6.1 SOLVING COMPLEX PROBLEMS WITH GIS AND ADVANCED METEOROLOGICAL DATA

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1.0 ABSTRACT

The use of Geographic Information Systems (GIS) combined with new types of advanced and localized meteorological data sets can be used to solve a wide range of complex business and safety issues. Examples include improved fleet transportation routing efficiencies, more accurate energy industry load forecasting, precise analysis of hurricane damage potential, enhanced public safety with lightning monitoring, water district management, flash flood forecasting, and improved emergency response to possible airborne bio-terrorist attack. The unique combination of GIS with appropriate meteorological data sets produces intriguing synergies and possibilities for improved problem solving in the future.

2.0 INTRODUCTION

For many years GIS has been used to organize and analyze primarily static geo-referenced data sets. However the access to, and management of, complimentary dynamic data sets including weather information was virtually non-existent. Today an extensive suite of reliable, consistent, and quality-controlled weather data, in GIS format, as well as GIS software components designed to help manage this weather data, are now available from Meteorlogix. The ability to "weather-enable" traditional GIS applications is now a reality and provides a host of new, wide-ranging opportunities to solve complex business problems.

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Established in October 2001 through the merger of three weather service leaders — business-to-business provider DTN Weather Services, broadcast and aviation weather forecaster Kavouras, and long-range forecaster and climate predictor Weather Services Corporation — Meteorlogix represents more than half a century of experience and weather information acumen. The company now serves more than 22,000 customers with a focus on the energy, public safety, broadcast media, transportation, and aviation industries.

For more information about Meteorlogix, please refer to www.meteorlogix.com

Meteorlogix supports a comprehensive suite of high-quality, commercial-grade weather information, from worldwide sources, available in GIS format, making it possible to immediately integrate "real-time" weather information into GIS-based applications.

For more information about Meteorlogix GIS weather, please refer to www.meteorlogix.com/GIS

3.0 BUSINESS APPLICATIONS OF WEATHER DATA IN GIS

GIS offers much more than a typical "display" of weather graphics; a GIS provides the capability of combining the weather data itself with virtually any other geographically based information and, perhaps most importantly, provides a means to perform advanced spatial analysis capable of calculating meaningful value-added results. This combination of weather information with GIS spatial analysis tools provides the ability for developing a *weather-enabled* decision support system. Quality-controlled weather data, combined with a GIS, can immediately unlock

analytical potential that was previously incomprehensible and help solve more complex business problems.

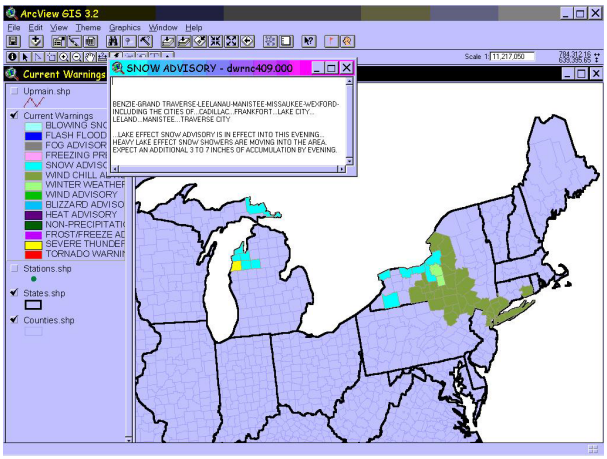

Figure 3.0
An example of National Weather Service watch/warning/advisory information displayed graphically along with hyperlink to text information in ESRI ArcView GIS desktop software

3.1 BROADCAST TELEVISION

Meteorlogix introduced GIS technology to the broadcast weather television in the form of a weather radar display and storm tracking system. Today's version of this application, the MxWeatherSpan StormCommander system, is an advanced application built upon GIS technology. StormCommander displays weather layers in conjunction with detailed map backgrounds that are *dynamically* generated while on-the-air, providing TV viewers a better understanding of the precise location of severe storms relative to familiar landmarks. The GIS technology also allows immediate geographical cross-reference between weather features and landmarks. For example, the location of individual storm cells, combined with their movement characteristics and a geographical database of towns and cities, are used to calculate the time of arrival of the storms at the towns and cities. The GIS technology used in MxWeatherSpan StormCommander allows a new level of interactivity, accuracy, and precision for communicating weather hazards to the general pubic.

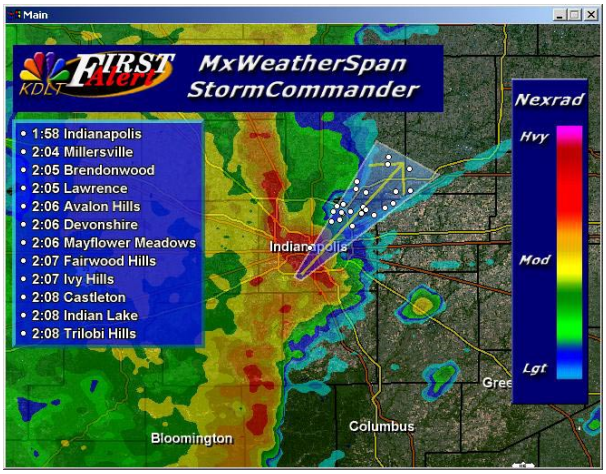

Figure 3.0

The MxWeatherSpan StormCommander system is a GIS-based radar display and storm tracking system used by television stations throughout the United States

For more information on StormCommander, please refer to http://www.meteorlogix.com/products/mxweatherspan/stormcommander.cfm

3.3 ENERGY

The effect that weather can have on service interruptions and the ability of an electric utility to consistently deliver energy to its customers is well known. The generation group is mostly concerned with forecast weather conditions. Their requirement is to know how hot or cold it's going to be today and tomorrow in order to efficiently manage the production and generation of energy. The non-regulated marketers also monitor forecast weather so they are prepared to buy and sell power due to fluctuating demand, often driven by weather conditions. Meanwhile, transmission operations are on the lookout for adverse weather conditions such as lightning, severe storms and winds. If there is weather-related damage, or potential for damage, the transmission engineer must be prepared to re-route energy or dispatch repair crews to return the grid to full operation. Finally, the distribution operations group monitors weather information, such as radar and lightning data, to manage field crews. As storms move into the service area, dispatchers need to know where to be prepared to direct repair crews and whether or not to pull them off jobs or put off-duty crews on standby.

Active storm tracking, based on the NEXRAD combined attributes table, introduces the ability for

an electric utility to monitor dynamically developing severe weather storm cells for much improved and more efficient decision-making. Meteorlogix converts this information into GIS format so that energy related industries, that have historically used GIS, can gain new benefits from weather data in GIS data formats.

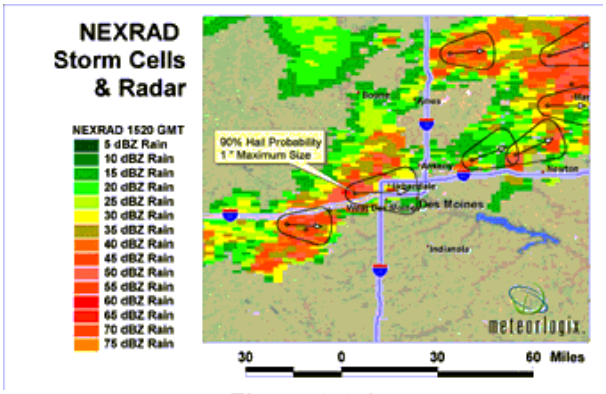

Figure 3.3.1

NEXRAD storm cell locations, derived from the combined attributes table, converted into GIS formats make possible the objective calculation of possible storm effects on energy industry infrastructure.

A new GIS-based Decision Support System from Meteorlogix — MxInsight EnergyWatch™ — can help utilities make more informed weather-related decisions. MxInsight EnergyWatch is an integrated suite of real-time GIS weather data and software that provides decision-support tools for dispatch and transmission/distribution managers of utility companies. Weather data is collected from a variety of sources, converted to GIS format, and delivered to a utility's network, allowing for the integration of the weather data with the utility's own operational maps. The viewing and query of data can be accomplished within a Browser via an Intranet or over the Internet. MxInsight EnergyWatch is a customized, turnkey solution that is easy to use and tailored specifically to each utility customer. With this new technology, a user can use MxInsight EnergyWatch to determine how wide a buffer between company assets and severe weather is necessary for safe operation. Then, if lightning, ice, heavy rains or high winds enter that "safe" area, company decision makers will have pertinent information in advance.

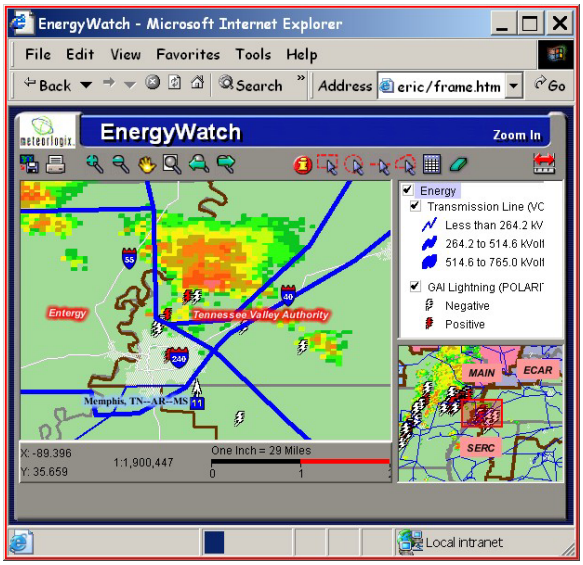

Figure 3.3.2
Example of weather radar and storm tracking merged with energy assets via Internet and/or Intranet delivered browser based client

For more information on EnergyWatch, please refer to
http://www.meteorlogix.com/products/mxinsight/GIS/energywatch.cfm

3.4 MONITORING LIGHTNING ACTIVITY

Meteorlogix is now able to provide information from Vaisala-GAI National Lightning Detection Network in the ESRI Shapefile format. This allows easy integration of lightning data directly into GIS applications. In addition to the traditional display of the location of lightning activity on a map, a GIS provides the opportunity for precise calculations of the proximity of lightning activity relative to golf courses, outdoor concerts, fuel storage facilities and a multitude of lightning sensitive events for any geographical point. The introduction of lightning data directly into GIS applications opens up new ways to provide solutions to weather related problems including tracking energy outage relative to individual lightning strikes, providing improved advance warning for city managers responsible for public safety at large outdoor events, and providing improved logistics support for the transport of hazardous materials along highways.

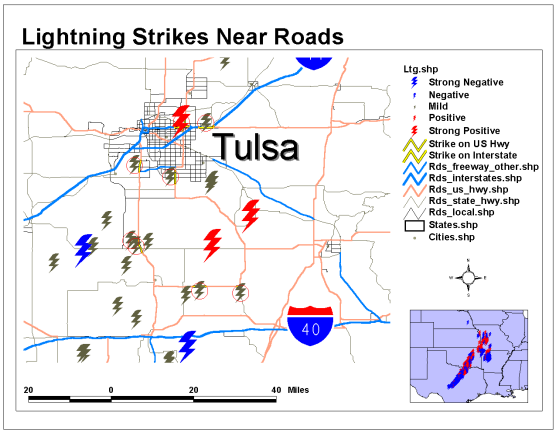

Figure 3.4

Vaisala-GAI lightning data, updated each minute, is now available in ESRI shapefile format from Meteorlogix ready for direct integration into GIS systems

3.5 EMERGENCY MANAGEMENT

Emergency management agencies, already a user of GIS technology for advance planning purposes, can now easily integrate real-time weather data from Meteorlogix into their operations to improve decision making and allow faster response times during threatening weather situations. Large-scale weather events such as hurricanes can now be monitored directly within a GIS. Numerous smaller-scale weather events can also be utilized with a GIS. For example, Meteorlogix provides continuous real-time access to individual storm cells and their corresponding meteorological characteristics including speed and direction of movement, intensity, presence and size of hail, and presence of possible developing tornadic activity. Emergency management agencies, equipped with GIS tools and the appropriate weather data, can be more proactive and responsive towards many natural disasters.

Significant large-scale weather events, such as tropical storms and hurricanes, can now also be monitored directly within a GIS. The combination of weather satellite, weather radar, and forecast hurricane tracks, combined in a GIS and cross-referenced to demographic data, can provide insight to possible future damage to the electric utility infrastructure and what extent outages to expect. GIS spatial analysis tools make it possible to objectively calculate meaningful damage estimates, providing information for advanced logistics planning.

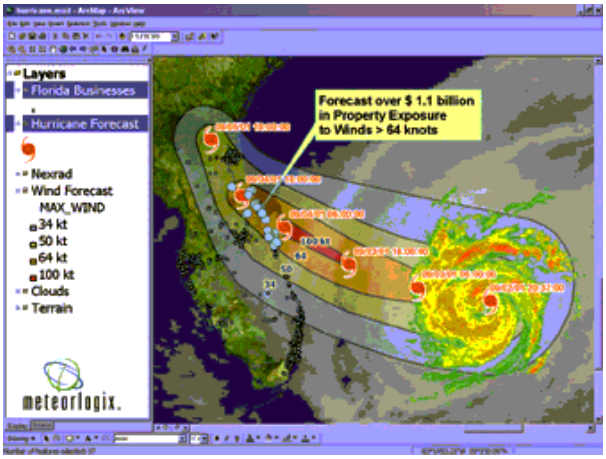

Figure 3.5
A hurricane damage model, integrated into a GIS, can objectively calculate potential damage using the forecast track of a tropical storm or hurricane

For more general information on GIS and emergency management, please refer to http://www.meteorlogix.com/products/mxinsight/GIS/metrowatch.cfm

3.6 TRANSPORTATION

Many land transportation management systems can benefit from the integration of weather into their GIS. One example is the railroad industry, interested in increasing overall efficiencies and reducing costs from weather induced derailments (high winds blowing material off rail cars and/or blowing rail cars off track). Meteorlogix recently implemented MxInsight RailWatch, an advanced automated weather alert system for a major railroad. Specific weather events, as defined by the railroad, are continuously and automatically monitored by the GIS system. When a particular weather parameter exceeds a pre-defined threshold, and threatens to affect a particular section of railroad track, a coded alert message is automatically sent to the individual dispatcher responsible for the affected section of track. The dispatcher decides whether or not to stop the train to prevent damage and possible loss of life due to a high-speed moving derailment caused by a high wind blow over. This GIS-based system allows continuous monitoring thousands of miles of track for user specified weather conditions. A similar system, MxInsight RouteWatch, has been developed to monitor the highway road system for dangerous weather conditions.

The combination of GIS technology and weather information makes possible advanced automated alert systems like this which have the potential to save substantial money due to smoother operations and fewer weather related disruptions of service.

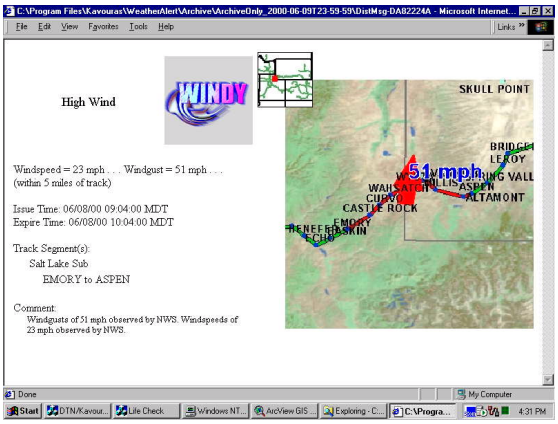

Figure 3.6
GIS Tools make possible automated monitoring of railroad track segments for threatening weather

For more information on RailWatch, please refer to http://www.meteorlogix.com/products/mxinsight/GIS/railwatch.cfm

For more information on RouteWatch, please refer to http://www.meteorlogix.com/products/mxinsight/GIS/routewatch.cfm

3.7 REAL-TIME WEATHER FOR HOMELAND DEFENSE

Meteorlogix has developed the capability to integrate truly real-time weather observations into a GIS, delivered directly from a network of weather sensors located at customer locations, via the Internet. This innovative use of the Internet brings essentially "live" weather directly into a GIS. Typical sources for surface weather observations (i.e. National Weather Service) have a nominal update frequency of one hour. The deployment of local sensors, at strategic locations, provides real-time weather data, updated as often as every 3 seconds.

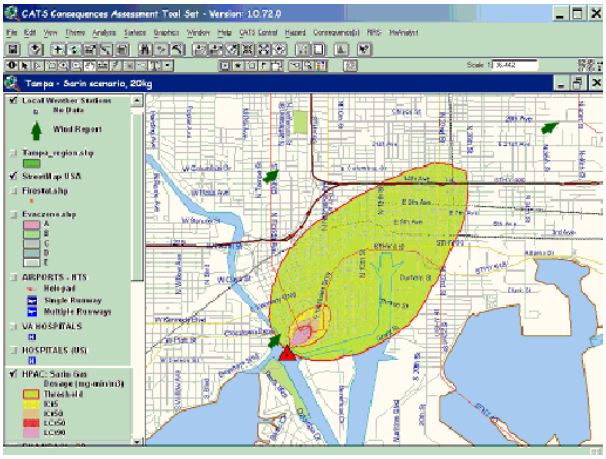

Figure 3.7
Local weather network sensors provide more precise and timely input into critical plume dispersion forecasts.

4.0 CONCLUSION

The merging of GIS technology with properly formatted and quality controlled real-time weather data makes possible a new level of information analysis systems that supercede the power and utility of traditional weather visualization systems. The unique synergy of weather information combined with GIS technology provide new capabilities to actively compare weather to geographic points, line segments, and geographic areas of interest in order to objectively calculate the meaningful impact of weather phenomena to population centers and to business entities.

A variety of GIS weather solutions are available today from Meteorlogix. For more general information on the new GIS-based weather-enabled decision support tools, please refer to http://www.meteorlogix.com/products/mxinsight/GIS/