Verification Results for the Integrated Icing Forecast Algorithm (IIFA)

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Introduction

This report represents an initial quality assessment of the Integrated Icing Forecast Algorithm (IIFA). For this study, IIFA forecasts have been verified over a period of approximately two months, from 20 January through 21 March 2000. Pilot reports (PIREPs) were used as the verification data for this evaluation; these observations currently are the only observations of icing conditions that are widely available.

Verification approach

The verification methods that were used for the evaluation are described in Brown et al. (1997; 1999; attached as Appendix 1 and 2). The verification statistics of interest include the following:

- PODy = Probability of Detection of Yes PIREPs; the proportion of positive icing PIREPs that were correctly forecast to be in locations with icing conditions. PODy ranges from 0 to 1, with 1 the "best" outcome;

- PODn = Probability of Detection of No PIREPs; the proportion of negative icing PIREPs that were correctly forecast to be in locations with *no* icing conditions. PODn ranges from 0 to 1, with 1 the "best" outcome; in many cases the statistic of interest is 1-PODn, which ranges from 0 to 1, with 0 the "best" outcome;

- % Volume = the percentage of the airspace volume that has a Yes forecast of icing.

PODy was computed in two ways, (i) using all positive icing reports and (ii) using only reports of moderate-or-greater (MOG) icing severity. PODn was computed using PIREPs that explicitly indicated no-icing conditions.

Because IIFA provides a continuous measure of icing potential, a threshold was applied to the IIFA output to obtain Yes and No icing forecasts. A variety of thresholds were applied to the forecasts, with verification statistics computed for each threshold.

Verification statistics for the IIFA forecasts are compared to statistics for the Integrated Icing Diagnostic Algorithm (IIDA) and the AIRMETs. IIDA essentially is a nowcast of icing conditions (McDonough and Bernstein 1999). The AIRMETs are the operational icing forecasts that are issued every six hours, with amendments issued when weather conditions change, by forecasters at the Aviation Weather Center (NWS 1995). Although AIRMETs are constrained to

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have certain characteristics (e.g., simple volume shapes) and are intended to capture icing conditions across a 6-h period, they are the current operational standard available to users, and thus it is appropriate to include them in this evaluation. Nevertheless, it is important to keep in mind the differences among the three types of forecasts (IIDA, IIFA, and AIRMETs) when examining the results of this study.

Results

Figure 1 shows the relationship between PODy and % Volume for the various thresholds applied to the IIFA output. Results for IIDA and the AIRMETs also are shown. Figure 1 summarizes the results for each forecast lead time (3, 6, 9, and 12 hr), with all forecast valid times combined. Similar results are available for individual valid times, but the statistics are somewhat less stable, due to the smaller numbers of PIREPs that are available at each valid time.

In Figure 1, statistics for better forecasts are located further toward the upper left corner of the diagram. Specifically, this diagram measures the trade-off between improvements in PODy and increases in the volume of airspace that is warned. The results in Figure 1 indicate that the IIDA statistics are somewhat better than the statistics for IIFA, and that both the IIDA and IIFA statistics are slightly better than the statistics for the AIRMETs.

Figure 2 shows the relationship between PODy and 1-PODn. This diagram measures the trade-off between correct classification of Yes observations and incorrect classification of No observations. As in Figure 1, the curves for better forecasting systems are located closer to the upper left corner. Moreover, the 45° line in Figure 2 represents the difference between forecasts with positive and negative skill. Curves for forecasts with positive skill fall above this line; curves for forecasts with negative skill fall below this line. The curve for no-skill forecasts would fall directly on the 45° line.

The results in Figure 2 indicate that IIDA, IIFA and the AIRMETs all have positive skill with respect to this combination of verification statistics. The IIDA curve is very slightly above the IIFA curve, and both the IIDA and IIFA curves are above the point for the AIRMETS. Interestingly, there appears to be little differentiation between the curves associated with the different IIFA lead times.

The results shown in Figures 1 and 2 are based on PIREPs reporting moderate-or-greater icing severity. Results for all icing severities are very similar.

Conclusion

The basic verification results presented here indicate that (i) the IIFA forecasts, for all lead times evaluated, out to 12 hours, have positive forecasting skill; (ii) the level of skill of the IIFA forecasts is slightly less than (but approaching) the skill of the IIDA nowcasts; and (iii) the skill of the IIFA forecasts is similar to or somewhat greater than the skill of the AIRMETs.

References

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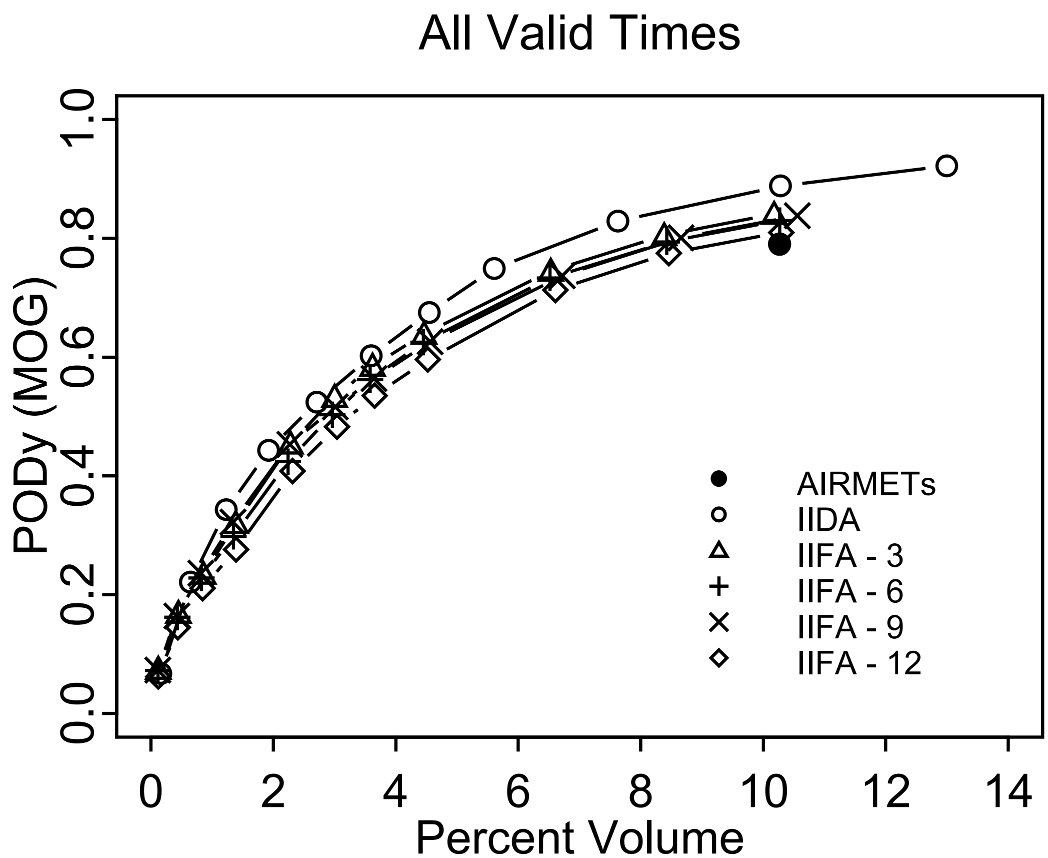

Figure 1. Relationship between PODy (for MOG PIREPs) and % Volume, by forecast lead time, for all IIFA forecasts, IIDA, and AIRMETs, for the period 20 January through 21 March 2000. Each point on the IIDA and IIFA forecast curves represents the verification statistics for a particular threshold. IIDA and IIFA thresholds (from right to left) are 0.00002, 0.05, 0.15, 0.25, 0.35, 0.45, 0.55, 0.65, 0.75, 0.85, and 0.95.

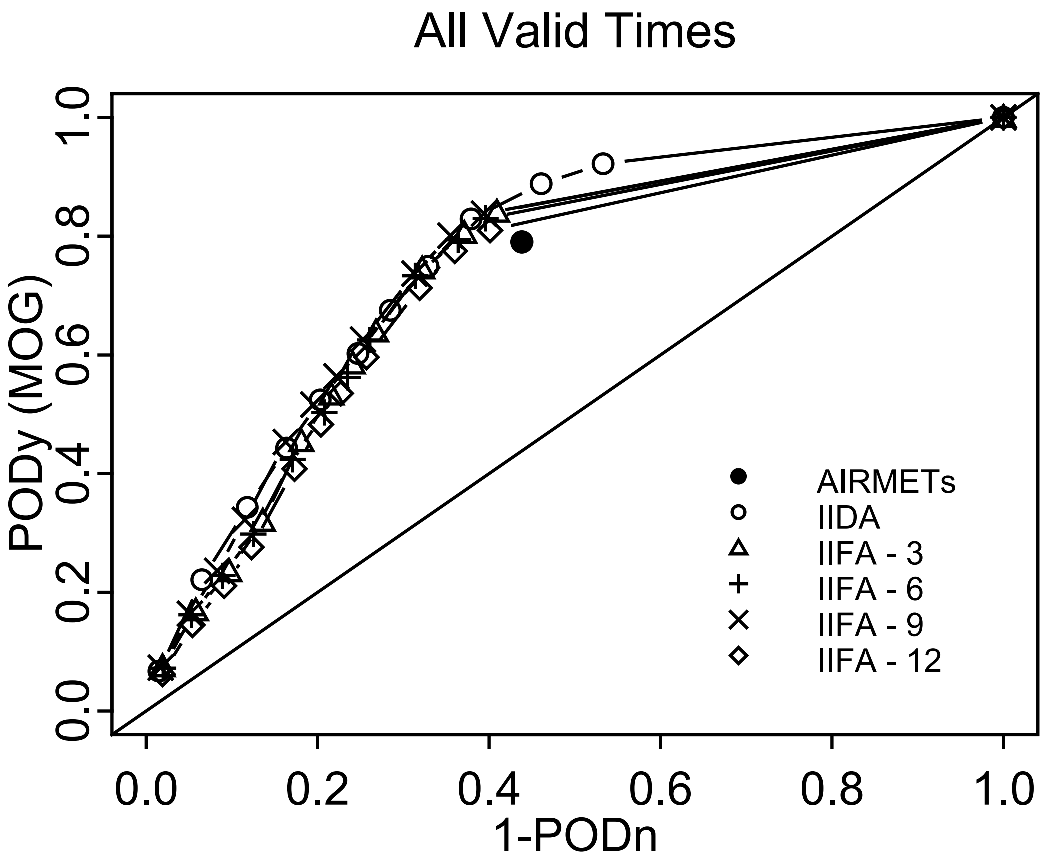

Figure 2. As in Figure 1, for PODy vs. 1-PODn.