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MORE INTUITIVE GRAPHICS FOR THE COLLABORATIVE CONVECTIVE FORECAST PRODUCT (CCFP)

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1. INTRODUCTION

Weather related delays due to convective activity are the single most disruptive force within the National Airspace System. The Collaborative Convective Forecast Product (CCFP) (Hudson, 2002) seeks to reduce these disruptions by collaboratively creating a more accurate forecast of convective weather (see Figure 1 for an example of the current CCFP). For the 2005 convective season, significant changes to the display of the CCFP are planned based upon extensive user feedback. The purpose of this paper is to describe the upcoming changes in the CCFP by explaining the rational for making the CCFP more intuitive, the design process, the options considered, and the final product that is scheduled for implementation.

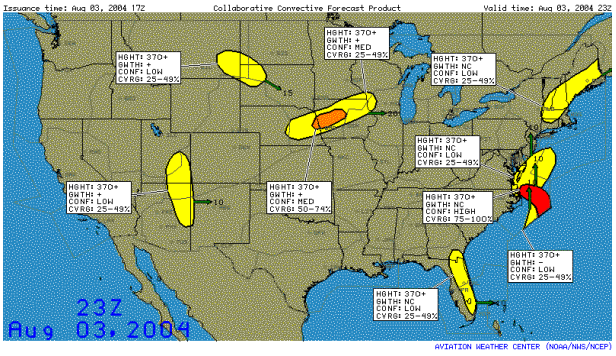

Figure 1. CCFP Current Example

2. CCFP DESCRIPTION

The CCFP is a 2-6 hour graphical forecast of convection developed specifically for use in the strategic planning and management of air traffic. It is produced in a collaborative manner by the National Oceanic and Atmospheric Administration National Weather Service Aviation Weather Center (NOAA/NWS/AWC), the Meteorological Services of Canada (MSC), NWS Center Weather Service Units (CWSUs) located at the Federal Aviation Administration (FAA) Air Route Traffic Control Centers, and airline meteorology departments. See Sims, 2004 for a more detailed description of the CCFP.

The primary users of the CCFP are air traffic management which includes both FAA and industry elements. The CCFP is the primary weather forecast product for collaboratively developing a Strategic Plan of Operations (SPO). The SPO is finalized during the collaborative teleconferences hosted by the Strategic Planning Team at the FAA Air Traffic Control System Command Center (ATCSCC) and conducted approximately every 2 hours. The current configuration for the CCFP has become the cornerstone weather forecast product for daily traffic management decisions.

The current CCFP graphic is composed of several items (WAWG, 2004). Polygons represent the geographical areas that are forecasted to have convection meeting the minimum CCFP criteria. The polygons are color coded according to the expected coverage as defined in Table 1.

Color	Description	Percent Coverage
Yellow	Low	25-49
Orange	Medium	50-74
Red	High	75-100

Table 1. CCFP Coverage Definitions

In addition to coverage, the CCFP also conveys information on the maximum echo tops forecasted within the areas of convection, an indicator of growth, and a subjective measure of the forecaster's confidence that the minimum forecast criteria will be met. Confidence is expressed as low (25-49%), medium (50-74%) and high (75-100%). These attributes (echo tops, growth, and confidence) are provided in a textbox attached to the polygon of interest (see Figure 2 for an example). Also included in the graphic is the direction (given by a green arrow) and speed of movement (in knots) of the entire area.

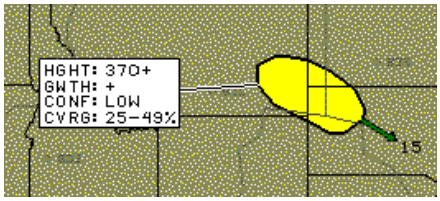

Figure 2. CCFP polygon and textbox

As shown in Table 2, the coverage and confidence alone leads to nine different combinations that producers and users have to decipher via a combination of color graphics and the textbox.

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	Coverage		
	Low-Low	Low-Medium	Low-High
	Medium-Low	Medium-Medium	Medium-High
Confidence	High-Low	High-Medium	High-High

Table 2. CCFP Confidence-Coverage combinations

3. USER FEEDBACK

Inherent in the continued enhancement of the CCFP is the collection of user feedback. To this end, personnel from the FAA ATCSCC Weather Unit surveyed over 75 users and user representatives over a nine-month period. The purpose of the survey was to solicit feedback on the CCFP, specifically the graphical depiction on convection. It was identified that the components of coverage, confidence, and echo tops were important. In addition, there was a desire to eliminate the textbox making the CCFP more usable "at a glance." Additional information indicated that users were interpreting CCFP areas as no-fly zones, even when coverage was forecasted to be low (i.e., 25-49% of the area). This was attributed to the solid, opaque look of the CCFP convective areas. In fact, the survey identified occasions when air traffic was rerouted away from a CCFP polygon simply because it was there. The users did not realize that areas were low topped, low coverage, low confidence and would have had little impact on en-route flights. These occasions were not isolated. Thus, an effort was initiated to change the CCFP display to convey as much information as possible in a graphical, intuitive manner.

4. DESIGN PROCESS

Based upon the user feedback, several options were developed by personnel at AWC working with ATCSCC personnel. The options used a combination of color and fill (or shading) to designate the appropriate coverage and confidence levels. The two options that resulted from this process were the following:

1. Use color for coverage (as is done with the current CCFP) and use fill for confidence (see Figure 3), or
2. Use color for confidence and use fill for coverage (see Figure 4).

Of these two options, it was viewed that the second option (Figure 4) would be more intuitive. Fill could be used for coverage on an increasing basis. Low coverage areas would be blank (with only an area outline to define them) or have minimal fill; medium would have progressively more fill, and high coverage would have even more fill or be solid. These two options were presented to the Weather Applications Work Group, operating under the FAA and airline industry's Collaborative Decision Making (CDM) process.

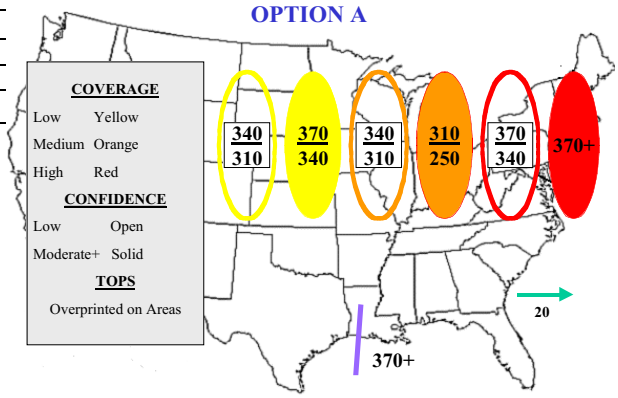

Figure 3. Color coverage and fill confidence option

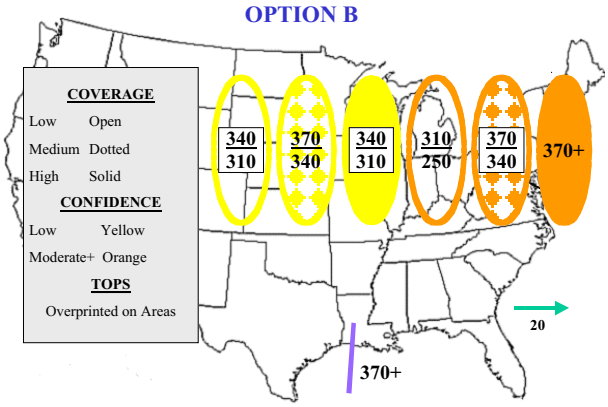

Figure 4. Color confidence and fill coverage option

The Weather Applications Work Group recognized that the options needed the advice of Human Factors experts. Thus, two independent, simultaneous reviews were conducted. One was by academia experts at the Ohio State University, while the other was conducted by experts at the FAA William J. Hughes Technical Center. Useful feedback was provided by both reviews including the need to have the options displayed in a setting comparable to what would be used for actual operations. As a result, personnel from the Human Factors Laboratory at the William J. Hughes Technical Center created operational mock ups of the two options. The mock ups were made with displays from the Enhanced Traffic Management System (ETMS). In addition to the CCFP areas, other ETMS overlays were included, such as aircraft positions, weather radar images, and flow constrained areas. When the mock ups were completed, they were presented to a subgroup of the Weather Applications Work Group. Further modification resulted in an agreed upon final product (see Figures 5 and 6). Two displays, one with a light background and one with a dark one, are shown since the background colors of the ETMS are user-selectable. The product utilized the second, more intuitive option

that uses color for confidence and fill for coverage. Heavy, scalloped outlines were selected to define the CCFP areas. Low confidence is indicated by yellow coloring and orange indicates medium confidence. Confidence values were also changed so that only two measures are used: low confidence represents 25-49% and medium represents $\geq$ 50%. High confidence was removed since this option was used very rarely. Coverage is now given by progressive levels of fill with empty areas indicating low coverage (25-49%), partial fill indicating medium coverage (50-74%), and solid areas indicating high coverage (75-100%). Tops are shown in an overstrike box for large CCFP areas while small areas will retain a small textbox offset from the CCFP area.

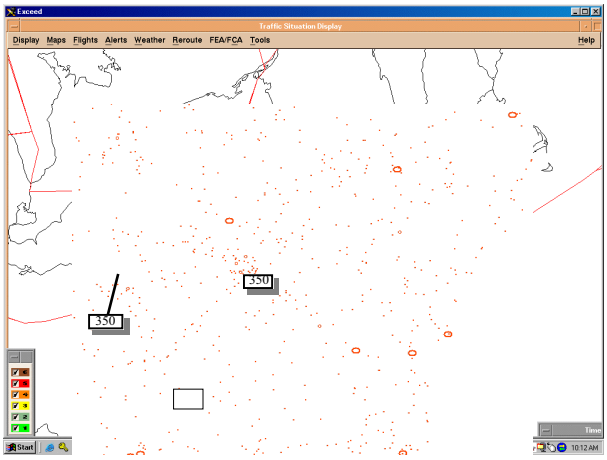

Figure 5. CCFP intuitive graphic on light background

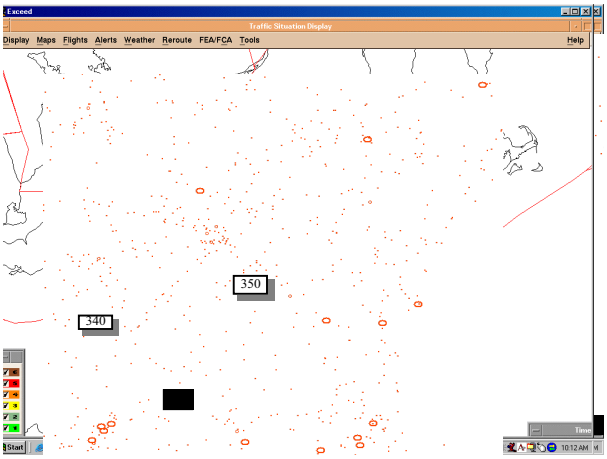

Figure 6. CCFP intuitive graphic on dark background

As a final step, the agreed upon final display was presented to both FAA and airline industry users. The reaction was favorable and the product has now been forwarded to the CDM leadership for inclusion into the enhancements planned for a Spring 2005 release of the ETMS.

5. NEXT STEPS

While the display work of the CCFP intuitive graphics is completed, other steps are needed in order for full operational use to occur. The Weather Applications Work Group publishes an annual CCFP Statement of User Needs (WAWG, 2004). This document includes a full description of the CCFP. This winter will be spent updating this document to reflect the changes in the CCFP display. In addition, new training materials will be developed by the ATCSCC Training Staff. These materials will be developed and provided to users prior to the start of the 2005 convective season.

6. SUMMARY

In summary, the CCFP display has been modified based upon extensive user feedback. Users identified that coverage, confidence, and tops were the important parameters that needed to be conveyed at a glance. As a result, a more intuitive CCFP graphic has been developed. This graphic was subjected to Human Factors and user reviews in order to provide a meaningful representation. Documentation and training will be developed during the next months in order to have the CCFP implemented for operational use in 2005.

6. REFERENCES

Hudson, H. R. and F. P. Foss, 2002: The CCFP from the AWC's Perspective. 10th Conference on Aviation, Range and Aerospace Meteorology, American Meteorological Society. 3 pp.

Sims, D. L. and D. Rodenhuis, 2004: Program Management for the Collaborative Convective Forecast Product (CCFP). 11th Conference on Aviation, Range, and Aerospace Meteorology, Hyannis, American Meteorological Society. 4 pp.

WAWG, 2004: Statement of User Needs, CCFP - 2004. Weather Applications Work Group (WAWG). Editor: K. Mullen, Collaborative Decision Making Workgroups. 32 pp.