VERIFICATION OF FORECASTER-GENERATED iCAST THUNDERSTORM NOWCASTS AND COMPARISON TO AUTOMATED THUNDERSTORM FORECASTS: PRELIMINARY RESULTS

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1. INTRODUCTION

The interactive Convective Analysis and Storm Tracking (iCAST) prototype is being developed to evaluate the use of an area-based, met-object approach to thunderstorm nowcasting, storm tracking and warning generation (Sills et al. 2009). For this study, we focus on only one aspect of iCAST – thunderstorm prediction in the 3-6 hour range.

The objective of this study is to compare a number of automated thunderstorm forecasts to thunderstorm nowcasts generated by forecasters using iCAST.

2. DATA AND METHODOLOGY

A team of three experienced forecasters generated thunderstorm forecasts for the Canadian province of Ontario and neighbouring regions valid for 18-21 UTC (2-5 pm local time) from 29 May to 26 September, 2011. The forecasters had access to all Canadian and US observational and NWP data via iCAST and other operational forecasting tools.

Four probability categories were defined: 'none', 'chance', 'likely', and 'certain'. For verification, the corresponding numeric values are 0.1, 0.35, 0.65, and 0.9. An example of an iCAST thunderstorm nowcast with lightning verification, converted to gridded format, is shown for 7 July 2011 in Fig. 1.

Lightning data are from the North American Lightning Detection Network. Both cloud-to-ground and cloud flashes are used. Only days with a valid iCAST nowcast in the forecast domain are included in the study, giving a sample size of 68 days.

Automated thunderstorm initiation and area (TIA) forecasts have been developed by Taylor and Burrows (2010). The modelling system from which TIA forecasts are derived is the Environment Canada Regional Deterministic Prediction System (RDPS) that includes a 15-km, limited-area version of the

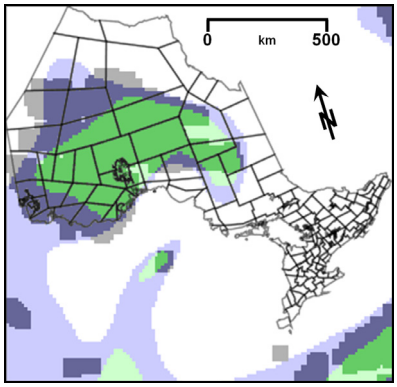

Figure 1. The iCAST thunderstorm nowcast (purple = 'chance', green = 'likely'), plus 75 x 75 km^2 lightning verification boxes (darker shades), for 7 July 2011.

Global Environmental Multiscale (GEM) NWP model (Côté et al. 1998). The TIA fields included in the study are:

OBTI – uses a four-level likelihood scale according to increasingly stringent thresholds of instability, convective inhibition, low-level convergence, and low-level wind shear, and

IVV – integrates the RDPS vertical velocity at each model level from the surface to the mixed-layer equilibrium level for each grid point in order to identify where strong upward vertical motions, near the surface and/or aloft, are likely to initiate and/or sustain deep moist convection.

Both OBTI and IVV make use of values from the Cloud Physics Thunderstorm Parameter (CPTP, Bright et al. 2005) calculated using RDPS data. CPTP uses cloud physics principles to forecast where cloud electrification is likely if deep moist convection develops. A CPTP >= 25 mask is applied to better delineate areas with thunderstorm potential. Resulting OBTI and IVV values are converted to 'none', 'chance', 'likely' and 'certain' forecast categories

The TIA fields are hourly forecasts. In order to compare them with the 3-hr iCAST forecasts, the 18, 19 and 20 UTC TIA fore-

casts are combined into one field, taking the maximum value at each grid point.

For this study, we have used a relaxed verification approach that allows leeway both spatially and temporally. Lightning flash occurrences at a grid point are spread to a 5 x 5 grid point (75 x 75 km^2) envelope, and these squares may overlap. Also, lightning from both the hour before and the hour after the 18-21 UTC verification period are included.

We have employed a system that allows categorical probability forecasts of binary events (thunderstorm vs. no thunderstorm). A good probability forecast system has resolution, reliability, sharpness, discrimination and skill. In this study, we use the Attributes Diagram, ROC score, and Brier Skill Score to measure these attributes. All are described in Wilks (2011).

The Attributes Diagram measures how well predicted probabilities of an event correspond to observed frequencies. There are three lines on an Attributes Diagram: the diagonal line representing perfect reliability - if the curve lies above (below) the diagonal it indicates underforecasting (overforecasting), a horizontal line at the reference climatology value indicating no skill over random guessing, and a third line exactly between these representing no skill over forecasts of climatology.

The ROC Score assesses the ability of a forecast to discriminate between two outcomes, while the Brier Skill Score measures the relative skill of the forecast over that of climatology. For both, 1 is a perfect score.

3. RESULTS

The Attributes Diagram for the entire 68-day sample using iCAST nowcasts and automated forecasts derived from the 12 UTC runs of the RDPS is shown in Fig. 2. The reference climatology for this sample is 11.6%. Each forecast has similar reliability for the 'none' and 'chance' categories, but the reliability of OBTI falls off significantly above that, with IVV falling off significantly for the 'certain' category. All methods generally overforecast.

The OBTI forecasts have superior sharpness, followed by iCAST, then IVV which has only a small number of forecasts in the 'likely' and 'certain' categories. All forecasts show significant resolution.

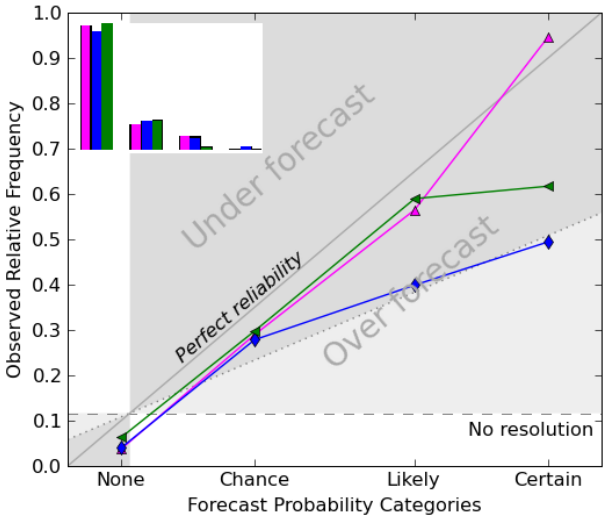

Figure 2. Attributes Diagram for 68-day sample. iCAST (magenta), OBTI (blue), and IVV (green) forecasts curves are shown, with frequency histogram at top left. See text for descriptions of the various attribute lines.

The Brier Skill Scores for iCAST, IVV and OBTI forecasts over the 68-day sample are 0.21, 0.11, and 0.06, respectively, while the ROC Scores for the same forecasts over the same period are 0.66, 0.44, and 0.62, respectively. Confidence intervals using bootstrapping will be added in the future.

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