

## AN EVALUATION OF THE GRAPHICAL AREA FORECAST FOR FLIGHT SERVICE STATION SPECIALISTS

Starr McGettigan  
FAA William J Hughes Technical Center  
Atlantic City International Airport, New Jersey

In order to meet U.S. obligations to Article 37 of the Convention on International Civil Aviation, Annex 3, Standards and Recommended Practices for International Air Navigation for Meteorological Services, the National Weather Service (NWS) and the Federal Aviation Administration (FAA) have been working with industry partners to develop new weather forecast products. With advances in technology, capabilities exist to replace existing text products with a graphic depiction of the weather. The Graphical Area Forecast (GFA) has adopted this new technology focus. The GFA is intended to eliminate the Area Forecast (FA) and Airman's Meteorological Information (AIRMET) text products. In order to begin to understand the effect of this change on flight service operations, an evaluation of the GFA was conducted by the Verification Services Division Weather Processors and Sensors Group (ATO-P). The objective of the evaluation was to determine whether or not the proposed GFA met user needs and requirements; specifically, GFA utility and suitability within the context of a Standard Briefing was assessed. The GFA evaluation was conducted at the FAA William J. Hughes Technical Center and four Automated Flight Service Stations (AFSS). A total of 23 Flight Service Station Air Traffic Specialists participated in the evaluation. Using high fidelity scripted-scenarios, participants issued Standard Briefings where perceptions of GFA usage were solicited via questionnaires and interviews. Overall, the GFA was well received. Participants indicated that the GFA was usable for Standard Briefings and provided timely, effective, and easy to interpret data. Specific results are discussed.

### INTRODUCTION

Under current practices, the National Weather Service (NWS) Aviation Weather Center (AWC) supports, in part, the aviation weather requirements established by the Federal Aviation Administration (FAA) for the provision of meteorological services in the National Airspace System (NAS) and U.S. obligations to Article 37 of the Convention on International Civil Aviation, Annex 3, Standards and Recommended Practices for International Air Navigation for Meteorological Services. With advances in technology, capabilities exist to replace existing text products with a graphic depiction of the weather for aerodrome and en route operations. The Graphical Area Forecast (GFA) has adopted this technology in that it can provide flight service personnel, pilots, and dispatchers with a graphical depiction of those weather elements that need to be forecasted in time and space (in the vertical and horizontal planes) to support operations.

Since users have indicated that there would no longer be a requirement for the Airman's Meteorological Information (AIRMET) and Area Forecast (FA) in their current format if the GFA provides the same or better information for flight planning purposes, it has been proposed that the GFA will replace the FA and AIRMET. It is also recognized that not all users have access to graphics; and therefore, a requirement still exists to maintain a text product that meets the FA and AIRMET criteria. Adoption of the International Civil Aviation Organization (ICAO) GAMET format will fulfill this need

in that all hazardous and non-hazardous weather information contained in the AIRMET and FA is also contained in Section I and Section II of the GAMET.

In order to ensure that the GFA/US GAMET were a suitable replacement for the FA and AIRMET, the Federal Aviation Administration's Aerospace Weather Policy and Standards Division sponsored an evaluation of the GFA and US GAMET. This evaluation was conducted by the Verification Services Division, Weather Processors and Sensors Group at the FAA William J Hughes Technical Center. The evaluation assessed the utility and suitability of the GFA and US GAMET for use during Standard Briefings in the absence of FAs, AIRMETs, 12/24 Hour Prognosis Charts, and Transcribed Weather En route Briefings (TWEB). The evaluation did not assess operational utility or suitability as the products were not presented on an operational platform. Results from this evaluation will be used to define GFA/GAMET product requirements as well as display requirements for NAS subsystems.

For purposes of these proceedings, only the evaluation of the GFA will be discussed.

### PRODUCT DESCRIPTION

The GFA is a graphical product that forecasts 16 weather elements. These weather elements are derived from the elements currently forecast in the FA and AIRMET along with new elements widely forecast by the international community. The elements are forecast as a

snapshot or moment in time. The following elements are included in the GFA:

1. Surface Windspeed,
2. Surface Visibility,
3. Significant Weather (Thunderstorms),
4. Mountain Obscuration,
5. Significant Cloud (IFR Ceiling [IFR]),
6. Significant Cloud (Tower Cumulus [TCU]),
7. Icing,
8. Turbulence,
9. Mountain Wave,
10. Low Level Wind Shear,
11. Psynoptic Systems,
12. Cloud,
13. Marginal VFR Visibility,
14. Freezing Level,
15. Volcanic Ash\*, and
16. Non-Convective SIGMET.

\*NOTE: Due to the lack of a volcanic event during the data collection period, Volcanic Ash was not assessed.

Currently, the FA is issued 3 times daily (every 8 hours while the AIRMET is issued 4 times daily (every 6 hours). If there is a significant change in conditions, the FA or AIRMET can be amended. The GFA will be issued more frequently than the current FA and AIRMET. The GFA will be issued 8 times daily (every 3 hours) with amendments as necessary.

In addition to the issuance schedule, the forecast type and valid times for the GFA will change as well. Currently both the FA and AIRMET are time-smear forecasts meaning that the worst case weather is smeared across the forecast valid time with changes in conditions noted. The FA is currently valid for 12 hours from the issuance time while the AIRMET is valid for 6 hours at most. The GFA is a snapshot forecast meaning that the forecast conditions are valid at a specific moment in time. GFA elements are forecast out to 24 hours in 3 hour increments for the first 12 hours and 6 hour increments for the last 12 hours.

While the GFA will cover the contiguous United States, the evaluation domain encompassed only two areas. One area included the northeast and the other the western third of the United States. Figure 1 illustrates the GFA domains for the test period.

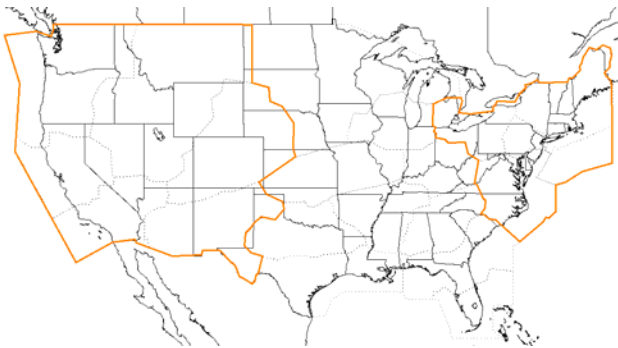


Figure 1. GFA domains used for the evaluation.

The GFA was displayed to users via Microsoft Internet Explorer. All remaining data was displayed in a windows-based program designed specifically for the evaluation. Radar and satellite imagery were displayed as a looping product. Given that most sites still currently use the Model 1 Full Capacity (M1FC), text data specific to each flight route was formatted to simulate data output from the M1FC. Figure 2 illustrates a sample image for the GFA.

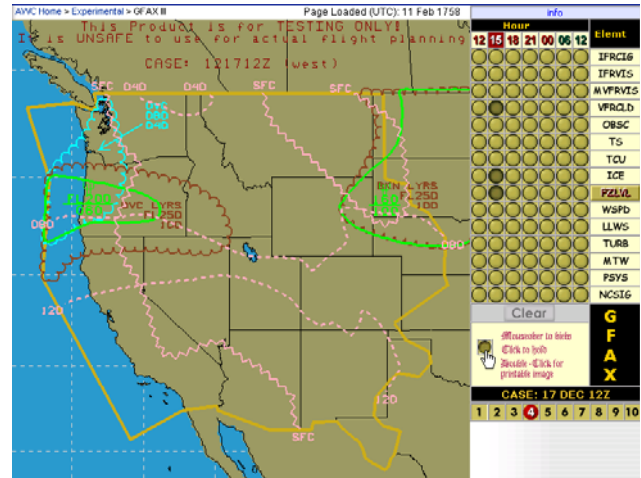


Figure 2. GFA as presented via Microsoft Internet Explorer during the evaluation.

## EVALUATION DESCRIPTION

The GFA evaluation was conducted at the FAA William J. Hughes Technical Center and four Automated Flight Service Stations (AFSS). The field sites included Bangor, ME; Williamsport, PA; Denver, CO; and San Diego, CA. The evaluation approach was the same across all locations. A total of 23 AFSS Air Traffic Specialists participated in the evaluation. All participants received training regarding the GFA. AFSS Air Traffic Specialists were asked to provide the weather portion of a Standard Briefing for a number of flight scenarios. In the scenarios, the participant was asked to use the GFA in conjunction with other available weather information (e.g., Significant Meteorological Statements [SIGMET], Aviation Routine Weather Reports [METAR], Aerodrome Forecast [TAF], Current Weather Charts, etc...). FAs, AIRMETS, Prognosis Charts, and Transcribed Weather En Route Briefings (TWEB) were not available to participants. Evaluators noted the following while the briefing is in progress:

- a. Weather information/products used,
- b. Concerns or issues with the GFA and its elements (if used),
- c. Required briefing information dissemination, and
- d. Any other pertinent information.

Following each briefing, participants were asked to answer a series of questions regarding the use of the GFA

as part of the briefing. After providing the required number of briefings, participants were asked to answer a questionnaire that assessed the utility and suitability of the GFA.

### Evaluation Scenario and Data Collection Tools

*Archived Data Sets* Ten weather data sets were archived for use during the evaluation. Of the 10 data sets, five were archived for the northeastern evaluation area and 5 were archived for the western evaluation area. The data sets included the GFA, US GAMET, national RADAR composite, national satellite imagery, surface analysis charts, METARs, TAFs, SIGMETs, Pilot Reports (PIREP), and Winds Aloft (FD).

*Flight Route Scenarios* Flight scenarios were developed for evaluator and participant use. Flight scenarios included short flights as well as longer flights to ensure realistic use of the GFA. Two flight scenarios were developed for each weather data set. Therefore a total of 20 flight scenarios were developed. Scenario routes were planned to ensure various weather phenomena were encountered as well as at least one Flight Information Region (FIR) boundary was crossed. Each participant at the FAA William J Hughes Technical Center was asked to brief 14 flight scenarios, while participants at the field locations were asked to brief 8-10 scenarios. All flight scenarios were randomly assigned to participants using a Latin Square procedure.

*Questionnaire* A questionnaire was developed to assess the utility and suitability of the GFA. Participants received the questionnaire after completing all necessary briefings. Two 5-point rating scales were used to assess user opinions. The questionnaire also included open-ended questions for suggested improvements. The questionnaire was designed to assess the GFA as a whole as well as the individual elements of the GFA. Additionally the questionnaire assessed the utility and suitability of the GFA for use during a Standard Briefing as a whole as well as each part of a Standard Briefing (i.e., Adverse Conditions, VFR Not Recommended, Synopsis, En Route Forecast, and Destination Forecast). Pertinent user task information was derived from FAA Order 7110.10R and the Limited Job Task Analysis for Aviation Weather Products (DOT/FAA/CT-TN98/11).

Terms used in the questionnaires to assess the utility and suitability of the GFA were defined as follows. Utility referred to the extent the GFA was useful for ATC Flight Specialist use, specifically, was the GFA applicable or worthwhile for use in planning and issuing Standard Briefings? The term suitability was used to express the extent the GFA was qualifiable, fitting, and adaptable for ATC Specialist use. Suitability was specifically measured according to Timeliness, Interpretability, and Effectiveness.

*Observations/Interviews* Observations were performed as a part of every scenario. Pertinent information observed during the briefings was recorded onto observation logs by evaluators. Data recorded focused on product usage,

problem areas noticed and other relevant user feedback. Additionally, evaluators used checklists to ensure all weather components of the briefing were provided. The checklists were not used to assess participant performance or the quality of the briefing. The sole purpose of the checklist was to ensure that all required weather information is disseminated.

Interviews were conducted by evaluators following each scenario. Interviews aided in obtaining feedback, capturing user comments, obtaining clarification and addressing any other pertinent information. Any problems noticed during the observations were clarified at this time. In addition to end of scenario interviews, end of session interviews were conducted after all scenarios were completed.

## RESULTS

### Factors Affecting Results

While it is unlikely to have had a major impact, the conduct of the evaluation in a non-operational environment may have affected participants' opinions of the utility and suitability of the GFA. Issues related to the non-operational vs. operational environment included:

- a. Due to the geographical restrictions of the evaluation data (i.e., data sets only in the Northeastern US and Western US), participants were required to brief areas well outside their traditional areas of responsibility. Many participants representing other areas of the country were continually required to brief areas they were unfamiliar with. While all AFSS Air Traffic Specialists are required to be able to brief across the United States, the evaluation requirement to brief unfamiliar areas may have resulted in increased workload for some participants.
- b. During the evaluation, each scenario presented a new weather situation that was archived on a different day. Therefore, unlike an operational setting, users could not use information gained from previous briefings to aid in the dissemination of future briefings. In essence, every briefing during the test was like the first briefing of the shift in an operational setting.
- c. While users had all critical data made available to them, some users noted that they would usually access additional weather products (e.g., upper air charts) in the course of a briefing. None of the users felt the lack of these products adversely affected their briefing.

### Questionnaire Results

Tables 1 and 2 summarize the questionnaire results for the GFA and each of its elements. Within each table, median ratings for the utility, timeliness, interpretability, and effectiveness metrics are provided. Questionnaire results regarding the GFA as a whole are summarized in Table 1. The GFA product received an overall utility rating

of somewhat useful (4) indicating that the GFA as a whole was acceptable for use during a Standard Briefing. Similarly, the GFA received a median rating of 4 for all suitability categories indicating participants found the GFA was acceptable with regard to timeliness, interpretability, and effectiveness. The GFA was rated as extremely useful and highly suitable for the dissemination of Adverse Conditions. All other briefing segment suitability ratings were suitable. The utility of synopsis and destination forecast briefing segments was rated as borderline indicating the usefulness of the GFA as a whole for the dissemination of information related to these segments provided neither benefit nor negative affect. Participant comments in the questionnaire indicated that the pressure system element did not provide enough information for the dissemination of the synopsis. Additionally, most participants indicated they preferred to use the TAF for destination forecast information.

Table 1. Questionnaire Results for GFA Use During a Standard Briefing

GFA as a Whole	Utility	Suitability		
		Timeliness	Interpret-ability	Effective-ness
Standard Briefing Overall	4	4	4	4
Adverse Conditions	5	5	5	5
VFR Not Recommended	4	4	4	5
Synopsis	3	4	4	4
En Route Forecast	4	4	4	4
Destination Forecast	3	4	4	4

\*Utility Rating Scale: 5 - Extremely Useful, 4 - Somewhat Useful, 3 - Borderline, 2 - Of Little Use, 1 - Of No Use.  
 \*Suitability Rating Scale: 5 - Highly Suitable, 4 - Suitable, 3 - Borderline, 2 - Unsuitable, 1 - Highly Unsuitable

In addition to providing an overall opinion of the GFA, specialists were asked to provide ratings for the individual GFA elements. In general, the elements received a median rating of 4 or higher for all measures of utility and suitability, indicated that the elements were deemed either acceptable or highly acceptable for use during Standard Briefings. One exception to this was the pressure system element. It received a median rating of 3.5 for interpretability and a median rating of 3 for effectiveness, indicating that the pressure systems element was borderline for these measures. Specialists indicated that the pressure systems element needed more information presented especially if it was intended to replace the information in the 12/24 hour prognosis charts. Specifically, specialists indicated that they would like to see the addition of troughs, ridges, and isobars. West coast specialists also noted that

they would need the product to cover further west (out over the Pacific Ocean) in order to identify approaching weather.

Table 2. Questionnaire Results for GFA/Element Use During a Standard Briefing

Element	Utility	Suitability		
		Timeliness	Interpret-ability	Effective-ness
GFA as a Whole	4	4	4	4
Surface Windspeed	4	4	5	4
IFR Visibility	4	4	4	4
SIGWX Thunderstorm	4	4	4	4
Mountain Obscuration	4	4	4	4
Significant Cloud (IFR)	4	4	4.5	4.5
Significant Cloud (TCU)	4	4	4	4
Icing	4	4.5	4	5
Turbulence	5	5	5	5
Mountain Wave	4	4	4	4
Low Level Wind Shear	4	4	5	4
Pressure Systems	4	4	3.5	3
Clouds	4	4	4	4
Freezing Level	4	4	4	4
Marginal VFR Visibility	4	4	4	4
Non-Convective SIGMET	4	4	5	4.5

\*Utility Rating Scale: 5 - Extremely Useful, 4 - Somewhat Useful, 3 - Borderline, 2 - Of Little Use, 1 - Of No Use.  
 \*Suitability Rating Scale: 5 - Highly Suitable, 4 - Suitable, 3 - Borderline, 2 - Unsuitable, 1 - Highly Unsuitable

**Observation and Interview Results**

Significant issues specific to the GFA that were identified during the observations and interviews are discussed below. In general, all participants indicated that issuing the forecast more often (i.e., every 3 hours) was a benefit. Positive comments regarding the GFA that were identified during the observations and interviews included the following:

## DISCUSSION

- a. Specialists indicated the graphical presentation helped make the weather information easier to visualize and quicker to process.
  - b. Specialists noted the ability to see weather trends across time was beneficial.
  - c. Specialists reported the ability to mix and match elements was helpful. The ability to overlay and view different elements at the same time allowed the specialist to effectively tailor the information.
- Significant issues identified during the observations and interviews are listed below.
- a. Specialists noted the need for icing type information to be included in the icing element;
  - b. Specialists noted the need for a precipitation forecast;
  - c. Specialists indicated the clouds and visibility information (currently briefed as one element) were difficult to disseminate separately;
  - d. Specialists indicated element descriptions need to include modifying words (e.g., light, moderate, severe);
  - e. Specialists identified the TWEB route forecasts as a critical piece of information for briefing, especially in the western United States. Specialists indicated that the loss of TWEB route forecasts would significantly impact the quality of their briefings. Of the specialists who use TWEB route forecasts, all indicated that the GFA did not adequately replace the TWEB route forecast information.
  - f. Specialists indicated the GFA did not provide enough detail and accompanying text would be necessary for a complete briefing. Specialists noted this was a problem for the significant cloud and cloud forecasts. Specialists indicated there was less granularity in the GFA with regard to cloud bases than the FA.
  - g. Specialists noted the pressure system element did not provide the entire synoptic picture. Specialists indicated the ridges, troughs, and isobars would improve the utility and suitability of the element.
  - h. Specialists indicated the arrangement of the GFA elements needs to be more meaningful. Specifically, all adverse weather should be at the top and the remaining elements should be in the order of a briefing.

The evaluation for flight service specialists assessed the utility and suitability of the GFA and GAMET for use during Standard Briefings in the absence of FAs, AIRMETs, 12/24 Hour Prognosis Charts, and TWEB route forecasts. The evaluation did not assess operational utility or suitability as the products were not presented on an operational platform. Currently there are no product requirements and no formal test criteria. While this evaluation did not address acceptability for implementation on a NAS subsystem, it did identify issues regarding the use of the GFA for the dissemination of Standard Briefings. Therefore, these results should aid in the definition of NAS requirements for the GFA.

Overall, the GFA was well received. Specialists indicated that the GFA was usable for the weather portion of a Standard Briefing and provided timely, effective, and easy to interpret data. Issues noted by specialists that would improve the utility and suitability of the GFA included providing ridge, trough, and isobar information on the pressure system element; providing icing type information and a precipitation forecast; including the use of modifying words for elements such as icing and turbulence (i.e., light, moderate, severe); and ensuring that future NAS interfaces arrange the GFA elements in the order the elements are disseminated.

One of the issues identified may improve with additional training and time using the product. Specialists noted that briefing clouds and visibility separately made dissemination difficult. In time, specialists may become accustomed to disseminating the information separately. Additional issues such as the lack of information or the arrangement of the elements will need to be addressed in future iterations.

## REFERENCES

- FAA. (2004). *7110.10R Flight Services* (FAA Order 7110.10R). Washington, DC: U.S. Government Printing Office.
- FAA. (1999). *Limited Job Task Analysis for Aviation Weather Products* (DOT/FAA/CT-TN98/11). Atlantic City, NJ: Author.