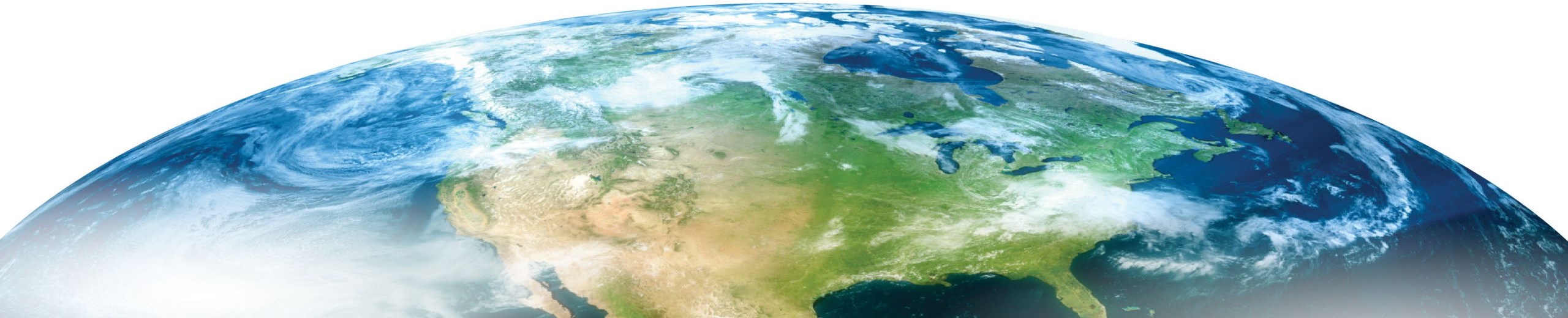
2021 Summer Experiment Graphical Forecasts for Aviation (GFA) Alaska Expanded Coverage Final Results

Presented to: Aviation Weather Center Testbed
By: FAA AWDE Services, ANG-C63
Date: October 2021



Topics

- Introduction
- Background and Objectives
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- Conclusions and Recommendations

Introduction

Introduction

- National Oceanic and Atmospheric Administration's (NOAA) Aviation Weather Center Testbed (AWT) conducted the 2021 Virtual Summer Experiment June 1 – September 30, 2021.
- AWT expanded the coverage of the Graphical Forecast for Aviation (GFA) to include the Alaska and Hawaii region.
- AWT updated capabilities to include Low Level Wind Shear (LLWS) forecast guidance and Geostationary Lightning Mapper (GLM) data from the GOES-R satellite.
- The Federal Aviation Administration's (FAA) Aviation Weather Demonstration and Evaluation (AWDE) Services team, supported by AWT, conducted virtual interviews to determine the usefulness and suitability of the GFA Alaska expanded coverage along with the LLWS and GLM.

AWC Aviation Weather Testbed Summer Experiment 2021. https://testbed.aviationweather.gov/content/page?name=gfa_ak_eval

Background and Objectives

Background

- Graphical Forecasts for Aviation are designed to provide meteorological information equivalent to the Textual Area Forecast (TAF) in a graphical format, as requested by the FAA.
- The GFA webpage was developed to provide the necessary aviation weather information to give users a complete picture of the weather that might impact flights.
  - The GFA originally provided coverage over the continental United States (CONUS), Gulf of Mexico, the Caribbean, and portions of the Atlantic and Pacific Oceans.
  - The GFA coverage has been expanded to include Alaska and Hawaii.
- Due to the distinct difference in terrain and weather conditions in the Alaska and Hawaii regions there is a need to determine if the GFA expanded coverage provides suitable and usable information to users.

Objectives

- Determine the suitability of GFA expanded coverage.
  - Is the resolution adequate?
  - Does the expanded coverage provide suitable supplemental information for decision making?
- Determine the usability of the GFA expanded coverage.
  - Are the map options easy to configure?
  - Is the GFA expanded coverage easy to use?

User Assessment Approach

Participant Summary

# of Participants	User Group	Primary Geographic Region	Flight Hour Range
2	Part 135 Pilot	Interior Alaska	8,500-15,000
1	Part 121/135 Pilot/Director of Operations*	Statewide	15,000
4	GA Pilot	Interior Alaska	3,000-5,500
1	Part 135 Dispatcher	Alaska Statewide	N/A
2	AAWU Meteorologists	Anchorage Flight Information Region, All of Alaska and beyond	N/A
2	CWSU Meteorologists	San Diego California, Seattle Washington	N/A
1	Testbed Meteorologist	All of Alaska	N/A
2	NWS WFO Meteorologists	Hawaii	N/A
3	NWS WFO Meteorologists	South East Alaska, Panhandle, Northern Alaska, Central Alaska and Western Alaska, statewide	N/A
1	Alaska Region Headquarters Meteorologist	All of Alaska	N/A
19	**Total**		

*Participant is certified as a Part 121 and Part 135 Pilot and is the Director of Operations for a carrier with both Part 121 and Part 135 Pilots. The participant was not able to participate in a structured interview, however, completed the questionnaire with detailed explanations.

Approach

- Participants were provided a link to the GFA expanded coverage experimental website located at https://testbed.aviationweather.gov/gfa.
- Participants were asked to use the GFA expanded coverage product as a supplemental tool between June 1 and September 30, 2021 to assess the suitability and usability.
- AWT conducted an introductory session to demonstrate the GFA expanded coverage product and to answer participant questions on June 15, 2021.
- AWT developed an Experimental GFA expanded coverage video tutorial, GFA Quick Guide, and GFA Help page that were posted on the GFA expanded coverage experimental webpage located at https://testbed.aviationweather.gov/content/page?name=gfa_ak_eval.
- AWDE conducted virtual interviews with participants, one at a time or in small groups, via Microsoft Teams.
- AWT team members attended each virtual interview session to provide subject matter expertise (SME) concerning the product.

Approach

- Each interview consisted of:
  - Introduction of AWT and AWDE team members.
  - Overview of the objectives and procedures of the virtual interview session.
  - Structured interview questions focused on determining the suitability and usability of the GFA expanded coverage.
- Upon completion of the interview, participants were asked to complete an online questionnaire via Google Forms.
- The Google Forms questionnaire consisted of:
  - Level of agreements statements focused on the usability and suitability of GFA for decision making, the usability of the map options and the GLM and LLWS features.
  - A 5-point Likert scale rating (5-Strongly Agree, 4-Agree, 3-Neither Agree/Disagree, 2-Disagree, and 1-Strongly Disagree).
  - Additional space was provided for comments.

Results

Questionnaire Results

GFA Usability Questionnaire Results

Question (Strongly Agree=5, Agree=4, Neither Agree nor Disagree=3, Disagree=2, Strongly Disagree=1)	Dispatchers N=1	Meteorologists Median N=5	Pilots Median N=6	Overall Median N=12
It is easy to find specific forecast information (TAF, CIG/VIS, Clouds, PCPN/WX, TS, Winds, LLWS, Turb, Ice).	5	4	4	4
It is easy to find specific observation/warning information (METAR, PCPN/WX, CIG/VIS, PIREP, RAD/SAT).	5	4.5	4	4
The zoom capability (moving in/out) is easy to use.	5	5	4.5	5
Navigating to a specific location on the map is easy.	5	5	4	5
The Map Options menu is intuitive and easy to use.	4	4	2.5	4
Finding a specific option in the Map Options window is easy.	4	4	3.5	4

Pilots "Disagree" the map options menu is intuitive and easy to use due to difficulty in understanding the functionality of the map option capabilities. Pilots provided a median rating of "Neither Agree/Disagree" that finding a specific option in the Map Options window was easy because finding specific options in the window was difficult and terms such as "Show" and "Scale" were difficult to understand to determine how the functions applied to the map display.

GFA Usability Questionnaire Results

Question (Strongly Agree=5, Agree=4, Neither Agree nor Disagree=3, Disagree=2, Strongly Disagree=1)	Dispatchers N=1	Meteorologists Median N=5	Pilots Median N=6	Overall Median N=12
Overall, the expanded coverage over Alaska is useful.	5	4	4.5	5
The GFA tool is easy to use.	5	4	4	4
Specific products and/or information are easy to find.	4	4	4	4
Overall, the information provided is easy to understand.	4	5	4	5

GFA LLWS Questionnaire Results

Question (Strongly Agree=5, Agree=4, Neither Agree nor Disagree=3, Disagree=2, Strongly Disagree=1)	Dispatchers N=1	Meteorologists Median N=5	Pilots Median N=5	Overall Median N=12
LLWS information is easy to understand.	4	4	(N=3) 4	4
LLWS information would aid me in making decisions/creating/updating forecasts/ flight planning decisions.	4	3.5	5	4
The thresholds (values provided on the legend) are useful for my operations.	4	4	4	4
The LLWS colors (see LLWS legend) are easy to distinguish from one another.	4	5	(N=2) 4.5	4.5
The LLWS colors are easy to interpret.	4	4.5	(N=3) 4	4

The Meteorologists provided a median rating of “Neither Agree/Disagree” for LLWS information would aid me in making decision/create/update forecasts. Meteorologists noted the per second (/s) unit of measurement is difficult to interpret; specifically, “/s” is not a typical unit of measurement for LLWS conditions. Since LLWS products aren’t widely used or available, wind conditions typically accessed use knots as a unit of measurement. Correlating units per second to knots is difficult. In addition, a description of the “/s” unit is not available and is needed to accurately interpret the values.

GFA GLM Questionnaire Results

Question (Strongly Agree=5, Agree=4, Neither Agree nor Disagree=3, Disagree=2, Strongly Disagree=1)	Dispatchers N=1	Meteorologists Median N=5	GA Pilots Median N=3	Overall Median N=9
GLM information is easy to understand.	4	3.8	3	4
GLM information would aid me in making operational decisions/creating/updating forecasts/flight planning decisions.	4	3.6	3.5	4
The thresholds (values provided on the legend) are useful for my operations.	4	4	3	4
The GLM colors (see GLM legend) are easy to distinguish from one another.	4	4.3	4	4
The GLM colors are easy to interpret.	4	4.5	4	4

Meteorologists provided a median rating of “Neither Agree/Disagree” for the GLM information being easy to understand, aid in updating forecast due to the fact that GLM is not available in most of Alaska and should be removed or not selectable until GLM is available in Alaska. GA Pilots provided a median rating of “Neither Agree/Disagree” for the GLM information being easy to understand, aid in flight planning, and thresholds being useful. The rating was provided because the GLM information does not cover most of Alaska and was not used by the GA Pilots.

Structured Interview Question Results

Question 1

Does the forecast and observation data available in the GFA provide adequate information for briefing pilots/forecast planning/flight planning?

- All participants agreed GFA provides adequate information in a quick glance overview of the weather statewide needed to brief pilots/forecast planning/flight planning.
- The GA Pilots stated the GFA, specifically the flight categories and winds, provided information needed to determine safe routes and altitudes to fly. However, the forecasts, observations, and terrain needed more detail on terrain features and the capability to zoom in without becoming blurry.
- GA Pilots stated a need to be able to zoom into specific locations throughout mountain passes to assess ceiling and visibility (C&V) conditions. To adequately support pilots the C&V information needs to clearly show which altitudes and specific locations, when zooming in/out and panning, that are affected.
- A Part 135 Pilot stated the GFA provides an adequate high level overview of weather conditions and the direction the weather is traveling.

Question 1 Continued

Does the forecast and observation data available in the GFA provide adequate information for briefing pilots/forecast planning/flight planning?

- The Part 121/135 Pilot stated the need to improve the forecasting models for ceiling and visibility. Better models are necessary to adequately determine if an instrument flight rules (IFR) approach is available or when lack of certified weather necessitates a VFR flight. The current forecast models are adequate, however improving the forecast models would improve the value of GFA to Part 121/135 operators.
- The meteorologists stated the resolution, particularly for winds, terrain, ceiling, and visibility, is not adequate to support forecast planning. The winds, terrain, ceiling, and visibility are needed to develop forecasts and current products used by meteorologists have higher resolution ensuring a more precise forecast.

Question 1 Continued

Does the forecast and observation data available in the GFA provide adequate information for briefing pilots/forecast planning/flight planning?

- The meteorologists in Hawaii stated the resolution of the precipitation product is not adequate to aid in developing forecasts. The GFA forecasts did not precisely identify where precipitation conditions may occur. For example, the possibility of precipitation is a common occurrence, however, to put precipitation into a TAF, a higher resolution forecast, the allows users to zoom into locations without becoming blurry, is needed to "pinpoint" an exact location of where the precipitation may occur. The GFA provides a large area of precipitation and when zooming in, the precipitation forecast becomes blurry and does not provide finer resolution/information of the forecast.
- The 135 Dispatcher stated the GFA does not provide the resolution needed to precisely identify specific locations of weather impacts to flights. Additionally, the GFA does not provide adequate resolution to determine the location and timing of the weather impacts.
- GA pilots indicated the GFA performs well above 2000 feet, however, GA pilots need detailed weather information below 2000 feet to aid in decision making.

Question 2

Does the tool provide ALL the information needed for your typical briefing pilots/forecast planning/flight planning? If not, what additional information is needed? What product(s) are you currently using to get the information?

- All participants stated the need for higher resolution forecast and observation models to provide higher spatial resolution of terrain features. When zooming into a location, the weather information becomes blurry and identifying specific locations on the map becomes difficult. In addition, the forecast and observations do not provide a finer resolution of weather information that is needed when zooming in to support user needs.
- The 135 Dispatcher and GA Pilots stated the need to have surface observations. Surface observations provide local weather conditions which are used for developing pre-flight weather briefings.
- Due to the increased threat of wild fires, participants stated the need to have smoke in the Ceiling and Visibility (C&V) forecast. Smoke can quickly change flying conditions from VFR to IFR. If smoke is not included in the forecast, then a disclaimer or warning is needed to alert users that smoke is not part of the C&V forecast.

Question 2 Continued

Does the tool provide ALL the information needed for your typical briefing pilots/forecast planning/flight planning? If not, what additional information is needed? What product(s) are you currently using to get the information?

- When an overlay is selected, the progressive display does not provide all the necessary information, of the selected overlay, when zoomed out. The progressive display of the overlay information is difficult to use when specific information, such as airports, are used as reference points by users at all zoom levels. The progressive display is also an issue with map features, such as rivers. Depending on the base map, participants stated rivers are either difficult to distinguish or are not available when zoomed out.
- When changing zoom levels, participants would often “get lost” in the map, had difficulty finding specific locations, and returning to an initial location on the map was difficult. Participants suggested including the capability to pin a location to more easily set a location of interest when zooming in/out and moving the map.

Question 3

How often do you look at LLWS information for flight planning/developing forecasts? What decision are made if you see a forecast that includes LLWS? Where do you get LLWS information typically? Do you find the LLWS grids easy to use? In your opinion what is the best way to display LLWS information? Is the LLWS data useful for your decision making/flight planning needs?

- All participants stated LLWS is predominately an issue in the fall and winter in Alaska and would be used during those seasons. If a PIREP or wind direction/speed indicate possible wind shear conditions, the LLWS forecast would be used to verify the observations.
- When LLWS conditions exist:
  - AAWU, CWSU and NWS Meteorologists will issue an advisory, and CWSU meteorologists inform air traffic users of possible LLWS conditions.
  - The Part 135 Dispatcher would use LLWS information to inform pilots of areas to avoid and to adjust air speeds.
  - GA Pilots use LLWS information to identify conditions that require the pilots to adjust speeds, re-route, adjust altitudes, delay flights, and make go-no-go decisions.

Question 3 Continued

How often do you look at LLWS information for flight planning/developing forecasts? What decision are made if you see a forecast that includes LLWS? Where do you get LLWS information typically? Do you find the LLWS grids easy to use? In your opinion what is the best way to display LLWS information? Is the LLWS data useful for your decision making/flight planning needs?

- LLWS is typically determined by:
  - Reviewing area forecasts,
  - Assessing wind speeds from the Juneau Airport Wind System (JAWS),
  - Assessing wind speeds at the surface and at 2000 feet, and
  - Assessing the wind speed and direction at various altitudes displayed by models, such as Velocity-Azimuth Display (VAD) wind profile model input, High Resolution Weather Research and Forecasting model (HiRes WRF), High Resolution Rapid Refresh (HRRR), Rapid Refresh (RAP) and North American Mesoscale Model (NAM), and Bufkit.
- Participants stated the LLWS product provided a quick and easy visualization of areas with LLWS conditions and could be useful for decision making.
- Meteorologists stated the LLWS information was easy to use, however, definitions explaining the units of measurement (/s) are needed to adequately interpret the data.

Question 3 Continued

How often do you look at LLWS information for flight planning/developing forecasts? What decision are made if you see a forecast that includes LLWS? Where do you get LLWS information typically? Do you find the LLWS grids easy to use? In your opinion what is the best way to display LLWS information? Is the LLWS data useful for your decision making/flight planning needs?

- The GA Pilots did not used the LLWS product during the assessment period, but stated the LLWS information could be used to determine if routes and altitudes are safe.
- Part 135 Pilots stated the LLWS product would aid in identifying areas with LLWS and provide the necessary information to adjust aircraft speed.
- The Part 135 Dispatcher stated the LLWS product would be useful to aid in providing wind shear conditions to the pilots and determine if routes and altitudes are safe.
- The meteorologists stated the LLWS information would be used to aid in developing and/or updating advisories.

Question 4

Graphical Lightning Mapper (GLM) potentially increases the lead time by identifying severe thunderstorm warnings before radar is able to pick-up the potential of severe weather. In your experience, would the GLM provide useful information for flight planning/pilot briefing/developing forecasts? If not, why? Is the GLM information easy to understand? What type of decisions would you make using GLM information?

(For non-Alaska participants)

- Meteorologists stated GLM would be used to update and/or develop SIGMETs.
- Participants stated the GLM information is needed because airports have specific requirements for operations when lightning is within 5 miles of the airport including restricting ramp operations, such as fueling, and loading/unloading of passengers and supplies.
- Participants stated GLM aids in identifying routes and altitudes to avoid as lightning can be hazardous to the aircraft.

Question 5

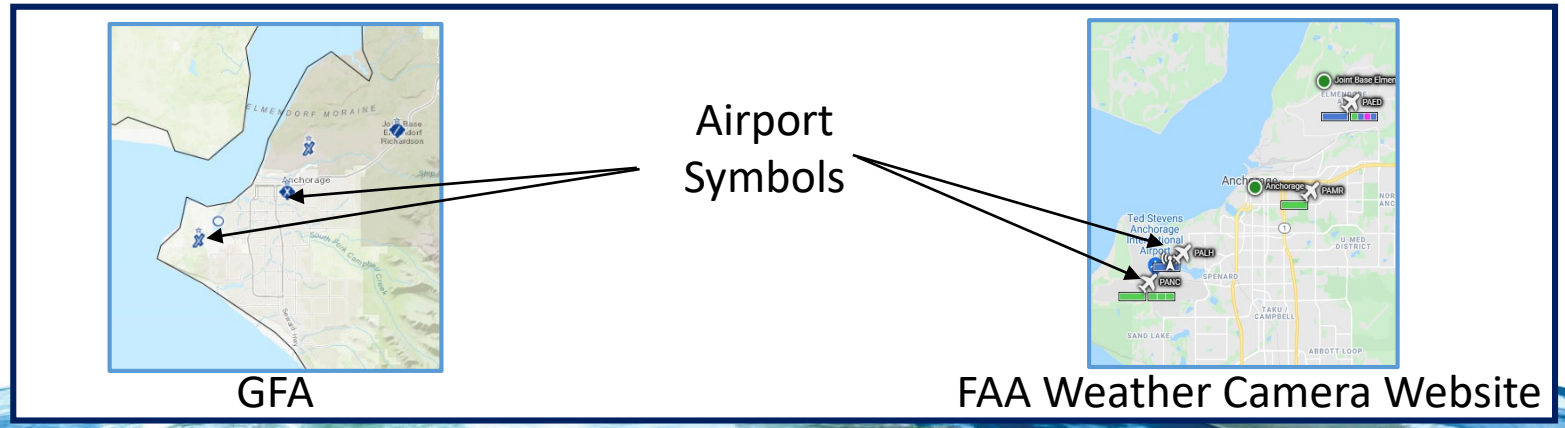
The Map options menu is intended to help users configure various parts of the GFA display. Did you find the Map Options dialog easy to use? If not, why? Do you have any suggestions on how to improve the Map Options dialog? Are there any configuration capabilities that you would like to have but are not currently available in the Map Options menu?

- Participants' suggestions to improve the Map Options dialog include:
  - Providing a clear visual indication, such as graying out, of map options that are not available, such as jet routes.
  - Provide feedback the system is processing a user request (i.e., hourglass or percentage complete bar) to let users with slow internet speeds know the system is working.
  - Ability to save map option configurations or create user profiles/preference settings to reduce the time needed to re-select map options when switching between devices. Such profiles would enable users to log-in and access a custom saved map options configuration on any device.

Question 6

Do you have any suggested changes to the tool that would improve its ease of use and /or suitability for your decision making? Are there any additional product or capabilities needed that would improve the GFA for use in Alaska? Are there any additional product or capabilities needed that would improve the GFA for use in Alaska?

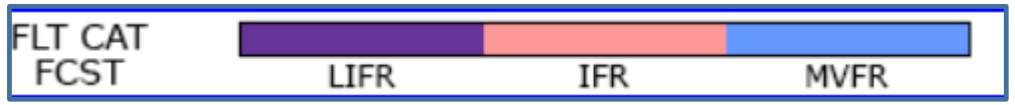
- Pilots and dispatchers need the ability to view all the airports, at all zoom levels, to aid in decision making.
- For flights between Alaska and the lower 48 states, weather information along routes in Canada is needed to assess routing impacts due to weather.
- To avoid misinterpretation of symbols, participants requested standardization of symbols such as airports across the experimental GFA and other commonly used tools such as the FAA Weather Cameras.



Question 6

Do you have any suggested changes to the tool that would improve its ease of use and /or suitability for your decision making? Are there any additional product or capabilities needed that would improve the GFA for use in Alaska? Are there any additional product or capabilities needed that would improve the GFA for use in Alaska?

- To avoid misinterpretation of colors, use colors schemes of commonly used products.



Flight Category colors used on Experimental GFA

Flight Category colors used on Aviationweather.gov

- Provide the capability to select a range of flight altitudes for wind, turbulence, and PIREPs.
- Display PIREPs for 20 hours instead of 12 hours to align with AAWU site.
- GA Pilots stated a need to have higher resolution forecasts for mountain passes to more easily and accurately determine weather conditions at the beginning, end, and through the mountain passes to ensure safe flying conditions.

Question 6

Do you have any suggested changes to the tool that would improve its ease of use and /or suitability for your decision making? Are there any additional product or capabilities needed that would improve the GFA for use in Alaska? Are there any additional product or capabilities needed that would improve the GFA for use in Alaska?

- After entering and drawing a route using the “Show Flight Path”, GA Pilots stated the need to drag the flight route on the map to display an alternate route. This capability would allow the pilots to more easily determine safer routes and altitudes based on weather conditions.
- Meteorologists require the ability to view radar and GLM concurrently (similar to AWIPS) to reduce the time needed to switch between products and mentally integrate information between to separate displays.
- Add the capability to pin a specific location when changing zoom levels. This capability will aid in map orientation and avoid “getting lost” on the map during zooming.
- Participants recommended including smoke in the C&V forecast. If smoke is not included in the forecast, participants require a disclaimer noting smoke is not part of the C&V forecast.

Question 6

Do you have any suggested changes to the tool that would improve its ease of use and /or suitability for your decision making? Are there any additional product or capabilities needed that would improve the GFA for use in Alaska? Are there any additional product or capabilities needed that would improve the GFA for use in Alaska?

- Pilots stated a need to have higher resolution models of ceiling, visibility, winds and turbulence, both are critical to determine safe routes and altitudes particularly through the valley's and mountain passes.
- GA Pilots stated a need to have a more mobile friendly version of the GFA due to limited access to computers and slow internet speeds.

Question 7

The GFA was designed to display necessary flight planning weather information in a graphical format to provide additional information beyond typical text forecasts. In general, what type of weather information do you find easier to interpret graphically? What information would you prefer by text? How would text versus graphics impact your flight planning?
(For Pilot and Dispatcher participants)

- GA Pilots prefer METARs, TAFs, and area forecasts in a text format.
- GA Pilots prefer to view flight categories and observations, such precipitation and winds, in a graphic format.
- Providing a graphical forecast allows pilots and dispatchers a quick glance view of the speed and direction of the weather.
- The graphical depiction of observations reduces the time required to read all the textual information.
- The 135 Dispatcher reads weather reports and forecasts textually prior to viewing the graphical display of weather and preferred a hybrid of textual and graphical information.
- Pilots and dispatchers with limited meteorological knowledge, the textual area forecast aids in interpretation of the graphical forecast.

Conclusions and Recommendations

Objective 1: Determine the *suitability* of GFA expanded coverage.

- The GFA provided all participants a quick glance view of the weather allowing the easy identification of weather conditions.
- The flight categories and wind forecasts provided suitable support for GA Pilots to conduct flight planning. GA Pilots who are only VFR certified used the flight categories forecast to determine if the weather conditions support VFR operations.
- All participants stated the GFA progressive display of terrain and overlay information does not provide suitable support. Terrain and select overlay information are required to determine specific locations on the map and use as reference points. All information should be displayed at all zoom levels.
- GA Pilots need higher resolution forecasts and observations for mountain passes to more easily and accurately determine weather conditions at the beginning, end, and through the mountain passes to ensure safe flying conditions.
- Meteorologists would not use the GFA as a primary tool as the GFA seems geared toward pilots. The GFA resolution, particularly the winds, terrain, ceiling and visibility, did not adequately support forecast planning. Higher granularity for winds, terrain, ceiling, and visibility information is needed to develop forecasts, and other products available to meteorologists have this needed resolution to support the development of forecasts.

Objective 1: Determine the *suitability* of GFA expanded coverage.

- GFA product resolution did not adequately support forecast development for meteorologists in Hawaii. The GFA data does not provide precise location information for weather conditions. For example, the possibility of precipitation is a common occurrence, however, to put precipitation into a TAF, a more detailed forecast is needed to “pinpoint” a more exact location of where the precipitation may occur. The GFA provides a large area of precipitation and when zooming in, the precipitation becomes blurry.
- The 135 Dispatcher requires improved geographical resolution product to identify specific locations of weather impact. The GFA does not provide this needed resolution.
- For flights between Alaska and the lower 48 states, weather information along routes in Canada is needed to assess traffic impacts due to weather.
- Due to the increased threat of wild fires, participants require the inclusion of smoke in the C&V forecast. Smoke can quickly change flying conditions from VFR to IFR. If smoke is not included in the forecast, a disclaimer noting smoke is not part of the C&V forecast is required.

Objective 2: Determine the *usability* of the GFA expanded coverage.

- The use of progressive display for overlays is not usable. Having all overlay information on the display is critical to support decision making. This is most important for airports and rivers as these are used as reference points by users.
- When changing zoom levels, participants would often "get lost" on the map. Adding the capability to pin a location to more easily set a location of interest when zooming in/out and moving the map.
- Providing feedback that the system is processing a user request (i.e., hourglass or percentage complete bar) to let users with slow internet speeds know the system is working.
- Some map options, such as jet routes, that are not available should be grayed out or non-selectable.
- To avoid misinterpretation of symbols, symbols such as airport indicators, should be standardized between the Experimental GFA and other commonly used tools such as the FAA Weather Cameras.
- To avoid misinterpretation of colors, the colors used should be standardized between the Experimental GFA, other products listed on Aviationweather.gov and other commonly used weather products.
- The LLWS information was easy to use, however, definitions explaining the units of measurement (/s) are needed to adequately interpret the data.
- A mobile friendly version of the GFA is needed to ensure ease of use when using a tablet or phone.

Recommendations

- A higher spatial resolution of weather forecasts and observations are needed to more precisely identify specific locations where weather may impact air traffic and timing of weather impacts, particularly in more remote locations and in the mountain passes.
- Provide the ability to view all overlays and terrain features, such as airports and rivers, at all zoom levels.
- Add a pin or location indicator to aid in orientation when changing zoom levels.
- Display feedback to the user when the website is processing a request by displaying a processing indicator such as a hour glass.
- Provide a smoke forecast for C&V. If smoke is not included in the forecast, a disclaimer should be added noting smoke is not included.
- Provide a legend describing the LLWS unit of measurement (/s).
- Provide an indicator when map options are not available by graying out the option.
- Ensure colors and symbols used for all products are consistent with other commonly used products to reduce the risk of misinterpreting weather information.