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Aviation Impact Variable (AIV) Editor Evaluation Report

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September 1997

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16. Abstract

This report summarizes the Aviation Impact Variable (AIV) Editor evaluation conducted at the Aviation Weather Center (AWC) in Kansas City, Missouri, by ACT-320, from February 13 through 23, 1996.

The AIV Editor was developed by the Forecast System Laboratory (FSL) to enable forecasters to view and edit weather data grids used to issue Airmen Meteorological Statements (AIRMETS). The current prototype version addresses in-flight icing potential only.

Many users indicated that training was inadequate; therefore, they were uncomfortable using several editor functions, especially the higher level concepts (i.e., Vertical Interpolation, Algorithmic Parameters, and Volume Viewer). The effect of training was evident in the results, as the higher level concepts received less than acceptable utility and ease of use ratings while most other concepts received acceptable ratings. However, almost all require some improvement.

The conclusions and recommendations contained within this report should be assessed for their feasibility and integrated into the AIV Editor, if possible. While these recommendations will not resolve every problem, they will, if implemented overcome many problems currently experienced by the forecaster.

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EXECUTIVE SUMMARY

This report summarizes the Aviation Impact Variable (AIV) Editor evaluation conducted at the Aviation Weather Center (AWC) in Kansas City, Missouri, by ACT-320, from February 13 through 23, 1996. Specific results, conclusions, and recommendations for the evaluation are detailed within this report.

Under agreement with the Federal Aviation Administration (FAA), AWC issues Area Forecasts, Airmen Meteorological Statements (AIRMETs), Significant Meteorological Statements (SIGMETs), Convective SIGMETs, and International SIGMETs for aviation use. To accomplish these tasks, AWC forecasters access gridded weather data produced by forecast models running at the National Centers for Environmental Protection in Camp Springs, Maryland. In order to produce graphical or textual aviation weather products AWC forecasters manipulate or "edit" the gridded weather data to modify model output. The National Oceanic and Atmospheric Administration (NOAA) Forecast Systems Laboratory (FSL), Boulder, CO, has been tasked with the development of automated productivity tools to enable forecasters to perform this data editing in a rapid and efficient manner.

In response, FSL has developed the AIV Editor for viewing and editing of weather data grids. Forecasters can use the editor to manipulate translational algorithm parameters as well as editing individual grid points. The current version of the editor addresses in-flight icing potential only.

A joint evaluation of the AIV Editor was conducted by the FAA William J. Hughes Technical Center and FSL. The evaluation took place in the Experimental Forecast Facility (EFF) forecaster work area mockup at AWC. The mockup simulates the current forecaster work areas. The objectives of the AIV Editor evaluation were to: (1) assess the human/computer interface, (2) determine the operational utility of the editing and viewing concepts, and (3) to determine whether or not the editing and viewing concepts conform to job task and information requirements of AWC forecasters.

Many users indicated that training was inadequate; therefore, they were uncomfortable using several editor functions, especially the higher level concepts (i.e., Vertical Interpolation, Algorithmic Parameters, and Volume Viewer). The effect of training was evident in the results, as the higher level concepts received less than acceptable utility and ease of use ratings while most other concepts received acceptable ratings. However, almost all require some improvement.

The conclusions and recommendations contained within this report should be assessed for their feasibility and integrated into the AIV Editor, if possible. While these recommendations will not resolve every problem, they will, if implemented overcome many problems currently experienced by the forecaster.

1. INTRODUCTION.

The National Centers for Environmental Prediction (NCEP) Aviation Weather Center (AWC) located in Kansas City, Missouri, issues Area Forecasts, Airmen Meteorological Statements (AIRMETs), Significant Meteorological Statements (SIGMETs), Convective SIGMETs, and International SIGMETs for aviation use. AWC forecasters issue these products for the contiguous United States and portions of the Atlantic and Pacific Oceans.

In order to produce the various aviation products, AWC forecasters access gridded weather data produced by forecast models running at NCEP in Camp Springs, Maryland. Based on additional meteorological information, the AWC forecasters may have the need to manipulate or "edit" the gridded weather data in order to produce more accurate graphical or textual aviation weather products. The National Oceanic and Atmospheric Administration (NOAA) Forecast Systems Laboratory (FSL), Boulder, Colorado, has been tasked with the development of automated productivity tools to enable forecasters to perform this data editing in a rapid and efficient manner.

In response, FSL has developed the Aviation Impact Variable (AIV) Editor for viewing and editing of weather data grids. Forecasters can use the editor to manipulate translational algorithm parameters as well as editing individual grid points. The current version of the editor addresses in-flight icing potential only.

Although not ready for operational use, the editing and viewing concepts of the editor are ready for evaluation to determine their operational utility. Therefore, a joint evaluation of the AIV Editor was conducted by the Federal Aviation Administration (FAA) William J. Hughes Technical Center and FSL. The evaluation addressed the editing and viewing concepts used by the editor. Although the evaluation only addressed the editing of icing grids, the results of the evaluation can be considered applicable to the editing of other AIVs such as turbulence and clouds.

The AIV Editor is currently in the Experimental Forecast Facility (EFF) at the AWC. The purpose of the EFF is to develop and evaluate new forecasting techniques. The EFF has been configured into a mockup of the AWC forecaster operational work area.

1.1 PURPOSE.

The purpose of this evaluation report is to document results of the AIV Editor evaluation.

1.2 SCOPE.

This report summarizes the AIV Editor evaluation conducted at AWC. The report is written using FAA-STD-024B as a guideline. Section and paragraph titles were changed where appropriate. The contents of this report include evaluation descriptions, evaluation results, conclusions, and recommendations for future iterations of the AIV Editor.

2. REFERENCE DOCUMENTS.

FAA-STD-024B	Federal Aviation Administration Standard Content and Format Requirements for the Preparation of Test and Evaluation Documentation, August 22, 1994.
ESD-TR-86-278	Guidelines for Designing User Interface Software, August 1986.
MIL-STD-1472D	Military Standard 1472-D, Human Engineering Guidelines, March 14, 1989.
AFOTEC Pamphlet 99-102	Air Force Operational Test and Evaluation Center Software Usability Evaluation Guide, Volume 4, June 1994.

3. SYSTEM DESCRIPTION.

3.1 MISSION REVIEW.

Not Applicable.

3.2 SYSTEM CONFIGURATION.

The AIV Editor is a software application currently configured to operate on a Hewlett-Packard HP755 workstation and running within the commercially available Application Visualization System (AVS). NCEP gridded weather data is provided to the AIV Editor via FSL. The data is provided as test data for demonstration and evaluation purposes.

3.3 SYSTEM OVERVIEW.

AIV Editor products include Icing Potential based on a National Center of Atmospheric Research/Research Applications Program (NCAR/RAP) algorithm, satellite imagery, and graphic plots of

Pilot Reports (PIREPs). The NCAR/RAP algorithm diagnoses Icing Potential by using temperature and relative humidity criteria applied to gridded output from the NCEP Rapid Update Cycle (RUC) model. The Icing Potential can be displayed as a composite, by individual flight levels, or a subset of flight levels. Additionally, categories (e.g., stable, unstable) of the Icing Potential algorithm can be displayed. Interactive display functions include zoom, pan, and reset. PIREPs and satellite images are time-matched to the Icing Potential.

3.3.1 Viewing Concepts.

The AIV Editor utilizes four different viewing windows:

a. Horizontal Cross-Section,

b. Vertical Cross-Section,

c. Three-Dimensional Volume Viewer, and

d. Point Soundings of RUC temperature, dew point, and wind plotted on a Skew-T log P diagram.

3.3.1.1 Horizontal Cross-Section.

The Horizontal Cross-Section is the primary window for viewing and manipulating data. Icing Potential, satellite imagery, and icing PIREPs are displayed and each can be individually toggled on or off as desired. A spatial loop of the Icing Potential in the Horizontal Cross-Section can be created and viewed.

3.3.1.2 Vertical Cross-Section.

The Vertical Cross-Section enables the user to view a vertical slice of the Icing Potential from 1000 to 45,000 feet above mean sea level. The Vertical Cross-Section can be positioned by placing the mouse cursor at any point in the Horizontal Cross-Section window and clicking the mouse once. A white index line (oriented east-west or north-south according to user preference) in the Horizontal Cross-Section indicates the location of the Vertical Cross-Section. In addition, the user can scan from north to south or from east to west in the Vertical Cross-Section.

3.3.1.3 Three-Dimensional Volume Viewer.

When selected, the Three-Dimensional (3-D) Volume Viewer overlays the Horizontal Cross-Section. This provides the user with a 3-D image of the Icing Potential. Selected flight levels are highlighted in red. The Icing Potential can be viewed from a top

down, east, west, north, or south view. The user can also enter an arbitrary azimuth view from 0° to 360°. Additionally, the user can manually rotate the image using the mouse.

3.3.1.4 Point Sounding.

The Point Soundings window displays the vertical RUC soundings of temperature, dewpoint, and winds. The sounding point can be selected by using the mouse to select a point on the grid or by selecting a site from the location identifiers menu.

3.3.2 Editing Concepts.

Data can be edited via two methods:

a. Graphical Editing, and
b. Interactive Algorithm Editing.

With either method, the user can edit all or parts of the grid.

3.3.2.1 Graphical Editing.

Graphical Editing is performed in the Horizontal Cross-Section. During graphical editing, a user can choose to either add or delete Icing Potential from a specified area for select flight levels. An undo button allows the user to remove any unwanted edits. Additionally, by using the Vertical Interpolation feature, a user can add an area of Icing Potential through a sloping layer.

3.3.2.2 Interactive Algorithm Editing.

Interactive Algorithm Editing enables the user to modify the Icing Potential by adjusting algorithm parameter thresholds. The thresholds are modified utilizing slider bars on the display.

3.3.3 Edited Grids.

After editing, the user has the option of saving the edited grids for future use. Since the AIV Editor is a prototype, no connections to existing AWC systems existed for the distribution of the edited grids.

4. EVALUATION DESCRIPTION.

4.1 SCHEDULE AND LOCATION.

Questionnaires for the evaluation were distributed to forecasters at AWC on February 13, 1996. Questionnaires were returned by

February 23, 1996. The remainder of the evaluation was conducted at AWC from February 20 through 23, 1996.

4.2 PARTICIPANTS.

Personnel from the following organizations conducted and supported the AIV Editor evaluation:

Organization	Role
ACT-320	Test Director and Evaluators
FSL	Technical Support, Observers, and Test Equipment
AWC	Forecasters and Test Equipment

4.3 SPECIALIZED EVALUATION EQUIPMENT.

The evaluation took place in the EFF forecaster work area mockup. The mockup simulates the current forecaster work area with the exception of the Automation of Field Operations and Services (AFOS) equipment. The AFOS equipment is being phased out of use at AWC. In place of the AFOS equipment, an extra Automated Weather Interactive Processing System (AWIPS) display developed for National Centers was installed.

4.4 EVALUATION OBJECTIVES AND CRITERIA.

4.4.1 Objectives.

The objectives of the AIV Editor evaluation were:

a. Assess the human/computer interface;

b. Determine the operational utility of the editing and viewing concepts; and

c. Determine whether or not the editing and viewing concepts conform to job tasks and information requirements of the AWC forecasters. This objective does not pertain to system speed or processing performance.

4.4.2 Criteria.

FSL was not required to design to formal system specifications; therefore, no formal success criteria were used for the evaluation. However, in order to identify both positive and negative attributes during the evaluation, the following success criteria were used:

a. Mode user ratings of less than 3 on the 5-point Likert scale for editing, viewing, and user-system interface concepts (1 = completely acceptable, 5 = completely unacceptable) and favorable user comments; and

b. General agreement with human engineering design guidelines.

4.5 EVALUATION DESCRIPTION.

The evaluation program was structured to identify problem areas with product/function utility, editor interface, data presentation, and job task and information requirements of the editor. Results and collected data will be provided to FSL for use in further editing and viewing development.

The FAA Technical Center, Communication/Navigation/Surveillance Engineering and Test Division, Weather Branch (ACT-320), in conjunction with FSL, developed procedures and tools for the AIV Editor evaluation.

Four techniques were utilized during the evaluation to identify problem areas with the editor. The four techniques were:

a. Questionnaire administration,
b. Scenarios,
c. Open forum, and
d. Human Factors design guidelines comparison.

4.5.1 Questionnaire Administration.

The objective of the questionnaire was to identify problem areas perceived by the AWC forecasters, assess utility and ease of use, and solicit suggestions for improvement. The areas assessed were AIV Editor viewing, editing, and user interface concepts. Questionnaire results were also compared to operational utility as derived from the scenarios.

4.5.2 Scenarios.

The objective of the scenario was to lead a forecaster in providing systematic and organized feedback. The scenario directed forecasters to assess and edit, if necessary, the icing grids in a specified geographical region for a specific valid time. Icing areas and valid times differed based on actual weather conditions at the time of scenario completion. In addition, evaluators asked structured questions to further facilitate information collection and clarify forecaster comments.

4.5.3 Open Forum.

The objective of the open forum was to provide a medium for additional comments and questions. Forecaster comments and questions were noted and summarized.

4.5.4 Human Factors Design Guidelines Comparison.

The objective of comparing the AIV Editor interface to the human factors standards and guidelines was to ensure that good human factors design principles are used in future iterations of the editor. It is important to note that these standards and guidelines were not used for pass/fail type criteria, as the AIV Editor was not designed to specifically meet these guidelines.

4.6 DATA COLLECTION AND ANALYSIS METHOD.

4.6.1 Questionnaire Analysis.

Descriptive statistics were used to summarize the data. Given the variability of the data, the mean was not appropriate. Therefore, the mode was the most appropriate statistic. The mode represents the rating most frequently selected by users. In some cases, a concept received a bimodal rating. A bimodal rating indicates two ratings were equally occurring, suggesting that users' opinions were split. In addition to the descriptive statistics, questionnaire comments were summarized. Questionnaire results are presented in section 5.1.1. Raw questionnaire data is presented in appendix A.

4.6.2 Scenario Analysis.

Forecaster procedures and comments from the scenario sessions were summarized and are presented in this report. A complete summary of user comments is presented in appendix B.

4.6.3 Human Factors Guidelines Analysis.

Results from the comparison of the human factors standards and guidelines to the AIV Editor display were summarized. Results were tabulated using a binary method of met or not met. These results are summarized in sections 5.3.1, 5.3.2, and 5.3.3.

5. RESULTS AND DISCUSSION.

5.1 QUESTIONNAIRE RESULTS.

This section presents the results of the questionnaire. Section 5.1.1 discusses the analysis of the rating scale while section

5.1.2 contains a summary of user comments concerning editing and viewing concepts.

5.1.1 Rating Scale Results.

Table 1 contains the mode utility and ease of use ratings for the viewing concepts. All of the viewing concepts received an acceptable rating with the exception of the volume viewer. The volume viewer received a borderline rating in both the utility and ease of use categories indicating that this concept requires significant improvement before it can be considered useful by forecasters.

TABLE 1. MODE UTILITY AND EASE OF USE RATINGS FOR VIEWING CONCEPTS

Viewing Concept	Utility (n=14)	Ease of Use (n=14)
Data File Selector	2*	2
Display Options	2	2
Horizontal Cross-Section	2	2
Vertical Cross-Section	2	2
Loop Controls	2	2
Flight Level Selectors	2	2
Data Options	2	2
Skew-T	2	2
Satellite Imagery	2	2
Volume Viewer	3**	3
Viewing Angles	2	2

1=Completely Acceptable, 2=Acceptable, 3=Borderline, 4=Unacceptable, 5=Completely Unacceptable

NOTE:
* n=13 for data file selector concept
** Volume Viewer received a bimodal rating of 2 and 3. The rating of 3 was selected given that the distribution curve was more heavily skewed towards the higher end of the scale.

Table 2 contains the mode utility and ease of use ratings for the editing concepts. All of the editing concepts received an acceptable rating with the exception of the vertical interpolation. The vertical interpolation concept received a borderline rating in both the utility and ease of use categories indicating that this concept requires significant improvement before it can be considered useful by forecasters.

TABLE 2. MODE UTILITY AND EASE OF USE RATINGS FOR EDITING CONCEPTS

Editing Concept	Utility (n=14)	Ease of Use (n=14)
Define Region	2	2
Selecting Vertical Levels	2	2
Delete Ice	2	2
Add Ice	2	2
Vertical Interpolation	3	3
Algorithm Parameters	2	2
Enable Flow	2	2
Default Values	1	2

1=Completely Acceptable, 2=Acceptable, 3=Borderline, 4=Unacceptable, 5=Completely Unacceptable

Table 3 contains the mode utility and ease of use ratings for the editor functions. All of the editor functions received an acceptable rating with the exception of the ease of use of the zoom function. Zoom ease of use received a borderline rating indicating that it would have to be improved before it can be considered useful by forecasters.

TABLE 3. MODE UTILITY AND EASE OF USE RATINGS PER FUNCTION

Function	Utility (n=14)	Ease of Use (n=14)
Zoom	2	3
Pan	2*	2
Reset	2	2
Undo	2	2

1=Completely Acceptable, 2=Acceptable, 3=Borderline, 4=Unacceptable, 5=Completely Unacceptable

NOTE:
* Pan received a bimodal rating of 2 and 3. The rating of 2 was selected given that the distribution curve was more heavily skewed towards the lower end of the rating scale.

Response time and display readability were also rated. Response time received a borderline rating indicating that response time of the system would have to be improved before it can be considered useful by forecasters. Display readability received an acceptable rating.

5.1.2 User Comments.

User comments from the questionnaire are discussed in the sections below. Comments are summarized for each editing and viewing concept as well as editor functions.

5.1.2.1 General Comments.

General user comments included increasing the image size, increasing font size or at least making font size user configurable, the addition of more PIREP information, looping of satellite imagery, addition of station identifiers, and the addition of icing intensities.

5.1.2.2 Specific Comments.

5.1.2.2.1 Data File Selector.

Users assigned the Data File Selector a mode rating of 2; however, improvements were noted that would make the concept more useful. For instance, users would like to have data automatically updated as it is received. Users would like the selector to indicate the actual valid time, instead of the current indication of model run time plus forecast interval.

5.1.2.2.2 Display Options.

The Display Options or Icing Category Selector received a mode rating of 2. User comments indicated that the concept would be more useful if icing intensity was displayed.

5.1.2.2.3 Horizontal Cross-Section.

The Horizontal Cross-Section was assigned a mode rating of 2; however, users suggested several improvements. Forecasters indicated they would like to see a larger data window. Also, the blue grids representing areas without icing tended to degrade the satellite imagery.

5.1.2.2.4 Vertical Cross-Section.

The Vertical Cross-Section received a mode rating of 2; however, users suggested several improvements. Many users noted that PIREPs should be displayed in this cross-section. Users suggested that reference points need to be added to the Vertical Cross-Section to aid in determining the location of icing. Additionally, hash marks need to be added to correlate the Horizontal and Vertical Cross-Sections. When users zoomed in on

either cross-section it was very difficult to determine the location from one cross-section to the other.

5.1.2.2.5 Loop Controls.

The Loop Controls received a mode rating of 2. Users would like more control over the looping speed and would also like more choices of looping speeds.

5.1.2.2.6 Flight Level Selectors.

The Flight Level Selectors received a mode rating of 2. Users indicated they would like to be able to manually type in flight levels as well as using the Flight Level Selector.

5.1.2.2.7 Data Options.

The Data Options concept received a mode rating of 2. Comments indicated that users need more information for each PIREP (i.e., type, time, and altitude) and additional data overlays such as relative humidity.

5.1.2.2.8 Satellite Image Selection.

The Satellite Image Selection received a mode rating of 2. Overall, users indicated they need to be able to loop the satellite imagery in order to improve utility.

5.1.2.2.9 Skew-T Plot.

The Skew-T Plot was assigned a mode rating of 2. Comments indicated that the Skew-T display was too small and that users would like to see soundings from additional models as well as observed soundings.

5.1.2.2.10 Volume Viewer.

The Volume Viewer received a bimodal rating of 2 and 3. While the ratings were split between acceptable and borderline, the distribution was skewed toward the unacceptable end of the scale. Many users indicated the Volume Viewer had little to no utility and should be removed from the display. Users consistently indicated that the manual rotation of the display was very difficult and cumbersome.

5.1.2.2.11 Viewing Angles.

Users assigned the Viewing Angles a mode rating of 2. Most comments indicated that the selection of the Viewing Angles was

fairly simple; however, given the Volume Viewer had little to no utility, the users noted the Viewing Angles provided little benefit as well.

5.1.2.2.12 Define Region.

Users assigned the Define Region concept a mode rating of 2. No improvements were suggested.

5.1.2.2.13 Selecting Vertical Levels.

The Selection of Vertical Levels received a mode rating of 2. The inclusion of a reminder or better indication of the levels a forecaster was working with was suggested.

5.1.2.2.14 Delete Ice.

The Delete Ice concept received a mode rating of 2. Overall, user comments indicated the concept was easy to use.

5.1.2.2.15 Add Ice.

The Add Ice concept was assigned a mode rating of 2. Similar to the Delete Ice concept, user comments indicated the concept was useful and easy to use. It was suggested to incorporate a reminder of the levels where icing was being added.

5.1.2.2.16 Vertical Interpolation.

Users assigned a mode rating of 3 to the Vertical Interpolation concept. Users indicated the Vertical Interpolation was difficult to use.

5.1.2.2.17 Algorithm Parameters.

The Algorithm Parameters received a mode rating of 2. Users indicated this would be more useful if changes made to the algorithm carried through all of the forecast times for the particular model run.

5.1.2.2.18 Enable Flow.

Users assigned a mode rating of 2 to the Enable Flow concept; however, some users indicated the concept was complicated. No suggestions were provided for improvement.

5.1.2.2.19 Default Values.

The Default Values received a mode rating of 1. No comments or suggestions were provided.

5.1.2.2.20 Zoom.

The Zoom feature received a mode utility rating of 1, but received a mode ease of use rating of 3. Several users indicated that the Zoom feature was difficult to use and quite cumbersome. Specifically, the two-hand activation of the Zoom feature seemed excessive. Users suggested a method similar to current AWC systems which entails positioning the cursor and then simply depressing the X or Z key. When zooming in the Horizontal Cross-Section, users commented that the Vertical Cross-Section should zoom in at the same ratio.

5.1.2.2.21 Pan.

Ratings for the Pan feature were equally divided between 2 and 3 indicating that opinions were split between an acceptable and borderline rating. Users desired a feature that was less complicated than the current method and which would include true roam capabilities similar to that on the (Visual Infrared Spin Scan Radiometer [VISSR] Atmospheric Sounder [VAS]) Data Utilization Center (VDUC).

5.1.2.2.22 Reset.

The Reset feature received a mode utility rating of 2. Most user comments indicated that reset was useful and easy to use. A suggestion included relocating the reset button to the menu.

5.1.2.2.23 Undo.

The Undo feature was assigned a mode rating of 2. It was suggested that an "undo all" button be implemented so a user could delete several actions at a time.

5.1.2.2.24 Response Time.

Response time acceptability received a mode rating of 3 indicating that response time was too slow.

5.1.2.2.25 Display.

Display readability received a mode rating of 2; however, several users suggested increasing the font size.

5.1.2.2.26 Training.

Although training was not formally assessed during the AIV Editor Evaluation, several comments regarding training were noted in the questionnaires. Users noted that they had little hands on experience with the system and that there was not enough written documentation with the display. Some users indicated that it was unfair to assess a system on which they had not been adequately trained. The lack of familiarity with the system may have skewed the results of the higher level functions (i.e., vertical interpolation, algorithm parameters).

5.2 SCENARIO RESULTS.

This section will document the results of the scenario sessions. During these sessions, evaluators noted how the editor was being used in order to edit an icing grid. User comments regarding the editor were also noted. Several forecasters indicated that while they had been trained to use the editor, they were unable to spend extra time working on it. For this reason, they expressed a reluctance to provide feedback. This may have impacted some portions of the scenario sessions; specifically, comments related to higher level functions (i.e., vertical interpolation and algorithm parameters).

5.2.1 Job Task Information.

While a formal job task analysis was not completed during the evaluation, evaluators noted procedural steps completed during the scenario session. These steps may begin to outline how the AIV Editor would be used in an operational setting to edit icing grids. Procedures noted here were steps most often completed. It should be noted, however, that these procedures varied for each forecaster and reflect a generalized approach to editing an icing grid. Each forecaster will approach grid editing somewhat differently than the stated procedures.

The following process was noted:

a. Zoom and pan on the editor to the area of interest.

b. Review the current analysis of icing grids presented on the editor in order to identify the geographical extent of icing.

c. Display PIREPs of icing on AWIPS developed for National Centers. AWIPS developed for National Centers displays more PIREP information. The PIREPs are overlaid on a satellite image to see the correlation between clouds and the icing PIREPs. The

editor analysis is compared to the PIREPs to assess model performance.

d. Review the forecasted icing grids presented on the editor, noting how overall features change from the analysis. The forecasted grids are compared to the AWIPS developed for National Centers displayed PIREPs.

e. Using the scan feature of the horizontal plan view, examine the Vertical Cross-Section to identify the forecasted bases and tops of the icing layers, also making note of low-level icing areas and thin layers of icing.

f. Compare the bases determined from the scanning of the cross-section to the forecasted freezing levels given by the models displayed on AWIPS developed for National Centers. Icing areas should not extend into areas with temperatures greater than freezing. Forecasters will use the freezing level from the model they have the highest confidence in. The choice of model varies from day to day.

g. Utilize satellite animation on AWIPS developed for National Centers in order to determine cloud trends, such as growth, decay, convection, and movement.

h. Utilize the Skew-T feature of the editor to determine the vertical thickness of the moist layers and where drying occurs. Moist layers are used to confirm forecasted areas of icing while drying is used to determine the height of the icing layer and cloud tops. Several Skew-Ts are displayed for both ice and ice-free regions.

i. Display icing guidance from other model forecasts, such as ETA output and the Neural Network icing product on AWIPS developed for National Centers. Forecasters may use the split screen capability of AWIPS developed for National Centers to perform a side-by-side comparison of different model icing forecasts; animate the output to display forecasted changes with time; or use the vertical scanning capability to identify changes with height. Other model forecast parameters, such as relative humidity, may also be used to confirm where areas of moisture (necessary for icing) are forecasted to occur.

j. Utilize observational data sources such as Surface Aviation Observations (SAOs) on AWIPS developed for National Centers and radar information on a dedicated monitor to identify areas of precipitation which infer extensive cloud coverage. The location of these areas are compared with the forecasted icing grids.

k. Perform manual editing of grids. Icing grids may be deleted due to the lack of clouds in an area or cloud trends that do not correspond to editor forecast grids; the presence of icing grid outliers not connected to larger areas of icing; thin layers of icing; or icing areas that are not supported by PIREP information. Icing grids may be added based upon additional model guidance using a forecaster preferred model (e.g., ETA, RUC, or NGM); PIREPs; satellite images; or areas may be joined to form uniform areas rather than many discrete areas.

l. After editing, the forecaster will confirm the edited icing grids by comparing PIREP information from AWIPS developed for National Centers and using the Vertical Cross-Section of the editor to check the vertical and horizontal extent of the forecasted icing grids.

5.2.2 Comments/Enhancements for Current Editor Concepts.

The users provided many comments during the scenario sessions. Comments and suggested enhancements most frequently made by users are discussed below.

5.2.2.1 Training.

While training was not formally assessed during the scenarios, user comments regarding training and editor familiarity were noted. Several users were hesitant at the start of the scenarios as they were unsure how to use many of the editor features (e.g., algorithm parameters, vertical interpolation). Most users stated that the training session was not long enough. Additionally, many users stated that they did not have the time to utilize the system following the training session. The lack of familiarity with the system may have skewed the results of the higher level functions (i.e., vertical interpolation, algorithm parameters).

5.2.2.2 PIREPs.

Users require additional PIREP information and features. PIREP information should contain icing type (depicted graphically), flight levels, and the time of the PIREP. Additionally, users want the ability to overlay PIREPs in the Vertical Cross-Section. They would also like to have control over the amount of PIREP information displayed via a density control button and progressive disclosure as they zoom into an area. Users also want to be able to display PIREPs independent of grid time.

5.2.2.3 Processing Speed.

Although assessing system speed or performance was not an objective of the evaluation, users noted system processing speed

needs to be increased. Given the time criticality of forecaster tasks, the viewing and editing should be user-paced and not system-paced. Evaluators noted several instances where the forecaster could not continue with tasks because the system was still processing.

5.2.2.4 Animation.

It was noted that animation or looping of satellite and icing grid is essential. Forecasters use animation in order to extract trend information.

5.2.2.5 Skew-T Plot.

While the model derived Skew-T plot was found to be very useful, it is too small. Users had a difficult time reading the display. Users did not resize the Skew-T window because it would obscure the icing image. Users require the ability to see both the Skew-T and the icing grids in order to use the sounding information most effectively. Users also suggested the Skew-T plot be labeled to better indicate the geographical location of the model-generated sounding for the particular Skew-T and noted that actual sounding observations would be very useful.

5.2.2.6 Zoom and Pan.

The Zoom and Pan features were cumbersome and difficult to use. These features are used consistently and need to be very simple operations. They should require only one key stroke or mouse button depression. Additionally, users requested the addition of preset zoom ratios.

5.2.2.7 Vertical Cross-Section Labels.

Users found it difficult to determine the exact location of icing areas in the Vertical Cross-Section. The addition of labels, especially US-Canada border information was suggested by several users.

5.2.2.8 Cross-Sections.

Users found the Horizontal and Vertical Cross-Sections to be very helpful in identifying bases and tops, low-level icing areas, and thin layers of icing. The cross-sections were also useful in confirming changes to the grid. While the cross-sections were useful, users did suggest improvements. Specifically, the Horizontal and Vertical Cross-Section displays need to be linked for zooming and panning operations to ensure users are looking at the same area in both windows. There were several instances when users zoomed into a specific area on the Horizontal Cross-Section

and were then unable to match information to the Vertical Cross-Section due to the ratio mismatch.

5.2.2.9 Display Size.

Several users indicated that the size of the icing grid needed to be larger. This could be accomplished through a larger monitor or by changing the menus to pop-up or pull-down menus to increase the space already available on the screen.

5.2.2.10 Non-Icing Grids.

It was noted by several users that the blue grids (indicating no ice) degraded both the satellite imagery and the PIREP icons. Users indicated that they only wanted to see the red grids indicating the presence of ice.

5.2.2.11 Flight Level Selector.

At times, users found the flight level buttons to be tedious. Users suggested providing the option of entering flight levels via the keyboard.

5.2.2.12 System Busy Indicator.

The System Busy Indicator needs to be more apparent to the user. Several users did not see the System Busy Indicator and continued to make entries while the system was still processing. The user then had to continue to wait while the system processed all of the redundant entries. The System Busy Indicator needs to be prominent in the middle of the screen and lock out the ability to make other entries.

5.2.2.13 Flight Level Prompt for Editing.

While editing icing grids, several users forgot to check which flight levels they were editing. In several cases, users edited levels that were not intended to be edited. It was suggested that the editor prompt the user to check the flight levels before each edit. This will ensure that users edit only the appropriate flight levels.

5.2.2.14 Font.

The font needs to be larger to make it more readable. Many users had difficulty reading the text due to the font size.

5.2.2.15 Volume Viewer.

Almost all of the users stated that the Volume Viewer had little to no utility, and they could not visualize using it in an operational setting.

5.2.2.16 Looping Controls.

While the Looping Controls were not widely used, forecasters stated that this feature would be useful in an operational setting.

5.2.3 Enhancements for Future Iterations.

In addition to requested modifications to current editor concepts, users also requested additional features. Forecasters provided information regarding how they would like to define AIRMET outlines (i.e., "From Lines") on the editor as well as view data over the AIRMET 6-hour forecast period. The following sections address these issues.

5.2.3.1 General Enhancements.

Forecasters requested the following enhancements:

a. Users requested the ability to overlay current icing AIRMETs and SIGMETs on the icing grids. Additionally, users want to be able to click on a specific AIRMET to retrieve the associated text.

b. Users requested the ability to overlay additional weather information such as temperature, relative humidity, and freezing level.

c. Station identifiers and coastal water boundaries need to be added as overlays to the editor.

d. Many forecasters rely on models other than the RUC; therefore, the ability to review other weather models (e.g., NGM, ETA) needs to be added to the display.

e. Users indicated that they want to be able to view data in a multi-panel format similar to AWIPS developed for National Centers. This gives the forecaster the ability to compare various models and forecast times.

f. Most AWC products are valid for 6 to 8 hours; therefore, forecasters require the ability to loop information in time. A temporal looping feature should be incorporated.

g. Several forecasters indicated that the addition of icing intensity information is crucial. The current ice/no ice grid does not provide sufficient information.

5.2.3.2 AIRMET From Line Creation.

During the scenario sessions, forecasters were asked to describe how they would like to use the editor to create an AIRMET. Most forecasters indicated that they would like to be able to use a point and click method on the display to draw the From Line and then initiate a procedure that would automatically transfer the From Line information to the word processing program that is used for generating AIRMET text. Additionally, forecasters wanted the editor to create the state list for the AIRMET text as well.

The automated point and click process is similar to the procedures utilized by the AWC Convective SIGMET forecaster. In the Convective SIGMET area, the VDUC allows the forecaster to draw the From Line around an area of interest using the point and click method. Once the forecaster is satisfied with the line, a command is initiated to transfer the From Line information from VDUC to the word processing program.

While the majority of forecasters wanted to create an AIRMET using the aforementioned process, some forecasters wanted the editor to draw an entirely automated "first guess" From Line and then allow the forecaster to modify the From Line by "rubberbanding" (i.e., reshaping or cropping). Given individual differences among forecasters, providing a choice of procedures may be beneficial.

5.2.3.3 6-Hour Forecasting.

Forecasters were asked how they would like to view data over the 6-hour valid AIRMET time period. Most forecasters indicated that they would like a temporal loop (i.e., animation). Some forecasters suggested adding the ability to create a time composite after editing grids over the individual forecast times.

5.3 HUMAN FACTORS GUIDELINES AND STANDARDS COMPARISONS.

5.3.1 Guidelines for Designing User Interface Software.

Table 4 presents the results of the comparison of the AIV Editor interface characteristics to a subset of guidelines from Guidelines for Designing User Interface Software.

TABLE 4. GUIDELINES FOR DESIGNING USER INTERFACE SOFTWARE

GUIDELINE	MET?	COMMENTS
1. Use graphics for spatial and temporal information	Yes	e.g., Satellite, grids, PIREPs, cross-section
2. Use graphics for quick scanning and data comparisons	Yes	
3. Use graphics when users must monitor changing data	Yes	
4. Use standard format and labeling for all graphic products	No	Text on data options buttons should be standardized i.e., 'get saved' should be called 'retrieve', 'Print!' should have the exclamation point removed. 'Hide' buttons should change to 'show' when they are toggled on
5. Tailor graphics to user needs and provide only necessary data	No	See discussions in sections 5.1 and 5.2
6. Highlight features that show critical data	Yes	e.g., altitude
7. Format annotations consistently	No	PIREPs need text information for greater detail
8. Display all labels in normal reading orientation	Yes	
9. Establish standard meanings for symbols	Yes	Name of 'glyphs' should be changed to 'icons' in the User's Guide
10. Design icons to resemble objects or processes they represent	Yes	
11. Use animation for dynamic information	No	Need to loop satellite and have temporal loop for different forecast times

Design guidelines stated as not met by the AIV Editor are as follows:

a. Guideline 4: Button labels are not standardized. For instance, the 'get saved' button should be labeled 'retrieve' to conform to standard labeling. The 'Print!' button should not contain punctuation in the label. Also, since the 'Hide' buttons act as a toggle, the label should change between 'hide' and 'show' to reflect the appropriate state of the button.

b. Guideline 5: Some graphics are not tailored to user needs. For instance, PIREPs need additional information (i.e., type, time, and flight level). Additional issues associated with the graphical information are discussed in section 5.2.

c. Guideline 7: PIREPs require text annotation to provide greater detail. See section 5.2.2.a.

d. Guideline 11: Satellite imagery and icing grids need to be animated in order to provide forecasters with trend information. See section 5.2.2.c.

5.3.2 Military Standard 1472D Guidelines.

Table 5 presents the results of the comparison of the AIV Editor interface characteristics to a subset of guidelines from Military Standard 1472D, Human Engineering Guidelines.

TABLE 5. MILITARY STANDARD 1472D GUIDELINES

GUIDELINE	MET?	COMMENTS
1. Alert/warning display shall provide increased probability of detecting condition	Yes	i.e., icing grid on/off
2. Sufficient contrast shall be provided between display information and display background	No	Blue non-icing grids degrade satellite imagery
3. Information shall be sufficient to allow the user to perform intended mission	No	See discussion in sections 5.1 and 5.2
4. Redundancy in the display shall be avoided unless required to achieve reliability	Yes	
5. Font style should allow discrimination of similar characters such as 1 from l	No	Font is too small

Design guidelines stated as not met by the AIV Editor are as follows:

a. Guideline 2: Blue grids degrade the contrast of the satellite imagery. The blue grids should be removed to improve the clarity of the satellite imagery and PIREP icons.

b. Guideline 3: In its current state, the editor does not provide forecasters with sufficient information to create an icing AIRMET. These issues are discussed in section 5.2.

c. Guideline 5: The font on the display is too small and is difficult to read. The font should be larger.

5.3.3 Air Force Operational Test and Evaluation Center Guidelines.

Table 6 presents the results of the comparison of the AIV Editor interface characteristics to a subset of guidelines from Air Force Operational Test and Evaluation Center (AFOTEC) Software Usability Evaluation Guide.

TABLE 6. AFOTEC SYSTEM USABILITY STATEMENTS

GUIDELINE	MET?	COMMENTS
1. Cursor is easy to locate	Yes	
2. Data fields are adequately labeled	Yes	
3. Data entry is user-paced	Yes	
4. The user is not required to enter data already available system	Yes	
5. System provides quick, positive feedback after inputs	No	'System Busy Indicator' needs to be more evident
6. A processing or working message appears while system is working	Yes	However, current indicator is not adequate. Indicator needs to be more apparent to user
7. Error messages are clear and succinct	No	Error messages need to indicate the problem and a potential solution
8. It is clear what mode the user is in	Yes	
9. Menu selection options are organized by function and order	No	'Define Regions' seems out of place in the Edit menu. Should be in Algorithm Parameters menu
10. System defaults are set on the most frequently used options	Yes	
11. Menu options are consistent in wording, order, and format	No	In loop controls, load loop section should be before loop initiation controls. User should select levels, load loop, and then initiate the loop from left to right
12. Menu options are appropriately labeled	Yes	
13. Wording of menu options is consistent with functions they control	No	'Get Saved' button should be labeled 'Retrieve'. 'Hide' buttons should say 'Show' when feature is toggled on
14. Activation of menu options is easy	Yes	However, pull down or pop up menus would increase size of data display

TABLE 6. AFOTEC SYSTEM USABILITY STATEMENTS (Continued)

15. Menu options are easy to locate within menu hierarchy	Yes	
16. Inactive menu selections are de-emphasized on the display	No	A user can't initiate a loop until loop sequence is loaded; therefore, loop initiation button should be grayed out until loop is loaded
17. Display update is fast enough to keep up with user inputs	No	System response time is too slow
18. Display minimizes requirement for interpretation or memorization	No	Need to be able to see more than one forecast time on display. Otherwise, have to remember previous model data while new time data is loading
19. Display formats are consistent across system	Yes	
20. Wording is consistent across all displays	Yes	
21. Text displays are easy to read	No	Font is too small
22. Display coding methods are consistent across displays	Yes	
23. Windows are easy to open and close	Yes	
24. Display symbols conform to accepted operational conventions	Yes	
25. The use of color enhances display readability	Yes	However, blue grids degrade satellite image
26. System messages are informative and concise	No	Error messages do not indicate potential solution
27. User's manual provides complete description of procedures	Yes	
28. User's manual is easy to use	Yes	
30. Routine operations can be performed without user's manual	Yes	
31. Operator workload is appropriate (neither too high or too low)	N/A	Evaluation was not long enough to overcome the learning curve; therefore, workload was not assessed

Design guidelines stated as not met by the AIV Editor are as follows:

a. Guideline 5: The system busy indicator does not provide the user with adequate system status. The busy indicator needs to be more apparent to the user.

b. Guideline 7: Current error messages do not provide the user with a good indication of the problem. Error messages should provide the user with a succinct definition of the problem and a potential solution.

c. Guideline 9: The Define Regions button seems out of place in the edit menu. Since this concept is related to the algorithm parameters, it should be located in the algorithm parameters menu.

d. Guideline 11: The loop controls menu and buttons are not ordered in the sequence of loop initiation. In essence, the user should select the flight levels, load the loop, and then initiate the loop from left to right.

e. Guideline 13: See guideline 4 from table 4.

f. Guideline 16: In the loop controls, a user cannot initiate a loop until a loop sequence is loaded; therefore, the loop initiation button should be grayed out until a loop is loaded.

g. Guideline 17: System response time needs to decrease.

h. Guideline 18: Forecasters need to be able to see data from more than one forecast time. Currently, the forecaster has to load the new forecast time which can take up to 10 seconds. Once the new forecast time is loaded, the user has forgotten the data from the previous forecast time.

i. Guideline 21: The current font is too small and difficult to read at times. The font should be larger.

j. Guideline 26: Error messages do not indicate potential solutions.

6. CONCLUSIONS.

6.1 GENERAL CONCLUSIONS.

The Aviation Impact Variable (AIV) Editor presented forecasters with some useful concepts for viewing and editing gridded data. While recognizing the editor is a prototype system, several

improvements are necessary in order for the viewing and editing concepts to be considered for operational use. The following paragraphs outline improvements for future development.

6.2 QUESTIONNAIRE.

Most concepts received an acceptable utility rating; however, almost all require some improvement. Both the Volume Viewer and Vertical Interpolation concepts received borderline ratings indicating that these would require significant improvement to be considered useful.

All concepts except the Zoom and Pan features received an acceptable ease of use rating; however, many concepts require some improvement. The Zoom and Pan features were rated as borderline indicating they require significant improvement. The Zoom and Pan features were cumbersome and very difficult to use.

In general, user comments from the questionnaire were as follows:

a. Increase size of data window,
b. Increase font size,
c. Provide additional Pilot Report (PIREP) information,
d. Provide temporal looping capabilities,
e. Provide additional weather and map overlays, and
f. Incorporate icing intensities.

6.3 SCENARIO.

Results from the scenario sessions enabled evaluators to outline how forecasters used the editor and obtain additional feedback regarding the editor concepts. The procedures outlined represented a generalized approach to editing an icing grid.

User suggestions for improvements of current editor concepts were as follows:

a. Provide additional PIREP information;

b. Increase system processing speed;

c. Provide temporal looping capabilities;

d. Increase Skew-T size;

e. Simplify Zoom and Pan features;

f. Add labels to cross-sections;

g. Link the Vertical and Horizontal Cross-Sections for zooming and panning;

h. Increase size of data display window;

i. Remove blue non-icing grids;

j. Add manual text input for flight levels;

k. Implement system busy indicator that is more apparent to user;

l. Implement check to ensure users are editing appropriate flight levels;

m. Increase font size; and

n. Remove Volume Viewer.

User suggestions for future enhancements or additions to the editor were as follows:

a. Provide overlay of current Airmen Meteorological Statements (AIRMETs) and Significant Meteorological Statement (SIGMETs);

b. Provide additional weather and map overlays;

c. Provide access to other forecast models;

d. Implement multi-panel format to view data;

e. Incorporate icing intensity information; and

f. Implement point and click method for AIRMET From Line creation with automatic data transfer from the editor to word processing program.

6.4 HUMAN FACTORS STATEMENTS AND GUIDELINES.

The AIV Editor display and interface follow many human factors standards and guidelines; however, both the display and interface require improvement in several areas as noted in paragraph 5.3. The interface should reflect job tasks and follow good design principles. A usable interface can improve performance and decrease forecaster workload and error during critical weather conditions.

6.5 TRAINING.

Many users indicated that training was inadequate. The length of training was insufficient to adequately train forecasters. Additionally, most forecasters did not have time to work on the editor after training. Consequently, many forecasters were uncomfortable with several editor functions; specifically, the Vertical Interpolation and Algorithm Parameter functions. This may have impacted the forecasters' opinions of these higher level functions.

7. RECOMMENDATIONS.

a. User job tasks should be defined prior to system development. The development agencies must have a thorough understanding of the user job tasks and information requirements in order to develop systems that are oriented to the user rather than expecting the user to adapt to a system.

b. All users should be trained to an acceptable level of performance prior to the start of any evaluation. Additionally, adequate time between training and the evaluation for user familiarization, thus, reducing biases resulting from users operating within the learning curve.

c. Future iterations of the editor should incorporate features from current AWC operational platforms and specifically include the following currently available editing and viewing concepts of the AIV Editor:

1. Horizontal and Vertical Cross-Sections,
2. Manual editing capability,
3. Overlay capability, and
4. Spatial animation.

d. Future iterations of the editor should have the following enhancements that are not a part of the current AIV Editor:

1. Temporal animation of satellite and model forecast grids;

2. Additional PIREP information, including type, time, and altitude;

3. Additional overlay capabilities of weather information such as relative humidity, temperature, freezing level, AIRMETs, and SIGMETs;

4. The editing must be portable so that grids from different models may be edited upon the same platform.

e. Editor enhancements should be prioritized to fill the most urgent needs of AWC forecasters first.

f. Future iterations of the editor should follow standard human factors guidelines for the presentation of information. Suggested guidelines include Human Factors Engineering Guidelines (MIL-STD-1472D) and Guidelines for Designing User Interface Software (ESD-TR-86-278).

g. Based upon a lack of strong user identified utility, no further development work should be conducted on the three-dimensional volume viewer.

h. Further assessment regarding the utility of the manipulation of algorithm parameters needs to be performed in order to proceed with further development.

8. ACRONYMS.

AFOS	Automation of Field Operations and Services
AFOTEC	Air Force Operational Test and Evaluation Center
AIRMET	Airmen Meteorological Statement
AIV	Aviation Impact Variable
AVS	Application Visualization System
AWC	Aviation Weather Center
AWIPS	Advanced Weather Integrated Processing System
EFF	Experimental Forecast Facility
FAA	Federal Aviation Administration
FSL	Forecast Systems Laboratory
NCAR	National Center for Atmospheric Research
NCEP	National Centers for Environmental Prediction
NGM	Nested Grid Model
NOAA	National Oceanic and Atmospheric Administration
NWS	National Weather Service
PIREP	Pilot Report
RAP	Research Applications Program
RUC	Rapid Update Cycle
SAO	Surface Aviation Observation
SIGMET	Significant Meteorological Statement
VAS	VISSR Atmospheric Sounder
VDUC	VAS Data Utilization Center
VISSR	Visual Infrared Spin Scan Radiometer

APPENDIX A

QUESTIONNAIRE DATA

VIEWING FUNCTIONS:

Data File Selector

1. Rate the utility of the data file selector.

1	1 - Completely Acceptable
11	2 - Acceptable
1	3 - Borderline
0	4 - Unacceptable
0	5 - Completely Unacceptable
0	NA

2. Rate the ease of use of the data file selector.

2	1 - Completely Acceptable
12	2 - Acceptable
0	3 - Borderline
0	4 - Unacceptable
0	5 - Completely Unacceptable
0	NA

3. List suggestions for improving the data file selector.

a. Too small and too fine print (font)

b. Data was already loaded, difficult to really judge

c. Would like verifying times added. Selector having more lines displayed would be nice

d. Needs to indicate valid time

e. Need a feature where you could view data over a selected time interval i.e., 12-15Z; ability to loop as well

f. Should be able to load a loop with SAT off

Icing Category Selector (Display Options)

1. Rate the utility of the Icing Category Selector.

2	1 - Completely Acceptable
11	2 - Acceptable
1	3 - Borderline
0	4 - Unacceptable
0	5 - Completely Unacceptable
0	NA

2. Rate the ease of use of the Icing Category Selector.

4	1 - Completely Acceptable
10	2 - Acceptable
0	3 - Borderline
0	4 - Unacceptable
0	5 - Completely Unacceptable
0	NA

3. List suggestions for improving the Icing Category Selector.

a. Icing should be in intensities

b. Of more value would be to incorporate Don McCann's neuronet program to differentiate between rime, mixed, or clear icing potential

c. Display is OK as is

d. Some relation to icing types would be useful

e. Intensity levels would be good

Horizontal Cross-Section

1. Rate the utility of the Horizontal Cross-Section.

2	1 - Completely Acceptable
11	2 - Acceptable
1	3 - Borderline
0	4 - Unacceptable
0	5 - Completely Unacceptable
0	NA

2. Rate the ease of use of the Horizontal Cross-Section.

1	1 - Completely Acceptable
9	2 - Acceptable
4	3 - Borderline
0	4 - Unacceptable
0	5 - Completely Unacceptable
0	NA

3. Rate the readability of the Horizontal Cross-Section.

0	1 - Completely Acceptable
8	2 - Acceptable
4	3 - Borderline
2	4 - Unacceptable
0	5 - Completely Unacceptable
0	NA

4. Rate the acceptability of the update speed of the Horizontal Cross-Section.

1	1 - Completely Acceptable
9	2 - Acceptable
3	3 - Borderline
1	4 - Unacceptable
0	5 - Completely Unacceptable
0	NA

5. List suggestions for improving the Horizontal Cross-Section.

a. Model data should be in computer's memory

b. Too slow -- Poor colors. Need quicker response and more color selections

c. Needs a delicate touch on the mouse or you "define a region" instead

d. It's easy to get ahead of the computer

e. The only labels to identify your position are at either end with nothing in between

f. Would like to see bigger image, also grid overlay tends to hide some of the clouds on satellite image

g. Delete blue grids. Provide for operator to change colors; i.e., color blind operators

h. Need a feature where zoomed image corresponds to cross-section. Also would be helpful to see a cross-section from just the area of interest

i. Intensities would be good

Vertical Cross-Section

1. Rate the utility of the Vertical Cross-Section.

1	1 - Completely Acceptable
12	2 - Acceptable
1	3 - Borderline
0	4 - Unacceptable
0	5 - Completely Unacceptable
0	NA

2. Rate the ease of use of the Vertical Cross-Section.

0	1 - Completely Acceptable
8	2 - Acceptable
5	3 - Borderline
1	4 - Unacceptable
0	5 - Completely Unacceptable
0	NA

3. Rate the readability of the Vertical Cross-Section.

0	1 - Completely Acceptable
10	2 - Acceptable
3	3 - Borderline
1	4 - Unacceptable
0	5 - Completely Unacceptable
0	NA

4. Rate the acceptability of the update speed on the Vertical Cross-Section.

1	1 - Completely Acceptable
13	2 - Acceptable
0	3 - Borderline
0	4 - Unacceptable
0	5 - Completely Unacceptable
0	NA

5. List suggestions for improving the Vertical Cross-Section.

a. Show intensities

b. Feature to step through flight levels would be helpful. Again need feature to match vertical and horizontal cross-sections if zooming

c. More difficult to identify location. Needs some reference points

d. Tie to zoom of horizontal cross-section. Need altitude labels retained when zoomed. No need of zooming in vertical, only horizontal

e. Add PIREPs to cross-section. Add some kind of hash mark to orient viewer between horizontal and vertical cross-sections. Link horizontal and vertical cross-section so that if you blow up or enlarge horizontal portion the vertical cross-section covers the same area (Only 1 to 1 at default setting)

f. Need to be able to set bounds to limit zoom area to better integrate area of intensities

g. Computer needs to be faster

h. Might consider adding diagonal cross-section capability

i. You need to be able to go directly to where you want a vertical cross-section rather than scan to it. Match with horizontal view especially when zooming

j. North/South not as useful as East/West

Loop Controls

1. Rate the utility of the Loop Controls.

1	1 - Completely Acceptable
8	2 - Acceptable
2	3 - Borderline
2	4 - Unacceptable
1	5 - Completely Unacceptable
0	NA

2. Rate the ease of use of the Loop Controls.

2	1 - Completely Acceptable
8	2 - Acceptable
1	3 - Borderline
2	4 - Unacceptable
1	5 - Completely Unacceptable
0	NA

3. Rate the acceptability of the animation speed on the Loop Controls.

0	1 - Completely Acceptable
10	2 - Acceptable
1	3 - Borderline
3	4 - Unacceptable
0	5 - Completely Unacceptable
0	NA

4. List suggestions for improving the Loop Controls.

a. Need choice of speeds

b. Might add a forward/reverse option

c. Crash

d. Loop of most recent 8 images or so should always be loaded so that looping is just turning on and off

e. Need windshield wiper mode

f. Little need for vertical looping with availability of vertical cross-section. Need a time looping capability

g. Speed seems too fast. Would be nice to be able to control speed of loop

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Flight Level Selectors

1. Rate the utility of the Flight Level Selectors.

5	1 - Completely Acceptable
7	2 - Acceptable
2	3 - Borderline
0	4 - Unacceptable
0	5 - Completely Unacceptable
0	NA

2. Rate the ease of use of the Flight Level Selectors.

5	1 - Completely Acceptable
8	2 - Acceptable
1	3 - Borderline
0	4 - Unacceptable
0	5 - Completely Unacceptable
0	NA

3. List suggestions for improving the Flight Level Selectors.

a. Why not just type in flight levels instead of long list of flight levels?

b. Though well displayed, sometimes forgot levels selected when doing an operation

c. Nice

Data Options

1. Rate the utility of the Data Options.

2	1 - Completely Acceptable
9	2 - Acceptable
3	3 - Borderline
0	4 - Unacceptable
0	5 - Completely Unacceptable
0	NA

2. Rate the ease of use of the Data Options.

2	1 - Completely Acceptable
8	2 - Acceptable
4	3 - Borderline
0	4 - Unacceptable
0	5 - Completely Unacceptable
0	NA

3. List suggestions for improving the Data Options.

a. Might consider more options such as RH values (mean or at different levels)

b. PIREPs need type and altitude data

c. OK as is, need more data types to be available for display

d. Need to be able to remove blue grid while retaining red grid

e. PIREP data somewhat difficult to read

f. Need more information on PIREPs. Could add more fields

Satellite Image Selection Options

1. Rate the utility of the Satellite Image Selectors.

2	1 - Completely Acceptable
10	2 - Acceptable
1	3 - Borderline
0	4 - Unacceptable
0	5 - Completely Unacceptable
1	NA

2. Rate the ease of use of the Satellite Image Selectors.

2	1 - Completely Acceptable
9	2 - Acceptable
2	3 - Borderline
0	4 - Unacceptable
0	5 - Completely Unacceptable
1	NA

3. List suggestions for improving the Satellite Image Selectors.

   a. Need looping or more looping capability

   b. Would be nice to have satellite looping capability

   c. Was not functioning during my session due to communication problems

   d. Simple enough

   e. Would like to be able to loop satellite images

Skew-T Sounding Plot Selector

1. Rate the utility of the Skew-T Sounding Plot Selector.

3	1 - Completely Acceptable
8	2 - Acceptable
3	3 - Borderline
0	4 - Unacceptable
0	5 - Completely Unacceptable
0	NA

2. Rate the ease of use of the Skew-T Sounding Plot Selector.

2	1 - Completely Acceptable
8	2 - Acceptable
3	3 - Borderline
0	4 - Unacceptable
1	5 - Completely Unacceptable
0	NA

3. List suggestions for improving Skew-T Sounding Plot Selector.

a. Need more models and a way of changing soundings

b. Remove 3-D contour option

c. Too small

d. Would be used more often with a larger display area

e. Larger font size for easier readability. Zoom feature is nice but would be helpful to have zoomed skew-t adjacent to Satellite picture and cross-sections for comparison

f. Could add stability indices

Three Dimensional Volume Viewer

1. Rate the utility of the Three Dimensional Volume Viewer.

1	1 - Completely Acceptable
4	2 - Acceptable
4	3 - Borderline
3	4 - Unacceptable
2	5 - Completely Unacceptable
0	NA

2. Rate the ease of use of the Three Dimensional Volume Viewer.

1	1 - Completely Acceptable
4	2 - Acceptable
5	3 - Borderline
2	4 - Unacceptable
2	5 - Completely Unacceptable
0	NA

3. Rate the readability of the Three Dimensional Volume Viewer.

2	1 - Completely Acceptable
6	2 - Acceptable
1	3 - Borderline
3	4 - Unacceptable
2	5 - Completely Unacceptable
0	NA

4. List suggestions for improving Three Dimensional Volume Viewer.

a. Need more intensities

b. Helpful feature but would take a while to get used to. Is it possible to zoom in? Could PIREPs or even temperature be plotted some way on a 3-D image?

c. Difficult to use without lots of practice. Don't see how it can be applied to our type of product

d. No operational need or use

e. Personally, I don't see the utility of this for the forecaster. Nice display but better for a conference

presentation or a TV meteorologist rather than an operational forecaster

f. Not much utility in use. Nice to see type thing

g. Cute, but the value of manual rotation is not clear

h. Neat idea but hard to handle with mouse

i. Questionable value at best. Vertical cross-section better tool and performs basically same function. Difficult to manipulate. Would prefer automatic rotating controls

j. Forget it!

k. Suggest this be dropped

Viewing Angles

1. Rate the utility of the pre-set Viewing Angles.

0	1 - Completely Acceptable
8	2 - Acceptable
4	3 - Borderline
2	4 - Unacceptable
0	5 - Completely Unacceptable
0	NA

2. Rate the ease of use of the pre-set Viewing Angles.

1	1 - Completely Acceptable
9	2 - Acceptable
2	3 - Borderline
2	4 - Unacceptable
0	5 - Completely Unacceptable
0	NA

3. Rate the utility of the user-specified Viewing Angle.

0	1 - Completely Acceptable
3	2 - Acceptable
8	3 - Borderline
3	4 - Unacceptable
0	5 - Completely Unacceptable
0	NA

4. List suggestions for improving the Viewing Angles.

a. Questionable value at best. Vertical cross-section is a better tool

b. Not bad

c. 3D limited utility on 2D screen

d. Since I question the utility of the three dimensional volume viewer, I also question the utility of this product in an operational environment

e. No operational need or use

f. Hard to orient icing areas with terrain when viewed at low angles

---

EDITING FUNCTIONS

Define Region

1. Rate the utility of the Define Region feature.

2	1 - Completely Acceptable
9	2 - Acceptable
1	3 - Borderline
1	4 - Unacceptable
0	5 - Completely Unacceptable
1	NA

2. Rate the ease of use of the Define Region feature.

1	1 - Completely Acceptable
10	2 - Acceptable
1	3 - Borderline
1	4 - Unacceptable
0	5 - Completely Unacceptable
1	NA

3. List suggestions for improving the Define Region feature.

a. Too hard to figure out

Selecting Vertical Levels

1. Rate the utility of Selecting Vertical Levels.

2	1 - Completely Acceptable
9	2 - Acceptable
3	3 - Borderline
0	4 - Unacceptable
0	5 - Completely Unacceptable
0	NA

2. Rate the ease of use of Selecting Vertical Levels.

0	1 - Completely Acceptable
0	2 - Acceptable
3	3 - Borderline
0	4 - Unacceptable
0	5 - Completely Unacceptable
0	NA

3. List suggestions for improving the selection of Vertical Levels.

a. Nice

b. Need requester or other clue to remind forecaster which levels they are working with

c. Found it somewhat cumbersome to understand and use

Delete Ice

1. Rate the utility of the Delete Ice feature.

2	1 - Completely Acceptable
10	2 - Acceptable
0	3 - Borderline
1	4 - Unacceptable
1	5 - Completely Unacceptable
0	NA

2. Rate the ease of use of the Delete Ice feature.

2	1 - Completely Acceptable
11	2 - Acceptable
0	3 - Borderline
0	4 - Unacceptable
1	5 - Completely Unacceptable
0	NA

3. List suggestions for improving the Delete Ice feature.

a. Easy to use

b. Works well

c. Fine

d. Why go against meteorology

e. Is imperative that this be integrated into the forecast phase

---

Add Ice

1. Rate the utility of the Add Ice feature.

2	1 - Completely Acceptable
10	2 - Acceptable
1	3 - Borderline
0	4 - Unacceptable
1	5 - Completely Unacceptable
0	NA

2. Rate the ease of use of the Add Ice feature.

2	1 - Completely Acceptable
11	2 - Acceptable
0	3 - Borderline
0	4 - Unacceptable
1	5 - Completely Unacceptable
0	NA

3. List suggestions for improving the Add Ice feature.

   a. Is imperative that this be integrated into the forecast phase

   b. Need way to be sure forecaster is adding ice in areas where they want them

---

Vertical Interpolation

1. Rate the utility of the Vertical Interpolation.

0	1 - Completely Acceptable
4	2 - Acceptable
5	3 - Borderline
1	4 - Unacceptable
0	5 - Completely Unacceptable
4	NA

2. Rate the ease of use of the Vertical Interpolation.

1	1 - Completely Acceptable
3	2 - Acceptable
6	3 - Borderline
0	4 - Unacceptable
0	5 - Completely Unacceptable
4	NA

3. List suggestions for improving the Vertical Interpolation feature.

   a. Didn't encounter this feature

   b. It's a little tricky to use

   c. Could not make it work

Algorithm Parameters

1. Rate the utility of the Algorithm Parameters.

1	1 - Completely Acceptable
8	2 - Acceptable
4	3 - Borderline
0	4 - Unacceptable
0	5 - Completely Unacceptable
1	NA

2. Rate the ease of manipulating the slider bars on the Algorithm Parameters.

1	1 - Completely Acceptable
8	2 - Acceptable
3	3 - Borderline
1	4 - Unacceptable
0	5 - Completely Unacceptable
1	NA

3. List suggestions for improving the manipulation of the Algorithm Parameters.

   a. Fine

   b. Need other ways at getting at data to manipulate model output so that feedback goes back to the model and other parameters change accordingly

   c. How about if you change an algorithm parameter at a certain point of a RUC run that that change continue on through the remainder of the grids. For example, off the 12Z RUC, you change a temperature or RH on the 15Z grid to retain those changes on the 18Z, 21Z, and 00Z grids?

   d. Did not use this. Need to work with it more

Enable Flow

1. Rate the utility of the Enable Flow feature.

0	1 - Completely Acceptable
9	2 - Acceptable
3	3 - Borderline
0	4 - Unacceptable
0	5 - Completely Unacceptable
2	NA

2. Rate the ease of use of the Enable Flow feature.

0	1 - Completely Acceptable
9	2 - Acceptable
3	3 - Borderline
2	4 - Unacceptable
0	5 - Completely Unacceptable
0	NA

3. List suggestions for improving the Enable Flow feature.

a. Did not use

b. Complicated

Default Values

1. Rate the utility of the Default Values feature.

7	1 - Completely Acceptable
6	2 - Acceptable
0	3 - Borderline
0	4 - Unacceptable
0	5 - Completely Unacceptable
1	NA

2. Rate the ease of use of the Default Values feature.

5	1 - Completely Acceptable
8	2 - Acceptable
0	3 - Borderline
0	4 - Unacceptable
0	5 - Completely Unacceptable
1	NA

3. List suggestions for improving the Default Values feature.

a. Fine

FUNCTIONALITY:

Zoom

1. Rate the utility of the Zoom feature.

8	1 - Completely Acceptable
4	2 - Acceptable
2	3 - Borderline
0	4 - Unacceptable
0	5 - Completely Unacceptable
0	NA

2. Rate the ease of use of the Zoom feature.

0	1 - Completely Acceptable
4	2 - Acceptable
6	3 - Borderline
2	4 - Unacceptable
2	5 - Completely Unacceptable
0	NA

3. Identify Zoom features that could be improved and provide suggestions for improvement.

a. Shift-middle button is clumsy

b. Awkward having to use 2 hands -- should be able to zoom in/out centered at a specified point

c. Requiring two hands to zoom seems excessive

d. Very important feature

e. Somewhat cumbersome to hold down shift-key and move cursor either up or down. How about like NTRANS set the point then either hit a X or Z key?

f. Change to use 2 mouse keys instead of a mouse and a keyboard key. Need to tie vertical screen to horizontal

g. Preset zoom values to zoom step by step would be helpful; just by clicking mouse button; left for zooming; right for unzooming

h. Cumbersome (should be done with one button)

Pan

1. Rate the utility of the Pan feature.

1	1 - Completely Acceptable
6	2 - Acceptable
6	3 - Borderline
0	4 - Unacceptable
0	5 - Completely Unacceptable
1	NA

2. Rate the ease of use of the Pan feature.

1	1 - Completely Acceptable
7	2 - Acceptable
5	3 - Borderline
0	4 - Unacceptable
0	5 - Completely Unacceptable
1	NA

3. Identify Pan features that could be improved and provide suggestions for improvement.

a. Fine

b. Needs to be true roam feature with image moving as mouse cursor moves

c. Cumbersome to use

d. Should be an easier way

Reset

1. Rate the utility of the Reset feature.

3	1 - Completely Acceptable
9	2 - Acceptable
2	3 - Borderline
0	4 - Unacceptable
0	5 - Completely Unacceptable
0	NA

2. Rate the ease of use of the Reset feature.

3	1 - Completely Acceptable
8	2 - Acceptable
3	3 - Borderline
0	4 - Unacceptable
0	5 - Completely Unacceptable
0	NA

3. Identify Reset features that could be improved and provide suggestions for improvement.

a. Prefer a menu button

b. Put reset image button on AIV workstation screen. Too easy to forget F7

c. Easy enough

d. What are we doing here? Evaluating hitting the F7 button

Undo

1. Rate the utility of the Undo feature.

2	1 - Completely Acceptable
12	2 - Acceptable
0	3 - Borderline
0	4 - Unacceptable
0	5 - Completely Unacceptable
0	NA

2. Rate the ease of use of the Undo feature.

2	1 - Completely Acceptable
12	2 - Acceptable
0	3 - Borderline
0	4 - Unacceptable
0	5 - Completely Unacceptable
0	NA

3. Identify Undo features that could be improved and provide suggestions for improvement.

   a. A button "undo all" when in editing mode would reduce number of steps needed to undo a line

   b. Multiple level undo would be handy. Some editor word processors have scroll bar to work back through your changes

   c. Easy

Response Time

1. Rate the acceptability of the response time (i.e., time between data entry and data presentation) of the products/functions.

0	1 - Completely Acceptable
6	2 - Acceptable
7	3 - Borderline
1	4 - Unacceptable
0	5 - Completely Unacceptable
0	NA

2. Identify any product/function in which the response time could be improved.

a. Add/delete ice

b. Computer needs to be faster

c. Need more feedback to let forecaster know something is happening

d. Remove 3-D Volume Viewer

e. Loading of data files; model data and time projections

f. Overall slow

DISPLAY:

1. Rate the overall readability of the display.

1	1 - Completely Acceptable
9	2 - Acceptable
2	3 - Borderline
1	4 - Unacceptable
0	5 - Completely Unacceptable
1	NA

2. List any suggestions for improving the readability of the display.

a. Too small and no way of reading individual reports. Need larger satellite picture and better data availability

b. Larger

c. Scalability of fonts and ability to resize and move things important for those with less than perfect eyesight

d. None

e. Larger screen. Put algorithm parameters in a pop up window to save screen space

f. More contrast to gray entries on left side of screen would be easier to read. Icing areas displayed in a solid color would be easier to see than cross hatched

---

3. Is there any product information in a graphical format that you would prefer in a textual format?

a. No

b. Actual observations and PIREPs

c. No

d. PIREPs

e. It would be nice to click on a PIREP and see the text in the original

f. No

g. Not that I'm aware of

h. Ability to add tops/bases to PIREPs, and PIREPs of no icing and reports not mentioning icing

i. PIREP information. Icing potential areas displayed on vertical and horizontal cross-sections summarized in textual format

---

4. List any colors that you had difficulty differentiating and provide suggestions for color changes.

a. None

b. State boundaries to light when data is displayed. Perhaps be drawn over grid

c. None

d. Satellite image enhancement and grid interferes with each other. Would likely change grid color or turn off grid in real-time use

e. Satellite pictures difficult to see

Use editor to scan N-S on 15Z analysis in order to become aware of general situation.

Change to 21Z forecast with PIREPS of +/- 3 hours plotted.

Look at SAOs on AFOS that coincide with icing areas. Checking cloud observations for agreement with icing areas on editor.

Look at PIREPS on N-AWIPS that include height information.

Use skew-T on editor to identify moist levels. Looking in both icing and ice free regions.

Manually deletes a small area separate from large icing region. PIREPs were only in large region. Skew-t show only shallow moist layer in deleted region.

Look again at SAOs for region around periphery of icing region. Cloud cover is not substantial. Radar does not show any precipitation (which would indicate substantial cloud cover).

Manually delete areas that feel are marginal based upon previous step.

Scan N-S checking bases and tops.

Satisfied with area based upon support from SAOs, PIREPs, and radar.

Comments and Enhancements:

Cross-section is very useful, especially when combined with scanning.

Vertical looping would be useful. Did not use due to unfamiliarity.

Time savings because graphical forecast is already made. Forecaster does not have to perform analysis.

Volume Viewer: May use as become more comfortable with manipulating image. Would probably use after editing grids as an auxiliary tool to display effect of editing. However, benefits are unknown currently.

Algorithm Parameters: Would rely upon defaults until realize something needs changing based upon experience with model.

RAP algorithm did predict fairly closely a couple of areas of mid/high level icing potential where models missed it

c. In general a very good system but has a few fancy displays of little practical forecasting use. Needs time looping capabilities and time/model comparison method

d. I had little on hands experience with the AIV editor. I did sit down a few times after the training to become more acquainted with it. However, I did not participate in the case scenario

e. Need to provide ways to interpolate from one forecast period to another and follow the process to ensure consistency and accuracy. This could be done by looping finished forecast products, etc...

f. For a first attempt has some value but is very far from being better than what we already have

g. You develop a system and send someone out to train the users... but not much written documentation on use

h. To require an evaluation with less than 2 hours of training (hands on training was less than 15 minutes) is grossly unfair to the system and what is trying to be accomplished

APPENDIX B

PROCEDURES AND USER COMMENTS FROM SCENARIO SESSIONS

Forecaster: 1

Scenario 1:

1. Description: Evaluation time of 15Z (9:00 am local). Icing potential valid for 18Z for MIA area.

2. Procedures:

Look at current analysis.

Use N-AWIPS to examine most recent PIREPs (within 3 hours). Identify severity, icing type, horizontal and vertical location.

Look at valid time.

Zoomed on southeast US and panned to center region of interest.

Used cross-section to manually scan through plan view and examine cross-section to identify bases and tops of icing areas.

Compare bases with freezing level. Contoured freezing level acquired off N-AWIPS for valid time using RUC (same model as editor). Use freezing level to determine icing bases.

Identify icing areas to delete. Use satellite to determine where cloud systems have already moved eastward out of icing areas.

Ignore outliers where only one or two grids are identified to have icing. Regions do not meet AIRMET size criteria.

Compares valid time (18Z) with initial conditions (12Z) to determine if and how conditions are changing.

Deletes icing from cloud free regions behind satellite-identified cloud system. Uses manual deletion of icing grids.

Use skew-T option to determine thickness of moist layers. Viewed several locations within icing area and cloud shield from satellite. Based upon skew-T observations, identified drying out of the atmosphere on western portions on cloud system. Manually deleted icing from western portion (trailing edge) of cloud system.

Manually extended icing area to include portions of cloud system that were known to be producing rain based upon previous understanding of current weather conditions. Vertical extent of additional icing area coincides with previously identified bases and tops.

Scenario 2:

1. Description: Same evaluation time. Valid time also of 18Z, but for SFO area.

2. Procedures:

Zoom and pan to center area of interest.

Examine cross-section manually to determine bases and tops.

Compare with freezing level from N-AWIPS.

Examine several skew-Ts within area of clouds, but with no icing potential predicted. Examining depth of moisture.

Compares with PIREPS on N-AWIPS.

Uses satellite animation on N-AWIPS to determine short term trends in cloud motion. Decides to remain ice-free forecasted region as is since satellite animation confirms moving out of area.

Leaves automated icing grids as is and would represent with one AIRMET. Original thought was to have two AIRMETs, but instead decided upon one area of icing based upon latest PIREP information and satellite animation trend which showed more clouds entering region.

Further examination of different icing classes (specifically stable and freezing drizzle--only classes of interest) on N-AWIPS, decides to have two separate areas of icing. One region will have rime, other region will have mixed and clear. Determination was made by animating model forecasts on N-AWIPS and also using four panel display which allowed comparison of different classes. Stable regions used for rime icing; freezing drizzle used for mixed and clear. Compared regions to PIREPs to confirm or modify.

Comments and Enhancements:

PIREPs need to emulate N-AWIPS display, specifically need to include symbol, type, and flight level.

Outlying icing areas which are too small for AIRMET criteria should be removed.

Speed needs to be increased.

Display freezing level as a contour option.

Need animation of satellite images in order to determine short term trends (such as speed of cloud systems). VDUC capable of clicking on beginning point and end point to determine speed and extrapolate future position. Preferred to animate last 6 hours of images.

Would prefer satellite images next to editor to decrease clutter, but still include animation under icing grids.

Animate icing grids to coincide with satellite animation. Can determine model trends.

Should emulate N-AWIPS capability to animate and have multiple panels displayed to look at different classes of algorithms and different valid times. Can not directly compare different classes (e.g., freezing drizzle and stable).

Should be able to overlay and differentiate between different algorithm classes.

Pre-set views of volume viewer are beneficial. Can determine sloping surfaces and outliers.

Vertical looping is beneficial for determining bases and tops.

Display current advisories for comparison with model forecasts.

Cross handed placement of current system is awkward. Need to make sure that the mouse is to the right of the keyboard.

Cross-section is extremely useful in picking out top layers of icing.

Would like to overlay current AIRMETs to compare information and be able to overlay PIREPs for the old AIRMET times.

Freezing level at surface, would like the topographic database.

The adding and deleting ice tools are very useful.

Wants to be able to compare stable and freezing drizzle algorithms similar to 2 panel display on NTRANS.

When looking at algorithm parameters. Would like to look at algorithm parameters to issue two separate AIRMETs based on type.

Would have used loop controls but didn't remember how to use it.

Liked pre-set views but didn't like to grab with mouse and rotate around.

To make an AIRMET:

Need location (VOR) identifiers or markers.

Need boundary between domestic and international areas.

Point and click to identify AIRMET area.

Transfer automatically to PC (as with current VDUC capability for Convective SIGMETs). Also include states.

Vertical extent of AIRMET would be entered manually based upon layers identified in editor.

Would also like to define states in the AIRMET as well as the station identifiers.

For a 6-hour valid AIRMET:

Edit 3, 6, and 9 hour forecasts (or whatever falls into valid block) and then form unison (composite). Hourly data probably too much data and would increase forecaster workload.

Would like to be able to bring up information across set times and be able to loop through the information.

Show grids at each of the time steps all overlaid.

Forecaster: 2

Scenario 1:

1. Description: SLC area; analysis time of 19Z; valid time of 21Z.

2. Procedures:

In horizontal plan view, go to northernmost point of area of interest. Use North to South scan to review cross-section in order to identify vertical extent of regions.

Examine several skew-Ts in icing regions to confirm depth of moisture as shown in cross-section. Especially noting at what levels drying occurs--important for determining tops of icing layers.

Look at PIREPs. Used AFOS on N-AWIPS to review last 3 hours. Needed flight level of PIREPs--not available on editor. Also, editor does not provide time identification of PIREP. Compare PIREPs to information on vertical extent from skew-Ts.

Look at gaps in horizontal plan view of icing. Are these realistic based upon PIREPs?

Low lying icing areas identified by scanning and vertical cross-section are checked by reviewing SAOs in region of interest. SAOs show warm temperatures and downsloping winds which lead to drying. Deleted areas manually. Confirmed downsloping winds by looking at RUC 850 mb wind field.

Changed to 21Z forecast grid. Scanned North to South in order to identify bases and tops from cross-section. Looking for agreement with earlier analysis.

Manually removed outliers (isolated extensions) of larger icing regions.

Scenario 2:

1. Description: CHI area, valid time of 21Z, analysis time of 15Z.

2. Procedures:

Look at RUC neural network output on N-AWIPS.

Use editor to scan N-S on 15Z analysis in order to become aware of general situation.

Change to 21Z forecast with PIREPS of +/- 3 hours plotted.

Look at SAOs on AFOS that coincide with icing areas. Checking cloud observations for agreement with icing areas on editor.

Look at PIREPS on N-AWIPS that include height information.

Use skew-T on editor to identify moist levels. Looking in both icing and ice free regions.

Manually deletes a small area separate from large icing region. PIREPs were only in large region. Skew-t show only shallow moist layer in deleted region.

Look again at SAOs for region around periphery of icing region. Cloud cover is not substantial. Radar does not show any precipitation (which would indicate substantial cloud cover).

Manually delete areas that feel are marginal based upon previous step.

Scan N-S checking bases and tops.

Satisfied with area based upon support from SAOs, PIREPs, and radar.

Comments and Enhancements:

Cross-section is very useful, especially when combined with scanning.

Vertical looping would be useful. Did not use due to unfamiliarity.

Time savings because graphical forecast is already made. Forecaster does not have to perform analysis.

Volume Viewer: May use as become more comfortable with manipulating image. Would probably use after editing grids as an auxiliary tool to display effect of editing. However, benefits are unknown currently.

Algorithm Parameters: Would rely upon defaults until realize something needs changing based upon experience with model.

Needs more information on PIREPs.

Would like to display PIREPs on cross-section.

Prefers separate display systems in order to compare products.

Would like to see more moisture information.

To make an AIRMET:

Point and click to outline area.

Electronic transfer of points to PC. Also include states (effectively making first two lines of AIRMET).

For a 6-hour valid AIRMET:

Need animation through time periods.

Look at skew-Ts for each time during the valid period.

Want to have capability to step through each time during the valid period.

Forecaster: 3

Scenario 1:

1. Description: No product.

2. Procedures:

   Forecaster uncomfortable with editor. Not enough hands-on use.

   Reviews editor features and provides comments.

Scenario 2:

1. Description: Icing potential valid for 21Z for SLC area.

2. Procedures:

   Look at PIREPs on AFOS (comfortable with AFOS display).

   With editor, looking at satellite image. Hiding icing grids because grid degrades image.

   Scan N-S and return.

   Using N-AWIPS to look at neural network icing product. Using composite to get idea of where icing is being predicted. Compare with PIREPs on AFOS.

   Look at 700 mb relative humidity on N-AWIPS to determine where is the forecasted moisture. Trying to determine non-moist areas that may be predicted by icing algorithm.

   Manually delete icing grids ahead of cloud system since feel cloud systems are not moving as fast as what RUC predicts.

   Use cross-section on editor to check icing tops and bases.

   Based upon forecast shift, knows icing is at high levels. Manually adds icing grids to increase vertical extent.

Comments and Enhancements:

   Cross-section is beneficial with scanning option.

   Would like to see PIREPs in the vertical cross-section.

   Some type of identification markers on vertical cross-section would be helpful in order to know location.

Mouse is too sensitive.

Would be beneficial to display current AIRMETs.

Grids every 3 hours are good. Run risk of data overload with more data unless tremendous improvements in model accuracy are achieved.

Interface is intimidating due to number of options.

More comfortable with typing flight levels of interest.

Time is critical. Can not devote a lot of time to editing. Other forecast problems must be dealt with.

Cross-section needs to be synchronized with horizontal plan view when zoomed.

More screen real estate for satellite image would be helpful.

Retain latest PIREPs on editor view regardless on image time rather than only a window around image time. Similar to satellite image concept.

Would like to see model relative humidity fields overlaid on editor icing grids.

No utility for volume viewer.

Looping controls appears as if would be helpful by the defining of interested levels. N-AWIPS only allows single level views or complete composite. Were not used due to a lack of familiarity.

Wants to see display size increased. Has suggested that this may be accomplished by removing menus from screen.

To make an AIRMET:

Include VORs on editor.

Point and click with points transferred to PC.

For a 6-hour valid AIRMET:

Split screen to see beginning and ending of valid period.

Forecaster: 4

Scenario 1:

1. Description: Forecaster not comfortable with editor.

2. Procedures: Walk through features.

Scenario 2:

1. Description: Still uncomfortable with editor.

2. Procedures: Walk through features.

Comments and Enhancements:

Plotting of PIREPs is important.

Allow individual to define pre-set colors. Some forecasters are color-blind.

Icing grid degrades satellite image. Perhaps only show icing grids. If no icing exist, then don't show grid.

No utility for volume viewer.

Bracket critical temperature regime for icing (0°C and 20°C).

Finds the stability indices very useful.

PIREPs need additional information (i.e., Type, Severity, Time).

Would like to see temporal looping.

Would like to be able to have option for text inputs to select flight levels.

Critical temperature overlays would be useful.

To make an AIRMET:

Point and click which would transmit points automatically to PC.

For a 6-hour valid AIRMET:

Wants to be able to loop through time models.

Forecaster: 5

Scenario 1:

1. Description: SLC area with a valid time of 21/00Z due to data problems with editor.

2. Procedures:

Compare with N-AWIPS. Look at icing product on Eta for valid time.

Use paper VOR map to sketch outline of icing area from Eta.

Look at RUC icing product for valid time.

Look at RUC neural net icing product.

Look at 500 mb vorticity product on N-AWIPS to identify short waves.

Look at relative humidity for 900, 700, and 500 mb to identify major areas of moisture. Compare with editor icing grids.

Looked at location of editor displayed PIREPs.

Manually delete icing grids that felt were an overforecast based upon information viewed on N-AWIPS and PIREPs.

Scenario 2:

1. Description: BOS area with a valid time of 21/09Z. No forecast information available due to data problems.

2. Procedures:

Compare editor icing grids to RUC neural network output on N-AWIPS. Seeing if agreement in areas is reasonable.

Use split panel capability of N-AWIPS to compare 09 and 12Z icing products to determine movement and changes.

Use zoom and pan functions of editor to display area of interest.

Look at freezing rain and freezing drizzle portion of icing grid. Knows freezing drizzle is occurring in western PA. May use freezing drizzle in wording of AIRMET.

Manually adds icing to join two separated areas.

Manually deletes icing.

Comments and Enhancements:

Would like to see freezing level on cross-section.

Would like to see relative humidity fields.

Cross-section is useful to determine icing fields. Could also be use to determine cloud tops.

Need location indicator on cross-section to show where cursor is in horizontal view.

Skew-Ts not used but would be beneficial.

Not much utility to Volume Viewer.

Looping control is useful.

Blue grid of no-icing areas is distracting. Would prefer to see only the icing grids.

Need more information on PIREPs than currently displayed.

Need satellite animation (looping of time sequence).

Animation (looping of time steps) is important since AIRMET is 6 hour product with an extended outlook.

Algorithm parameters not modified. Not comfortable with parameters. Would not use until was comfortable with understanding of the science and statistics.

Need a better busy indicator.

Need a check (perhaps a prompt) so will not add icing to levels below the freezing level. For instance, a dialog box prompting the user "are you sure you want to add/delete ice between these flight levels?"

Would like to see "raw" data that goes into algorithm (e.g., relative humidity) rather than just the derived product.

Wants to be able to apply the NCAR/RAP algorithm to more models.

Would like the 'reload list' feature to update automatically.

To make an AIRMET:

Point and click to draw outline. Would like to be able to edit lines in order to avoid short distances from location identifiers.

Transfer points to word processor in similar manner as Convective SIGMET position.

For a 6-hour valid AIRMET:

Would like to step through with snapshots at 3-hour intervals.

Another possibility, but not preferred, is to have a 6 hour composite.

Forecaster: 6

Scenario 1:

1. Description: BOS area with a valid time of 18Z (analysis time of 15Z). Current satellite images not available on editor.

2. Procedures:

Using editor cross-section, scan South to North and back. Checking heights of bases and tops. Scan East to West.

Use N-AWIPS to look at SAOs (text product) in area of interest. Identifying precipitation in area.

Look at AFOS graphics for indication of precipitation. Look at radar tops.

Look at satellite image to identify convective activity.

Look at relative humidity fields on N-AWIPS to determine moisture trends. Look at 700 mb level since icing displayed on editor was in that general level.

Scenario 2:

1. Description: SLC area with a valid time of 18Z.

2. Procedures:

Look at freezing level from Eta on N-AWIPS.

Look at 700 mb fields (relative humidity, advection) on N-AWIPS.

Scan editor cross-section.

Based upon wind flow at 700 mb and satellite image, would add icing. Would use freezing level as base and cloud top information from skew-Ts to determine top of icing area.

Comments and Enhancements:

Include heights of PIREPs.

Include radar data underlayed on icing grids.

Include freezing level on the editor.

Skew-T is too small. Need larger display, possibly a two headed system which allows full screen display.

Skew-Ts should display modifications, for example, user specified changes to freezing level.

Would be helpful to see skew-Ts from observations in addition to model derived ones.

Need full screen display so detail is not lost. This is important with high resolution satellite images.

Models other than RUC need to be on the editor so forecaster can use model of choice.

Font size needs to be user configured.

Animation is needed. Past 24 hours of icing grids to see how models have been handling. In addition, animation of PIREPs and AIRMETs is needed to determine how well models are performing.

Include lightning data so convective areas will not be given an Icing AIRMET.

Flight levels are preferred over isobaric levels.

Volume viewer does not show utility. It is too easy to lose locations (perspective).

Looping control is beneficial.

Scanning is an excellent tool.

Would like to set boundaries on cross-section scanning in order to go back and forth over an area of interest.

Terrain representation on cross-section is useful. Allows identification of terrain induced icing.

Would like to have a prompt identifying what levels icing will be added when manually editing grids. Perhaps a default based upon temperature criteria (0-20°C) so unrealistic flight levels will not have icing added.

Would like to have a busy indicator that is more apparent to the user.

Wants editor to make some intelligent assumptions.

To make an AIRMET:

Point and click to identify outline. Automatic transfer of points and states to word processor. Bases and tops should also be transferred.

For a 6-hour valid AIRMET:

Use 3 hour increments.

Changes in 3 hour increments should be sent to word processor for inclusion into AIRMET. For example, if icing conditions end on a westward edge in the next 3 hour increment, then the change should be reflected in the information transferred to the word processor.

Would want to animate (loop) edited grids in order to check for consistency and smoothness between the increments.

Forecaster: 7

Scenario 1:

1. Description: BOS area with a valid time of 21Z.

2. Procedures:

   Look at RUC neural network icing product on N-AWIPS. Scan vertically through neural network levels and comparing to icing grid on editor.

   Based upon neural network, identify 6-12 Kft as levels of icing.

   Using editor skew-Ts to define thickness of moist layers. Thin layers manually deleted.

   Manually deletes icing areas above 12 Kft based upon neural network guidance.

   Use cross-section to check bases and tops.

Scenario 2:

1. Description: SLC area with a valid time of 21Z.

2. Procedures:

   Look at RUC neural network icing product on N-AWIPS. Scan vertically through neural network levels and comparing to icing grid on editor.

   Manually delete cloud free regions on editor.

   Manually add icing areas based upon neural network composite.

   Using N-AWIPS, overlay PIREPs on satellite to identify significant areas of icing.

   Manually remove icing areas based upon neural network composite.

   Manually scan horizontal plan view and examining cross-section.

Comments and Enhancements

Top levels of skew-T are not needed. Including this information degrades the detail and limits the size of the skew-T. Use resolution as displayed on N-AWIPS which allows better cloud top estimates.

Looping control is beneficial. However, manual stepping through the vertical levels is more important.

Need a busy indicator.

Volume viewer is a "toy" that is not beneficial unless editing can be done in 3-d space.

Editing on the cross-section would be useful, for example, sloping bases could be visualized.

Icing intensities are needed. If in a contour product, it would be useful to edit the contours.

Editing of the neural network icing product would be useful since the neural network product gives intensities.

Would like to see PIREPs independent of grid time.

Would help to stop skew t at 300 MB. Would enable you to increase skew t size without increasing window size

As long as your fixed to a 2-D screen it is very difficult to truly utilize 3-D.

Overall, editor is pretty good.

Should be able to add intensities.

Likes the cross-section.

Didn't use algorithm parameter. Partly because unsure that he doesn't think it's the right algorithm.

To make an AIRMET:

Editor may make first guess for AIRMET outline but forecaster has to be able to modify if necessary.

AIRMET outline should be automatically transferred to word processor. Short distances from VORs should be moved to the VOR.

For a 6-hour valid AIRMET:

Keep the time increments separate from one another.

May want a composite of the time increments as a final check, but not as a final product.

Want to keep temporal grids separate. Might want to do a composite at end to review all 3 times. Need to loop temporal data.

Forecaster: 8

Scenario 1:

1. Description: BOS area with valid time of 00Z.

2. Procedures:

   Compare editor icing grids with neural network icing product on N-AWIPS. Vertically scanning neural network levels.

   Look at PIREPs on editor.

   Examining moisture profile of cloud regions. Using editor skew-T to check depth and vertical location of moist areas. Comparing to freezing level.

   Check Nested Grid Model (NGM) icing thickness on N-AWIPS. General agreement is seen with editor grids.

Scenario 2:

1. Description: SLC and SFO areas with a valid time of 00Z.

2. Procedures:

   Using looping controls to determine tops and bases of icing areas.

   Check NGM icing thickness on N-AWIPS. Some differences from editor grids identified.

   Change flight levels to only those of interest. Manually adds icing based upon what shown on NGM.

Comments and Enhancements

Cross-section is very useful, but would like to not be limited to only North-South and East-West. North-South cross-section would probably be used the most since variability in the bases is usually oriented north to south.

Cross-section needs geographical indicators.

Skew-T is useful.

Looping controls appear useful. However, cross-section is a better way for determining bases and tops.

In order to use the algorithm parameters, would have to use the icing product over time in order to see if any trends are identified (e.g., constant overforecasting).

Would prefer a larger display.

Addition of freezing level would be useful.

The volume viewer does not appear to be useful.

Valid time on the display needs to be more prominent.

When looking at a single level, the level needs to be prominently displayed.

Would like to see PIREPs independent of grid time.

Prefers fixed menus that do not click on and off, such as with N-AWIPS.

Would like to see additional information on the editor, such as relative humidity, temperature, and freezing level.

Editor could be used to amend existing AIRMETs.

Would need more than one monitor to view different models. Display would become too cluttered in limited to one display.

Algorithm could be useful if you noticed trends that it was overforecasting.

Doesn't see use for the volume viewer.

Need data level indicator on loop as well as plan view.

Would like additional indicator as to what level your at in looping control.

Need more flexibility as to how you can view PIREPs -- so would like to look at PIREPs for any time.

Would like to see an automated product that developed AIRMETs within current constraints.

Would like to see cross-section on an angle other than North/South or East/West.

On North/South scan, you need some indication between Canada and US so you can see border.

To make an AIRMET:

Point and click to outline area could be a possible option.

Would be useful to have location identifiers to define points.

Does not prefer an editor determined AIRMET area. The editor would probably generate an area with too many identifier points. The forecaster should be able to outline the area.

Would like to create AIRMETs in the same fashion as the convective SIGMET VDUC.

Would be useful to have VOR points.

For a 6-hour valid AIRMET:

Create a composite from 3 hour increments. Overlay beginning and ending times to form a total area.

Accumulate in the overlay -- create a single composite.

Forecaster: 9

Scenario 1:

1. Description: CHI area with a valid time of 03Z.

2. Procedures:

   Zoomed in on area of interest.

   Looking at cross-section to identify vertical extent of icing layer (i.e., tops and bases).

   Look at skew-Ts in icing regions to determine vertical extent of moist areas. Compare with tops and bases from cross-section.

   Manually deleted icing areas.

Scenario 2:

1. Description: CHI area with a valid time of 00Z.

2. Procedures:

   Comparing Eta icing output on N-AWIPS.

   Based upon knowledge of PIREPs, editor grids are realistic.

   Determine bases and tops from editor cross-section.

Comments and Enhancements

Would add satellite animation in order to know cloud trends and movements. Would include at least the past 6 hours of satellite images, maybe the last 12 hours.

Looping Controls are useful. Manually stepping through levels is useful.

The horizontal plan view scanning feature should include a step-by-step such as the Looping Controls have. This would allow the forecaster to manually step through cross-sections.

The mouse was very sensitive.

The horizontal plan view and the vertical cross-section need to be linked so when the horizontal view is zoomed, the

cross-section automatically adjusts so that the two views are correlated geographically.

Zooming is a useful function. Would not want pre-determined forecast area (FA) views since weather crosses FA boundaries.

Wants to be able to loop the satellite imagery at least 6 hours worth.

Would be helpful to have some sort of marker in the vertical cross-section to let you know where you are.

Loop controls are a useful tool -- a step by step feature is good.

System is not fast enough.

Found it to be very tedious to have to keep the mouse perfectly still when moving scanning line. If user moved the mouse at all while the mouse button was depressed, it would start to draw a line.

Nice zoom feature but too difficult to use.

Would like options for zoom from pre-set to free zoom.

Some sort of indication as to which Skew T is up on the chart.

Font on Skew T is very difficult to read.

Ensure that enlargement of Skew T doesn't obscure window.

Need three hours of information either side of current time.

Wants to be able to put PIREPs in 3D image.

Loop the development of clouds -- time loop how clouds are building or changing over 6 hours or 12 hours.

To make an AIRMET:

Point and click to outline an area.

Overlay location identifiers.

For a 6-hour valid AIRMET:

Edit each 3-hour increment during the AIRMET valid period. Manually step through each time increment (as current N-AWIPS capability).

Forecaster: 10

Scenario 1:

1. Description: CHI area with a valid time of 18Z. Analysis time was 12Z.

2. Procedures:

Examine 12Z analysis grid on editor.

Use Looping Controls to identify where the levels where the majority of the icing is.

Change to 18Z forecast grid on editor.

Use manual stepping of Looping Controls to scan levels.

Check the four categories of the algorithm (i.e., stable, unstable, freezing rain, and freezing drizzle).

Varying the location of the cross-section in order to identify vertical and horizontal extent of forecasted icing area.

Look at PIREPs on N-AWIPS (AFOS) to get details of reports. Looking at reports of both icing and no icing. Looking at vertical extent of PIREPs.

Examine levels on editor that correspond to PIREPs of icing.

Change to 15Z forecast. Compare with PIREPs. Appears that forecasted icing grids are lagging PIREPs of icing.

Change back to 18Z forecast.

Manually delete small portion of icing grid.

Define flight levels and manually add icing based upon PIREP information.

Switching between 15Z and 18Z forecasted grids to assess model performance.

Scenario 2:

1. Description: SLC and SFO area with a valid time of 18Z.

2. Procedures:

Look at PIREPs on N-AWIPS (AFOS) and compare with 12Z analysis to assess model performance.

Look at editor cross-section to determine icing levels. Compare to PIREPs.

Change to 15Z forecasted icing grid.

Manually remove icing grid point outliers. Considered to be noise.

Using cross-section to review icing in mountainous areas. Cross-section reveals areas to be thin layers and low level. Manually delete areas.

Define flight levels and manually add icing to extend forecasted area.

Comments and Enhancements

Would like to have another window to compare the different categories of the icing algorithm.

Include time animation.

Vertical resolution is not used to full extent since AIRMET must provide an envelope of conditions.

Cross-section is useful for giving the horizontal and vertical extent, but needs time animation.

Cross-section needs to zoom to align with horizontal view when horizontal view is zoomed.

More PIREP information is needed, such as time and altitude. Shouldn't have to switch between editor and AFOS to get PIREP information.

Would like to be able to control density of plotted PIREPs similar to AFOS feature.

Grid covers satellite image. Get rid of grid where there is no icing.

Have to be able to save edited grids.

Volume Viewer has no utility for operations.

Skew-T was not used, but is probably useful for looking at specific features. However, the Skew-T is limited to a specific point rather than a broader horizontal extent.

Must be familiar with algorithms before making any adjustments to algorithm parameters.

Busy indicator needs to be more obvious.

Include coastal water boundaries for forecaster's area of responsibility.

Need user specified colors since some forecasters are color blind.

Need forecasted information for the type of icing, not just whether it exists or not.

Zoom and pan functions need to be easier. Should not have to use mouse in conjunction with keyboard.

Stepped zoom as currently on editor is preferred.

Freezing level would be a good addition as an overlay. Prefers color filled product rather than contours.

Outliers should be manually removed. Manual editing is easy and there may be instances where outliers are representative of an actual icing threat.

Would like to have another window available to see different regimes.

Horizontal cross-section gives good detail for vertical extent.

Current plan view should be looped in time along with the lower window.

Need more detail in PIREPs:

time
type
level
severity

Wants to be able to toggle on and off various PIREP information.

Would usually look at a couple of models to decide which is best one for the day.

Really wants to turn blue grids off -- don't need to see blue grids.

Likes that vertical cross-section shows icing even when it's not in the selected range.

Would really like to click on VORs.

For PIREPs, would like both progressive disclosure and a data density control.

Really need a freezing level overlay to be able to toggle on and off.

To make an AIRMET:

Point and click (similar to Convective SIGMET process). Editor should generate From Line and make adjustments to prevent small distances (10-20 miles) from location identifiers.

Include location identifiers.

Include a text window with editor so do not have to have external connection to a PC for generating AIRMET text.

Outline horizontal area first, then the vertical levels second.

For a 6-hour valid AIRMET:

Would edit beginning time step and ending time step and then see composite.