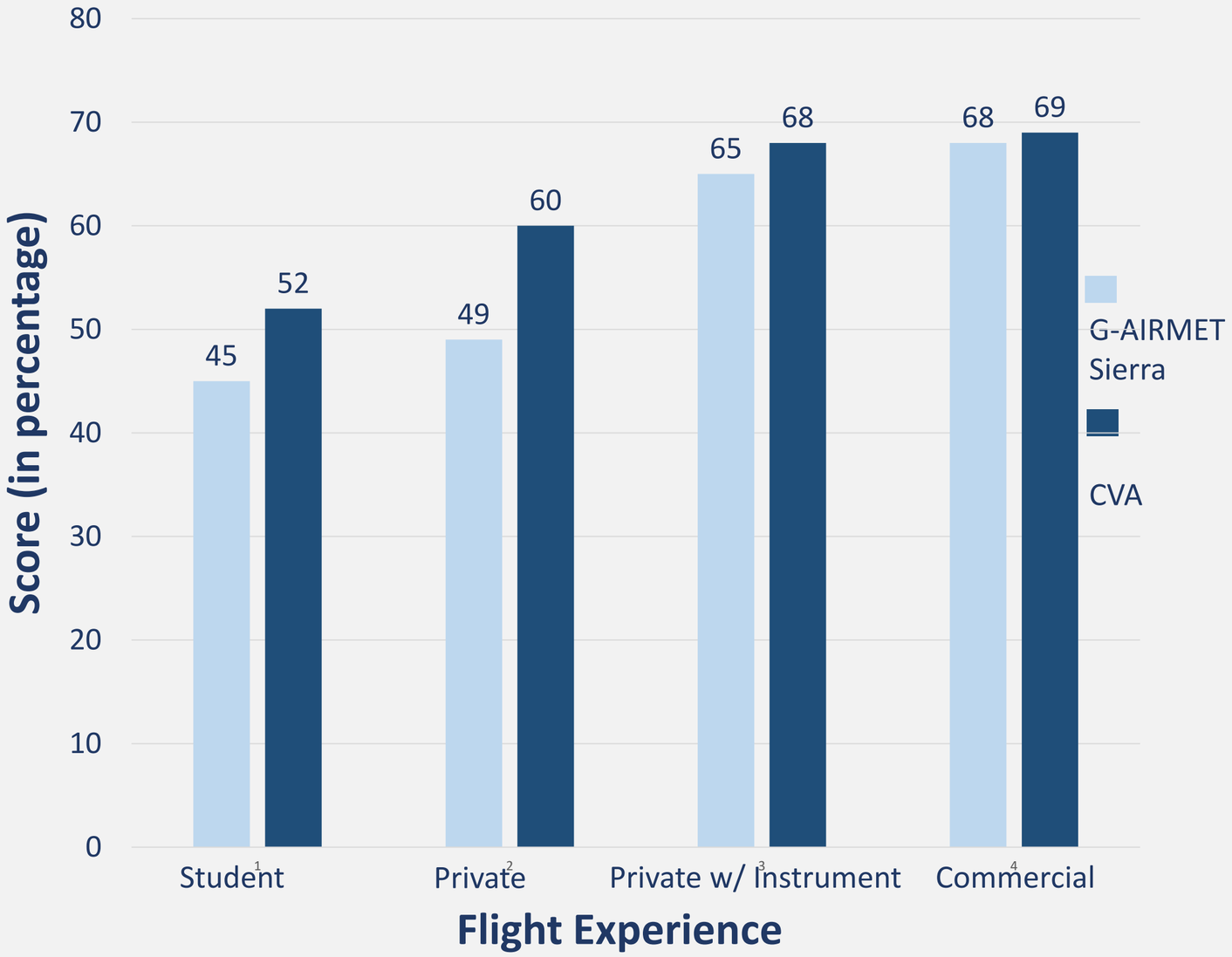
No significant main effect of icing product generation on icing interpretation scores

Commercial Pilots scored significantly higher than Private and Instrument pilots

Instrument pilots significantly scored Higher than Student pilots

Results

Effect of Visibility Product Generation on Product Interpretation scores



4 x 2 Mixed ANOVA

- Visibility Product generation by experience on percentage correct

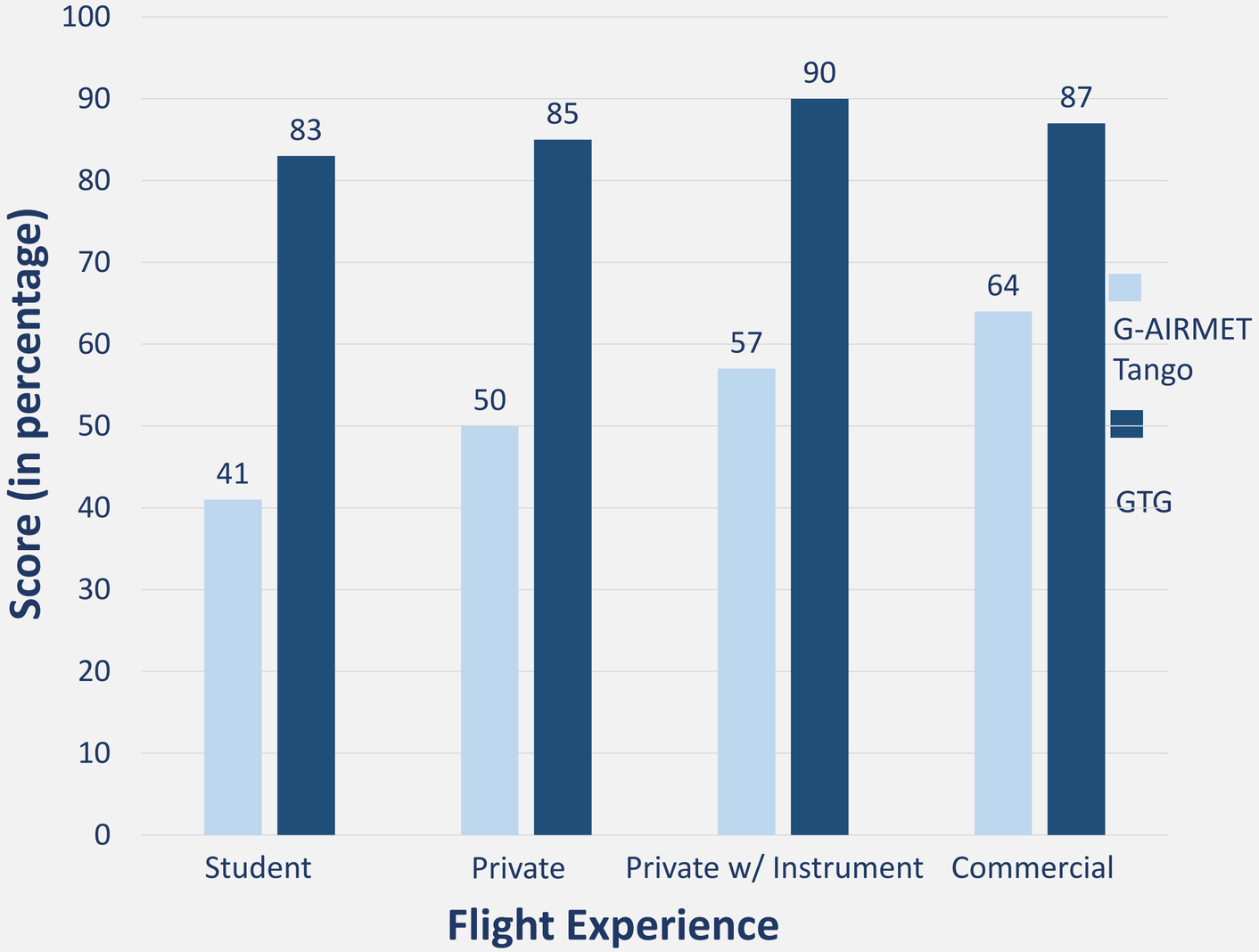
No significant main effect of visibility product generation on visibility interpretation scores

Student Pilots scored significantly lower than Commercial Pilots

No other significant relationships occurred

Results

Effect of Turbulence Product Generation on Product Interpretation scores



4 x 2 Mixed ANOVA

- Turbulence Product generation by experience on percentage correct

Pilots scored significantly higher on automated GTG weather products interpretation scores

No significant main effect of the pilot certificate on turbulence product interpretation scores

No other significant relationships occurred

Discussion

The purpose of this study was to examine pilots' abilities to interpret traditional human- in-loop graphical products and newer fully-automated aviation weather products.

- Pilots performed better on automated products than on questions using traditional products
- For icing and visibility products, the results indicate similar interpretation scores for both traditional and automated generation products.

Discussion cont.

- Turbulence products results indicated that participants' scored higher on the automated turbulence product interpretation questions.

- The significant differences found could be due to the same suite of contributing factors, training, pilot preference, and product usability

- Usability of the weather products analyzed could also contribute to this significant difference in scores.

Limitations

- Participants were relatively low-hour pilots

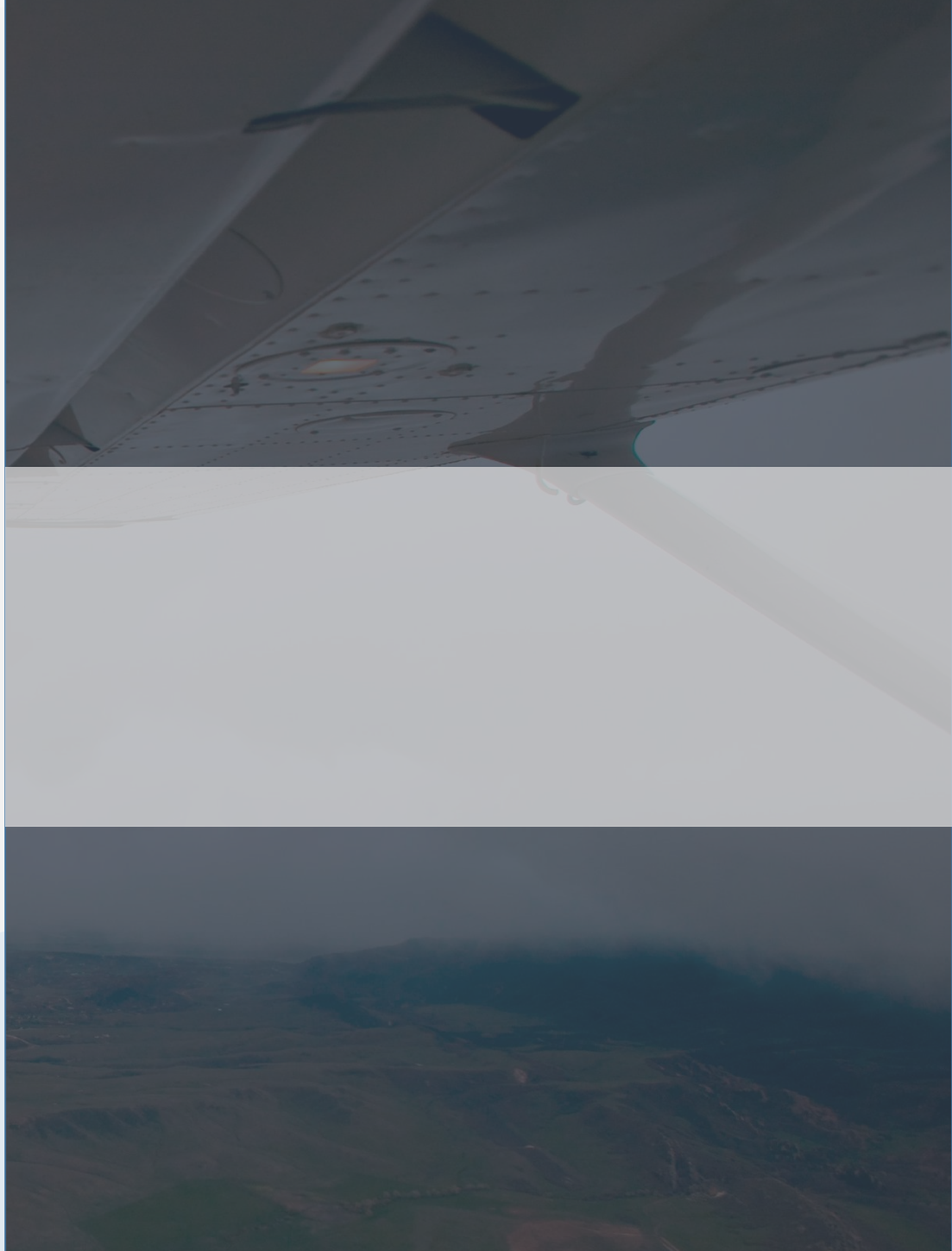
- More generalizable sample could provide insight into how pilots are interpreting the automated products.

- Research is also needed to identify underlying reasons for the similarities and difference in interpretation scores.

Thank You


GARMIN
CHARTS
SELECT
ALERTS
KECP
KLSF
KABY
NXRD
Back
MSG
TRAFFIC

Questions?



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