Icing Product Alaska (IPA) Diagnosis and Forecast User Evaluation Results and Recommendations Briefing

Presented to: ANG-C61 IPA Lead
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Results & Recommendations Briefing

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Introduction

Introduction

- ANG-C61 is funding research and development focused on improving icing products to support aviation in Alaska.
- The Aviation Weather Research Program (AWRP) is funding the National Center for Atmospheric Research (NCAR) In Flight Icing Product Development Team (IFIPDT) to develop an icing diagnosing and forecasting product.
- AWDE (ANG-C63) has been tasked with gathering user input regarding the suitability and usability of the Icing Product Alaska (IPA) Diagnosing and Forecasting products.

Background

Background

- Weather in Alaska presents a special challenge for icing detection and forecasting due to the:
  - Terrain,
  - Air-sea interaction, and
  - Variation in weather conditions across the state coupled with limited surface and space-based observations.
- Additionally, product verification is difficult due to lack of Pilot Reports (PIREP).
- Research and development has focused on developing a product that accurately diagnoses and forecasts icing.
- The goal is to develop an automated diagnostic and forecast icing capability used by pilots, dispatchers and meteorologists to support timely decisions regarding icing threat areas, optimum routings, and identification of areas to avoid.

Objectives

- Determine how participants use the IPA products to aid in decision making strategies;
- Determine if the IPA products have the information needed for decision making;
- Determine the usability and suitability of the products; and
- Gather user feedback to determine product improvements as related to the participant operational environment.

User Evaluation Approach

Approach

- Conducted cognitive walkthroughs and interviewed participants at the following locations:
  - October 16th Anchorage, Alaska
    - 2 Part 135/ Air Ambulance Pilots
    - 1 Part 135 Dispatcher
    - 1 General Aviation (GA) Pilot
  - October 17th Anchorage, Alaska
    - 3 Part 121 Pilot
    - 2 Part 121 Dispatcher
    - 1 Part 135 Pilot
  - October 18th Anchorage, Alaska
    - 1 Part 135 Pilot
    - 2 Alaska Aviation Weather Unit (AAWU) Meteorologists

Approach (Cont'd)

- Conducted cognitive walkthroughs with participants at the following locations:
  - October 18th Fairbanks, Alaska
    - 2 GA Pilots
    - 1 Part 121 Dispatcher
    - 3 Part 135 Pilot
  - October 19th Juneau, Alaska
    - 1 GA Pilot
    - 5 Part 135 Pilot
    - 6 Air Traffic Managers (ATM) and Flight Service (FS) personnel

Participant Summary

Total	User Group	Primary Geographic Flying Region	Aircraft Certified for Icing		Average Flight Hours	Formal Training for Icing Products		How Often Icing is used for Decision Making (# of responses in parenthesis)
			Yes	No		Yes	No	
12	Part 135/Air Ambulance	Western, Southeast, Statewide, South Central, Central and Northern, Interior	11	1	11250	11	1	(4) Often (3) Rarely (1) Always (2) Sometimes
3	Part 121	South Central, Northern, Western	3	0	6277	3	0	Sometimes, Always, Often
4	GA Pilot	Southeast, Interior, South Central	1	3	>3100	3	0	(4) Sometimes
4	Dispatcher (Part 121 and 135)	South Central, All AK, Interior, North Slope	3	1	--	4	4	(2) Sometimes (1) Often (1) Always
2	AAWU*	--	--	--	--	--	--	--
6	ATM/Flight Services*	--	--	--	--	--	--	--
31	**Total**							

Note: Demographic questionnaires and product questionnaires were not give to the ATM/Flight Services personnel or AAWU Meteorologists.

User Evaluation Approach

- Cognitive walkthroughs were conducted with multiple participants in attendance.
- Each cognitive walkthrough consisted of:
  - The AWDE Team providing a description of the IPA products, evaluation, protocols, and participants expectations.
  - Each pilot participant completed a demographic questionnaire to gather data about flight experience, training, and icing products used.
  - Two scenarios:
    - Participants were asked to consider planning a flight when icing conditions are present; however, those conditions are not significant.
    - Participants were asked to consider planning for a flight expected to encounter severe icing conditions which are expected to have a significant impact on the flight.

User Evaluation Approach Continued

- Each scenario had two estimated departure times
  - First departure time was within 2-3 hours of the session start time.
  - The second departure time was within 24 hours of the session start time.
- During the scenarios, participants were asked to walk through each step in their decision making process while planning a flight during an icing event.
- Participants were asked to use a think-out-loud protocol while using the IPA products.
  - The think-out-loud protocol allowed the AWDE Team to identify tools used, weather characteristics considered, icing severity concerns, icing severity thresholds, other weather information used, and how participants would use the IPA products.
  - Participants were encouraged to interact with the products as much as possible to aid them in their pre-flight decision making processes.

User Evaluation Approach Continued

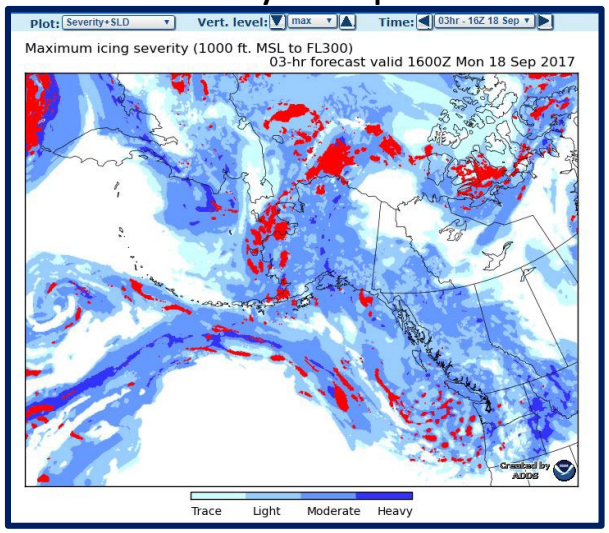
- During the scenarios, the AWDE Team collected data using:
  - Observation Forms
    - Projected time of flight,
    - Weather characteristics/situation,
    - Icing Severity,
    - Risk Thresholds,
    - Which tool was used, IPA-D and/or IPA-F,
    - Weather information being used,
    - Issues/concerns with the tool, and
    - What additional weather/icing tools would they use.
  - Structured Interview Questions
    - Allowed participants to provide comments regarding their use of IPA-D and IPA-F forecasts for strategic decision making.
    - Questions focused on information used to support decisions, utility of forecast characteristics, and any additional information participants wanted to make available.

User Evaluation Approach Continued

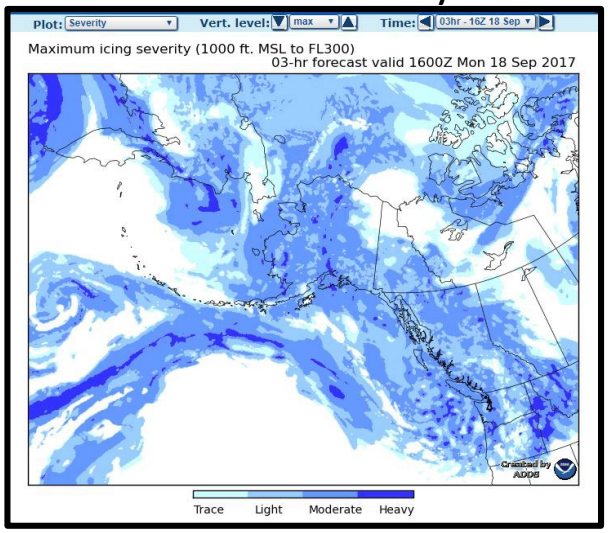
- After completion of the two scenarios and interacting with the products, participants completed a two-part questionnaire.
  - The first part focused on the IPA products usability and suitability, as a whole.
    - 5-point Likert scale rating was used (5-Very Effective, 4-Somewhat Effective, 3-Borderline, 2-Somewhat Ineffective, and 1-Very Ineffective, 0-N/A).
    - Space for additional comments was provided.
  - The second part focused on each individual product (IPA-D and IPA-F).
    - 5-point Likert scale rating was used (5-Strongly Agree, 4-Agree, 3-Neither Agree/Disagree, 2-Disagree, and 1-Strongly Disagree).
    - Space for additional comments was provided.

Five Plots for IPA

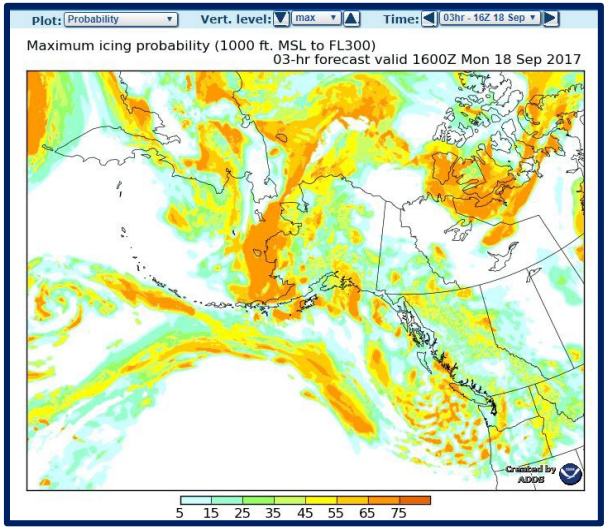
IPA-F Severity + Supercooled Large Droplets (SLD)



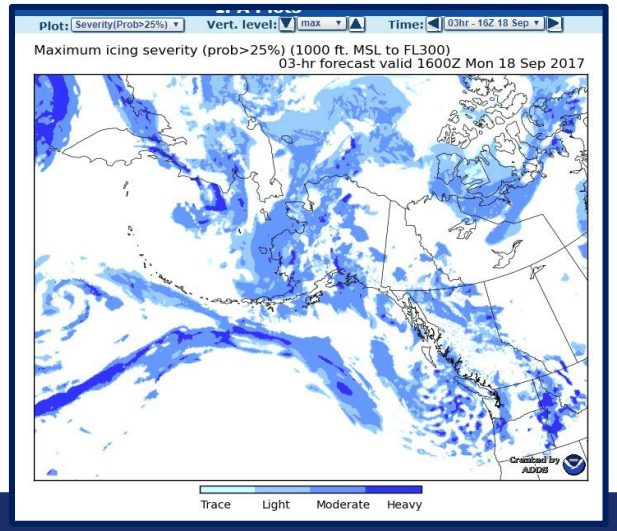
IPA-F Severity



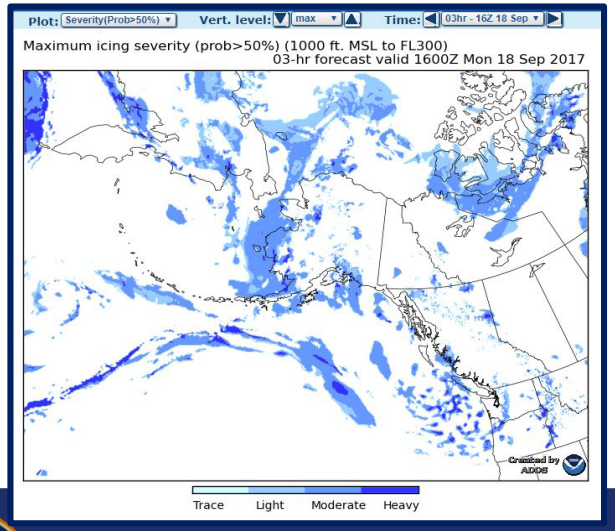
IPA-F Probability



IPA-F Severity Probability >25%



IPA-F Severity Probability >50%



Note: The plots are identical for IPA-D and IPA-F, the difference is the time option. IPA-D is the current time, therefore, the time option is 00hr.

User Evaluation Results
for
IPA Product

Rating Scale Definitions

5. Very Effective. This response indicates the product being rated provides exceptional support for planning in response to icing forecasts.

4. Somewhat Effective. This response indicates the product as being rated provides sufficient support for planning in response to icing forecasts.

3. Borderline. This response indicates the product being rated provides neither effective nor ineffective support for planning in response to icing forecasts.

2. Somewhat Ineffective. This response indicates the product being rated does not provide support for planning in response to icing forecasts.

1. Very Ineffective. This response indicates the product being rated impedes support for planning in response to icing forecasts.

0. Not Applicable (N/A). This response indicates the feature or capability in question does not apply.

IPA Questionnaire Results

User Group	Overall IPA presentation: Median (Mean)		
	Suitability/ Effectiveness	Ease of Use	Readability
Part 135/Air Ambulance (N=12)	4.5 (4.5)	4 (4.12)	4 (4.33)
Part 121 (N=3)	4 (4)	4 (4)	4 (4)
GA Pilot (N=3)	4 **(3.33)**	**3 (3.33)**	4 (4)
Dispatcher (Part 121 and 135) (N=3)	4 (4.33)	5 (4.67)	5 (4.67)

- The GA Pilots stated a need to define the severity categories. Without proper definitions, pilots do not know what information is taken into consideration when developing the categories (i.e., aircraft type).
- Participants stated a need for a better zoom capability.

IPA Questionnaire Results

User Group	IPA icing presentation: Median (Mean)		
	Suitability/ Effectiveness	Ease of Use	Readability
Part 135/Air Ambulance (N=12)	5 (4.58)	4.5 (4.33)	5 (4.33)
Part 121 (N=3)	4 (4.33)	4 (4.33)	4 (4)
GA Pilot (N=3)	4 (4)	4 (4.33)	4 (4.33)
Dispatcher (Part 121 and 135) (N=3)	4 (4)	4 (4.33)	4 (4)

Participants stated the product provided good information to help identify icing at different altitudes. Which will aid them in their decision making strategies.

IPA Questionnaire Results

User Group	IPA icing severity levels (trace [light blue] to heavy [dark blue]): Median (Mean)		
	Suitability/ Effectiveness	Ease of Use	Readability
Part 135/Air Ambulance (N=12)	4 (4.33)	4.5 (4.33)	4.5 (4.25)
Part 121 (N=3)	4 (4.33)	4 (4.33)	4 (4.33)
GA Pilot (N=3)	4 (3.67)	4 (4)	4 (4.33)
Dispatcher (Part 121 and 135) (N=3)	4 (4.33)	4 (4.33)	4 (4.33)

- All participants rated the color coding as either very effective or effective in suitability, ease of use, and readability.
- Participants stated if the product had a better zoom capability the color coding would be more effective because they could more precisely see the differences in the colors.

IPA Questionnaire Results

User Group	IPA icing probability presentations (5% [light blue] 100% [orange]): Median (Mean)		
	Suitability/ Effectiveness	Ease of Use	Readability
Part 135/Air Ambulance (N=12)	4.5 (4.5)	4 (4.33)	4.5 (4.5)
Part 121 (N=3)	5 (4.67)	5 (4.67)	5 (4.67)
GA Pilot (N=3)	4 (4.33)	4 (4)	4 (4.33)
Dispatcher (Part 121 and 135) (N=3)	5 (4.67)	5 (4.67)	5 (4.67)

- All participants rated the color coding as either very effective or effective in suitability, ease of use, and readability.
- Participants stated the color coding scheme is similar to other products providing probability information.

IPA Questionnaire Results

User Group	Combining Severity and Supercooled Large Droplets (SLD): Median (Mean)		
	Suitability/ Effectiveness	Ease of Use	Readability
Part 135/Air Ambulance (N=12)	5 (4.58)	5 (4.58)	5 (4.33)
Part 121 (N=3)	4 (3.67)	4 (4)	4 (4)
GA Pilot (N=2)	4.5 (4.5)	4 (4)	4.5 (4.5)
Dispatcher (Part 121 and 135) (N=3)	5 (4.67)	4 (4.33)	4 (4.33)

- Participants stated it is good to see locations of SLDs.
- The products need a SLD legend.
- Participants stated there is a need to zoom into locations of SLD to get a better estimate of the size and location.
- Participants stated the SLD estimates seem to be very large and not precise.

IPA Questionnaire Results

User Group	IPA vertical controls: Median (Mean)		
	Suitability/ Effectiveness	Ease of Use	Readability
Part 135/Air Ambulance (N=12)	5 (4.75)	5 (4.67)	5 (4.82)
Part 121 (N=3)	4 (4)	4 (3.67)	4 (4)
GA Pilot (N=2)	4.5 (4.5)	4 (4)	4 (4)
Dispatcher (Part 121 and 135) (N=3)	4 (4.33)	5 (4.67)	5 (4.67)

- All participants rated the vertical controls as either very effective or effective in suitability, ease of use, and readability.
- Participants liked the “play” capability when using the arrows for altitude and forecast times.

IPA Questionnaire Results

User Group	IPA icing forecast options: Median (Mean)		
	Suitability/ Effectiveness	Ease of Use	Readability
Part 135/Air Ambulance (N=12)	5 (4.67)	5 (4.58)	5 (4.58)
Part 121 (N=3)	5 (4.67)	5 (4.67)	5 (4.67)
GA Pilot (N=2)	5 (5)	4.5 (4.5)	4.5 (4.5)
Dispatcher (Part 121 and 135) (N=3)	4 (4)	4 (4)	4 (4)

All participants rated the IPA forecast options as either very effective or effective in suitability, ease of use, and readability.

IPA Questionnaire Results

User Group	IPA icing coverage: Median (Mean)		
	Suitability/ Effectiveness	Ease of Use	Readability
Part 135/Air Ambulance (N=12)	5 (4.75)	5 (4.58)	5 (4.42)
Part 121 (N=3)	5 (4.67)	5 (4.67)	5 (4.67)
GA Pilot (N=2)	4.5 (4.5)	4.5 (4.5)	4.5 (4.5)
Dispatcher (Part 121 and 135) (N=3)	4 (4.33)	4 (4.33)	4 (4.33)

- All participants rated the IPA icing coverage as either very effective or effective in suitability, ease of use, and readability.
- Participants stated a better zoom capability would make the ease of use more effective when estimating the icing coverage in an area.

IPA Questionnaire Results

User Group	Colors used for icing conditions (light blue to dark blue): Median (Mean)		
	Suitability/ Effectiveness	Ease of Use	Readability
Part 135/Air Ambulance (N=12)	5 (4.5)	4.5 (4.25)	4.5 (4.1)
Part 121 (N=3)	4 (4.33)	4 (4)	4 (4.33)
GA Pilot (N=2)	4.5 (4.5)	4 (4)	4 (4)
Dispatcher (Part 121 and 135) (N=3)	4 (4)	4 (4)	4 (4)

- All participants rated the colors used for icing conditions as either very effective or effective in suitability, ease of use, and readability.
- Participants stated if the product had a better zoom capability the color coding would be more effective because they could more precisely see the differences in the colors.

IPA Questionnaire Results

User Group	Colors used for icing probability (light blue to orange): Median (Mean)		
	Suitability/ Effectiveness	Ease of Use	Readability
Part 135/Air Ambulance (N=12)	4.5 (4.42)	4.5 (4.42)	4 (4.33)
Part 121 (N=3)	4 (4.33)	4 (4.33)	4 (4.33)
GA Pilot (N=3)	4 (3.67)	4 (4.33)	5 (4.67)
Dispatcher (Part 121 and 135) (N=3)	5 (4.67)	5 (4.67)	5 (4.67)

All participants rated the colors used for icing probability as either very effective or effective in suitability, ease of use, and readability.

User Evaluation Results
for
IPA-D and IPA-F

Rating Scale Definitions

5. Strongly Agree. This response indicates you are in complete agreement with the statement.

4. Agree. This response indicates you agree with the statement.

3. Neither Agree or Disagree. This response indicates you neither agree or disagree with the statement.

2. Disagree. This response indicates you disagree with the statement.

1. Strongly Disagree. This response indicates you are in total disagreement with the statement.

IPA-D Questionnaire Results

Question	Part 135/Air Ambulance (N=12) Median (Mean)	Part 121 (N=3) Median (Mean)	GA Pilot (N=4) Median (Mean)	Dispatcher (Part 121/135) (N=3) Median (Mean)
1. IPA-D information would be suitable for use in my operational environment.	5 (4.75)	5 (4.67)	**3.5 (3.75)**	5 (4.75)
2. IPA-D information would provide a consistent view of icing conditions over the Alaskan region.	4 (4.25)	5 (4.67)	4 (**3.75**)	4 (4.25)
3. IPA-D information would help reduce the risk of flying into severe icing conditions.	5 (4.67)	5 (4.67)	4.5 (4.25)	4.5 (4.5)
4. IPA-D would provide improved icing information in a timely manner to support safe and efficient routes in the Alaskan region.	5 (4.67)	5 (5)	5 (4.33)	4 (4.25)
5. IPA-D information would allow you to proactively plan and execute efficient icing-related route deviations and reroutes.	4 (4.17)	5 (5)	**3 (3.5)**	4.5 (4.5)
6. IPA-D information would help decrease risk along fight routes associated with icing conditions.	4 (4.25)	5 (5)	**3.5 (3.75)**	4.5 (4.5)
7. IPA-D information would improve situational awareness of icing coverage and severity.	5 (4.67)	5 (5)	4.5 (4.5)	5 (4.5)

IPA-D Questionnaire Results

Question	Part 135/Air Ambulance (N=12) Median (Mean)	Part 121 (N=3) Median (Mean)	GA Pilot (N=4) Median (Mean)	Dispatcher (Part 121/135) (N=3) Median (Mean)
8. IPA-D information would support the identification of areas with severe icing conditions.	4 (4.25)	5 (5)	4.5 (5)	4.5 (4.5)
9. IPA-D information would provide more time to develop and implement flight plans.	4 (3.91)	5 (4.67)	**3.5 (3.5)**	4.5 (4.5)
10. IPA-D information would help predict flight routes.	4 (4.25)	5 (4.67)	4 (3.75)	4 (4.25)
11. Using IPA-D would reduce my risk associated with icing.	4 (4.08)	5 (5)	4.5 (4.25)	4 (4.25)
12. IPA-D would aid me in my flight planning decision making.	5 (4.5)	5 (5)	4.5 (4.5)	4 (4.25)
13. The information IPA-D provided sufficiently supported my decision making process.	4 (4.08)	5 (5)	4.5 (4.25)	4 (4.25)

Questionnaire Comments

- (Part 135) The products would help with deviations from original route.
- (Part 135) The products would help to identify areas where a pilot could get out of icing conditions.
- (All Participants) The products need a better zoom capability.
  - The zoom capability should based on the regions the AAWU has defined.
  - The zoom should have the capability to zoom into a region and stay zoomed-in.
  - The zoom capability would make it easier to see the fine details over small areas.
- (All Participants)The products do not have a legend for SLD.
- (GA Pilots) Because GA Pilots typically do not have de-icing equipment, they generally avoid ANY icing. Therefore, they would use the product to determine if any icing is occurring and make go-no-go decisions.

IPA-F Questionnaire Results

Question	Part 135/Air Ambulance (N=12) Median (Mean)	Part 121 (N=3) Median (Mean)	GA Pilot (N=4) Median (Mean)	Dispatcher (Part 121/135) (N=3) Median (Mean)
1. IPA-F information would be suitable for use in my operational environment.	4.5 (4.5)	5 (4.67)	4(4)	4.5 (4.5)
2. IPA-F information would provide a consistent view of icing conditions over the Alaskan region.	4 (4)	5 (5)	4(4)	4 (4.25)
3. IPA-F information would help reduce the risk of flying into severe icing conditions.	4 (4.25)	5 (4.67)	**3.5 (3.75)**	4.5 (4.5)
4. IPA-F would provide improved icing information in a timely manner to support safe and efficient routes in the Alaskan region.	4 (4.17)	5 (4.67)	4(4)	4.5 (4.5)
5. IPA-F information would allow you to proactively plan and execute efficient icing-related route deviations and reroutes.	4 (4.17)	5 (4.67)	**3.5 (3.5)**	4.5 (4.5)
6. IPA-F information would help decrease risk along fight routes associated with icing conditions.	4 (4.25)	5 (4.67)	**3 (3.25)**	4.5 (4.5)
7. IPA-F information would improve situational awareness of icing coverage and severity.	4 (4.1)	5 (4.67)	4.5 (4.25)	4.5 (4.5)

IPA-F Questionnaire Results

Question	Part 135/Air Ambulance (N=12) Median (Mean)	Part 121 (N=3) Median (Mean)	GA Pilot (N=4) Median (Mean)	Dispatcher (Part 121/135) (N=3) Median (Mean)
8. IPA-F information would support the identification of areas with severe icing conditions.	5 (4.58)	5 (4.67)	**3.5 (3.75)**	4.5 (4.5)
9. IPA-F information would provide more time to develop and implement flight plans.	4 (3.75)	4 (4)	**3.5 (3.5)**	4 (4.25)
10. IPA-F information would help predict flight routes.	4 (4.12)	4 (4.33)	4 (4.25)	4 (4.25)
11. Using IPA-F would reduce my risk associated with icing.	4 (4.25)	5 (4.67)	**3 (3.5)**	4.5 (4.5)
12. IPA-F would aid me in my flight planning decision making.	5 (4.59)	5 (4.67)	4.5 (4.5)	4.5 (4.5)
13. The information IPA-F provided sufficiently supported my decision making process.	4.5 (4.33)	5 (4.67)	4 (4)	4 (4.25)

IPA-F Questionnaire Comments

- (GA Pilot) The visualization of icing offer good capabilities to help make decisions. Because GA Pilots typically do not have de-icing equipment, they generally avoid ANY icing. Therefore, they would use the product to determine if any icing is occurring and make go-no-go decisions.
- (Part 135) The altitude changes help find routes that may have less icing.

Structured Interview Question Results

Structured Interview Question Results

- **What specific icing information is most important for go-no-go decisions?**
  - Part 135/Air Ambulance and Part 121
    - Freezing level
    - Freezing rain and drizzle
    - Severity and duration
    - Surface temperatures
    - Upslope icing from mountains
  - GA Pilot
    - Any potential for icing
    - Severity
    - Temperature (very important to know because there may be a potential to melt the ice)
  - Dispatcher Part 135 and 121
    - Freezing level
    - Severity and duration
    - Upslope icing from mountains

Most important icing information:
- ✓ Freezing level
- ✓ Severity and duration
- ✓ Freezing rain and drizzle
- ✓ Temperature

Structured Interview Questions Results

- **What is your threshold, related to icing, for go-no-go decisions?**
  - Part 135/Air Ambulance
    - Moderate and continuous icing (severity and duration)
    - Any SLD
    - Trace or worst
  - Part 121
    - Heavy icing
  - GA Pilot
    - Any potential for icing
    - Any SLD
  - Dispatcher
    - (Part 135) Moderate and continuous icing
    - (Part 121) Heavy icing
  - AAWU
    - Probabilities >76% of icing occurring

Thresholds depend on de-icing equipment available. No de-icing equipment pilots stated ANY icing will impact decisions.
If equipped with de-icing, thresholds are:
✓ Moderate and continuous icing
✓ Heavy icing

Structured Interview Questions Results

- **Are there certain types of icing conditions that prevent take-off? Landing? What are considered the worst icing conditions?**
  - Part 135/Air Ambulance
    - Moderate and continuous icing (severity and duration)
    - Ground icing
    - Freezing rain on the ground
    - Freezing drizzle/precipitation
  - Part 121
    - Freezing precipitation
  - GA Pilot
    - Any icing
  - Dispatcher
    - (Part 135) Moderate and continuous icing
    - (Part 121) Heavy icing

Structured Interview Questions Results

- **How often do you use icing information to determine an Estimated Departure Time (EDT) and route?**
  - All participants stated using icing information continuously to determine an EDT and route.
  - All pilot participants stated a need to have continuous icing information during pre-flight and in-flight.

When flying IFR, pilot participants continuously check icing. When flying VFR, pilot participants do not check as often. This is because if there is ANY ice when flying VFR they simply will not fly.

Participants stated it is very important to check icing continuously because icing is so dynamic, the forecast can change quickly.

Structured Interview Questions Results

- **Are there other critical pieces of weather information, in addition to icing, considered for go-no-go decisions?**
  - Freezing level
  - Severity and duration
  - Freezing rain or drizzle
  - Upslope icing
  - Surface icing
  - Temperatures
  - Runway conditions
  - Wind (direction and speed)
  - Tops and bases
  - Turbulence
  - C&V

Specifically for icing, the most important information for go-no-go decisions are:

- ✓ Freezing level
- ✓ Severity and duration
- ✓ Freezing rain and drizzle
- ✓ Upslope icing
- ✓ Surface icing

Structured Interview Questions Results

- **If you could change the IPA-D and/or the IPA-F products in any way, what would you change/add?**
  - Add freezing level
  - Better zoom capabilities
    - Zoom into a specific region
    - Stay zoomed in
  - Add PIREPs as an overlay
  - Add historical trends
  - Add regions (the same as the AAWU)
  - Add temperatures
  - Add surface icing
  - Add SLD legend
  - See probability of no icing (white)
  - Add winds as an overlay (direction and speed)
  - (Dispatchers) The term Heavy should be Severe, this is consistent with the terminology used and what is used in the PIREPs.

Structured Interview Questions Results

- ***Continued:*** **If you could change the IPA-D and/or the IPA-F products in any way, what would you change/add?**
  - AAWU
    - Need to be able to select regions and "shave" them as necessary for forecasts.
    - Add PIREPs as an overlay
    - AAWU does not have time to review each vertical layer, participants stated the need to have the vertical layers in the following buckets:
      - 1000-5000
      - 6000-10000
      - 11000-15000
      - 16000-20000
      - 21000-25000
    - Participants stated to be consistent with terminology the descriptions used are:
      - Isolated moderate
      - Occasional moderate (AIRMET)
      - Moderate with isolated severe (SIGMET)
      - Occasional severe (Rarely Used)

Conclusions/Recommendations

Conclusions

- **Determine how participants use the IPA products to aid in decision making strategies.**
  - All participants would use all the Plots the IPA products provide.
    - Participants stated they would use IPA-D to determine current weather conditions then proceed to “play” the forecasted weather out to the time they are expected to complete their entire trip.
    - Participants stated all the IPA plots are very useful and would be used to delve further into icing forecasts. There is not one plot that would be used alone. Together, the plots provide an awareness of icing occurring in the region.
  - All participants stated a need to see historical trends.
  - Part 135 and 121 participants stated they would “play” through both the altitudes and forecast time to find areas of no icing. Decisions on routes and altitudes would be determined on finding areas of no icing.
  - Pilot participants would not use the MAX altitude, they do not fly at that level.
    - Most participants fly in between altitudes of 7,000-15,000.
    - Most try not to fly above 10,000 due to oxygen issues.

Conclusions

- **Determine if the IPA products have the information needed for decision making.**
  - All participants need to be able to zoom into specific regions and stay zoomed in.
    - The regions should be similar to those the AAWU uses.
    - The zoom capability should allow participants to zoom into an area, stay zoomed in, scroll through both forecast time and altitude options.
  - All participants stated the need to see where the freezing level is on the product. The freezing level is important to make critical decisions to determine safe altitudes to fly.
  - All participants stated the need to have PIREPs displayed as on overlay. All participants rely heavily on PIREP information, being able to see and access PIREPS directly on the IPA product would be greatly beneficial in aiding with decision making strategies.
  - Participants stated a need to see icing historical trends for the past 2 to 3 hours.

Conclusions

- ***Continued:*** **Determine if the IPA products have the information needed for decision making.**
  - All participants stated a need to see temperatures. Temperatures allow participants to estimate if icing will melt or continue.
  - All participants stated a need to see surface information. This includes icing and temperatures. Surface information is important to know to make critical decisions to determine if it is safe to land, take-off, and duration of stay at locations.
  - All participants stated a need to see freezing rain or drizzle. This is because the freezing rain or drizzle cause rapid structural icing on aircraft.

Conclusions

- **Determine the usability and suitability of the products.**
  - All participants stated the zoom capability was not sufficient.
    - Participants need to be able to zoom into specific regions.
    - Participants need to be able to stay zoomed-in on the display.
    - While zoomed-in, participants need to be able to use the altitudes and forecast time controls.
  - All participants stated the IPA products need to display the regions the AAWU has defined. This will allow the capability to select an area and compare forecasts across products. It also will reduce any learning curve related to identifying regions of interest.
  - Participants stated the desire to have access to the IPA products for both pre-flight and in-flight.

Conclusions

- ***Continued*: Determine the usability and suitability of the products.**
  - Pilot participants stated a need to define the Severity categories. It is important to know what types of information are considered when defining the categories (i.e., aircraft type).
  - The Dispatchers and ATM participants stated a concern using the term Heavy instead of Severe. PIREPs and ATM use the term Severe. There is some concern pilots may not be clear as to which term to use when submitting a PIREP.

Conclusions

- **Gather user feedback to determine product improvements as related to the participant operational environment.**
  - Improve the zoom capability:
    - Participants need to be able to zoom into specific regions.
    - Participants need to be able to stay zoomed-in on the display.
    - While zoomed-in, participants need to be able to use the altitudes and forecast time controls.
  - Display the freezing level.
  - Provide PIREPs as an overlay.
  - Provide regional areas, the same as the AAWU uses.
  - Provide the capability to see historical trends of at least the previous 3 hours.
  - Provide surface icing information.
  - Provide temperatures at all altitudes including surface.

Recommendations

- **Improve the zoom capability**
  - Participants need to be able to zoom into specific regions.
  - Participants need to be able to stay zoomed-in on the display.
  - While zoomed-in, participants need to be able to use the altitudes and forecast time controls.
- **Display the freezing level**
  - The freezing level provides participants the capability to determine safe altitudes to fly.
  - The freezing level will direct participants to look at PIREPs for the route of interest to validate information. Thus, reducing risk.
- **Provide PIREPs as an overlay**
  - PIREPs are the most used products by all participants.
  - Displaying PIREPs as an overlay on the IPA products would decrease workload, increase situation awareness, and decrease the mental gymnastics needed to combine several sources of information.

Recommendations

- **Provide regional areas, the same as the AAWU uses**
  - All participants are accustomed to products using AAWU defined regions.
  - The regions increase the usability of the products by being able to identify areas of interest and zoom into those areas.
- **Provide the capability to see historical trends of at least the previous 3 hours.**
  - Weather changes often, including icing. Therefore, being able to see the last few hours of icing trends will provide insight for future icing forecast.
  - Historical trends are used by all participants to help determine future trends.

Recommendations

- **Provide surface icing information**
  - Surface information is necessary to have for several critical decisions:
    - To determine if flight will go to the location (go-no-go).
    - To determine the duration of the layover in a location.
    - To determine if special equipment will be needed when landing.
  - Surface information is only found in the Area Forecasts. By including it in the IPA, it would decrease workload, increase situation awareness, and decrease the mental gymnastics needed to combine several sources of information.
- **Provide temperatures at all altitudes including surface**
  - Temperature is a critical piece of information because it gives participants the capability to determine if there are possibilities of the ice melting or not.
  - Temperatures at each altitude are necessary to help make decisions to determine which altitudes are safe to fly.

Deliverables

Deliverables

Task	Date
User Evaluation Plan and Data Collection Tools	September 29, 2017
Recruit Participants	August 21 – October 13, 2017
Conduct Evaluation	October 16- November 3, 2017
Final Report/Briefing	December 15, 2017

Questions?