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OPERATIONAL SCRIBE NOWCASTING SUB-SYSTEM : OBJECTIVE VERIFICATION RESULTS

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1. Introduction

The Meteorological Service of Canada is currently implementing a National Weather Element Database. One of the main production tools used to update the database is the SCRIBE expert system (Verret et al, 1993) developed at the Canadian Meteorological Centre.

This system uses guidance from numerical weather prediction (NWP) models and their derived statistical outputs, namely Perfect Prog (PP) (Klein et, 1959) or Updateable Model Output Statistics (UMOS) (Wilson and Vallée, 2002). In practice, this means that the weather elements forecasts available in SCRIBE are solely based on model data, without any explicit observation data. Therefore, SCRIBE is totally unaware of recent weather events, and this limitation is particularly acute for weather elements which are generated long after the model run. This "blind" effect has to be compensated by the operational forecaster, who has to make adjustments to merge model forecasts data with current observations.

Recently, a Nowcasting Sub-System (NSS) has been implemented that attempts to minimize these necessary manual adjustments.

It has been demonstrated in several experiments that most of the modification work that forecasters perform on the SCRIBE guidance is to merge model forecasts with current observations. Thus, the main functionality of the NSS is to merge the SCRIBE weather elements with the latest local observations and nowcasting model data. The NSS is capable of ingesting surface, radar and lightning observations and projecting these observations into the short term future using a short range forecast model.

Objective verification has been performed on many weather elements for the first six hours after the observation hour. Results show that the nowcasting weather elements verified better than the SCRIBE weather elements.

2. The SCRIBE System

SCRIBE is an Expert System capable of generating automatically, or interactively, any type of weather products for a region or a specific locality (see Verret et al, 1997 for more details). The data that feeds the system come from a set of matrices which are generated after the 00Z and 12Z model runs. These matrices contain different types of weather elements such as NWP output, statistical guidance from PP models and UMOS models and other model analyses and climatological data. The time resolution is 3 hours. When ready, the regular matrices are sent to each regional SCRIBE system. Upon arrival, the data is processed by the Concept Generator and are synthesized and downsized to a set of well defined weather elements called *"concepts"*. These concepts, which can be displayed on a graphical interface, are then modified by the forecaster to reflect the latest observations and understanding of the weather situation. The concepts which are in a digital coded format called METEOCODE will be used by the regional office to generate local products.

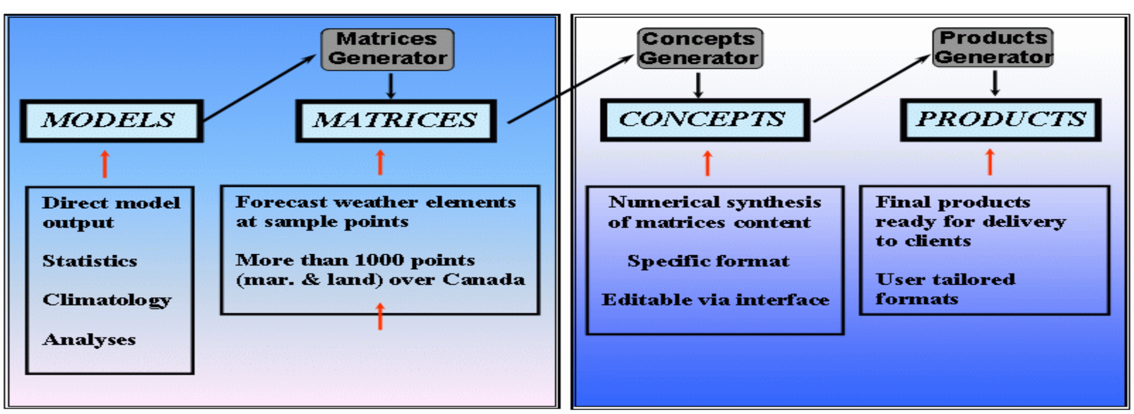


Fig. 1. Basic Scribe System information flow with the different data formats.

The concepts will also be sent to a National Weather Elements Forecast Database where a suite of national products can be generated. figure 1 shows the main steps in the Scribe data processing

.3. The Nowcasting sub-system

The SCRIBE Nowcasting Sub-System (NSS) has been developed over the past three years and recently implemented operationally. It can ingests observed and nowcasting model weather data on a continuous basis. Once an hour, a consistent set of weather elements can be used to update the automated regular Scribe weather elements concepts, or the current weather concepts on which the forecaster is working. This update is done either automatically or interactively by the forecaster. Three dynamic databases are updated hourly to support the NSS. The first one contains the surface observed weather elements. The second, contains the Radar and lightning observations and their short range extrapolation. Finally, the third one contains statistical model and NWP model data. All these data are than analysed by a network of rules that will build a matrix containing a consistent suite of continuous weather elements where seven hours of observations are followed by 12 hours of forecasted data. The time resolution of the observed and nowcasting data in the matrices is 1 hour compared to three hours in the regular SCRIBE matrices.

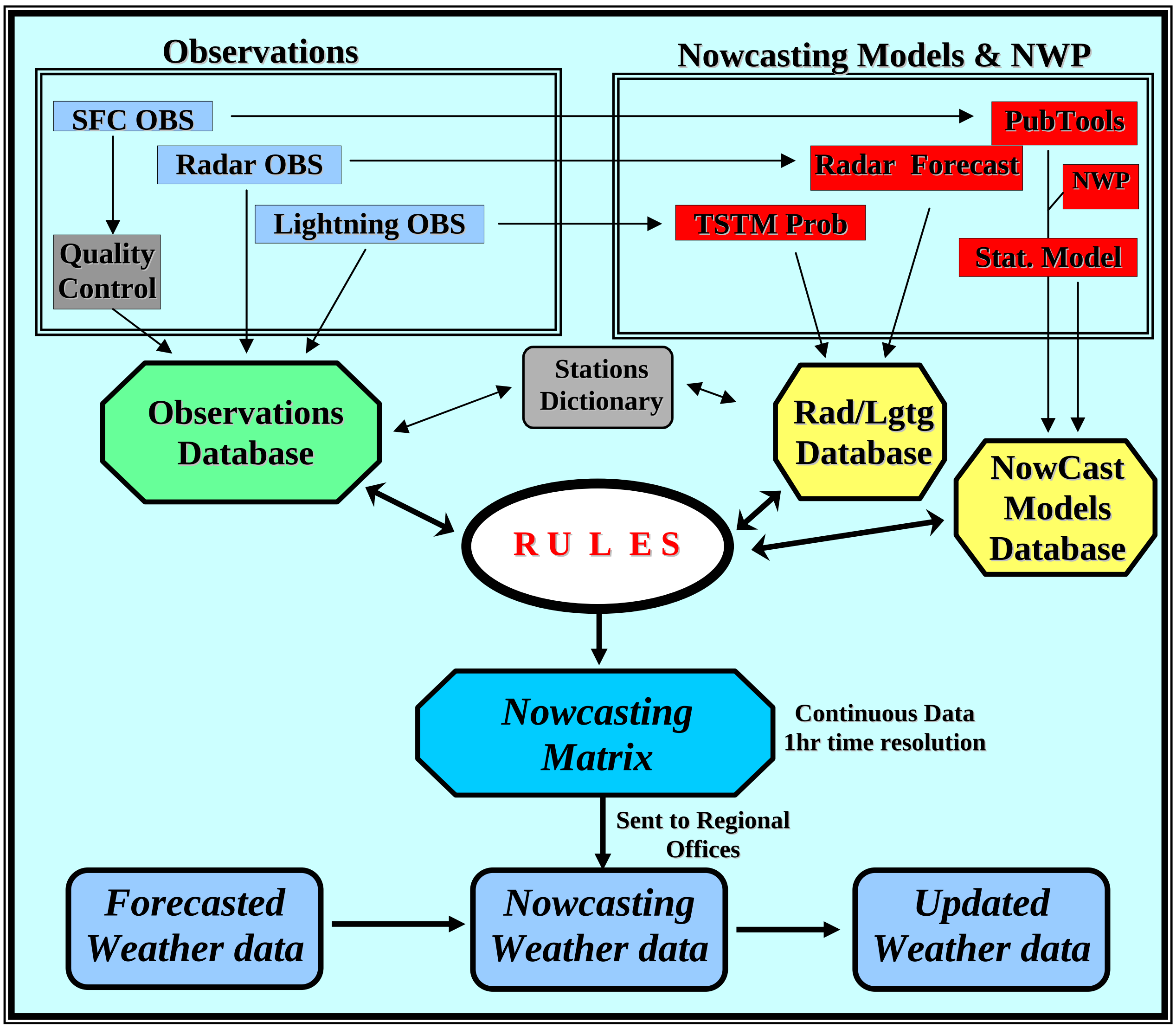


Fig. 2. Architecture of the Nowcasting Scribe Sub-system. Observations and Nowcasting data are processed, synthesized and merged into a continuous set of weather elements which are sent to each regional offices. Data is then locally transformed into weather elements concepts and used in real time to update the SCRIBE weather elements.

These *Nowcasting Matrices* are sent hourly to all Canadian Regional SCRIBE installations and processed locally to update the SCRIBE weather elements concepts. Figure 2 represents the architecture of the Nowcasting Sub-System.

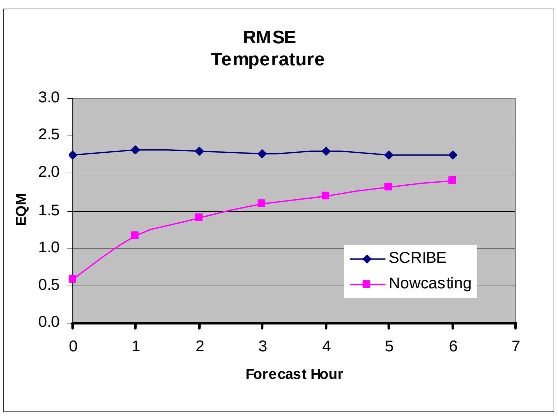
Updated weather elements for more than 450 stations are currently available about 30 minutes after the hour ready to be merged with the SCRIBE weather elements or the current working forecast.

4. Verification

A first objective verification has been produced to evaluate the performances of the nowcasting weather elements with respect to the regular Scribe weather elements. An hourly verification was done on the first 6 forecast hours. Different scores were calculated on the following weather elements: temperature, dew point, clouds amounts, winds, probability of precipitation and precipitation types. The time period on which the verification was performed was from November 2003 to February 2004. A selection of 23 stations across Canada with 24 hours METAR observations was used. Verification time was based on the morning forecast issue where the time of the observation used by the nowcasting was one hour prior to the issue time. Hour h_o, is the observation and h_1 to h_6 are the forecast hours. More than 2000 forecast events were available for verification .

The resulting scores show that for most weather elements, and for all 6 forecast hours, the Nowcasting performs better than the pure Scribe model weather elements. Examples of these results are presented in fig. 3 and show the Root Mean Square Error (RMSE) for temperature and winds.

Probability of precipitation (POP) is in general a more difficult parameter to predict, even in the short term. Nevertheless, the Nowcasting weather elements did show a significant improvement upon Scribe. The Brier Skill Score in fig. 4. shows that up to hour 4 of forecast, the Nowcasting scores higher than Scribe. An other interesting aspect of the Nowcasting POP forecast, is that fewer midrange POPs are forecast compared to Scribe, thus showing more sharpness (Fig 5.).



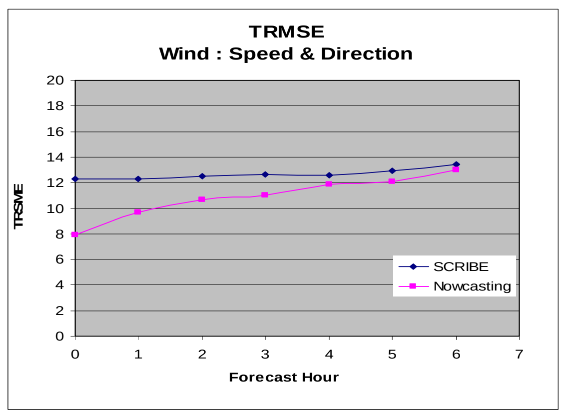


Fig. 3. RMSE and TRMSE (Total RMSE) for temperature and wind for the first 6 forecast hours. Nowcasting is based on observations at hour h_o while Scribe temperature are based on UMOS model data.

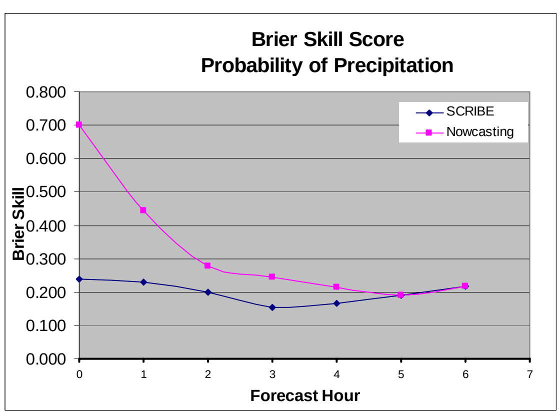
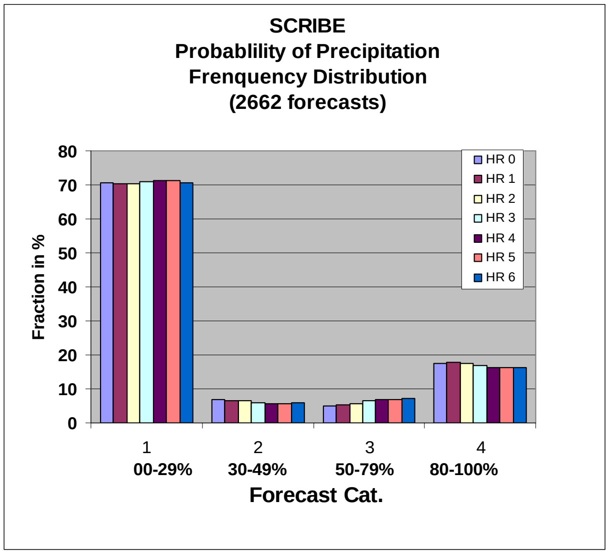


Fig. 4. Brier Skill Scores for Probability of Precipitation.



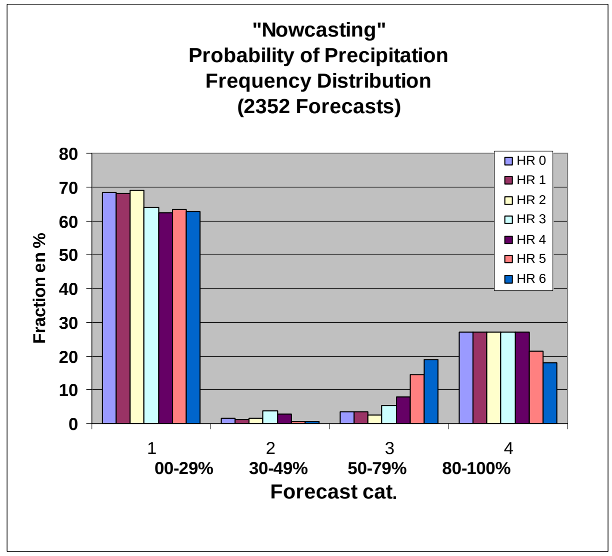


Fig. 5. Frequency Distribution of POP for the first 6 forecast hours. Nowcasting shows more sharpness than Scribe by forecasting fewer POP events in the middle range bins.

5. Conclusion

The verification of the Scribe NSS shows a significant improvement over the regular Scribe weather elements for the first 4 to 6 hours of a forecast. The NSS is sharper. Thus, the weather elements prepared for the forecaster to update are, on average, a reliable source of real time information. Further objective verification on the forecast for the summer 2004 will be performed and analysed soon.

6. Reference

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