ALASKA CEILING AND VISIBILITY (C&V) USERS NEEDS ASSESSMENT
ALASKA PILOT STUDY

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1. INTRODUCTION

Alaska presents some of the greatest challenges to providers and users of aviation weather information in general, and C&V identification and prediction in particular. Alaska is unique, due mostly to its vast size, remoteness, large proportion of General Aviation (GA) traffic, and topographic and climatic variability. Given the extremes in distance and terrain between observing and forecast stations, weather information systems are often unable to provide accurate information on current or forecast C&V conditions along low-altitude flight paths. The Alaskan aviation accident rate is three to four times greater than that of the other 49 states (Nelson, 1999). For many of these accidents, reports cite poor C&V conditions as a factor, evidencing the need for better and more available C&V information sources.

Under the auspices of the FAA's Operations Planning Research and Development Aviation Weather Research Program (AWRP), and as part of the National C&V Product Development Team's (PDT's) initiative, the FAA's William J. Hughes's Technical Center (WJHTC) Verification Services Division Weather Sensors and Processors Group, conducted an Alaska C&V Users Needs Assessment (May – October 2003) to help provide direction and need for future Alaskan C&V product development.

2. ASSESSMENT CONDUCT

The overall objective of this study was to explicitly seek out a definition of C&V product/support requirements and priorities from the Alaska user community that characterize operational needs via feedback regarding: the regional importance of C&V; information needed to permit more accurate hazard avoidance; value of current sources of C&V information; operational requirements for C&V graphics; and required and desired C&V product forecast performance.

Participants included: Alaska Pilots; Kenai AFSS Air Traffic Control (ATC) Specialists; Juneau AFSS ATC Juneau (PJNU) ATCT Management and ATCs; Anchorage Air Route Traffic Control Center (ARTCC) (ZAN) TMCs; Alaska Aviation Weather Unit (AAWU) Specialists; Anchorage International Airport (PANC) ATCT and TRACON Traffic Management Coordinators (TMCs), Supervisors, and Air Traffic Controllers (ATCs); forecasters; Anchorage National Weather Service (NWS) Weather Forecast Office (WFO) forecasters; ZAN Center Weather Service Unit (CWSU) forecasters; and Era Airlines Inc., pilots and dispatchers.

For the purposes of this paper, results from one participant group, Alaska pilots (N=98), are presented since they are the primary end-users of C&V information. Pilot results, too, were mostly consistent with and to some extent representative of Alaska assessment participants as a whole (FAA, 2003).

2.1 METRICS

Questionnaires were designed to collect feedback on pilot's perceptions of C&V issues and conditions; the benefit of available C&V resources; and requirements for future C&V product displays. Ratings of current C&V product information sources were structured using a 5-point Likert scale design. Relative importance of future product options was also solicited. A pencil and paper copy of the questionnaire was administered to pilots at the Alaska Airmen's Air Show in Anchorage, AK. An Internet-based version, accessible from the WJHTCs Weather Sensors and Processors Group web server, was developed to reach a greater cross-section and number of Alaska pilots.

To better define Alaskan areas, the state was divided into five distinct regions: South Central, Southwest, Inside Passage, Interior, and Far North (Figure 1).

Figure 1. Alaska Regional Map

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2.2 DATA ANALYSIS

Data were summarized and tabulated. Questionnaire ratings on current C&V weather information product use were analyzed using descriptive statistics, with the mean as the measure of central tendency. Tests of significance were applied to acceptability ratings using a Student T-Test with an alpha level of .05. For demographics and C&V information/product requirements analysis, percentages were used.

3. RESULTS

3.1 DEMOGRAPHICS AND C&V CONDITIONS

The distribution of pilot categories and certifications is illustrated in Table 1. Most pilots indicated they were Part 91, or GA. Note that individual pilots could fall into multiple categories.

Table 1 – Pilot Type

Pilot Type	N	%
Commercial Pilot	39	40
Private Pilot	47	48
Instrument Pilot	34	35
ATP (Air Transport Pilot)	22	22
Part 121	43	44
Scheduled Part 135	3	3
Non-Scheduled Part 135	14	14
Part 91	67	68

A typical area of flight for most pilots was over the South Central Alaska region (see Figure 1). This is the most densely populated area of Alaska. Table 2 shows the distribution of regions flown.

Table 2. Areas of Flight

Area of flight	N	%
South Central	63	64
Southwest	23	23
Inside Passage	12	12
Interior	31	32
Far North	9	9

Many pilots indicated the most problematic C&V effect on flight was unexpected changes from Visual Flight Rules (VFR) to Marginal Visual Flight Rules (MVFR) and to Instrument Flight Rules (IFR). Terrain obscuration and adverse conditions enroute were other significant C&V concerns (see Table 3).

Table 3. C&V Issues

C&V Problem Encountered	N	%
Unexpected change from VFR to MVFR	78	80
Unexpected change from VFR to IFR	68	69
Unexpected fog in mountain passes	49	50
Clouds below 12,000 feet enroute	57	58
Adverse C&V conditions at destination	57	58
Adverse C&V conditions enroute	70	71
Clouds/fog obscuring terrain	74	76
Ice fog	24	24

The types of geographical, seasonal, and climatological conditions that characterize areas of Alaska and contribute to adverse C&V conditions were solicited. Major contributors were perceived as: mountainous terrain; strong winds; body(s) of water surrounded by mountains; and snow (see Table 4).

Table 4. Conditions Contributing to Adverse C&V

C&V Condition	N	%
Seasonal		
Summer	38	39
Fall	66	67
Winter	52	53
Spring	38	39
Body(s) of water surrounded by mountains	56	57
Fog occurrence from tidal effects of warm, coastal water	47	48
Extreme cold	38	39
Mild temperatures	25	26
Fluctuations in temperature	32	33
Heavy precipitation	35	36
Snow	55	56
Ice fog	30	30
Mountainous terrain	80	82
One or more deep cloud layers	43	44
Frozen precipitation	40	41
Drifting, shallow fog banks	44	45
Significant moisture, high humidity	39	40
Strong winds	68	69
Sea/ocean breezes	44	45
Erratic wind direction	54	55
Lakes and/or streams	48	49

3.2 RATINGS OF CURRENT C&V INFORMATION SOURCES

Available C&V weather information sources were rated on their operational acceptability based on the dimensions of **usefulness, availability and accuracy** using scoring anchors from 5 (highly acceptable operationally) to 1 (highly unacceptable operationally), with 3 indicating a borderline rating (neither operationally acceptable nor unacceptable). Sources included: Pilot Reports (PIREPs); weather cameras; human weather observers; FSS/AFSS briefings (adverse conditions, current conditions, and enroute),

ASOS/AWOS reports, Terminal Aerodrome Forecasts (TAFs); Area Forecasts (FAs); NWS reports; AIRMETs; Center Weather Advisories (CWAs); and AAWU forecast products including IFR/VFR area maps, and the Significant Weather Chart (Figure 2).

Although usefulness ratings of all C&V sources were operationally acceptable, the usefulness of most observation sources, especially PIREPs and human weather observers, were significantly higher ($p<.05$) than C&V forecast sources such as FAs and AIRMETs. ASOS/AWOS reports, also an observation source, were the exception and on a par with forecast product ratings. Of the AFSS briefings, usefulness ratings for current conditions briefings were rated significantly higher than enroute and adverse conditions briefings.

Ratings on the availability of PIREPs, weather cameras, and ASOS/AWOS reports fell between borderline and acceptable, with the lowest borderline rating for human weather observers.

Accuracy ratings of most observation sources, with the exception of ASOS/AWOS reports, were significantly higher ($p<.05$) than those for most forecast sources. Of these, the accuracy of FAs, AIRMETs, and TAFs were operationally borderline. Accuracy ratings for AFSS briefings were mixed, wherein accuracy of the current conditions briefing was operationally acceptable, enroute and adverse conditions briefings were borderline.

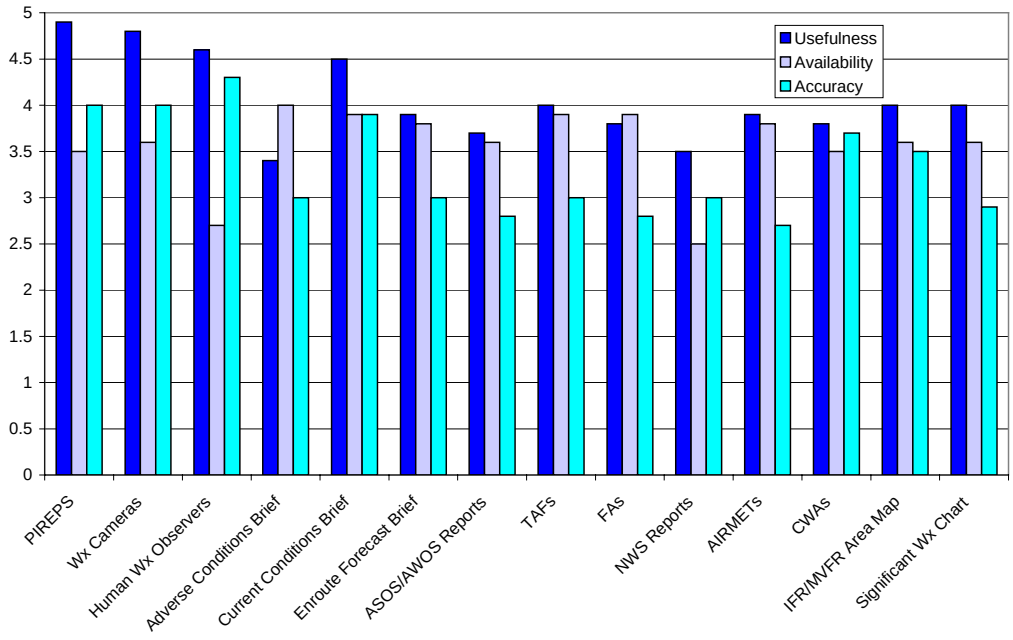

Figure 2. Mean Ratings on the Operational Acceptability of Current C&V Sources

Questionnaire comments indicated the following:

By reporting actual conditions at a given location and time, PIREPs were the preferred source of C&V information. Their effectiveness, however, was limited by infrequent reporting since PIREP issuance is not a requirement.

Weather cameras were very helpful, although problems with breakdowns and poor maintenance were cited. The need for more strategically placed cameras was indicated. Mountain passes such as Rainy Pass and Ptarmigan Pass were identified as areas in critical need of camera observations.

Reports from human weather observers were also considered excellent sources of C&V information. Like PIREPs, these reports contain actual C&V occurrences. However, the number of weather observers and reporting offices were notably decreasing. When available, reports were oftentimes too far apart for effective flight planning purposes. The need for additional observers and timelier reporting was expressed.

Although FSS/AFSS briefings were reportedly helpful, the occurrence of adverse C&V conditions was considered overstated. Advisories for "VFR flight not recommended" when conditions were marginal or favorable was noted.

ASOS/AWOS reports were considered useful, although their reliability and accuracy were questioned, due mostly to station outages and sensor limitations. Still, a need for more ASOS/AWOS reporting stations

was expressed in order to provide some information where none exists. According to one pilot, "ASOS/AWOS accuracy is disappointing, but a least it gives a report where there is no human observer."

Comments on C&V forecast products, such as TAFs, FAs, and AIRMETs, indicated that although useful for long-range flight planning, the forecasts are too generic, cover too great an area, and may be inaccurate.

3.3 C&V PRODUCT REQUIREMENTS

Pilots were asked to rate the importance of several items as part of a future Alaska C&V product display. Figure 3 shows percentages of importance of listed product requirements. Overall PIREPs, cloud bases, and visibility depictions in miles were components considered most important.

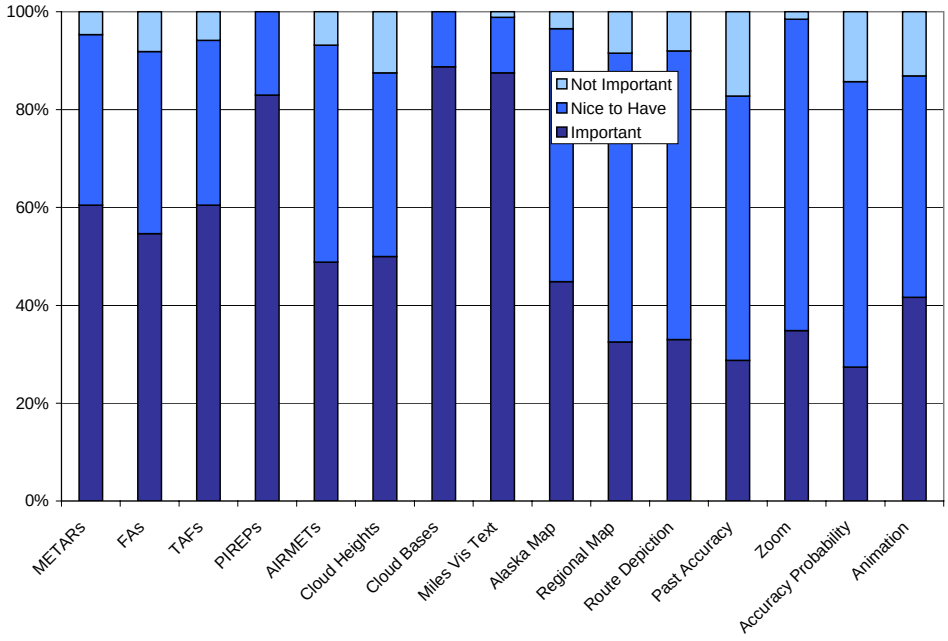

Figure 3. C&V Product Requirement Importance

Pilots were asked to identify useful product display overlays (Table 5). Most indicated PIREPs, geographical landmarks (e.g. rivers, lakes, passages), and airports as most useful.

Table 5. Overlay Usefulness

Overlay	N	Useful %
PIREPs	72	73
VORs	33	34
Airports	68	69
Navaids	42	43
Geographical Boundaries	35	36
Geographical Landmarks	71	72
Terrain Altitude Indicators	62	63
AFSS/FSS Locations	38	39

Other requirements included: cloud height ranges from 0 - 20,000 feet; cloud height increments from 100 - 500 feet; PIREPs no more than 2 hours old; and past animation images ranging from 2 - 12 hours. Forecast accuracy should be at least 70%. The overall preferred spatial display resolution was 5 to 10 kilometers, and the length of time for data latency or updates fell between 10 and 30 minutes. C&V product forecast ranges (number of hours out from the current time) varied from 6 to 24 hours.

4. CONCLUSIONS

For pilots, flying into unexpected adverse C&V conditions, especially when conditions changed unexpectedly from VFR to MVFR or IFR were the most problematic. Obscured terrain, caused by fog and clouds, also had a significant negative impact on flight.

Environmental characteristics conducive to the promotion of adverse C&V included the effects of: mountainous terrain; strong winds; bodies of water surrounded by mountains; and snow.

Observation sources including PIREPs, weather cameras, and human weather observers, were considered the most useful C&V information sources currently available. Although operationally acceptable for accuracy, observation availability was limited. Reportedly, PIREP and human weather reporting was infrequent, and ASOS/AWOS reports were at times old, unavailable, or inaccurate.

A clear need for additional C&V information sources, specifically observations, was expressed. This was strongly supported by other assessment participants (FAA, 2003), adding that most VFR flights within Alaska take under one hour, underscoring a greater need for current C&V reports. Mountain passes in particular were cited as areas in great need of C&V information.

The lower acceptability ratings of current forecast products were supported by pilot comments. Evidently, C&V forecasts were useful for longer term flight planning, but were too generic, covered too wide an area, and oftentimes unable to provide actual C&V conditions along a given flight path. As noted by other assessment participants (FAA, 2003), the unavailability of observations may compromise the accuracy of any forecast C&V product.

Finally, pilot requirements for future C&V display products stressed the need for: PIREPs, cloud bases, textual depictions of visibility in miles, and overlays of geographical landmarks and airports for effective display design.

5. REFERENCES

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