2018 Weather Survey

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Introduction

AOPA's 2018 Weather Survey served as a follow-up to two AOPA Flight Service surveys[1], a Pilot Weather Report (PIREP) survey[2], and a weather survey conducted last year. [3] The present research was conducted to further investigate pilots' needs for weather resources, such as Hazardous Inflight Weather Advisory Service (HIWAS), and to identify how general aviation pilots access weather information. Parts of the survey were segmented between Continental United States (CONUS) and Alaska pilots due to significant differences in infrastructure, and variations in weather products available and distribution outlets. By comparing and contrasting these segments of the user population we hope to be able to gather a better understanding of the entire system, while at the same time addressing specific geographic needs.

Method

A short survey on weather-related topics was created using Qualtrics, an online survey tool. The survey consisted of 40 questions in total, 37 of which were shown to subjects from CONUS, and 33 of which were shown to subjects from Alaska. An email invitation to take the survey was sent to a total of 1,516 AOPA members from Alaska with current medicals and a random sample of 30,003 AOPA members with current medicals from CONUS, for a total of 31,519 people invited to take the survey. CONUS subjects received two emails reminding them to take the survey. Alaskan subjects received three reminder emails, in an effort to increase the sample size and decrease the related margin of error. No incentive was offered in exchange for participation.

Key Findings

1. Alaskan pilots relied on the National Weather Service's (NWS) Alaskan Aviation Weather Unit (AAWU) and Federal Aviation Administration (FAA) weather camera website for weather information, both initially and immediately prior to flight.
    - Alaskan pilots' clear and continued reliance on FAA weather cameras warrants greater investment in the technology.
    - Alaskan pilots desire continued upgrades to mobile compatibility and graphical products available on the AAWU website.
2. The FAA's FIS-B service has continued to gain popularity with pilots. Still, issues exist.
    - Alaskan subjects were more often dissatisfied with FIS-B than CONUS subjects, primarily due to extensive regional gaps in coverage.
    - Subjects of all age groups, locations, ratings, and certificate levels were, overwhelmingly, unsure of what the NOTAM uplink limitation was on the FAA's FIS-B service; just 17% of subjects correctly identified the uplink limitation. Thus, additional outreach and education through all sources including AOPA articles, FAA publications, manufactures documentation, and other sources is needed.

[1] Middlestadt, S. E., Smith, T., Hu, Y., & Ison, D. (June 1, 2016). Technical Research Report on General Aviation Pilot Beliefs About Obtaining a Standard Pilot Weather Briefing.
[2] George, T., & Duke, R. (July 26, 2016). AOPA 2016 Pilot Report Survey.
[3] George, T., & Duke, R. (Aug. 4, 2017). AOPA 2017 Weather Survey.

3. About half of all subjects (54%) were unfamiliar with the NWS Aviation Weather Center (AWC) web-based PIREP submission portal. Still, most subjects (79% of CONUS pilots and 60% of Alaskan pilots) said they would use such a tool if it were integrated with their primary inflight application on their Electronic Flight Bag (EFB). Current instrument rated pilots were more often willing to use such a tool if it were integrated with their primary inflight application. Those who were unwilling to use the tool cited concerns about increased workload, distractions, and face-down time in the cockpit. Pilots (and especially pilots from Alaska) often cited a need for more PIREPs, even though few reported routinely providing unsolicited PIREPs to ATC.
4. Alaskan pilots experienced unforecast adverse weather, changed course (diverted, landed, or turned back), and re-evaluated their pre-flight planning due to adverse weather with greater frequency than CONUS pilots. All pilots re-evaluated their pre-flight planning after experiencing adverse weather *more* often than they diverted, landed, or turned back as a result of such weather.
5. Though most respondents had never heard of the Helicopter Emergency Medical Services tool, almost all believed that the tool would be beneficial to them. It is possible that the tool's title (Helicopter Emergency Medical Services) discourages users from exploring the tool further. The title can be modified to encourage more pilots to use the tool, without adversely affecting the original, primary user base.
6. Most subjects (68%) never or rarely used HIWAS in the past 12 months. Respondents who reported that the removal of HIWAS would *not* have a negative impact on their ability to access weather information were more often:
    - Between the ages of 45 – 54
    - Current, instrument rated pilots
    - Airline Transport Pilots (ATPs) or commercial pilots

    Still, 9% of respondents frequently or always used HIWAS when flying. Furthermore, 14% of pilots believed that the removal of HIWAS would have a negative impact on their ability to access weather information. More research must be conducted before removing HIWAS to ensure that all pilots have adequate access to this type of weather information.

2018 Survey Results

A total of 124 AOPA members with current medicals from Alaska and 2,728 AOPA members with current medicals from CONUS responded to the survey in April of 2018, over the course of a 4-week period. A total of 1,516 pilots from Alaska and 30,003 pilots from CONUS were originally invited to take the survey. Thus, the margin of error for Alaskan pilots was approximately 8.4% at a 95% confidence level, and the margin of error for CONUS pilots was approximately 1.8% at a 95% confidence level. The overall margin of error (considering pilots from all regions) was approximately 1.8% at the same 95% confidence level.

Sample Characteristics

The sample characteristics were similar to those found in AOPA's 2017 Weather Survey (Table 1). About 54% of all subjects were private pilots. Most subjects (74%) were at least 55 years old. About 51% of respondents were instrument current, including 33% of Alaskan subjects and 51% of CONUS subjects (Figure 1). Approximately 34% of Alaskan subjects and 17% of CONUS subjects had an instrument rating but were not current. Most subjects reported flying single-engine piston, fixed gear aircraft (Figure 2). Across all certificate types, respondents reported logging an average of 117 hours[4] in the past 12 months, and an average of 3,520 hours[5] in total. Private pilots reported logging an average of 66 hours[6] in the past 12 months, and an average of 1,098 hours in total.

Table 1. *Highest level of pilot certificate held.*

Certificate	AOPA 2018 Survey		AOPA 2017 Survey		FAA	
Student	71	2%	17	4%	149,121	24%
Sport	19	1%	0	0%	6,097	1%
Recreational	4	0.1%	0	0%	153	0.03%
Private	1,530	54%	191	50%	162,455	27%
Commercial	767	27%	107	28%	98,161	16%
ATP	458	16%	63	17%	159,825	26%
No pilot certificate	0	0%	2	1%	-	-
Total	2,849	100%	380	100%	609,306	100%

Note. This table compares responses to AOPA's 2018 Weather Survey to AOPA's 2017 Weather Survey, in addition to the current FAA numbers. FAA estimated active airmen certificates accurate as of the last update (12/31/17; source: FAA U.S. Civil Airmen Statistics).

[4] This statistic reflects the mean number of hours logged recently after removing one outlier (a private pilot who reportedly logged 341,200 hours in the past 12 months).
[5] The mean number of total hours logged was 3,520 hours after removing 2 outliers (both ATP pilots who reported logging 100,000 hours or more in total).
[6] This statistic reflects the mean number of hours logged recently for private pilots, after excluding the aforementioned outlier.

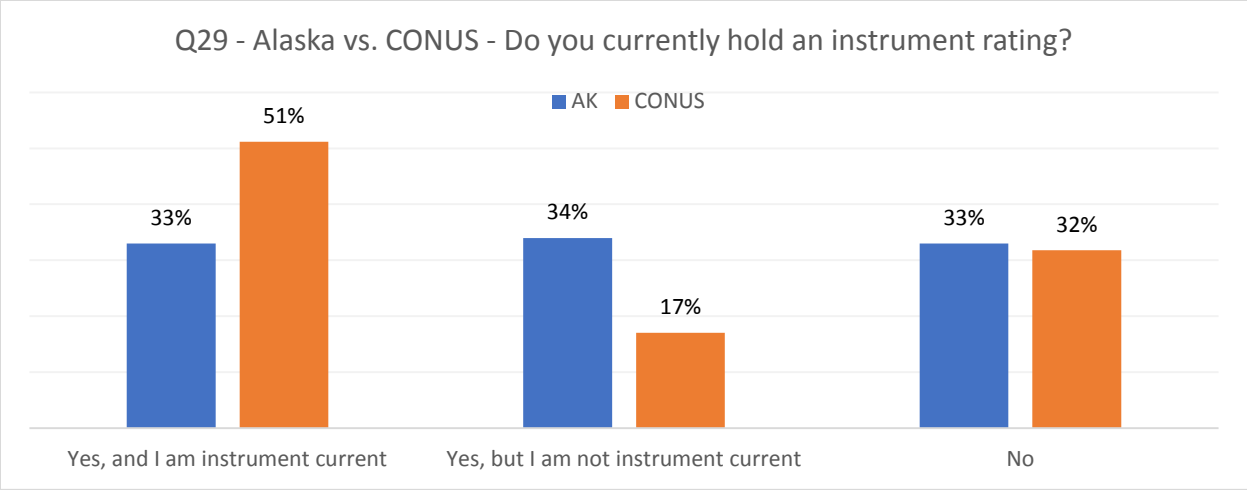

Figure 1. Number of pilots in current sample who were instrument rated (measured by responses to Q29, "Do you currently hold an instrument rating?"). Note, the FAA reports 306,652 (50% of total pilot number) instrument rated pilots, as of 12/31/17 (Source: FAA U.S. Civil Airmen Statistics).

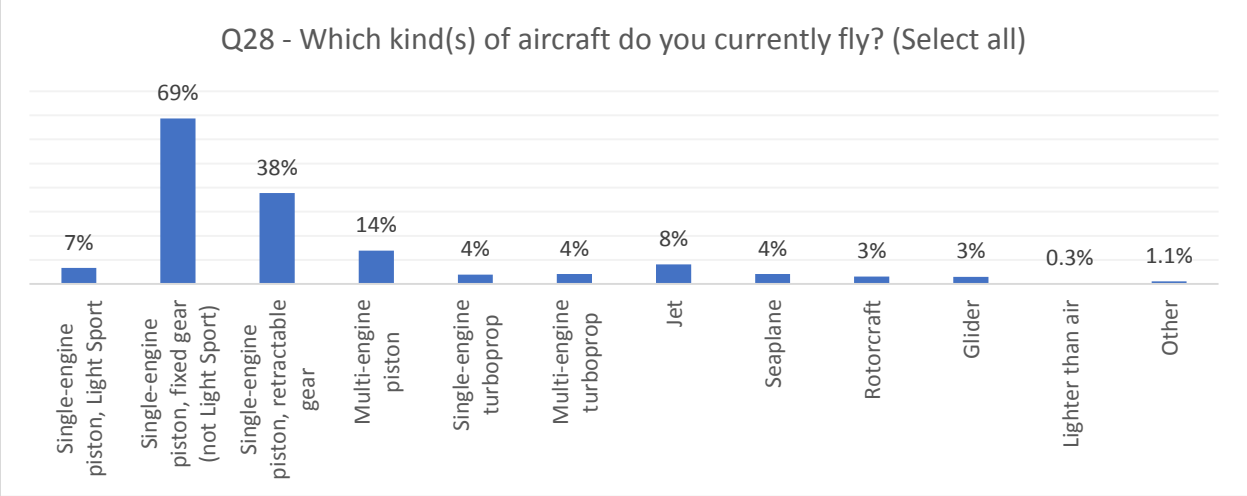

Figure 2. Responses to Q28, "Which kind(s) of aircraft do you currently fly? (Check all that apply)." Percentages reflect the number of people who selected that response out of the total number of subjects who answered the question (n = 2849).

Pre-Flight Weather Resources

Initial source used. Alaskan pilots used FAA weather cameras[7] and the AAWU[8] website frequently (Figure 3). Pilots from CONUS relied on aviation applications and AWC's website more often. Initial sources used to check the weather did not change substantially or significantly over time (from 2017 to 2018).

[7] The FAA Weather Camera Program is an Alaska based activity that provides web camera views at over 220 locations across the state, updated every 10 minutes, as a supplementary FAA product to improve situational awareness regarding weather conditions for aviation use. For more info see: avcamsplus.faa.gov.
[8] The NWS operates a forecast office in Anchorage, Alaska, the AAWU, which generates aviation weather forecasts.

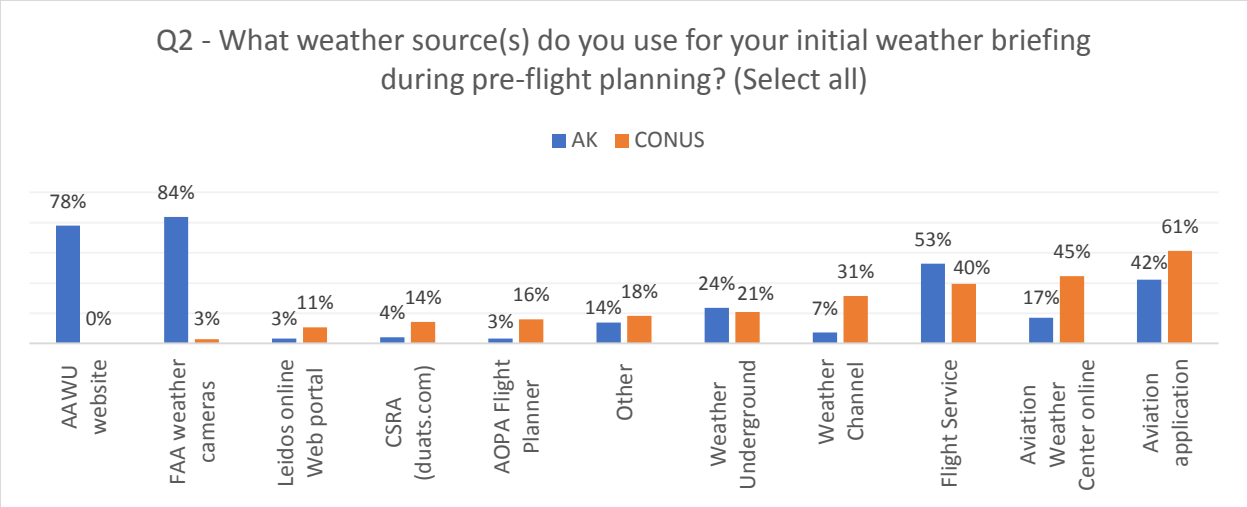

Figure 3. "What weather source(s) do you use for your initial weather briefing during pre-flight planning? (Select all that apply)." Percentages reflect the number of people who selected that response, out of the total number of people who answered the question, for each given location. Common fill-in responses for the "other" category included fltplan.com (11% of "other" comments), and Weathermeister (6% of "other" comments).

Sources used immediately prior to flight. All pilots increased their use of Flight Service for the time period immediately prior to flight, under challenging weather conditions. Regional differences remain, with Alaska pilots primarily accessing the FAA weather camera website when checking the weather immediately prior to flight, presumably due to the timely (10 minute) update cycle. CONUS pilots tended to rely on aviation applications such as ForeFlight or Garmin Pilot (Figures 4 - 5), with Flight Service a close second choice, when facing possible adverse weather.

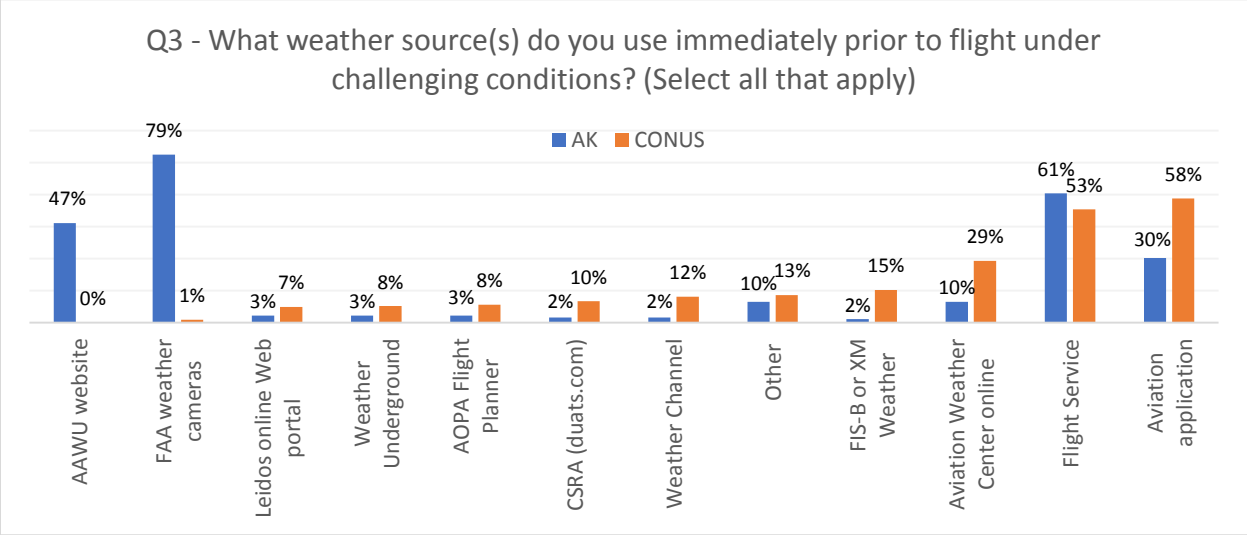

Figure 4. "What weather source(s) do you use immediately prior to flight under challenging conditions? (Select all that apply)." Percentages reflect the number of people who selected each option, out of the total number of subjects for that given location. Common fill-in responses for the "other" category included: fltplan.com (37 out of 408 comments); ATIS, AWOS, or ASOS (24 comments); MyRadar (24 comments); N/A, would not fly (24 comments); Skyvector (19 comments); and Aeroweather (18 comments).

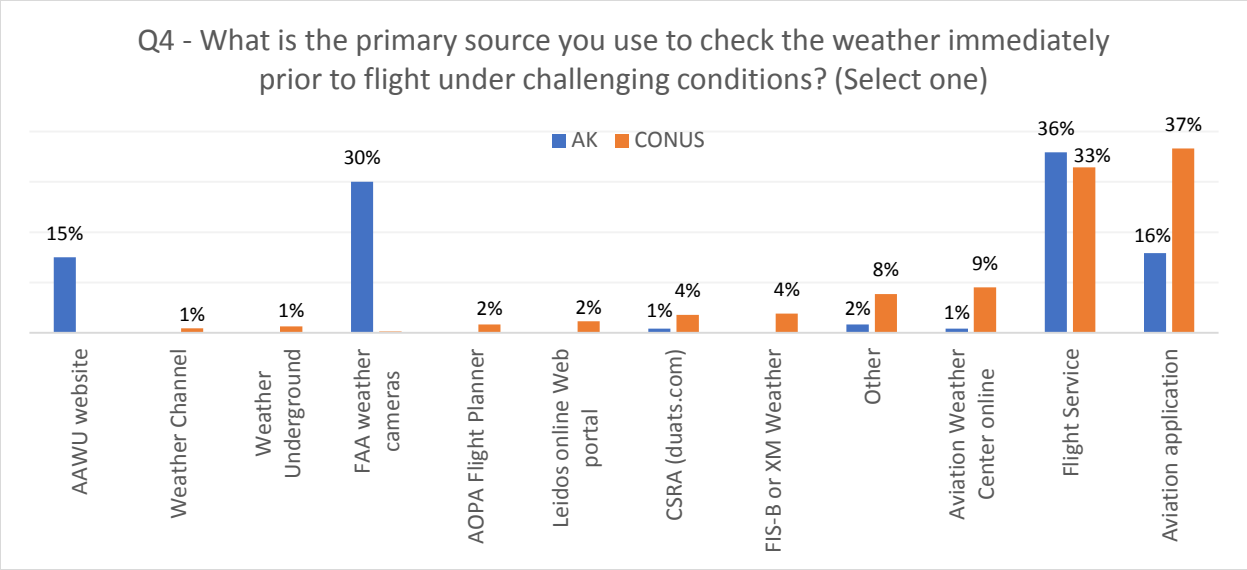

Figure 5. Responses to Q4 in 2018, "What is the primary source you use to check the weather immediately prior to flight under challenging conditions? (Select one)." Common "other" comments included: fltplan.com (27 comments); N/A, would not fly (23 comments); MyRadar (13 comments); Weathermeister (11 comments); myself (6 comments).

Aviation applications and Flight Service. Aviation applications (including ForeFlight or Garmin Pilot) and Flight Service were among the most popular sources for checking weather information immediately prior to flight. Use of aviation applications as the primary source of weather information has increased over time across all locations (as seen in Figures 6 – 7). Use of Flight Service has also changed over time, increasing for Alaskan pilots but decreasing for CONUS pilots.

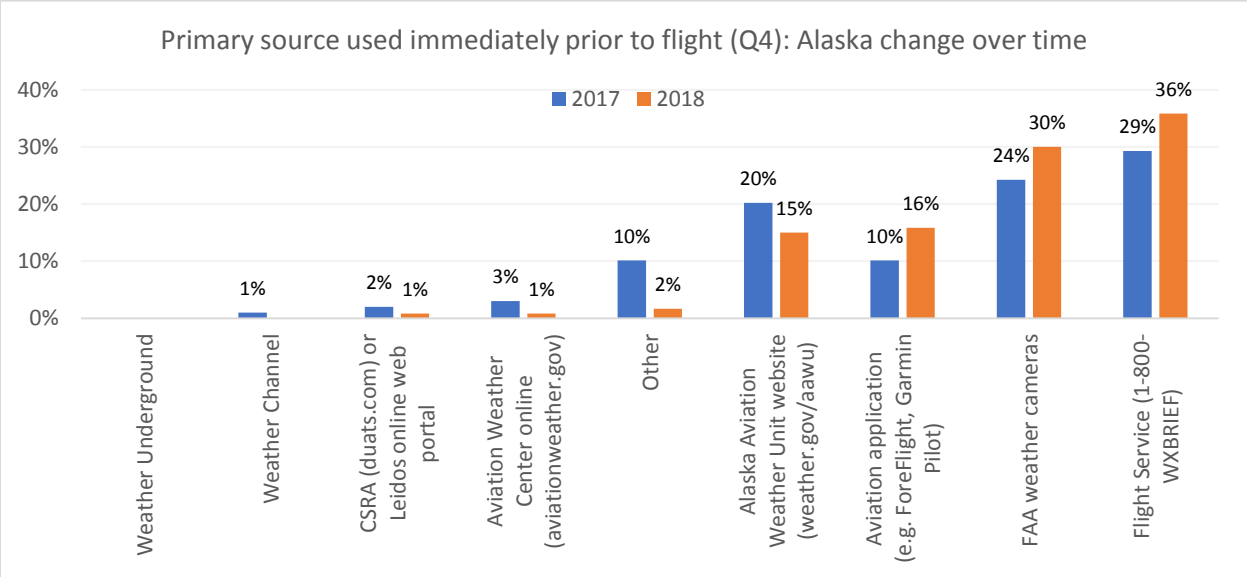

Figure 6. Change over time for the primary source used to check weather information in Alaska. Figure depicts responses to the question, "What is the primary source you use to check the weather immediately prior to flight under challenging conditions? (Select one)" in 2017 and 2018 for Alaskan pilots.

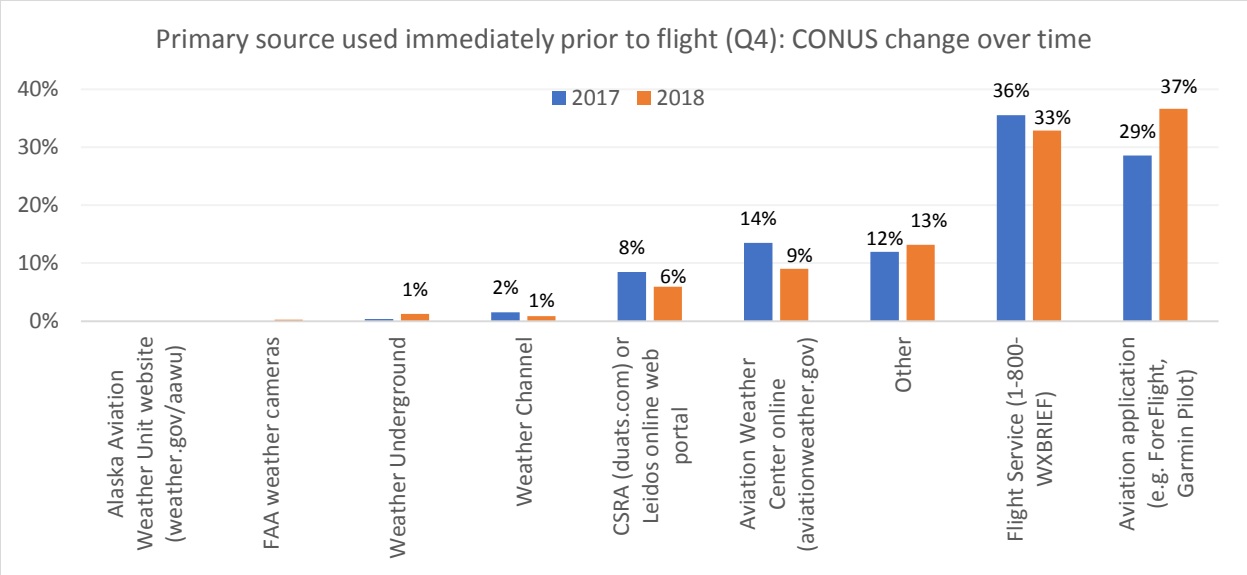

Figure 7. Change over time for the primary source used to check weather information in the continental US. Figure depicts responses to the question, "What is the primary source you use to check the weather immediately prior to flight under challenging conditions? (Select one)" in 2017 and 2018, for pilots from the continental US.

Aviation applications were the most popular weather resource for instrument rated and current pilots, followed by Flight Service (Figure 8). Pilots with no instrument rating and pilots who had an instrument rating but were not current relied on Flight Service more often than they relied on aviation applications. Younger pilots reported preferring aviation applications more frequently than older pilots (Figure 9). Older subjects listed Flight Service as their primary source for weather information immediately prior to flight more often than younger subjects.

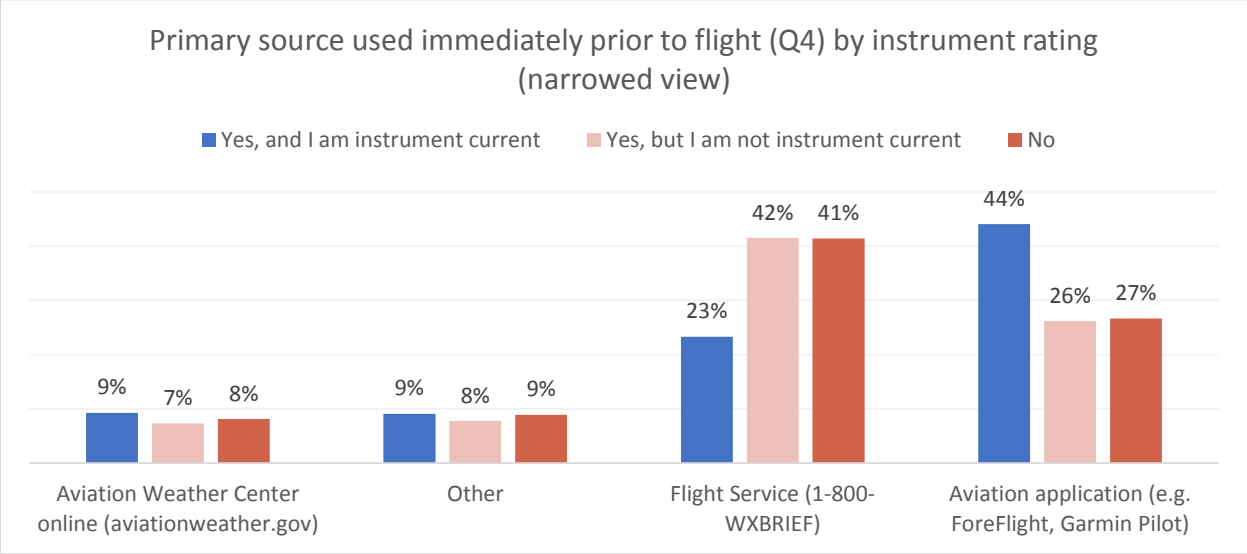

Figure 8. Top 4 most commonly selected primary sources used to check weather information immediately prior to flight, by instrument rating/currency.

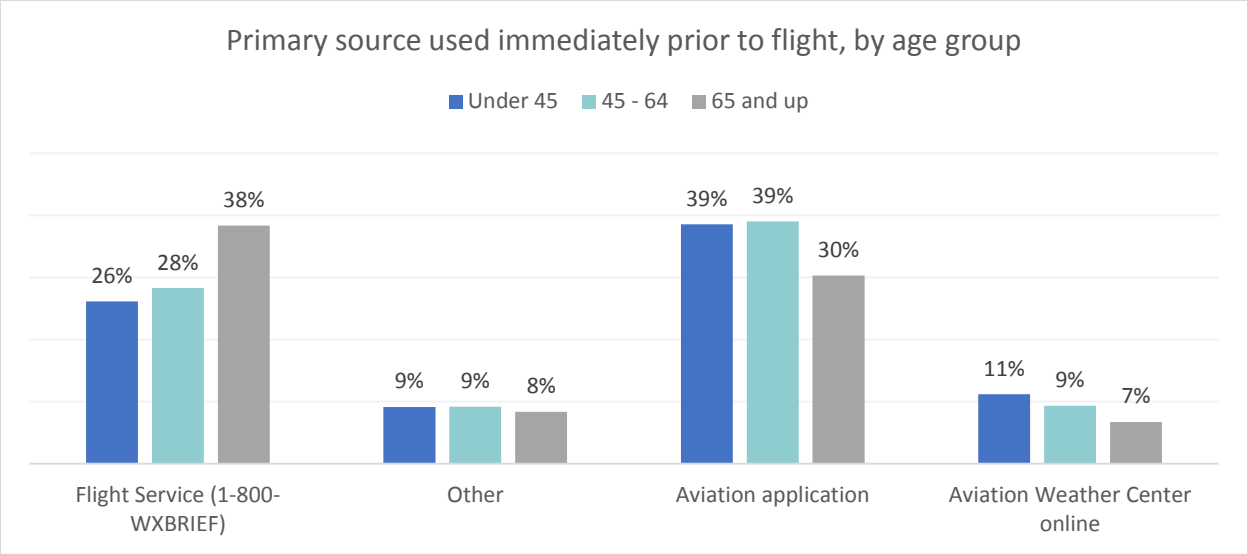

Figure 9. Top 4 most commonly selected primary sources used to check weather information immediately prior to flight, by age group. The top 3 most commonly selected sources were: an aviation application (n = 932), Flight Service (n = 896), "other" (n = 247), and Aviation Weather Center online (n = 236). Percentages reflect the number of people from each age group who selected each source, out of the total number of people in that age group.

Of those who selected Flight Service as their primary information source, 83% of CONUS pilots and 80% of Alaskan pilots did so for the ability to ask questions or receive a professional opinion (Figures 10 - 11). More people in Alaska than in CONUS cared about how reliable Flight Service was; 48% of Alaskan subjects selected Flight Service as their primary source of information because the source was reliable, compared to just 36% of CONUS. Fewer Alaskan pilots cared about legal ramifications; 25% of Alaskan pilots and 42% of CONUS pilots preferred Flight Service because the source was considered "legal" or is recorded.

Most subjects who selected an aviation application as their primary source of weather information did so because of the source's user-friendly interface (54% of CONUS and 67% of Alaska), available graphics (53% of CONUS and 28% of Alaska), or speed (49% of CONUS and 56% of Alaska). Notably, only 1% of subjects who relied on aviation applications did so for the ability to ask questions or receive a professional opinion – whereas 83% of pilots who selected Flight Service found that feature important (Figure 12).

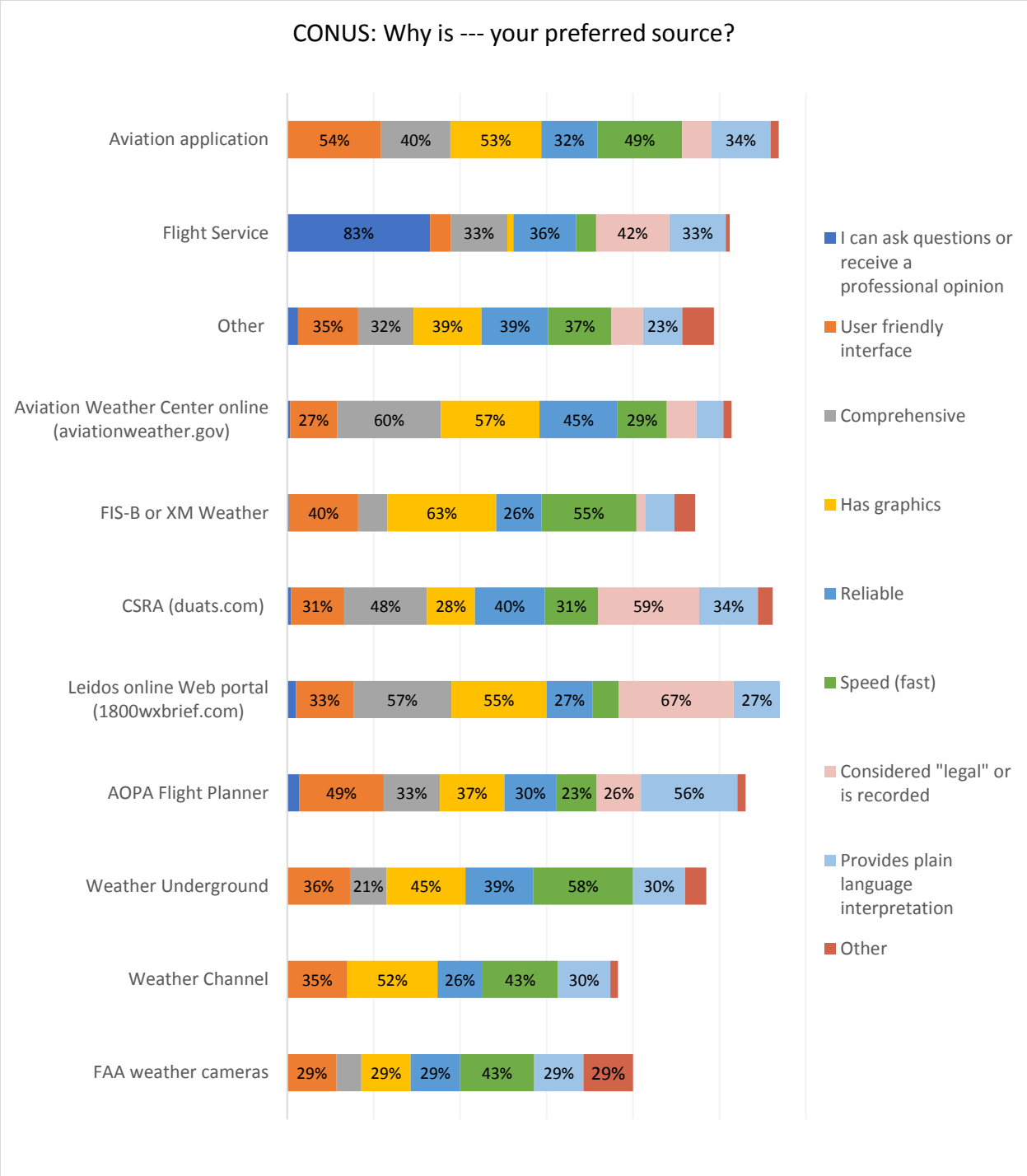

Figure 10. Reasons for choosing given preferred source, CONUS. Percentages reflect the number of people who chose each given reason, out of the total number of people who selected that source as their primary source. Subjects could select up to 3 reasons for their preference, so summed percentages may exceed 100 percent.

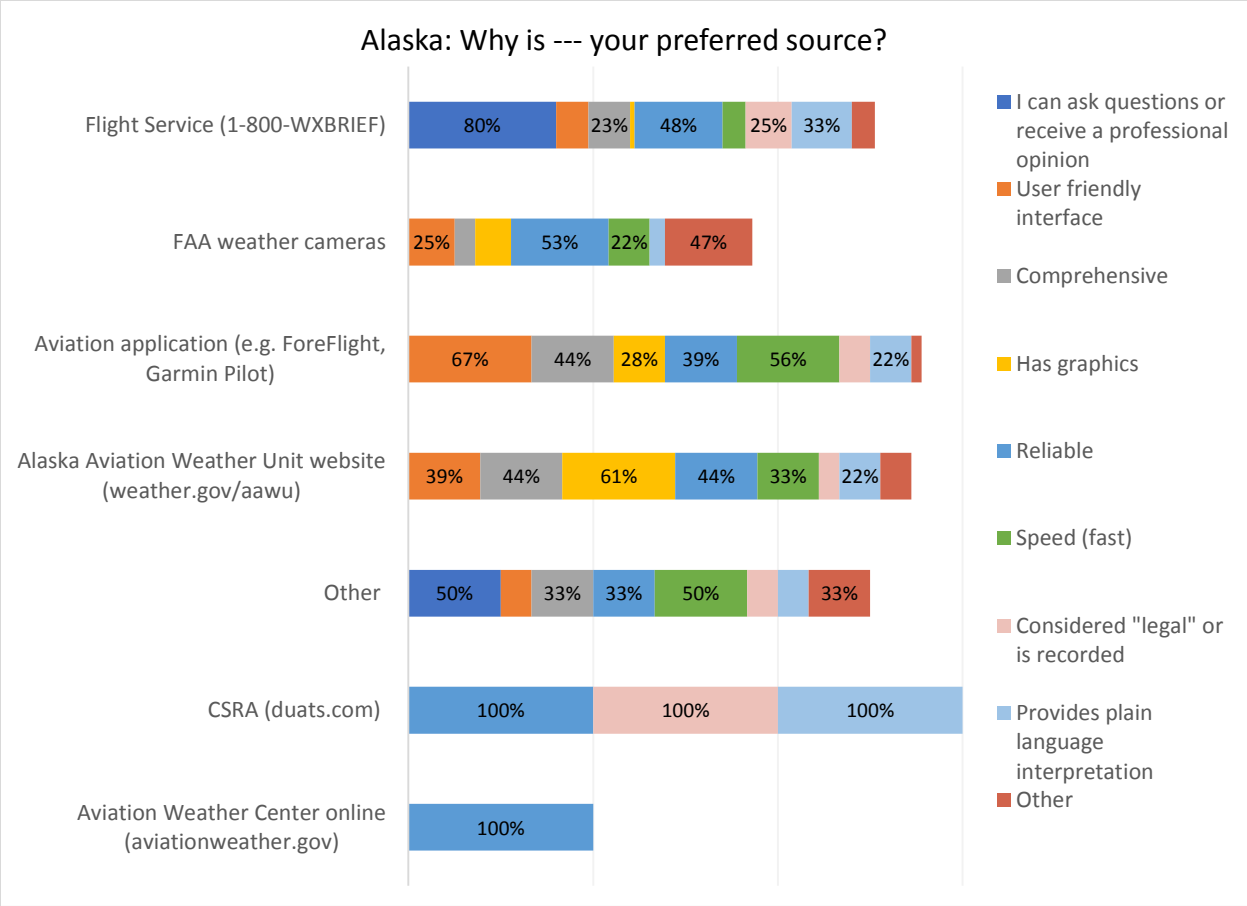

Figure 11. Reasons for choosing preferred source, Alaska. No subjects from Alaska selected FIS-B or XM Weather, Leidos online, Weather Channel, Weather Underground, or AOPA Flight Planner as their primary source. Subjects could select up to three reasons for their preference, so summed percentages may exceed 100 percent.

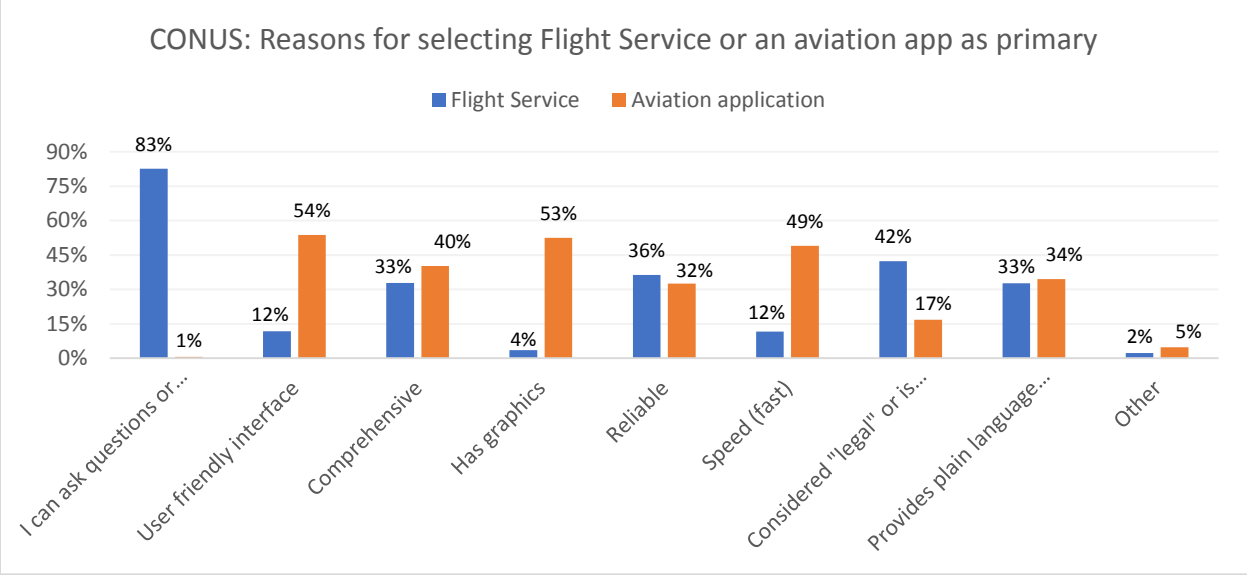

Figure 12. Close-up look at CONUS subjects' reasons for selecting Flight Service (n = 914) or an aviation application (n = 856) as their primary source.

FAA weather cameras. Use of FAA weather cameras has increased over time (Figure 6). In 2017, 24% of Alaskan pilots selected FAA weather cameras as their preferred source of weather information but that grew to 30% of Alaskan pilots in 2018. Alaskan pilots reported preferring FAA weather cameras primarily because of their ability to visualize weather conditions, with increased situational awareness, even at locations with a conventional automated weather station. Of the 47% of Alaskan pilots who selected "other" reasons for that preference, most reported that the source allowed them to see actual conditions in real-time ("a picture is worth 1,000 words").

Alaska Aviation Weather Unit (AAWU). More than three-quarters (79%) of Alaskan pilots always or frequently accessed AAWU prior to flying (Figure 13). Just 15% of Alaskan pilots reported that the AAWU website was their primary source of weather information immediately prior to flight under challenging conditions (Figure 5). Of those who said the AAWU was their primary source, 61% said this was because the site had graphics; 44% said the site was comprehensive; and 44% said the site was reliable.

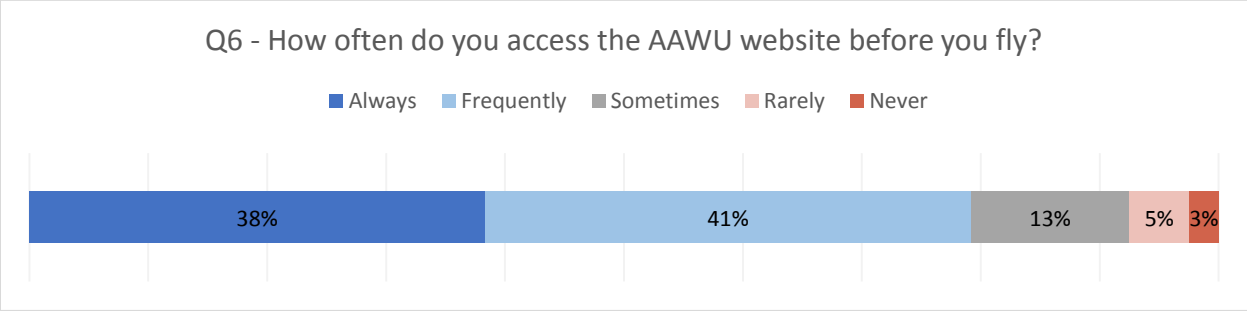

Figure 13. Q6, "How often do you access the AAWU website before you fly?" Question was directed only towards Alaskan subjects (n = 120)

Alaskan pilots' use of the AAWU site has decreased over time (Figure 6). In 2017, 20% of pilots from Alaska selected AAWU as their preferred, primary source. In 2018, 15% of pilots from Alaska selected AAWU as their preferred, primary source of information.

Follow-up questions on use of the AAWU website were directed to subjects from Alaska. Respondents often reported liking the new AAWU website's graphics, details, customizability, and ease of use.

> *"Easy to navigate; many different weather maps available on one webpage."*
>
> *"It's still great. I didn't like having to learn new ways because I knew exactly where to go and in what order on the old website, as strangely organized as the old one was. The new one is better organized for a new user."*

Most negative comments about the new website related to adjusting to the new layouts after the change, and the resulting difficulties in finding information. A small percentage of subjects also mentioned technical problems, including slow updates or loading speeds.

"The new site is not as mobile friendly, difficult to navigate compared to the old web site."

"*It took a while to get the feel of the new site."*

Only three subjects had suggestions for improvements to the AAWU website that would enable them to use the site more often. Of those, two subjects requested an iPhone or iPad application. The third subject discussed the need for more localized information.

Helicopter Emergency Medical Services (HEMS) Tool. Questions pertaining to the HEMS weather tool were only provided to subjects from CONUS. Most respondents (72%) had never heard of the HEMS tool (Figure 14). Those who had heard of the tool and used it (at least rarely) were primarily ATP, commercial, or private pilots. About 76% of subjects who had never heard of HEMS believed the tool would be at least moderately beneficial to them after reading a brief description of the tool and its features. Only 13% of subjects still believed the HEMS tool would not be beneficial at all (Figure 15).

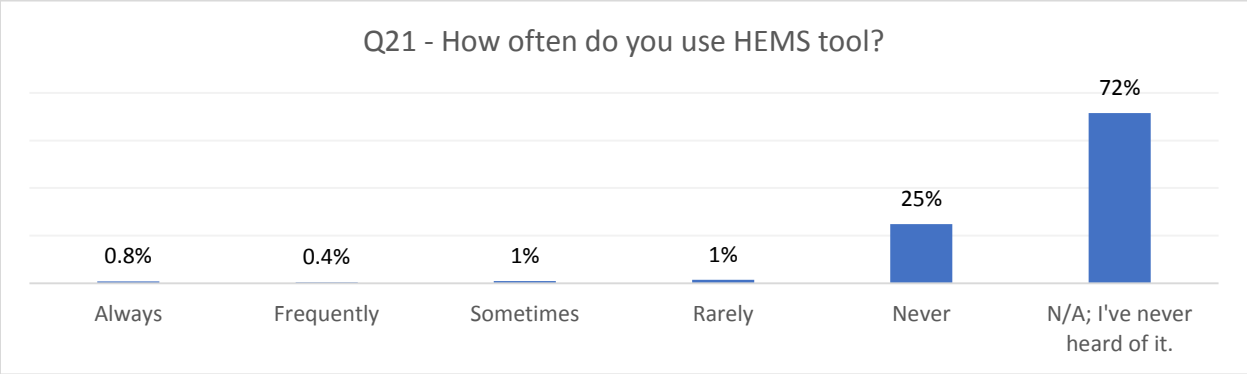

Figure 14. Q21, "How often do you use the Helicopter Emergency Medical Services (HEMS) weather tool on the Aviation Weather Center website?" This question was only shown to subjects from the continental U.S. (n = 2517)

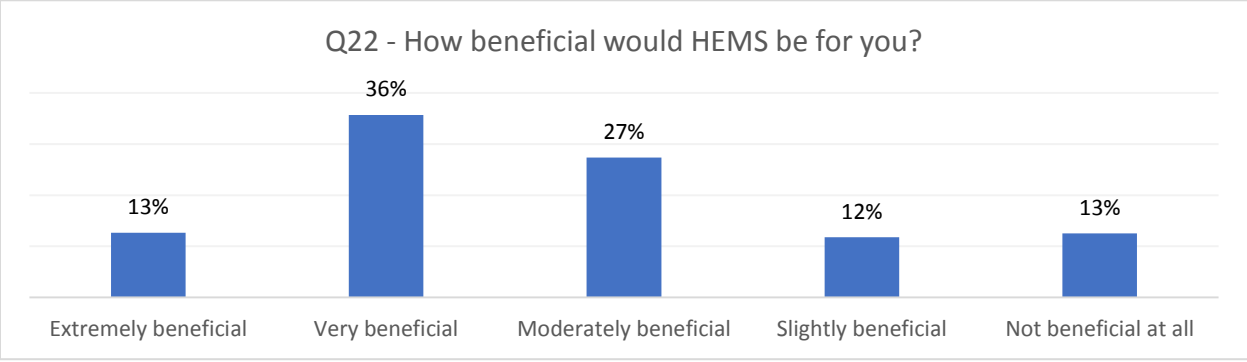

Figure 15. Q22, "The Helicopter Emergency Medical Services (HEMS) weather tool is an interactive weather display that provides low-altitude weather and aviation data on a zoom-able and scrollable map display […]. How beneficial would this tool be for you?" This question was only shown to CONUS subjects who had indicated that they had never heard of or never used the HEMS tool in Q21 (n = 2390).

Hazardous Inflight Weather Advisory Service (HIWAS). Questions pertaining to HIWAS were shown to subjects from CONUS. About 68% of respondents reported never or rarely using HIWAS in the past 12 months (Figure 16). Approximately 60% of subjects reported that the removal of HIWAS would *not* negatively impact their ability to access weather information (Figure 17).

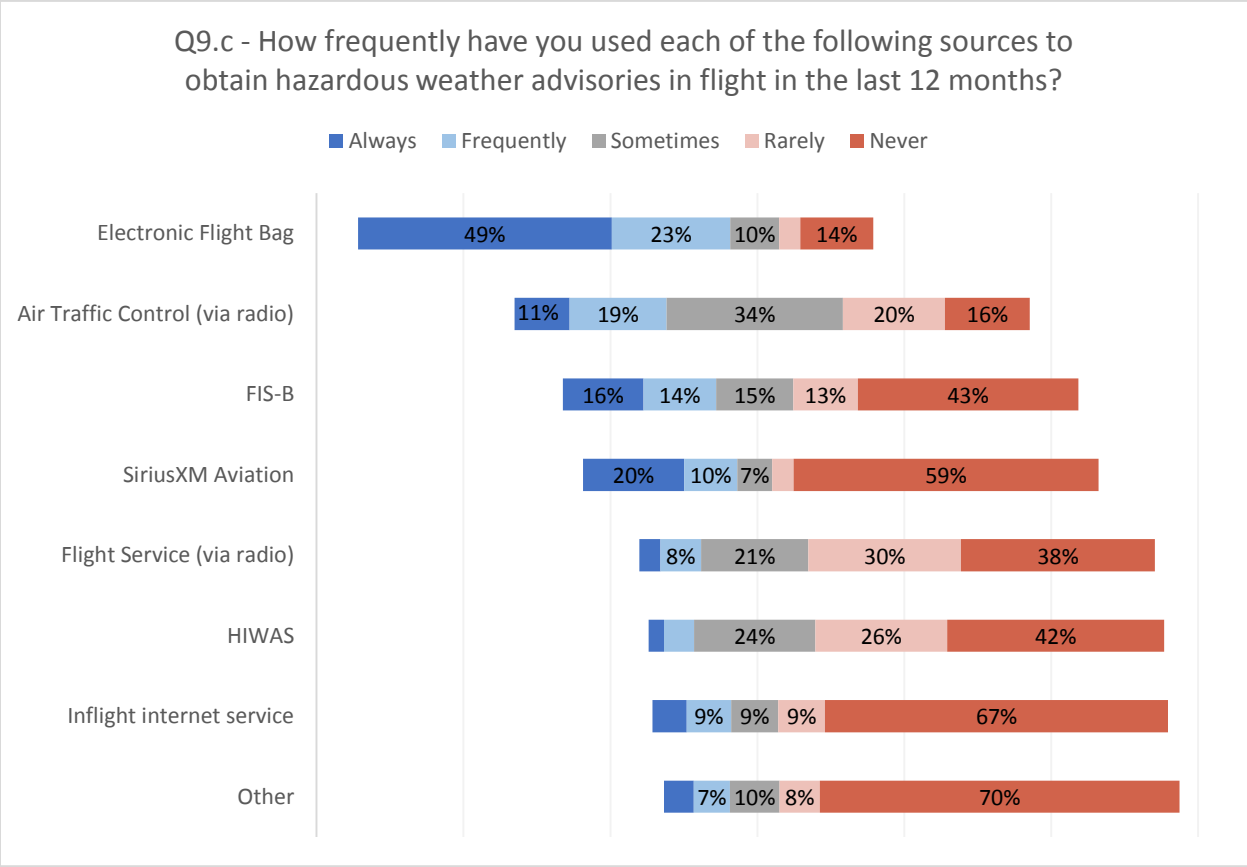

Figure 16. Responses to Q9.c, "How frequently have you used each of the following sources to obtain hazardous weather advisories in the last 12 months?" Question was shown only to CONUS respondents.

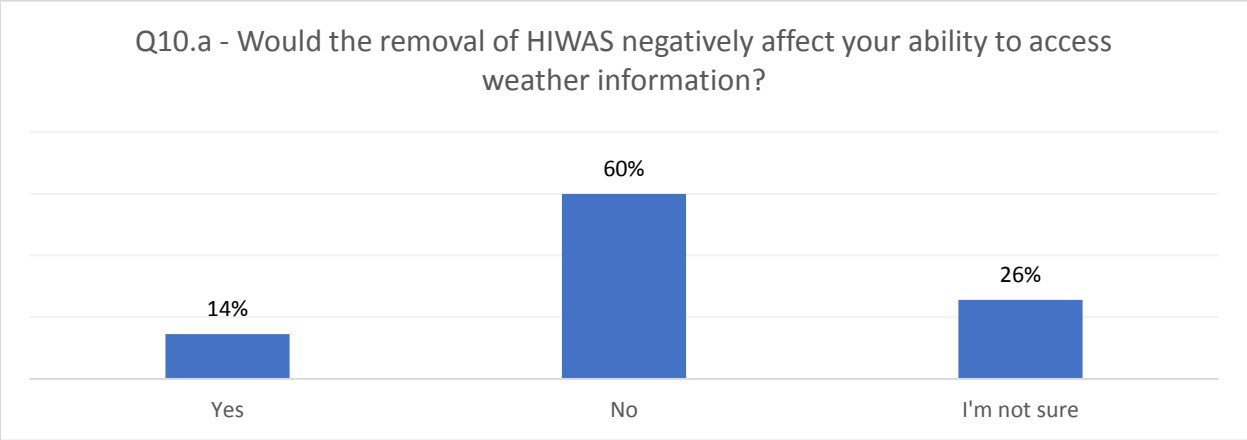

Figure 17. Responses to Q10.a (directed to CONUS subjects), "Would the removal of HIWAS negatively affect your ability to access weather information?"

Pilots that believed the removal of HIWAS would negatively impact them predominantly indicated: (1) HIWAS often acts as an important safety precaution or redundancy; (2) HIWAS is especially useful for those who may not have access to other electronic options inflight (perceive no substitute for their needs); (3) HIWAS is convenient, and/or easy to use, and offers useful weather updates inflight that help make decisions (leading to safer pilots); (4) pilots feel it is better to use HIWAS than to bother Air Traffic Control (ATC). For example, some of those who *would* be negatively impacted by the removal of HIWAS said:

> *"Removes a valued "back-up" source of weather information (in other words, I may not use it all the time – but the fact that it is there is invaluable. I can always use it if I need to!!!)"*

> *"Although the hazardous weather information can be obtained from other sources, the tools for the safety of flight should be augmented not reduced in number. Using multiple sources ensures an accurate picture of your route of flight current and impending weather."*

On the contrary, many pilots believed that the removal of HIWAS would *not* negatively impact them because: (1) they do not currently use (and do not think they will ever need to use) the service; (2) acceptable substitutes (including other weather resources and ATC) exist, and can be easily accessed and used; (3) the information provided by HIWAS can be vague, inconvenient, or otherwise not useful; and (4) some pilots simply avoid flying in the type of challenging weather which would necessitate the use of HIWAS.

> *"I have multiple weather sources prior to departure and in-flight that provides access to current weather. I use these anytime there is significant weather."*

> *"With proper pre-flight weather planning, there are very rarely any in-route surprises that appear."*

Interestingly, pilots on opposite sides of the HIWAS debate used very similar language to explain why the change would (or would not) impact them.[9] The same attribute can be seen as useful or as pointless, depending on perspective of the pilot. For example, one pilot may view the availability of alternatives as a positive (alternative or back-up sources act as failsafes that ensure safety during flight) or as a negative (the service is redundant, and never used).

We also noted a unique relationship between age and the perceived importance of HIWAS. There was not a strict linear progression, such that as age increased or decreased, so did the perceived importance of HIWAS. Rather, subjects who were between 45 and 54 years old reported that the removal of HIWAS would not negatively impact them more often than any other age group. Much younger (e.g., 34 years old or younger) and much older (e.g., at least 75

[9] In fact, 14 out of the 15 most frequently used words in Q10.b ("Please explain why the removal of HIWAS would affect your ability to access weather information") were the same as the most frequently used words in Q10.c ("Please explain why the removal of HIWAS would not affect your ability to access weather information."), even after excluding common English stopwords (e.g., "I," "myself," "our," etc.).

years old) respondents were the least likely to report that the removal of HIWAS would negatively impact them (though, the majority still did hold that belief).

There seems to be a relationship between the amount of experience a pilot has and their apparent dependence on the HIWAS system. Current instrument rated pilots were more likely to believe that they would *not* be negatively impacted by the removal of HIWAS (compared to pilots who were instrument rated but not current and pilots who were not instrument rated). Pilots who held an ATP or commercial certificate also reported that the removal of HIWAS would *not* negatively impact their ability to access weather information, more so than any other comparable group of pilots. Thus, more experienced pilots seem less dependent on HIWAS than less experienced pilots.

Technology Used

EFB, FIS-B, and Sirius XM Aviation. Use of EFBs, FIS-B, and Sirius XM Aviation also differed by location and instrument rating or currency. More people utilized an EFB than used FIS-B, and more people had accessed FIS-B than Sirius XM Aviation. This pattern held true in both Alaska and CONUS. Still, fewer people overall in Alaska reported having access to an EFB, FIS-B, and/or Sirius XM Aviation than in CONUS (see Figure 18). Pilots in Alaska who did have access to these resources also reported using them less frequently than pilots from CONUS. These results in Alaska are undoubtedly influenced by differences in availability of FIS-B and Sirius XM Aviation weather products. FIS-B coverage is lacking over an estimated 40% of Alaska. XM Aviation coverage is largely limited to the southeast Alaska, and not available for the remainder of the state.

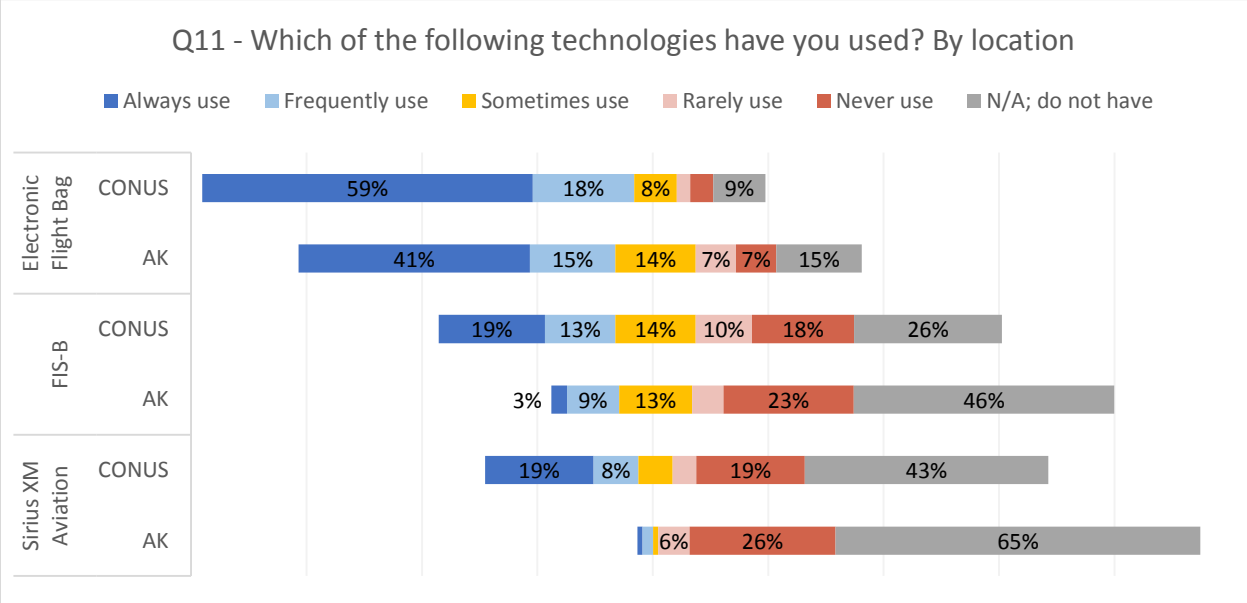

Figure 18. Q11, "Which of the following technologies have you used in the past 12 months?" by location.

Instrument current pilots reported using EFBs, FIS-B, and/or Sirius XM Aviation more frequently than pilots with no instrument rating. Pilots with no instrument rating were more

likely to report not having access to each of these sources, or to have access but rarely or never use the source.

Follow-up questions on use of FIS-B were posed to those who reported using FIS-B either sometimes, frequently, or always. Pilots from CONUS were, overall, more often satisfied or extremely satisfied with the FAA's FIS-B service than pilots from Alaska were (Figure 19). Most pilots received their information on the FIS-B service from AOPA articles (Figure 20). Almost all pilots said they never or rarely use FIS-B as their only source of NOTAM information (Figure 21). When asked what would improve the FIS-B service, to make it more effective, most subjects suggested increasing coverage, improving graphics, or providing more accurate and more real-time information.

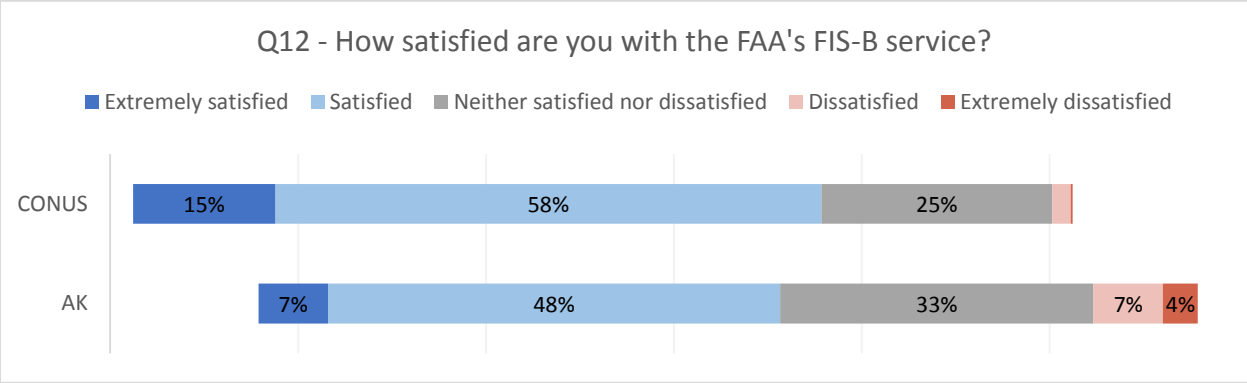

Figure 19. Responses to Q12, "How satisfied are you with the FAA's FIS-B service?". Note that Q12 was only asked of subjects who reporting using FIS-B at least "sometimes" in Q11. (n = 27 for Alaska and n = 1063 for CONUS)

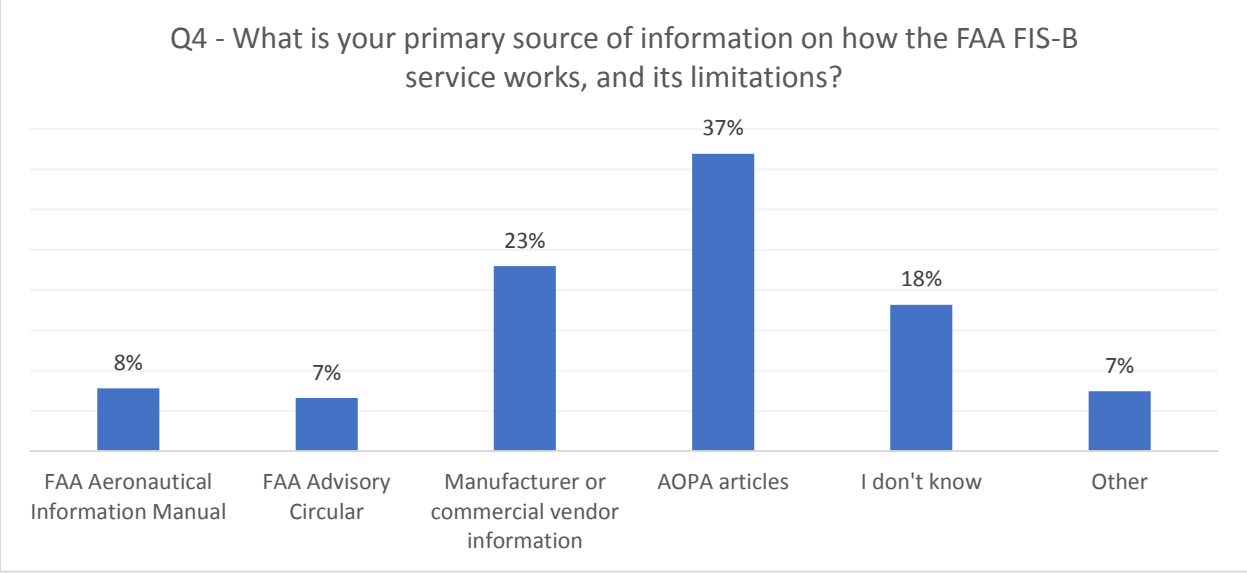

Figure 20. Q14, "What is your primary source of information on how the FAA's FIS-B service works, and its limitations?" (n = 1061)

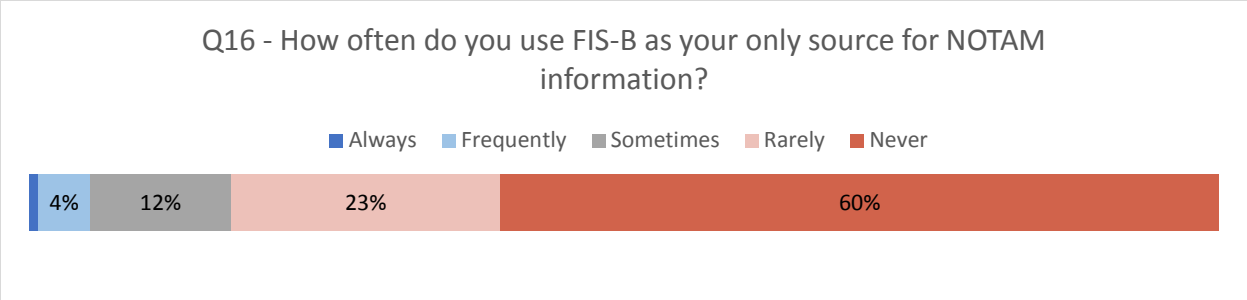

Figure 21. Responses to Q16, "How often do you use FIS-B as your only source of NOTAM information?" Note, this question was only provided to subjects who used FIS-B at least "sometimes." (n = 1029)

Respondents of all age groups, locations, ratings, and certificate levels were, overwhelmingly, unsure of what the NOTAM uplink limitation was (Figure 22). Just 17% of subjects provided the correct answer (only those NOTAMs issued or effective within the last 30 days are uplinked). About 69% of subjects said they had no idea what the answer was.

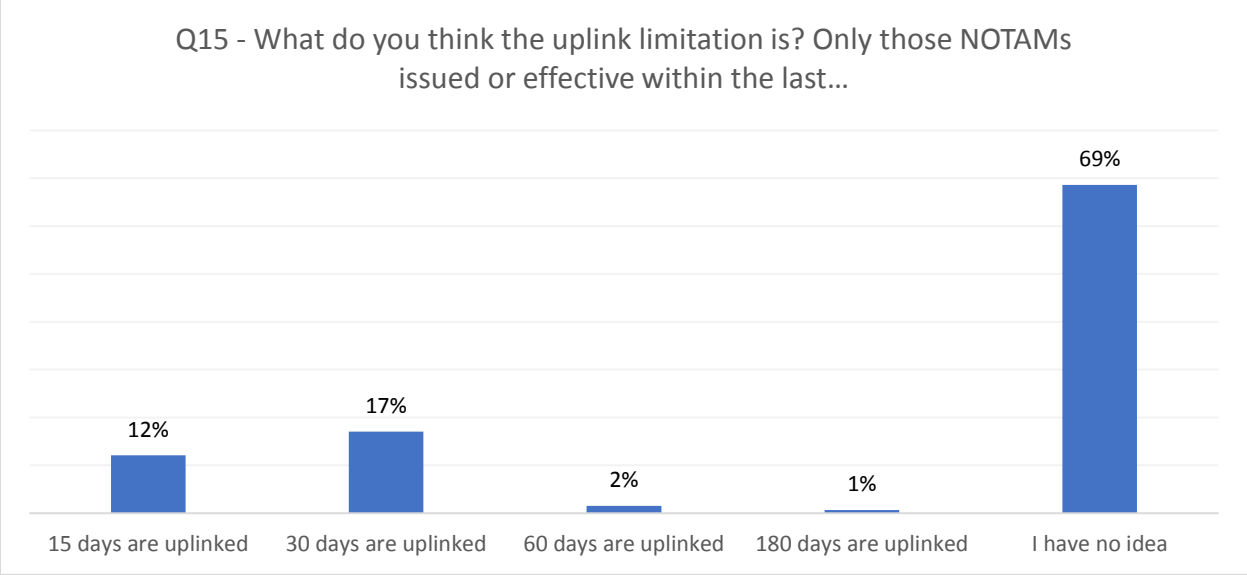

Figure 22. Responses to Q15, "The FAA FIS-B service only uplinks certain NOTAMs. What do you think the limitation is? Only those NOTAMs issued or effective within the last…" Note, this question was also provided to subjects who used FIS-B at least "sometimes." (n = 1049).

Terminal Aerodrome Forecast (TAF). Overall, 81% of subjects were somewhat or extremely likely to use a completely automated TAF, if available. Likelihood of using a completely automated TAF varied by whether or not an instrument rating was held (Figure 23). Pilots who were instrument current more often reported that they were at least somewhat likely to use a completely automated TAF, as compared to pilots who were not instrument current and/or not instrument rated.

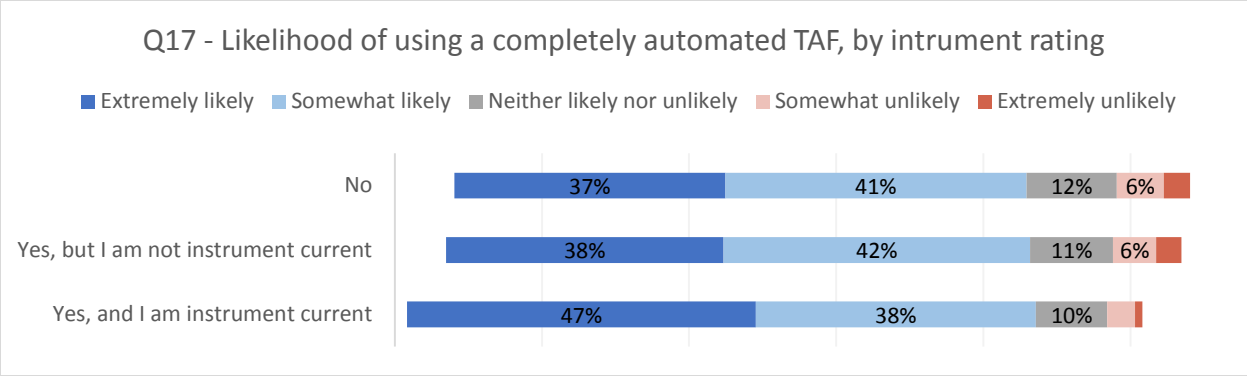

Figure 23. Responses to Q17, "Many General Aviation airports do not have a Terminal Aerodrome Forecast (TAF) due to limited human resources. If available, how likely are you to use a completely automated TAF which has not been reviewed by a human weather forecaster?", by instrument rating held (n = 2307).

Pilot Weather Reports (PIREPs)

PIREP submission tools. Overall, 54% of subjects reported that they were unfamiliar with the AWC's web-based PIREP submission portal (Figure 24). Familiarity with the tool did not differ between CONUS and Alaska pilots.

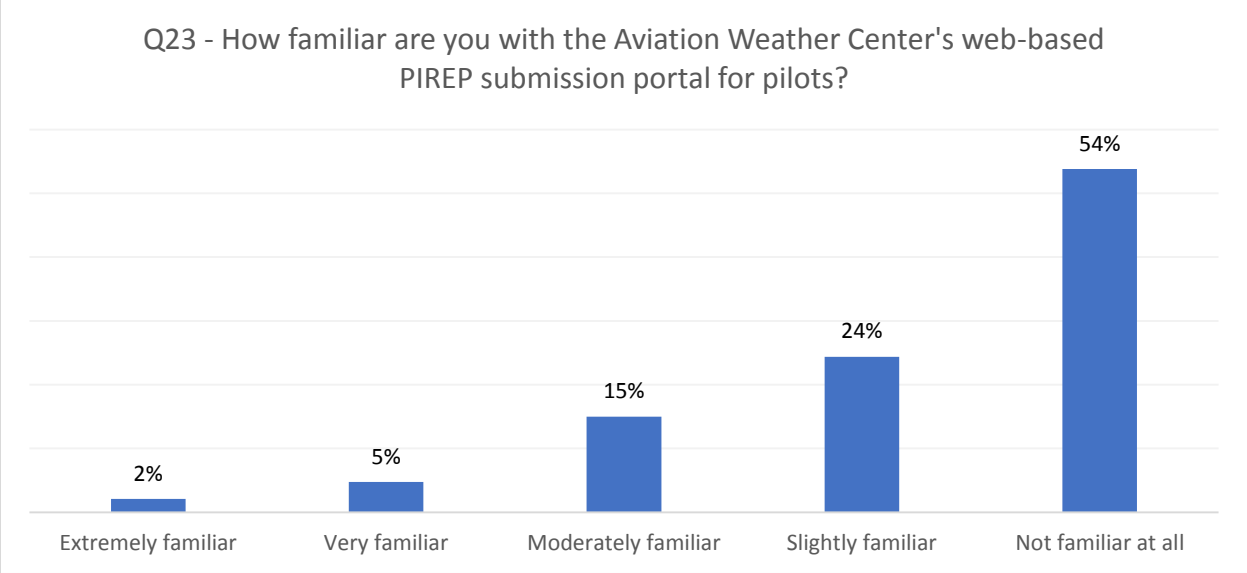

Figure 24. Q23, "How familiar are you with the Aviation Weather Center's web-based PIREP submission portal for pilots?" (n = 2260)

Most subjects said they would use a PIREP submission tool if it were integrated with their primary inflight application on their EFB (Figure 25). Pilots who were not instrument rated and pilots who were instrument rated but not current were less likely to say they would use such a tool.

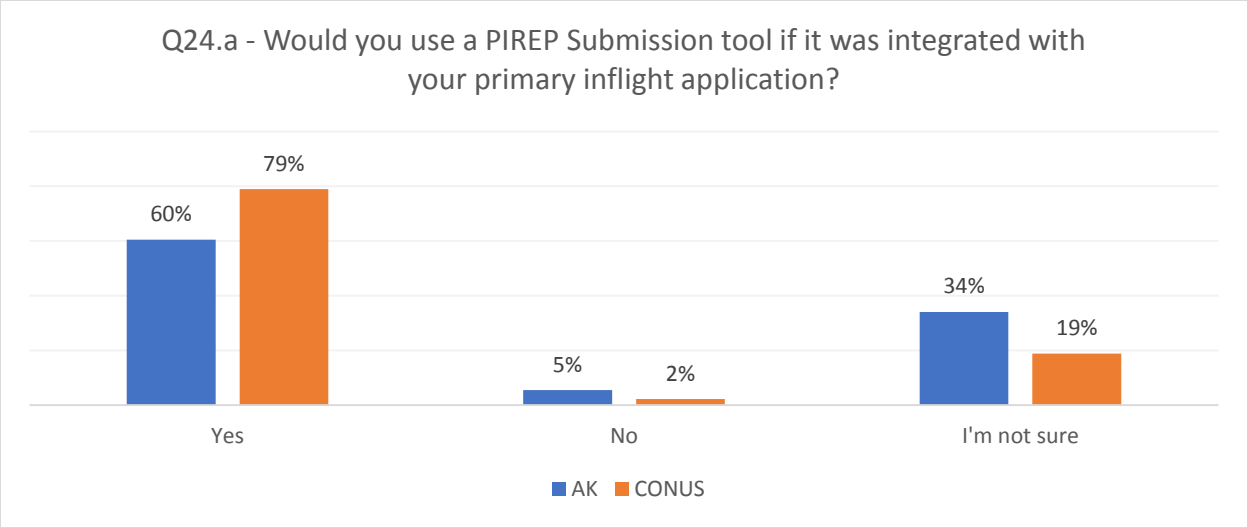

Figure 25. Q24.a, "Would you use a PIREP submission tool if it was integrated with your primary inflight application, such as ForeFlight or Garmin Pilot, on your Electronic Flight Bag (e.g., iPad or tablet)?" Differences shown by location.

Those who were unwilling to use an integrated PIREP submission tool often believed there would be no way to upload the information while in flight, due to the lack of an internet connection. Once the information could be uploaded, it would be old and no longer relevant or useful. Furthermore, subjects reported that other ways of reporting PIREPs (such as talking to ATC) were more convenient, and wouldn't involve the potentially dangerous and distracting action of typing into an app while flying.

> *"There is no way to upload it in flight and by the time I landed location would not be accurate and conditions would have likely changed"*

> *"Too much distraction and head down time."*

Respondents who were unsure if they would use an integrated PIREP submission tool often cited their unfamiliarity with how the tool would work. Most subjects said their use of the tool would depend on its ease of use given flight conditions (99 comments, or 33%). Many subjects also said they would have to see or try the tool before deciding whether or not to use it (47 comments, or 16%). Several respondents also brought up their concerns about how the information would be disseminated without access to internet in flight (31 comments, or 10%).

> *"If the submission was too distracting while flying, I wouldn't use it."*

> *"How would it get disseminated until you land and go somewhere with Internet access?"*

Providing PIREPs. Alaskan pilots provided unsolicited PIREPs more often than CONUS pilots (Figure 26). Current instrument rated pilots were more likely to provide unsolicited PIREPs than non-instrument rated pilots were. Finally, ATP and commercial pilots provided unsolicited PIREPs more frequently than private pilots did.

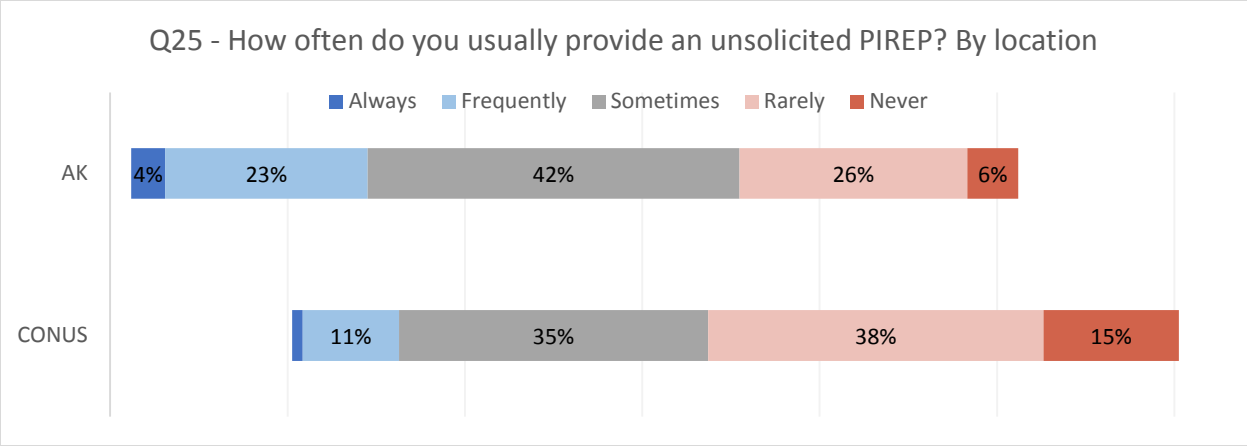

Figure 26. Q25, "How often do you usually provide an unsolicited PIREP?" broken down by location.

In general, about 62% of subjects said ATC never or rarely requests PIREPs from them. Alaskan pilots received proportionally more requests for PIREPs from ATC than CONUS pilots did.

Perceived value in older PIREPs. Alaskan pilots more often believed there was value in having access to older PIREPs than CONUS pilots (Figure 27). Similarly, pilots with current instrument ratings more often believed there was value in seeing older PIREPs than pilots without instrument ratings.

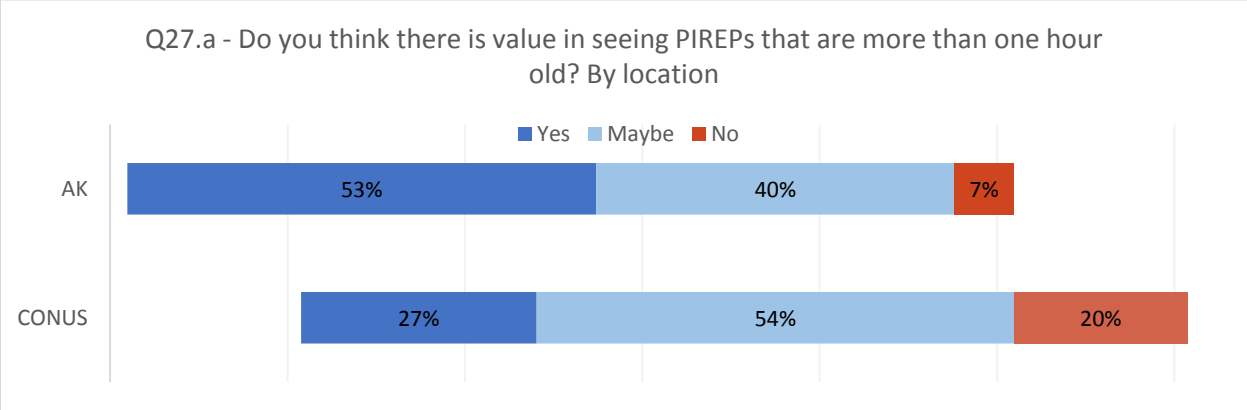

Figure 27. Q27.a, "Do you think there is value in seeing PIREPs that are more than 1 hour old?" broken down by location.

Those who did not see any value in seeing PIREPs more than one hour old explained that weather changes too quickly for that information to be of any use. For example, some respondents said:

> *"Weather can change rapidly and PIREPs more than an hour old can contribute to bad decision making and/or a false sense of security."*

"Weather is dynamic, PIREPS are great when they're recent but it doesn't make sense to base a prediction on a report of conditions that have most likely changed and have certainly moved."

Respondents who believed there was value in seeing PIREPs often cited the ability to use PIREPs to track trends. Other pilots said it was better to see an old PIREP than nothing at all. For example, comments included:

"May be only information in specific location. Would rather have it dated than not at all."

"Weather trends are huge and can help a lot with planning a flight or route."

Limitations and Improvements to Weather Information

Limitations. We asked pilots if there were limitations in the weather information they had in several categories, including: icing; turbulence; convection or thunderstorms; ceilings, visibility, or flight category; and winds (see Figure 28 for all responses, and Figure 29 for categories that differed by location).

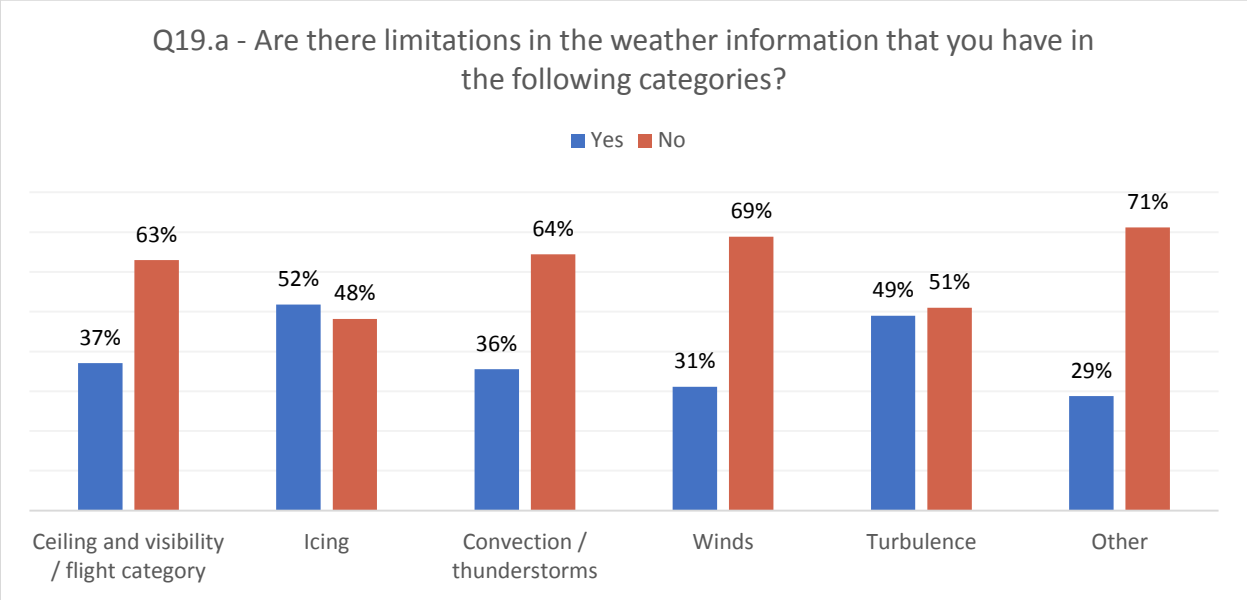

Figure 28. Q19.a, "Are there limitations in the weather information that you have in the following categories?" Responses for both locations aggregated.

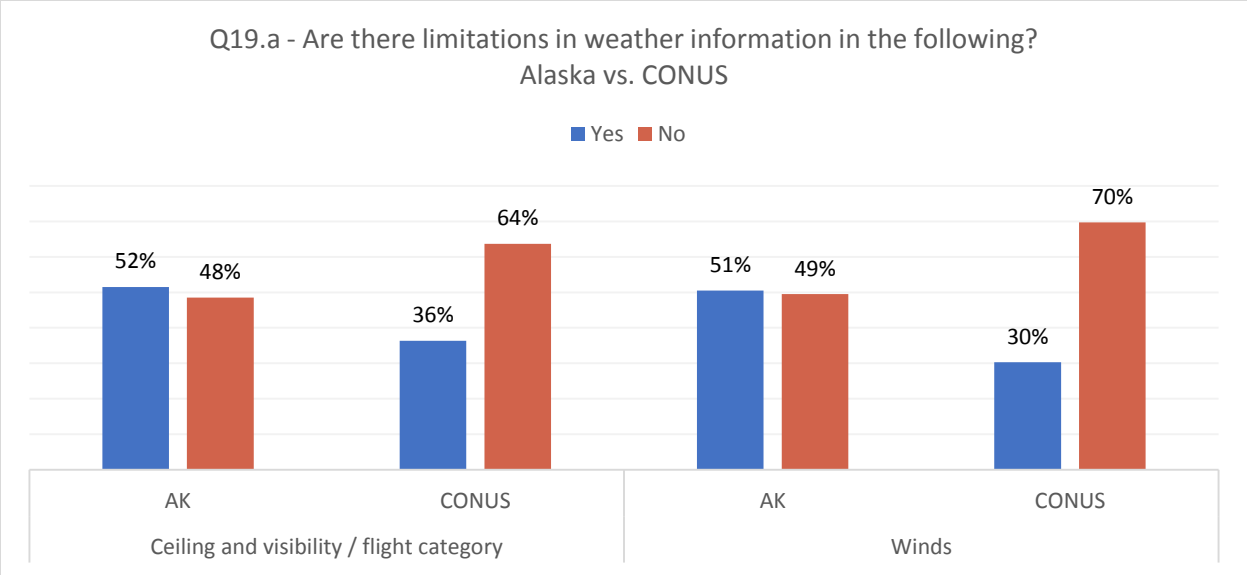

Figure 29. Q19.a, "Are there limitations in the weather information that you have in the following categories?". Only those categories which differed significantly by location are displayed.

Icing. About 52% of all subjects believed there were limitations in available icing weather information (Figure 28), with no significant differences by location. When asked to describe these limitations, most respondents discussed the lack of accuracy and reliability of existing icing information. Respondents also frequently discussed the need for greater detail in reports, more localized information (ideally from a greater number of reporting stations), and more PIREPs. Examples of comments include:

> *"Not enough PIREPs, need better technology to predict the actual existence of ice"*

> *"The area forecasts are generally pretty good but again due to the sparsity of collection sites they lump together areas that should be separate."*

Turbulence. About 49% of all subjects perceived limitations in weather information related to turbulence, with no differences by location (Figure 28). Many respondents believed that reports regarding turbulence lacked detail and accuracy.

> *"We guess where the turbulence is, but really don't know unless we get a pirep."*

> *"Severity categories affected by type of airplane, need more PIREPs, need better forecasting"*

Convection or thunderstorms. About 36% of all subjects perceived limitations in weather information related to convection or thunderstorms, with no differences by location (Figure 28). Most respondents discussed the accuracy and reliability of information on thunderstorms, and the need for more frequent updates of such information. Those who requested more detail often mentioned graphics, tracking, location, and intensity. Several subjects also discussed the need to have more easily interpretable and accessible sources of information.

"More frequent updates for changing conditions"

"Need better granularity for intensities and boundaries. Need faster refresh rates and updates. Tstorms are often shown worse than actual on most graphics."

Ceilings, visibility, or flight category. Alaskan pilots were more likely to perceive a limitation in the available weather information related to ceilings, visibility, or flight category than CONUS pilots (Figure 29). Approximately 52% of Alaskan pilots identified a limitation in this category, compared to just 36% of CONUS pilots. Almost all Alaskan pilots discussed the need for more localized information regarding ceilings and visibility. Examples of comments from Alaskan pilots include:

"Usually generated by a machine looking up at one spot in space. The cieling [sic] can be very different at another spot on the same runway"

"In Alaska I fly in many areas that simply done [sic] have a way to observe the weather so usually we just have to go take a look. Weather cameras are a great benefit."

Pilots from CONUS found issues in the accuracy and reliability of information in this category, at times due to the lack of human observers. CONUS pilots called for greater detail (including greater detail on cloud tops), more frequent updates, and more reporting stations. For example, one CONUS pilot said:

"I've encountered very marginal if not ,ifr [sic] weather conditions between airports (both vmc) within 80 miles of each other. No reporting stations in between."

Winds. More Alaskan pilots (51%) than CONUS pilots (30%) perceived limitations in the availability of weather information related to winds (Figure 29). Again, major limitations included the accuracy and reliability of information on winds. Pilots in CONUS also frequently and specifically mentioned issues with detail in information regarding winds aloft. Examples of comments include:

"More granularity; more frequent updates."

"Wind forecast for direction and speed never seem to be what I've observed"

Other. About 29% of subjects perceived a limitation in available weather information for a category not previously mentioned, with no significant differences by location (Figure 28). Of those respondents, over half (about 54%, or 38 people) reported requiring more information about cloud tops.

Improvements. We asked pilots how important several potential improvements to weather information would be to them (illustrated in Figure 30, with significant differences by location shown in Figure 31). Improved forecast performance was most often classified as an extremely important improvement by all pilots. Of those who chose to classify improved forecast performance, 61% listed it as extremely important, and 36% listed it as important. Increased

frequency of updates was the second most important improvement overall for pilots in both locations. Of those who chose to classify increased frequency of updates, 45% described it as extremely important, and 48% described it as important.

Pilots from Alaska and CONUS differed in their perceptions of importance of increased weather infrastructure (e.g., more observations), and better pilot guidance (see Figure 31). Alaskan pilots classified increased weather infrastructure more frequently. When they did classify increased weather infrastructure, Alaskan pilots claimed the improvement was extremely important relatively more often than CONUS pilots did. About 44% of Alaskan pilots classified weather infrastructure as extremely important, compared to just 22% of CONUS pilots who did the same.

Conversely, CONUS pilots described "better pilot guidance," which refers to the need for better documentation on how to interpret and use specific products, as an important or extremely important improvement relatively more frequently than Alaskan pilots did. A total of 45% of CONUS pilots classified better pilot guidance as important or extremely important, while just 31% of Alaskan pilots did the same. Only 15% of CONUS pilots believed better pilot guidance was unimportant, compared to 25% of Alaskan pilots who believed the same.

Pilots from both locations found increased granularity of updates to be among the least important improvements to weather information. About 42% of all subjects who classified increased granularity deemed it unimportant – giving this potential improvement the largest share of the "not important" category (19%).

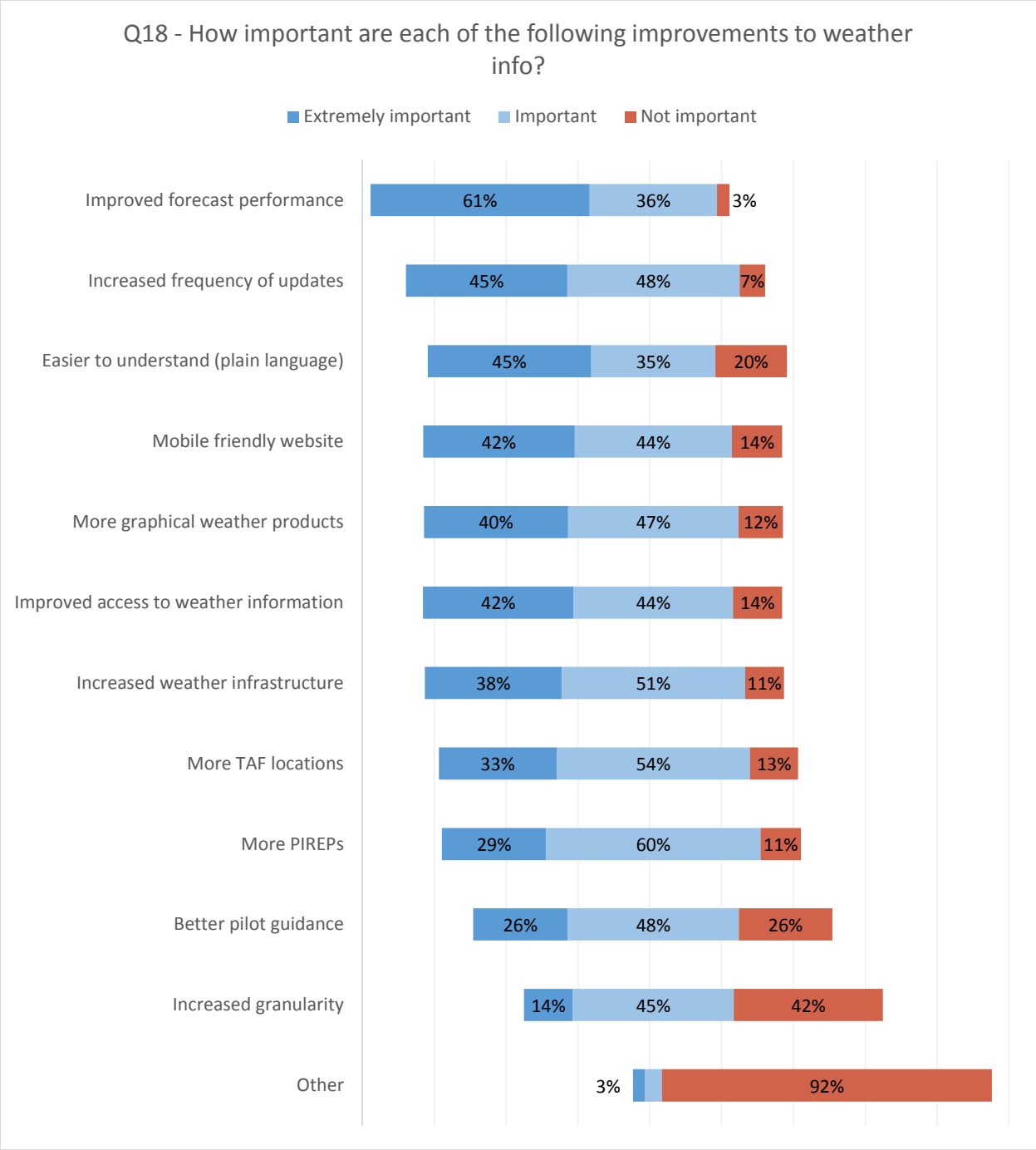

Figure 30. Q18, "How important are each of the following improvements to weather information?" Participants ranked improvements as extremely important, important, or not important. Percentages are by attribute (the number of people who classified each given improvement, into each given category, out of the total number of people who chose to classify that attribute).

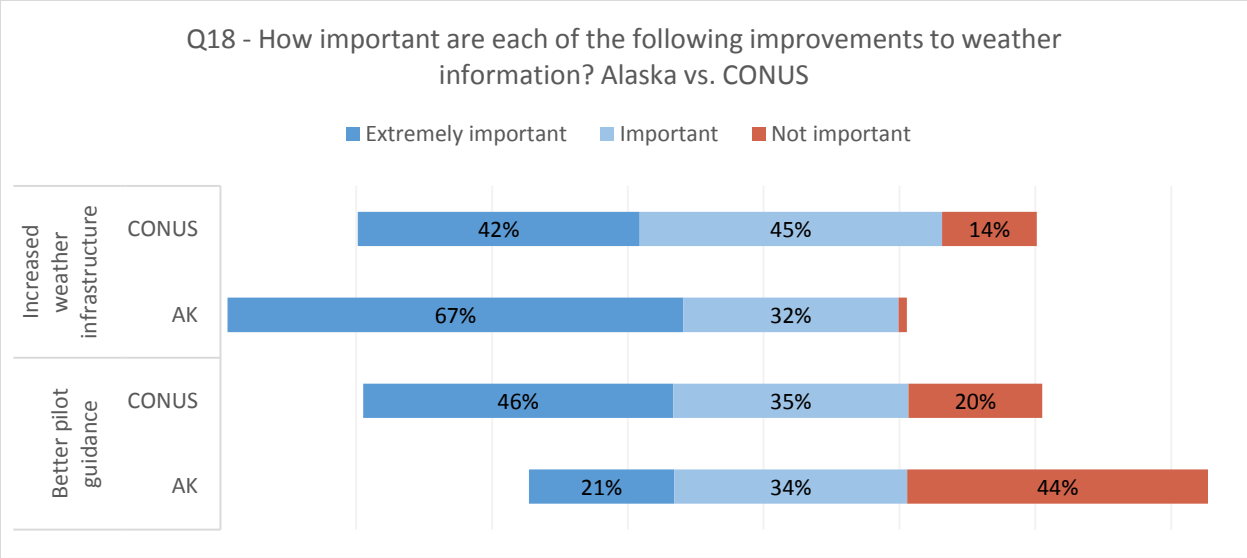

Figure 31. Categories with differences by location for Q18, "How important are each of the following improvements to weather information?" Categories include increased weather infrastructure (more observations; n = 82 for Alaska and n = 1724 for CONUS) and better pilot guidance (n = 70 for Alaska and n = 1623 for CONUS). Percentages are by attribute.

Behavior Changes due to Adverse Weather

We attempted to investigate how subjects' behavior changed as a result of encountering adverse weather in flight by asking how many times in the past 12 months subjects had (1) experienced unforecast adverse weather in flight; (2) diverted, landed, or turned back due to adverse weather; and (3) re-evaluated pre-flight planning due to adverse weather. In each case, we found significant differences by location.

Generally, Alaskan pilots experienced unforecast adverse weather in flight more often than CONUS pilots did (Figure 32). Alaskan pilots also diverted, landed, or turned back more frequently than CONUS pilots did. Finally, Alaskan pilots re-evaluated their pre-flight planning with greater frequency than CONUS pilots.

In all locations, pilots were more likely to re-evaluate their pre-flight planning than they were to divert, land, or turn back due to adverse weather. For example, of the 1,199 CONUS pilots who had experienced adverse weather between one to three times in the past 12 months, just over half (51%) diverted, landed, or turned back at least once, but almost all (93%) re-evaluated their pre-flight planning at least once as a result.

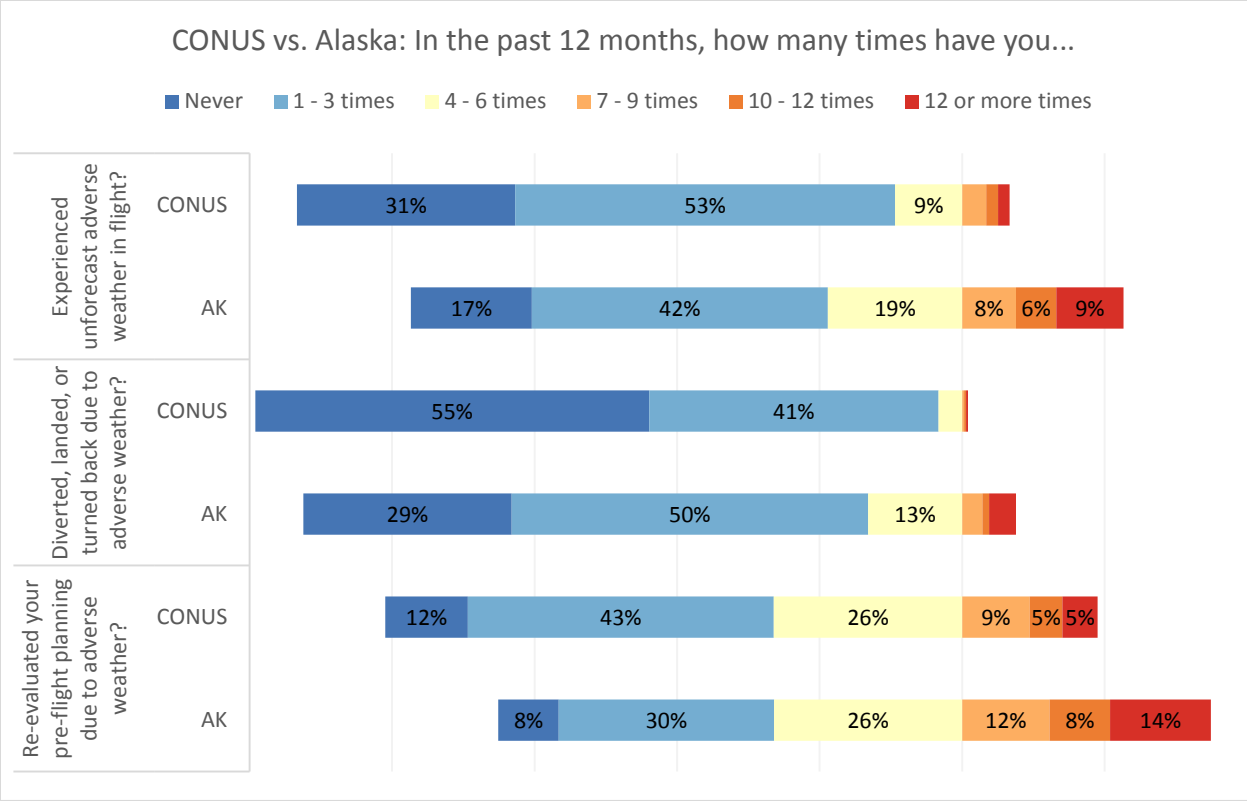

Figure 32. Q20, "In the past 12 months, how many times have you…" either "experienced unforecast adverse weather in flight" or "diverted, landed, or turned back due to adverse weather" or "re-evaluated your pre-flight planning due to adverse weather?" Responses broken down by location.

Discussion

Following-up on the results of AOPA's 2017 weather survey, this survey's goal was to better understand how general aviation pilots access weather information, the weather challenges they face, and what improvements they desire. This year's survey asked similar questions to last year's to allow us to begin to track trends in weather utilization, and we asked new questions to ascertain pilot's thoughts on innovative concepts and the hot topics for various government agencies. These surveys help drive new AOPA educational products and online courses. Summarizing responses and comments from the different questions and themes identified previously, the following topics are identified.

Proposed Removal of HIWAS

In response to the FAA considering discontinuing or significantly downsizing the HIWAS network, we asked several questions to gauge how pilots obtain hazardous weather information today and whether the removal of HIWAS would have an impact. The results showed 9% of respondents always or frequently use HIWAS (Figure 16), and 14% of pilots noted the removal of this system would negatively affect their ability to access weather information (Figure 17). The majority of pilots are accessing hazardous weather advisories in flight via other mechanisms, like FIS-B, but the results show the removal of this service would have an adverse impact for

some pilots. Additional research should be conducted before ending this service to ensure this important weather information is available to all pilots.

FAA Weather Cameras

As we saw from AOPA's 2017 weather survey results, it is apparent that Alaskan pilots heavily rely on weather cameras during preflight planning. The top request for weather improvements from Alaskan pilots in the 2018 survey was for more weather infrastructure, also echoing last year's results. Weather cameras are an important weather observation in Alaska as they provide details of weather conditions beyond the immediate "spot" measured by an automated weather sensor. Given the high utilization of weather cameras by pilots and the continued request for more of them, we believe more investment in this technology and additional locations are desired. The normal utilization of weather cameras for operational decision making should also lead to these systems being maintained and monitored more rigorously by the FAA in a manner similar to how other operationally significant weather systems are.

FIS-B Products and Guidance

The utilization of the FAA's free FIS-B service is increasing among general aviation. The 2017 survey indicated 31% of CONUS pilots used the service and the 2018 survey shows 46% of CONUS pilots always, frequently, or sometimes use the service. Most pilots indicated they were satisfied with the service but there was higher dissatisfaction reported by Alaskan users, primarily due to a very limited ground station network for FIS-B coverage in that state. As the number of FIS-B user's increase, it is important education and guidance is getting to these pilots. AOPA articles were the primary method pilots learned about the system's limitations, followed by the manufacturer or commercial vendor's information. As only 17% of pilots correctly answered the question on the limitation of FIS-B to uplink NOTAMs (Figure 22), additional outreach is needed by all involved.

Automated TAF

Nearly 90% of pilots indicated additional TAF locations are important or extremely important. Providing a TAF-like product at locations with a surface observation could dramatically improve the point forecasts available at smaller airports but, to achieve this goal, the forecasts would likely need to be automated. About 81% of pilots, and nearly all pilots who are instrument current, noted they would likely use this product. We believe this result supports the FAA and NWS effort to provide an automated point forecast at many Alaska airports.

PIREPs

AOPA will be incorporating more PIREP questions in our annual survey to track the trend of PIREP submission issues. About 89% of pilots indicated it was important or extremely important for there to be more PIREPs; however, most pilots were not familiar with the AWC web-based PIREP submission tool. The AWC tool is primarily for submitting PIREPs when the flight is over, and not normally accessible from the cockpit, but if there was better integration of a PIREP submission tool into popular EFB applications, the majority of pilots indicated they would utilize

it. As we saw from the 2016 PIREP survey, providing technological solutions to assist with submission is important for general aviation pilots, but connectivity from the cockpit remains a serious limitation. Timely PIREPs therefore need to be provided to ATC or Flight Service, yet, most pilots indicate providing an unsolicited PIREPs is not a routine habit.

HEMS Tool

The HEMS tool was created for low-altitude helicopter operators who normally fly short distances and who need a tactical tool for flight planning on a compressed timeline. General aviation pilots, who can operate in a similar environment, have had low interest and poor utilization of this tool due to the limited outreach to this large user community; however, as the tool is not restricted to just HEMS operators, there would be a benefit to modifying the title of the tool which currently may act as a deterrent. Most general aviation pilots believe the tool would be beneficial for their operation (Figure 15). The HEMS tool title should be modified to target this larger user community, as there are safety and operational benefits in general aviation using this unique tactical tool, while not adversely affecting the primary HEMS user.

Recommendations

Based on the results from this survey, and subsequent meetings and discussions with stakeholders, the following recommendations are made.

1) Before discontinuing or downsizing the HIWAS network, additional feedback from pilots should be solicited by the FAA, such as via a Federal Register notice, to ensure pilots do have effective alternatives to access hazardous weather advisories in flight.

2) The FAA should make a greater investment in weather camera infrastructure as it improves access to remote communities and promotes better weather decision making.

3) The FAA should maintain and monitor weather cameras in a manner consistent with their operationally significant purpose to ensure their observations are available for pilots.

4) The FAA should continue supporting and developing FIS-B given the weather benefits it provides.
    a. The FAA should work with manufacturers, commercial vendors, and associations to ensure guidance is up to date and FIS-B service limitations are being communicated.
    b. The FAA should modify the FIS-B service in Alaska to improve user satisfaction and to overcome the coverage limitations. AOPA and the Alaska Airmen Association have requested that the look-ahead range of all FIS-B data in Alaska be increased to 500 nautical miles.
    c. The FAA should increase coverage of the ground station network to provide better access to FIS-B data along major flight routes (VFR and IFR) in Alaska.

5) The FAA and NWS should continue their effort to provide an automated TAF-like product at general aviation airports in Alaska and consider providing a similar product at CONUS airports.

6) The FAA should continue their efforts to increase the quantity of PIREPs and to positively address the National Transportation Safety Board's 2017 recommendations.
    a. The AWC should work with associations and the FAA to increase general aviation's awareness of their PIREP submission website.
    b. EFB application vendors should investigate integration of a PIREP submission tool.
    c. The FAA should continue the Air Traffic Organization's Top 5 PIREP effort to address concerns raised by pilots related to submission of PIREPs via ATC.

7) The FAA and AWC should consider changing the title of the HEMS tool to the "Low Altitude Operator Tool" or incorporating the HEMS tool benefits important for general aviation, such as additional weather observations (i.e., Meterological Assimilation Data Ingest System [MADIS] observation data), into the Graphical Forecasts for Aviation (GFA) tool.

8) Flight Service specialists should remain available and accessible, during preflight and inflight, for general aviation pilots as they are a primary resource when it comes to weather understanding.

9) The AAWU weather website should be upgraded to be mobile-friendly and maximize the advantages of graphical interfaces.

Survey Limitations

There are several important limitations to note when interpreting results from this survey. First, though AOPA's 2018 Weather Survey benefitted from a larger overall sample size than those of previous years, the small sample size and larger margin of error for Alaskan pilots may lead to more uncertainty in the relevant statistics and estimates. The margin of error will also be notably higher (and thus, estimates will be less reliable) where individual questions have fewer responses.

Second, a potential for bias towards AOPA exists, as the survey was released by AOPA, to AOPA members. It is possible that those who decided to respond and take the survey also already had more favorable opinions regarding AOPA. Notably, this bias may have impacted the observed number of people who use AOPA Flight Planner (i.e., it is possible that subjects who were AOPA members and already predisposed to "liking" AOPA were also more likely to use AOPA's products and services).

Finally, it is important to avoid making assumptions about respondents' intentions in open-ended comments. For example, one participant in the present study answered an open-ended question

about HIWAS by saying, "This is valuable."[10] The coder (a person who reads and evaluates answers to free-response questions for overarching themes and insights) must avoid making assumptions about what exactly the respondent was referencing and why he or she believed it to be valuable. Even with multiple trained readers, the potential for bias (and a resulting lack of accuracy) in coding free-response questions will always exist. AOPA's use of a single coder precludes the calculation of interrater reliability statistics, which would help estimate the existence of bias in such a scenario. AOPA strives to provide detailed and accurate assessments of all data gathered. Thus, we openly acknowledge these potential limitations.

The Aircraft Owners and Pilots Association (AOPA) is a not-for-profit individual membership organization of general aviation pilots and aircraft owners. AOPA's mission is to effectively serve the interests of its members and establish, maintain and articulate positions of leadership to promote the economy, safety, utility and popularity of flight in general aviation aircraft. Representing two thirds of all pilots in the United States, AOPA is the largest civil aviation organization in the world.

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[10] When asked to explain why the removal of HIWAS would negatively affect his or her ability to access weather information, one participant in AOPA's 2018 Weather Survey responded, "This is valuable."