J1.3 COLLABORATIVE CONVECTIVE FORECAST PRODUCT (CCFP) ISSUANCE ANALYSIS

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1. INTRODUCTION

The Collaborative Convective Forecast Product (CCFP) is a key component in the strategic planning of air traffic over the National Air System (NAS). The forecasts are used primarily by the Federal Aviation Administration (FAA) Air Traffic Control System Command Center (ATCSCC) and airline dispatchers to determine whether alternate flight routes are necessary for moving air traffic around convective weather. The CCFP is issued with lead times of two, four and six hours, with the strategic emphasis placed on the four and six hour forecasts.

Two of the most significant CCFP attributes are the *coverage* of convective weather within a forecast polygon and the forecaster *confidence* in meeting the minimum forecast requirements. In this analysis, the frequency of issuance of the coverage and confidence attributes is examined. This information provides a summary of CCFP forecast characteristics that can be applied to strategic risk assessment activities.

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2. DATA AND METHODOLOGY

The CCFP forecasts are produced through a collaborative process between forecasters from the National Weather Service (NWS) Aviation Weather Center (AWC) and meteorologists from airlines, Center Weather Service Units (CWSU), and the Meteorological Service of Canada. After the collaboration process, the final forecasts are issued by the AWC. The forecasts, issued with 2-, 4- and 6-h lead times, are polygons that delineate areas of intense convection and thunderstorms. Minimum requirements for the issuance of a CCFP forecast polygon includes an area of at least 3,000 mi^2 with convective coverage of at least 25% coupled with echoes of at least 40 dBZ, and also a coverage of at least 25% with echo tops of 25,000 ft and higher (Weather Applications Workgroup, 2005).

There are three possible coverage categories for CCFP forecasts: sparse (25-49% coverage within a polygon), moderate (50-74%), and solid (75-100%). The confidence is defined as the forecaster’s confidence that convective weather will occur and meet CCFP minimum requirements within the forecasted polygon for the specified valid time.

Categories of different coverage and confidence combinations were created in order to assess patterns in the issuance of

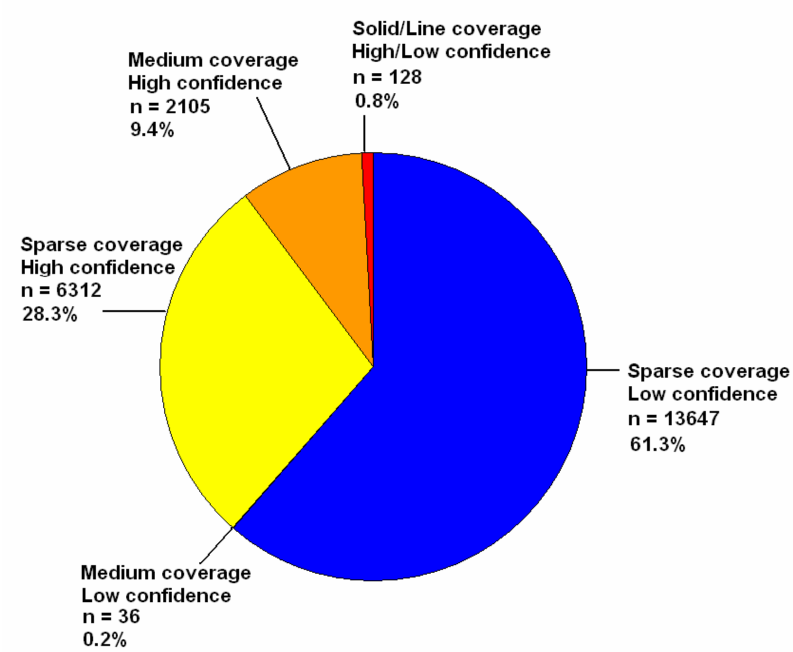

Figure 1. The frequency of various combinations of coverage and confidence attributes of CCFP polygons issued over the period 3 April – 1 October 2005. For all lead times combined.

the CCFP. CCFP polygons are analyzed from 1 April – 1 October 2005 and the number of polygons issued for each coverage/confidence category was collected. The month of March was excluded from the study to avoid complications from the Daylight Savings Time change, which affects the CCFP issue time. The data are assessed by issue time for each forecast lead time. Coverage values are computed in the same manner as is described by Mahoney et al. (2000, 2002) for previous evaluations of the CCFP.

3. RESULTS

The frequency for each coverage/confidence category for the 2005 convective season is shown in Figure 1. The sparse/low category is the type of polygon issued most frequently, with the second and third most frequently issued categories being sparse/high and medium/high, respectively. As expected, the most severe category of line or solid coverage with high/low confidence was issued infrequently, less than 1% of the time. Of the solid coverage forecasts, all of the forecasts were issued with high confidence. The medium/low forecast category was almost never issued (0.2%). Table 1 lists the issuance frequencies for the 2-, 4- and 6-h lead time forecasts. The same general pattern emerges from these data, with sparse polygons being issued most frequently.

A striking feature from this analysis is the high frequency of polygons that are issued with sparse coverage, which are issued almost 90% of the time. Interestingly, the percent of sparse polygons is much greater for the 6-h forecasts than the 2-h forecasts. Because sparse/low polygons have the least risk associated with them, they may not be regarded as useful or significant for 6-h strategic planning.

Table 1. The frequency of observations for each coverage/confidence category for the 2-, 4- and 6-h lead times over the period 3 April – 1 October 2005.

Category	2-h		4-h		6-h	
	% total	# polys.	% of total	# polys.	% of total	# polys.
Sparse/low	54.0	4439	63.3	4656	68.1	4579
Med/low	0.2	14	0.0	7	0.2	15
Sparse/high	32.1	2641	27.4	2017	24.6	1654
Med/high	12.5	1031	8.5	626	6.7	448
Line or solid/low,high	1.3	103	0.7	50	0.4	29

To further investigate the frequent issuance of sparse polygons, the forecast coverage attribute was examined more closely. Figure 2 shows box plots of the observed coverage percentages for all lead times combined categorized by the three coverage forecast categories. Analysis of the observed percent of convective coverage for each polygon indicates the accuracy of the coverage forecast. Box plots show various quartiles of the distribution of coverage data. The central box includes the 25th, 50th, and 75th percentiles, along with the top and bottom lines which extend to cover the range of data between the 5th and 95th percentiles. Notches denote the 95% confidence interval for the median.

The sparse category, which by definition should have 25 to 49% coverage, shows that most observations actually fell between 10 and 40%, with the median value of 27%, approximately. A similar trend is seen for the forecasts with medium coverage: the majority of observations occurred between 30 and 65%, which is somewhat lower than the medium coverage forecast definition of 50-74%. For the polygons forecasted with solid coverage, the observed coverage fell mostly between 45 and 75%, much lower than the definition for solid coverage. These results, which are consistent with those found in Kay et al. (2006) show that the forecast coverage categories are often too high for the convection that actually occurs.

Similar coverage features are evident when results are stratified by lead time, as shown in Figure 3. A decrease in coverage accuracy is seen as the lead-time increases. The 4- and 6-h forecasts tend to be substantially less accurate at forecasting the coverage than the 2-h forecasts. This is true particularly for the medium and high forecast coverages, which show that the largest difference occurs between the 2- and 6-h forecasts.

Figure 4 shows the frequency of polygons for each issuance time, categorized by coverage/confidence. There is a peak in issuance of sparse/low polygons at 1700-1900 UTC (noon-2pm EST). For sparse/high and medium/high polygons, the peak in issuance occurs at 1900 UTC (2pm EST). Although there are not many solid or line/high or low polygons, the issuance of this category peaks at 0300 UTC (10pm EST). The number of medium/low polygons is so small that an issuance peak cannot be accurately determined. These trends indicate that sparse forecasts are issued more frequently earlier in the day, often before the initiation of convection, and are issued less frequently later in the day when convection has already developed.

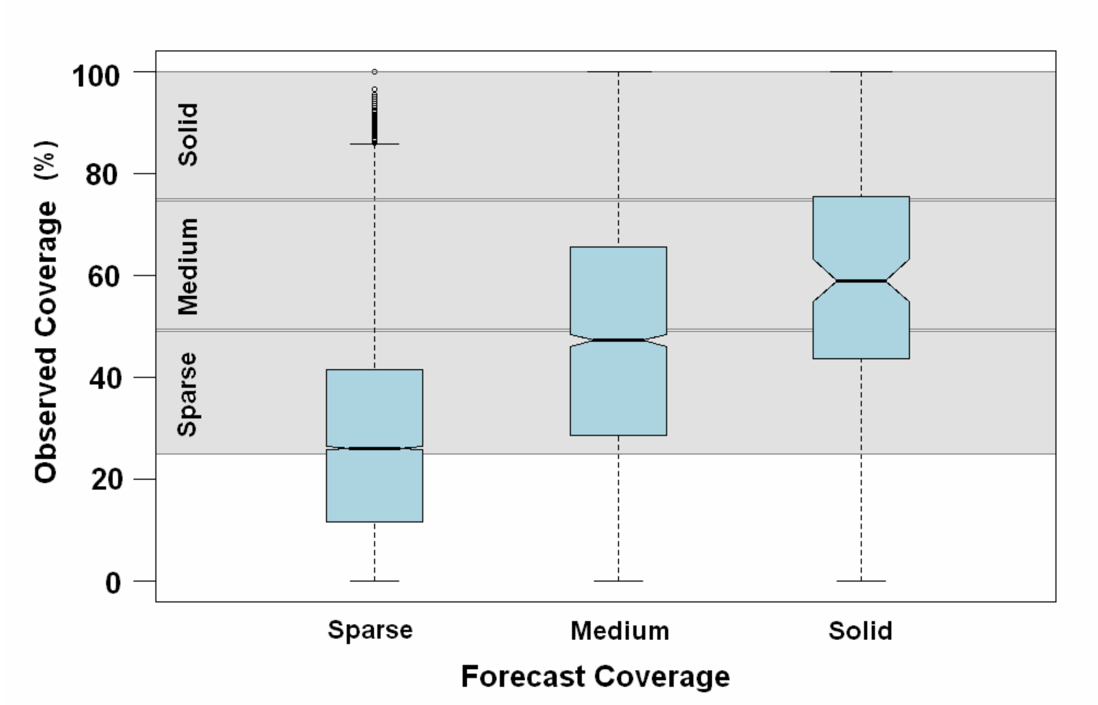

Figure 2. The observed percent coverage of convection compared to the forecast coverage for CCFP forecasts for all lead times combined for the period 1 April – 1 October 2005. The coverage definitions for each category are shown along the y-axis.

Figure 5 shows the percentage of each polygon category for each issuance time. Sparse/low polygons constitute the majority of percentages for all time periods, with a peak during the early morning hours (6-8am EST) decreasing as the afternoon progresses, reaching a minimum at 2300Z (6pm). Also note that the percentage of high confidence categories (sparse/high and medium/high) increases as the afternoon progresses. This trend highlights an uncertainty in forecasting when the early morning convection initiation occurs, followed by more forecast certainty as the convective development continues through the afternoon.

The frequency of polygons issued for the 2-, 4- and 6-h lead time forecasts are shown in Figure 6. The most notable differences are between the 2-h forecasts, which are most similar to the tactical time frame, and the 6-h forecasts, which most closely represent true strategic forecasts. The number of sparse/low forecasts in the morning hours is much greater for the 6-h lead time than the 2-h. The peak of sparse/low forecasts occurs at 1700 UTC for the 6-h forecasts and at 2100 UTC for the 2-h forecasts. Also note that the high confidence forecasts (sparse/high and medium/high) are more frequent for the 2-h forecast than those with longer lead times.

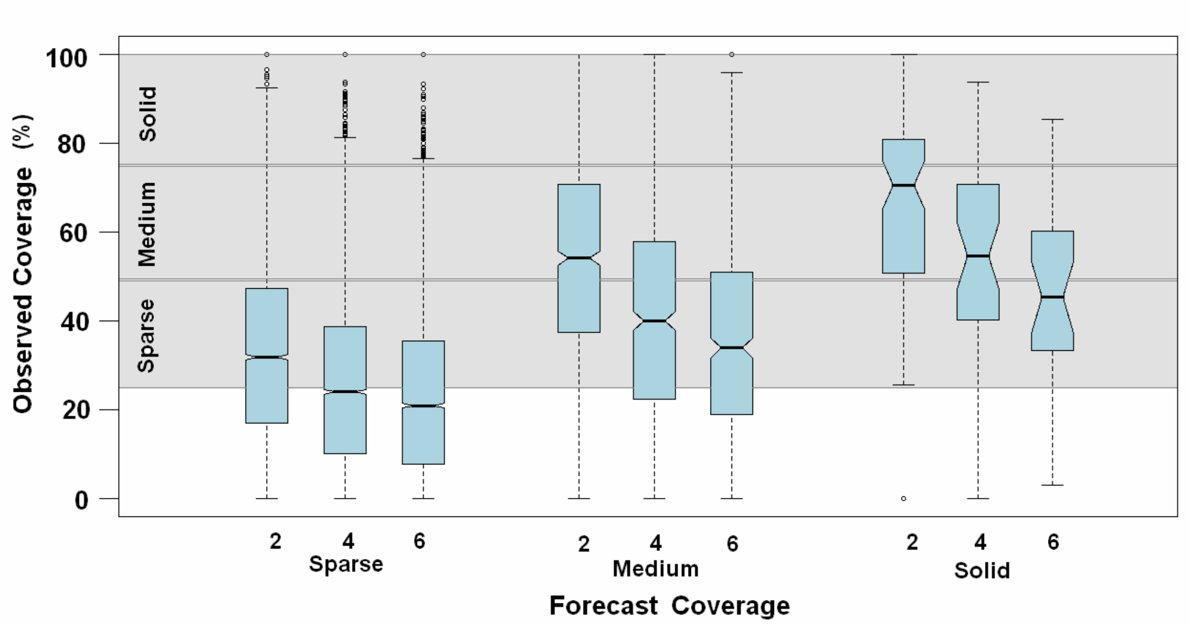

Figure 3. Same as Figure 2, but stratified for all lead times.

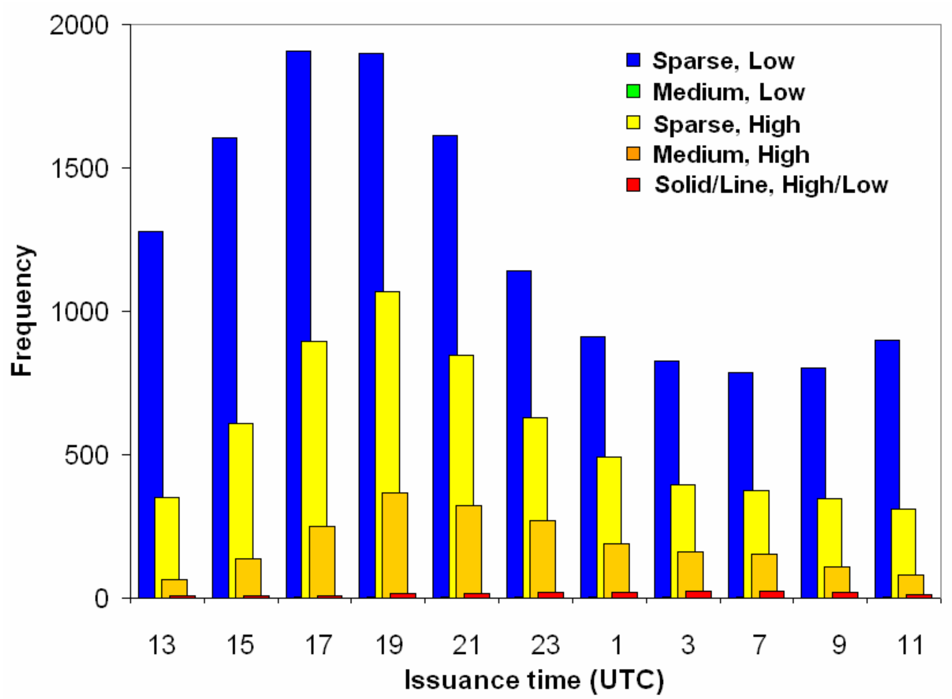

Figure 4. The frequency of polygons issued for each coverage/confidence category over the period 3 April – 1 October 2005. For all lead times combined.

4. CONCLUSIONS AND FUTURE WORK

A brief analysis of polygon issuance for the period April – October 2005 reveals the following issuance characteristics:

- Sparse/low polygons are issued most frequently, over 60% of the time
- Low confidence polygons make up approximately 90% of the total polygons issued
- The observed coverage at all lead times is typically lower than the forecasted coverage
- The forecast coverage tends to be less accurate as lead time increases. This is especially true for the medium and high forecast coverage.
- Low confidence polygons are issued more frequently in the morning
- High confidence polygons are issued more frequently in the afternoon
- Cursory investigations shows that polygons with solid coverage and high confidence are often associated with mesoscale convective systems or tropical storms

These tendencies give insight into the issuance characteristics of the CCFP. Some of the trends reflect the diurnal pattern of convection, as there is more uncertainty in the morning before convection develops. However, strategic planning is most effectively done in the morning; therefore the forecast accuracy at the 6-h lead time is the most critical. Due to the nature of sparse/low polygons, they may not be as useful to strategic planners as polygons with higher coverage/confidence. Future studies will be performed on the operational value of the CCFP. Also, additional verification projects, such as the addition of echo top heights as well as providing statistics by polygon, will provide more insight in to the overall skill of the CCFP forecasts.

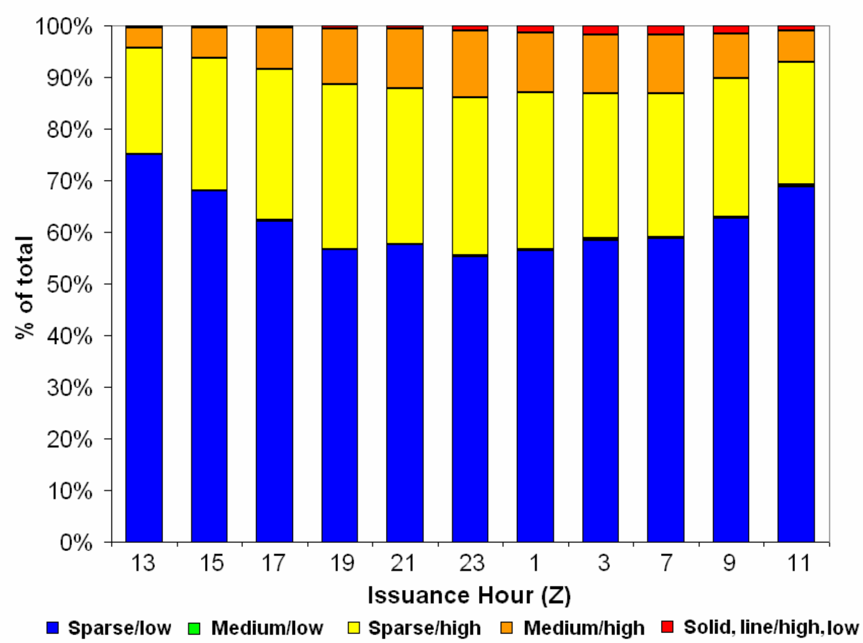

Figure 5. The percentage of each coverage/confidence category for each issue time (all forecast lead times combined). For the period 3 April – 1 October 2005.

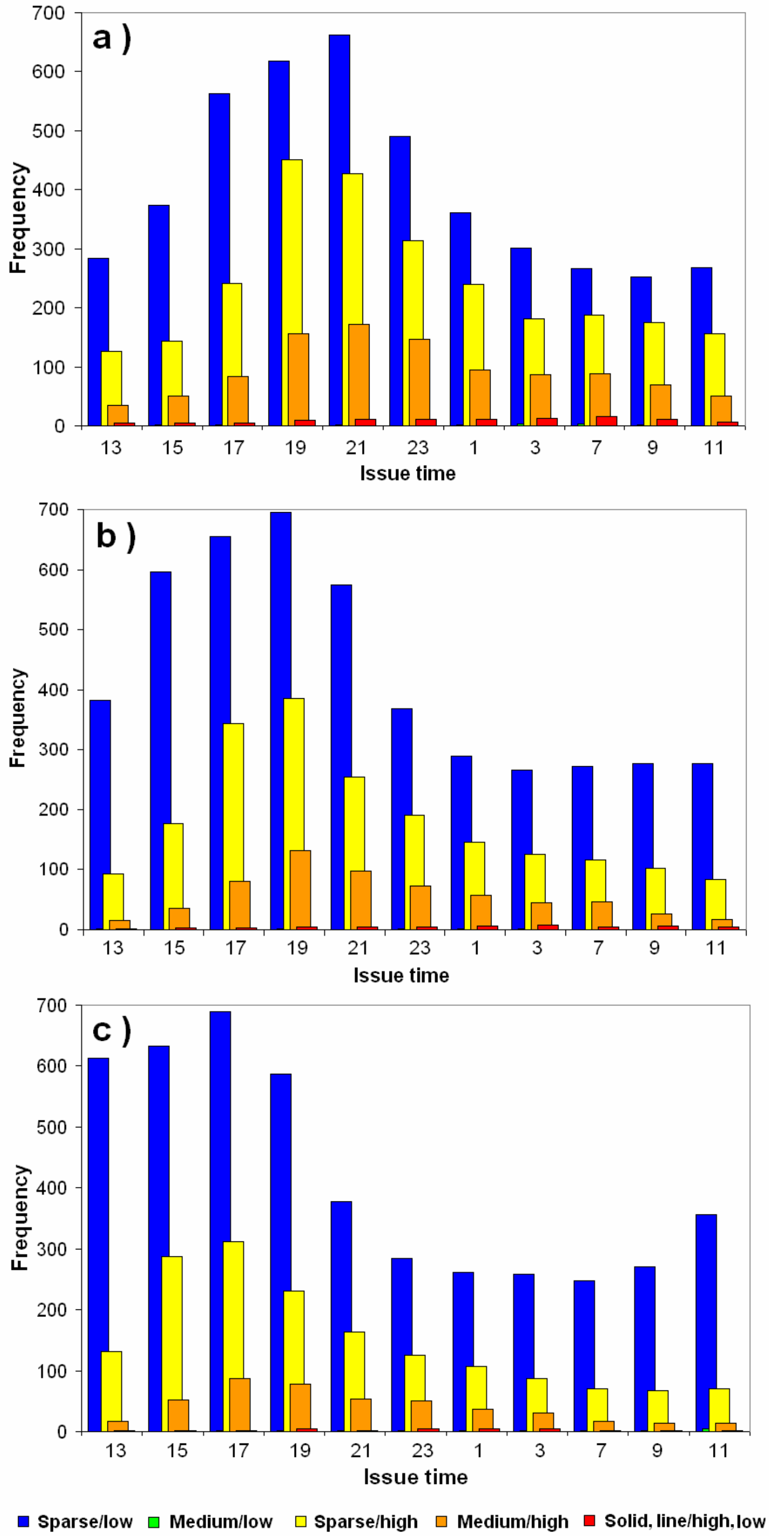

Figure 6. The frequency of polygons issued for each coverage/confidence category over the period 3 April – 1 October 2005 for lead times of a) 2-h, b) 4-h, and c) 6-h.

5. ACKNOWLEDGEMENTS

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