1.0 INTRODUCTION

Most public and aviation forecasts are issued at specific scheduled times. It has been recognized that persistence is a tough competitor to beat during the first few hours of the forecasts. This is valid even for high resolution numerical weather prediction (NWP) models (Benjamin et al. 2004, Ganguly and Bras, 2003). This is especially true for certain parameters useful to the aviation community (e.g. ceiling height, horizontal and vertical visibility, etc) or related to public forecast (sky condition, cloud cover).

The Canadian Meteorological Center (CMC), a component of the Meteorological Service of Canada (MSC), has identified the need to improve forecasts over that initial period (0 to ~6 hours). We have developed two statistically based nowcast modules, one dedicated to aviation forecasts (TAFTools) and one to public forecasts (PUBTools). These first prototypes are based solely on surface observations. That approach has its limitations. We also want to improve aviation forecasts in the 6-24 hour range. To fill that need, we will build another module to statistically relate NWP data to specific weather elements. Nowcasting and short-term forecasting capabilities are expected to improve accuracy of forecasts for up to 24 hours and to help reducing the workload of operational meteorologists.

2.0 OBSERVATION-BASED MODULES

The observation-based component of PUBTools and TAFTools statistically relate observations at a time To to observations at a later time To+dT. The relations are developed using two statistical techniques, Multiple Discriminant Analysis (MDA) and Multiple Linear Regression (MLR). Equations were derived from a long climatological archive (up to 40 years) composed of hourly observations across Canada. Although we produce forecasts for lead time up to 12 hours, the observation-based modules aim at improving forecasts during the first 6 hours. The current operational versions of PUBTools and TAFTools ingest only routine surface observations (METAR, SAS) and analysis produced from those observations to produce hourly forecasts. The probabilistic forecasts produce by MDA may be converted into categorical ones using a scheme based on past performance. PUBTools and TAFTools are very similar modules; they differ only in regard of their predictants.

For different reasons, a piece of information (or a whole observation) may be missing from the database. This will prevent the forecasts from being generated. To avoid that, a synthetic observation module has been designed to fill missing observations in real time. The different pieces of information composing a surface observation (surface temperature, wind direction, precipitation type, etc) are analyzed on a grid using kriging. Different tests make sure that the different analyses are consistent. Values are extracted from these analyses to complete, partially or totally, missing observations.

Verifications for 26 Canadian stations over a 2-year period indicate that observation-based nowcasts of cloud cover, visibility, precipitations types become better than persistence after 2 or 3 hours. However, nowcasts of precipitations occurrences do not show any significant improvement over persistence.

2.1 PUBTools

The forecast elements are: sky conditions, precipitation occurrence and types, visibilities, convection, temperature, dew point, wind direction and speed. That system has recently become
operational at CMC. It is mainly used to provide input to Scribe, a weather forecast product expert system (Landry et al., 2005).

2.2 TAF Tools

There is a strong will from MSC and NAV Canada to improve the accuracy of terminal forecasts (TAF), which are coded forecasts describing expected weather conditions around airports. In Canada, TAF forecasts are issued by two Canadian Meteorological Aviation Centers (CMAC), CMAC-east (Montréal) and CMAC-west (Edmonton). Any improvement in forecast accuracy will result in significant savings and in increase in safety. TAF forecasts are produced manually by trained meteorologists. Forecasts result from a subjective evaluation of the past conditions (climatology, local effects, etc), the current conditions (observations, radar, satellite, etc) and the forecast conditions (trend, extrapolation, numerical data, etc). TAFTools aims at producing objective guidance for the main elements of a TAF.

The forecast elements are: sky conditions, ceiling heights, precipitation occurrence and types, visibilities, convection, wind direction and speed.

3.0 FUTURE MODULES

It was noted that precipitations occurrences was not well handled by observation-based nowcasting. For that reason, we are evaluating the potential of nowcasting using an extrapolation technique (Bourgouin and Verret, 2005). That approach should improve significantly the skill of PUBTools and TAFTools.

We also want to develop a short term module (6-24h) using NWP data. This will be done by building a database using NCEP North American Regional Reanalysis data at 35 km resolution and combine that with our observation database to derive statistical equations relating NWP data from our regional model to observed elements. This will allow us to extend the forecast period to 24h.

The meteorological research branch (MRB), a component of MSC, has build a system using fuzzy logic and data mining, WIND-3, (Herzegh et al. 2004, Hansen 2005) to generate forecast of ceiling and visibilities. TAFTools and WIND-3 produce complementary information.

Performance of the observation-based module, the extrapolation module, the model-based module and WIND-3 will be compared. Verification scores will determine how to blend these different components to produce the best possible forecasts.

4.0 CONCLUSION

Motivations for developing nowcasting and short-term forecasting modules at MSC are two-fold: assure that forecasts fit well with observed conditions during the first few hours in the forecast (0-6 hours) period and improve the accuracy of TAF forecasts (0-24 hours). This should result in a gain in productivity. The first part of the project was to create an observation-based nowcast module prototype. Verifications on a 2-year independent sample show encouraging results. However, the system lacks skill at forecasting precipitations occurrence. For that reason, an extrapolation module will be added to complement the system. We will also develop a statistical model for short-term forecasting using NCEP North American Regional Reanalysis data and observations. This model will be run using data from our regional NWP model. Furthermore, input from WIND-3, another statistical model, will be evaluated.

5.0 REFERENCES


Bourgouin, P., R. Verret, 2005: Development of an extrapolation component for a nowcasting module for aviation (TAFTools) at CMC. Included in this preprint.


Information and Processing Systems, American Meteorological Society.
