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INTEGRATING NEW WEATHER TECHNOLOGY IN FORECAST OPERATIONS AT METEORLOGIX – A NEW PARADIGM

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1 Introduction

Meteorlogix has recently integrated several new weather technologies into its forecast operations, and in the process changed its weather forecast paradigm. The automated forecast system that assimilates model, statistical, and climatological data is described. The use of the National Weather Service's Graphical Forecast Editor (GFE) system as a means of manually editing and adding value to the forecast is explained, along with the use of GIS technology as an aid in graphical forecast presentation. The benefits to clients in energy and surface transportation are described.

2 Meteorlogix Overview

Meteorlogix was created in 2000 by combining three commercial weather organizations: Weather Services Corporation (WSC), Kavouras, and DTN Weather, together.

2.1 Meteorlogix and DTN

Meteorlogix is the weather division of DTN, the leading provider of information and transaction services to the energy, agriculture, and weather markets.

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DTN has over 117,000 direct subscribers receiving weather information, and over 1 million subscribers via redistribution.

As the weather division of DTN, Meteorlogix provides all of the weather content, including forecasts, graphics, and text. Meteorlogix has over 18,000 direct subscribers of its own, virtually all of whom are businesses who subscribe to a variety of weather services. These businesses include eight of the 10 largest energy companies in the US, nearly 50 commercial airlines, Departments of Transportation in over 40 states, as well as thousands of smaller businesses in the turf (golf and recreation), construction, and aviation areas.

2.2 Meteorological Forecasts

All meteorological services provided by Meteorlogix are made in its Meteorological Operations (MetOps) forecast center. Nearly 50 meteorologists work in MetOps to provide all of the weather products and services required by DTN and its clients.

MetOps provides a variety of services, including forecasts and consultations. The forecast information required includes:

- Hourly parameters (i.e. air temperature, cloud cover, visibility, etc.)

- Daily parameters (i.e. max/min temperatures, liquid equivalent precipitation, etc.)
- Graphical objects (fronts, etc.)

3 Changing Operational Paradigms

Changes in technology and communications have revolutionized the weather enterprise. Weather data and forecasts from a multitude of sources are now available very frequently. The internet allows that information to be available to all users quickly and inexpensively. These changes have made weather forecasts a commodity, and have forced changes to the businesses that provide them.

3.1 Traditional forecast preparation

The traditional method of making forecasts for clients was to do it one forecast at a time…a stovepipe. Every client had individual forecast forms or preferred formats for delivery. Preparing a forecast involved pulling up a form on a computer, filling in the blanks, and annotating the forecast as necessary. The forecaster was responsible for then determining how to deliver the forecast to the customer, and had to make sure that it was delivered.

This workflow severely limits how many clients a single forecaster can handle, since a forecaster has to touch each individual forecast product. This limitation is acceptable when there a few hundred forecasts to prepare, but it is not practical when thousands of clients are involved.

Inevitably, forecasters get crunched for time, especially when the weather situation requires more attention to critical thresholds. Since providing forecasts to clients is always the top priority, the first thing a meteorologist does is spend less time looking at current weather and the latest forecast guidance. This in turn leads to less accurate forecasts.

Finally, the traditional workflow can lead to inconsistencies in forecasts. With each individual responsible only for the forecasts they prepare, it is quite possible that different people are preparing forecasts and updates for the same customer. This in turn can lead to some large swings in forecast conditions, unless extraordinary efforts at communication are made between forecasters.

3.2 Meteorlogix forecast paradigm

Meteorlogix has completely changed its forecast preparation paradigm by making the meteorologist responsible only for the core forecast content, and automating the preparation and delivery. Furthermore, by using advanced tools to eliminate the labor involved in producing forecast elements that meteorologists add little or no value to, meteorologists are allowed to focus their efforts on the forecast elements that they can add value to, thereby improving overall accuracy.

The first step in this new process is to produce the best possible automated forecast as a first guess. This is done by integrating an ensemble of forecast inputs into a statistical forecast system. The forecast inputs include:

- MOS (NAM, GFS, etc.)
- Gridded model data (NAM, etc.)
- Climatology
- Current observations

The forecast inputs are processed to into the individual forecast elements, and are corrected for biases, etc. Each forecast element is continually scored over a running 90 day period, and each element is independently weighted according to its performance. This technique produces forecasts for each element that are consistently better than any one individual input (Gerding, 2003). This process is repeated for every observation location, every hour. The most current observations are incorporated into each forecast update, and a forward error correction scheme is applied to adjust, or nudge, forecasts into alignment with reality.

The second step in the forecast process is to allow meteorologists to view and manage the first guess forecast. Using the Graphical Forecast Editor (GFE) software developed at NOAA's Forecast Systems Laboratory (Roberts, 2004), the first guess forecast is transformed into a two dimensional spatial field that can be annotated and edited. In addition to manual editing, GFE provides smart tools that allow routine processes such as terrain correction to be done automatically. The end result is a spatially continuous 5 kilometer resolution forecast of each of the forecast elements, at hourly time intervals, for the duration of the forecast time period.

The final step in the forecast process is the production, distribution, and delivery of the actual forecast products (Figure 1). All of the information necessary to produce a numerical forecast for any location is contained in the GFE forecast grids. The point information necessary for any individual forecast is extracted from the GFE data, and stored in a SQL database. This information is then used to automatically produce customized products for individual customers, and deliver these products.

This system produces forecasts for the entire continental United States at 5 km resolution. Forecasts are updated every hour. Meteorologists are allowed to focus on areas where they can add value or on parameters (such as precipitation) where the first guess is likely to need adjustment. The end result is a mix of man and machines that tales advantage of the strengths of each to produce the best possible forecast.

4 Graphical Forecasts

One of the best ways to communicate forecast information is by using graphics. However, drawing graphics is a time-consuming process that requires meticulous care to insure that the resulting graphic is both accurate and effective at communicating the weather information. Meteorlogix has utilized Geographic Information System (GIS) off-the-shelf software to create tools that facilitate the creation of meteorological graphics (Sznaider, 2003).

4.1 GIS Met Workstation

Meteorlogix has created a software application utilizing standard ESRI ArcView software to create and manage graphical products (Figure 2). A special graphic editor has been created that allows a meteorologist to enter common features such as fronts anywhere in the world. The software allows the meteorologist to think in their terms about the objects they are drawing, providing (for example) isobars and isotherms as drawing aids for frontal boundaries.

The software automatically converts all of the objects into GIS standard ESRI shape files, and these objects are stored with their attributes in an relational database. They can be recalled and updated or annotated as necessary.

Since these objects are not tied to any particular map or projection, the same object can be used in multiple graphics, including world, national, and regional maps. These objects are also available for other spatial queries and applications.

5 Benefits

The new forecast system pays benefits both internally and externally. The end result is that the best possible forecast is produced consistently and reliably. This is accomplished by focusing meteorological resources and skills where they can make the biggest difference, incorporating new data and models whenever they are available, and leveraging proven technologies to take advantage of the continual advances in the science of meteorology.

5.1 Business benefits

The benefits of the new forecast system within Meteorlogix are:

- Quality
    - All available forecast data is used in each forecast
    - Forecasts are updated frequently and consistently
    - Meteorological experience is focused where it can add value
- Reliability
    - The best possible forecast is always available
- Scalability
    - New forecasts or locations don't require additional resources

5.2 Customer benefits

The benefits of the new forecast system to Meteorlogix's customers are that their forecasts are:

- More localized
    - High spatial resolution that factors in terrain and local observations
- More frequent
    - Updates hourly, so the forecast always incorporates the latest information
- More consistent
    - All elements match each other at all times
    - Graphical, textual, and numeric forecast all provide the same answer
    - No sudden changes after shift changes
- More accurate
    - Consistently better than any individual model or MOS guidance
    - Hard numbers that can be verified and proven

6 References

Gerding, S., and W. Myers, 2003: Adaptive Data Fusion of Meteorological Forecast Modules. CD-ROM, 19th Intl. Conf. on Interactive Processing Systems (IIPS) for Meteorology, Oceanography, and Hydrology, Albuquerque, NM, Amer. Meteor. Soc., 4.8

Roberts, W.F., 2004: Examples of Graphical Forecast Editor Use in Operations during 2003. CD-ROM, 20th Intl. Conf. on Interactive Processing Systems (IIPS) for Meteorology, Oceanography, and Hydrology, Seattle, WA, Amer. Meteor. Soc., 8.11

Sznaider, R. and J. Block, 2003: Weather-Enabled Decision Support Systems used in Business Applications. CD-ROM, 19th Intl. Conf. on Interactive Processing Systems (IIPS) for Meteorology, Oceanography, and Hydrology, Albuquerque, NM, Amer. Meteor. Soc., 3.8

Weather Forecast System

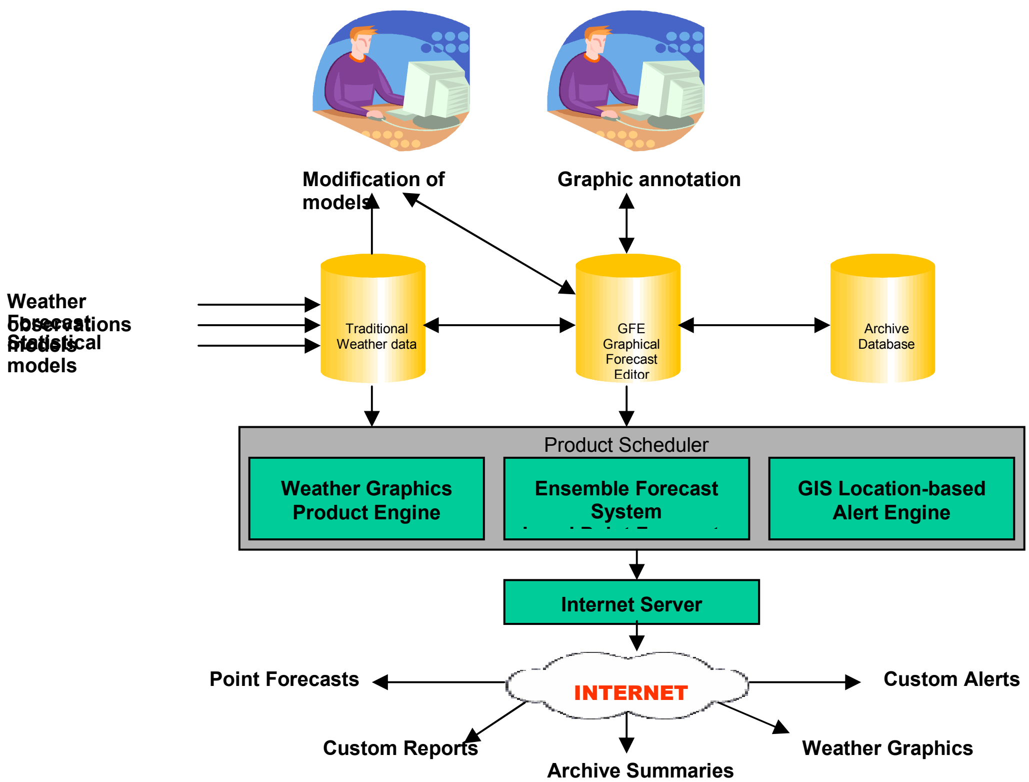

Figure 1. An overview of the Meteorlogix weather forecast system.

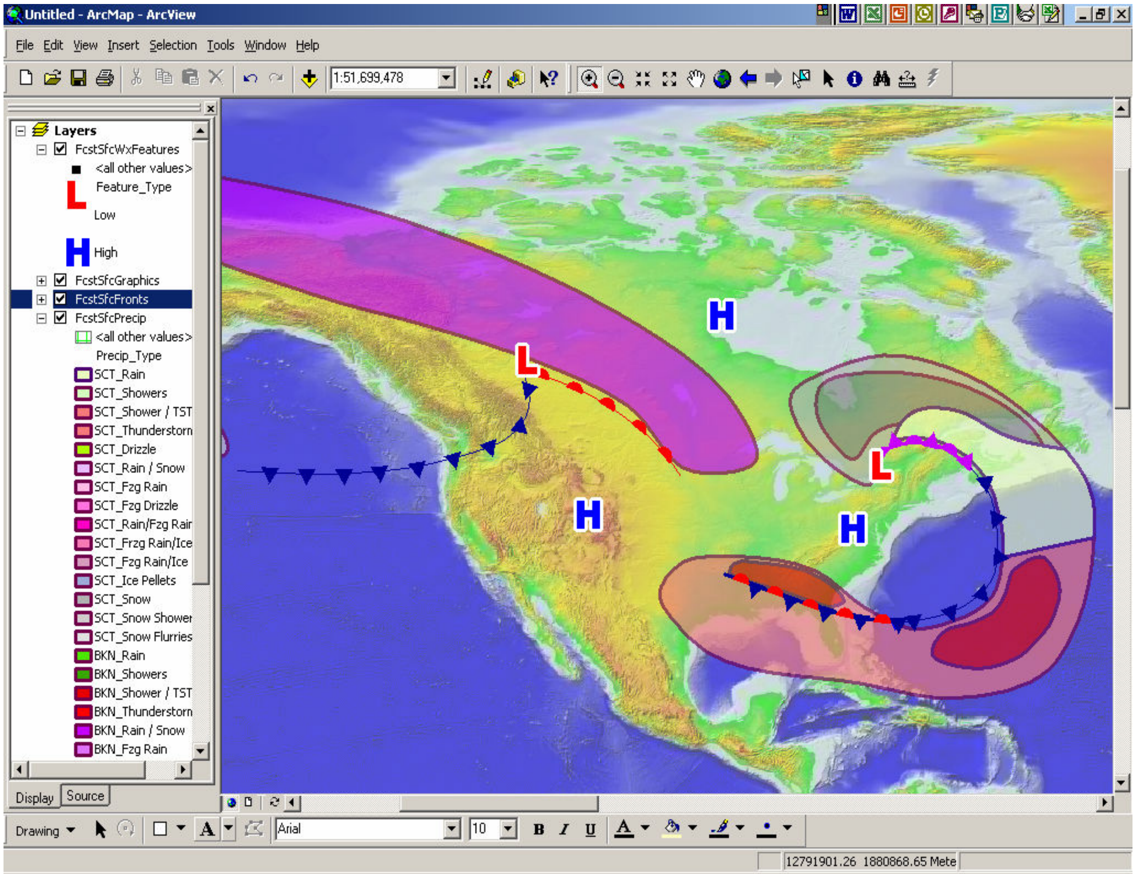

Figure 2. A screen shot of the GIS-based meteorologist graphical workstation.