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OPERATIONAL FEEDBACK REPORTS TO PROVIDERS OF AVIATION'S COLLABORATIVE CONVECTIVE FORECAST PRODUCT

Duane Torbert* and Dave Rodenhuis
FAA, ATCSCC, Herndon, Virginia

1. INTRODUCTION

Since the summer of 2000, the National Weather Service and meteorological departments from some of the major commercial airlines have collaborated to produce a six-hour thunderstorm forecast for the contiguous United States and the immediate surrounding areas. It has evolved each year in terms of production (it is now updated every two hours through the operational day), in terms of participation (Meteorological Service of Canada is now a collaborator), and impact (it is recognized by the FAA and users as the primary thunderstorm forecast for air traffic flow management).

The skill of the Collaborative Convective Forecast Product (CCFP) has also improved in terms of its accuracy, its precision and its consistency. Part of the reason for this is the feedback that is received by the producers of the CCFP. They receive operational feedback on the usefulness of their forecasts in daily "CCFP Operational Feedback Reports", produced by the FAA at the Air Traffic System Command Center (ATCSCC). They also receive quantitative feedback on accuracy, precision and consistency in both daily scores and in periodic reports from NOAA's Forecast Systems Laboratory (FSL) Forecast Verification Branch (FVB).

2. THE COLLABORATIVE CONVECTIVE FORECAST PRODUCT

The CCFP is defined by 3 components: collaboration, the forecast, and the application, as explained by Hudson and Foss (2002). A CCFP forecast is produced and issued every other hour from 3 AM to 11 PM Eastern Daylight Time, every day from early March to late October, and is the result of the collaboration of several meteorological facilities. Each issuance includes three forecasts; one with a lead time of +2 hours from the issue time, one with a +4 hour lead time and one with a +6 hour lead time. The domain of the forecast is the 48 contiguous United States, southern Ontario and southern Quebec, and certain adjacent areas. The forecast parameters are the expected location, coverage, tops and movement of thunderstorms (WAWG, 2004).

Corresponding author address: Duane Torbert, Air Traffic Control System Command Center, FAA, 13600 EDS Dr, Herndon, VA, 20171; email:Duane.Torbert@faa.gov.

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3. THE CCFP OPERATIONAL FEEDBACK REPORT

The CCFP Operational Feedback Report (Fig.1) was initiated in 2003 to provide immediate operational feedback to the producers of the CCFP. The Report is produced at the ATCSCC and is distributed to the producers, primarily the National Weather Services' Aviation Weather Center (AWC) and Center Weather Service Units (CWSUs). Several airlines and a number of FAA facilities, users, researchers and commercial weather service providers also receive the Report for their own technical interests.

Figure 1: Title page header of a CCFP Operational Feedback Report

Each CCFP from the heart of the operational planning day, (as a minimum, 9 AM to 3 PM Eastern Daylight Time), is compared with observed convection by FSL using the Real Time Verification System (RTVS). The National Convective Weather Detection (NCWD) is used to compare the CCFP with those lines and/or areas of thunderstorm that met certain agreed upon thresholds for the valid time in question (Mahoney, et al., 2002).

In addition to the verification by FSL, the evaluation includes a study of the transcripts of the CCFP collaborations, certain Air Traffic Control daily logs and any other reports that are pertinent and available.

The results of the evaluation are written in a summary that includes 3 skill measures. This Summary report is attached to a selection of maps and ATC logs to complete the Operational Feedback Report. Through the Report, producers learn of the impact that their forecasts had on air traffic flow management, either good or bad. They learn how accurate their forecasts were with respect to location and timing. Other thunderstorm intensity characteristics such as aerial density and echo tops are not yet explicitly verified. The producers also learn of how precise their forecasts were (Did they over forecast or under forecast?), and finally,

they learn of how consistent their forecasts were from one issuance time to the next.

3.1 Operational Impact

Each of the daily CCFP Operational Feedback Reports begins with a subjective evaluation of how the CCFP impacted the system, or how decisions that were based on the CCFP effected the safe and efficient flow of air traffic. For example, if air traffic planners made reroute decision based on the CCFP that turned out to be necessary and effective, that would be identified in the report and followed up by supporting explanations when available.

3.2 Weather

A brief and general description of the thunderstorm producing weather systems is given to help to paint a picture of the overall weather pattern that the producers were evaluating that day.

3.3 Weather Chat Room

An Internet Weather Chat room with white board, hosted by the AWC, is used by the producers to collaborate on their forecasts. For thirty minutes producers contribute to the CCFP production process by sharing their forecasts with other participants, listing the factors that went into their forecast, and depicting their forecast on the whiteboard for others to view. The Chat Room transcripts are reviewed and significant discussions or observations are listed and commented on in the Report.

3.4 Accuracy, Precision and Consistency

The CCFP Operational Feedback Report gives producers feedback on the accuracy, precision and consistency of their forecasts in two forms. The first is a narrative describing the CCFP's accuracy, precision and consistency that is the result of a visual comparison of key CCFP forecasts with the corresponding RTVS. The second is the analytic and objective scores from the RTVS analysis (Table 1). A brief explanation of each of the three scores appears on each report Monthly and yearly scores of these parameters may be obtained directly from the Forecast Verification Branch (http://www-ad.fsl.noaa.gov/fvb/index.html).

3.5 Delays

Each Report records the total number of delays throughout the National Airspace System to provide the users with a sense of the magnitude and scope of the impact that thunderstorms can have on air traffic. A list of each airport that reported at least 50 delays is also given. (Delays are defined as 15 minutes or more.)

Accuracy/PODy[1] Score: 0.35 (July 2003 average PODy 0.29).
Precision/Bias[2] Score: 0.99 (July 2003 average Bias 0.99).
Consistency[3] Score: 0.66 (June 2004 average Consistency 0.61).

Table 1: Examples of skill scores that appear in a Report.

3.6 ATCSCC Log Excerpts

Daily ATCSCC log excerpts from each of five areas within the ATCSCC are included in the report when they comment on the impact that the CCFP had on their operations or when they comment on thunderstorm activity in general. The National Traffic Management Officers and Traffic Management Specialists who write the ATCSCC logs will occasionally critique the CCFP from their perspective and will include specific instances where the CCFP resulted in a traffic management initiative. This makes the producers aware of how their product is used in the field and of the impact that its use can have.

3.7 RTVS

The final portion of the CCFP Operational Feedback Report includes the 2 hour, the 4 hour and the 6 hour CCFP from each of the 4 CCFP issuances from 9 AM to 3 PM Eastern Daylight Time. Each of those 12 CCFP forecasts is superimposed on the NCWD for the same valid time (Fig. 3). This graphical comparison makes it easy for producers to see those portions of their forecasts that were accurate and those that were not.

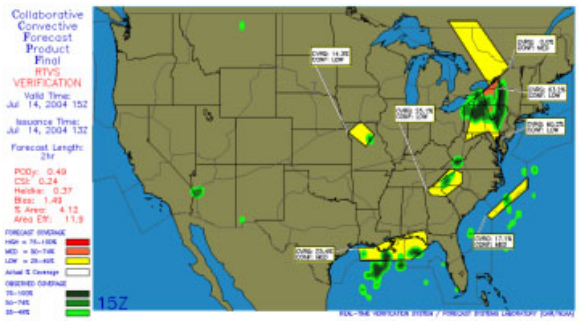

Figure 3: A CCFP with NCWD superimposed.

4. SUMMARY *AND CONCLUSIONS*

The producers of the CCFP benefit from the feedback that the CCFP Operational Feedback Report provides in several ways. The Operational Impact Statement gives producers a view of the usefulness of their products in the setting where they are used. Subjective analyses and quantitative scores make the producers aware of

how their forecasts performed with respect to accuracy, precision and consistency. ATCSCC log excerpts allow producers to learn of the effect their products have on Traffic Flow Management from those in the field who make decisions based on them.

The benefits of feedback to the CCFP producers-forecasters can be seen in a comparison of RTVS scores from 2002, 2003 and 2004 (Table 2). The PODy and CSI scores have improved each year, while the Bias has moved closer to the optimum 1.00 each year.

Year	PODy	CSI	Bias
2002	0.242	0.15	0.84
2003	0.305	0.17	1.08
2004	0.313	0.18	1.03

Table 2: A summary of yearly skill scores from CCFP RTVS for all forecast lead times combined.

Producers of the CCFP will continue to need feedback so that they can remain focused on the purpose of the CCFP and how it is used. There will continue to be a benefit in informing CCFP producers of how their forecasts have performed with respect to accuracy, precision and consistency. An awareness of the benefits to Traffic Flow Management by accurate and precise thunderstorm forecasts need to be documented, as well as the consequences of inaccuracy and imprecision.

Acknowledgements

During the summer of 2003, the idea of creating CCFP Operational Feedback Reports was inspired by the exasperation of Jack Kies, ATT-1, Manager of the Air Traffic Tactical Operations Program at the ATCSCC.

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