A GIS/WEATHER DECISION SUPPORT SYSTEM

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Introduction

This paper describes a GIS based, Weather Enabled Decision Support System approach to aid in mitigation, preparedness, response and recovery approaches to large and small scale, environmentally based natural and man-made disasters.

Background

AWIPS is the integrating element of the NWS Modernization. AWIPS integrates the NWS Modernization data sources – GOES, NEXRAD Doppler radars, ASOS, and the latest generation of numerical forecast models from the National Centers for Environmental Prediction (NCEP) – into a system that the NWS meteorologist and hydrologist can use rapidly and effectively. AWIPS consists of a wide area network (WAN), NOAAPORT T1 satellite broadcasts, a Network Control Facility (NCF), Weather Forecast Offices (WFOs), and River Forecast Centers (RFCs). This presentation will describe the AWIPS components and the benefits of AWIPS - namely the timely delivering of weather data to the users.

The goal of the Weather Enabled Decision Support System (DSS) is to enable meteorological data user to apply weather information to mitigate losses to their mission critical assets and to facilitate decision making during emergency events. The Weather Enabled DSS fuses GIS and weather technologies. The NWS Modernization and related activities have improved weather forecasts and warnings. During the timeframe of the NWS Modernization, GIS has become a critical management tool with more and more businesses and government agencies using GIS to track and manage their mission critical assets. The GIS and weather technologies have been fused into a DSS that will allow meteorological data users to consider weather effects and impact in daily operations. The DSS allows an operator to define a weather event and threshold of importance and an action to recommend in response to the weather event. For example, the operator may define a weather event of freezing rain over a service area. The operator may also define a corresponding action or set of actions such as notify work crews or automatically update a variable message sign. When the GIS/Weather DSS determine the weather event and threshold have occurred, the GIS/Weather DSS initiates the actions specified by the operator. Thus the DSS assists the operator in making timely and accurate decisions on mitigating the effects of the weather event.

Goals for the GeoWeather Solution™ DSS

The *GeoWeather Solution*™ DSS is designed to collect environmental information and data, process and perform analysis on that input, and to provide timely, tailored comprehensive products to federal, state, and local emergency management personnel. It also applies to use by key industrial sectors, such as utility industry, and business, where weather has a direct effect on fixed or mobile mission critical assets.

To provide this critical support, *GeoWeather Solution™ DSS* collects data and information from various environmental resources and modeling activities and uses advanced computing assets to fuse data sets and perform analysis. *GeoWeather Solution™ DSS* then employs automated information processes to develop tailored DSS products and disseminate these products via robust, diverse communications architectures. These capabilities support the four phases of the decision support cycle: monitoring, preparation, assessment and restoration. It should be noted that the products suggested in this paper are not conventional weather products. Rather, they are decision support products, or "directed actions", as defined by operations and management personnel.

GeoWeather Solution™ Decision Support Cycle

As shown in Figure 1, emergency management activities often overlap across one or more of the phases. Throughout each of these phases, GeoWeather Solution™ DSS monitors, performs analysis, disseminates and provides Decision Support information products in real-time.

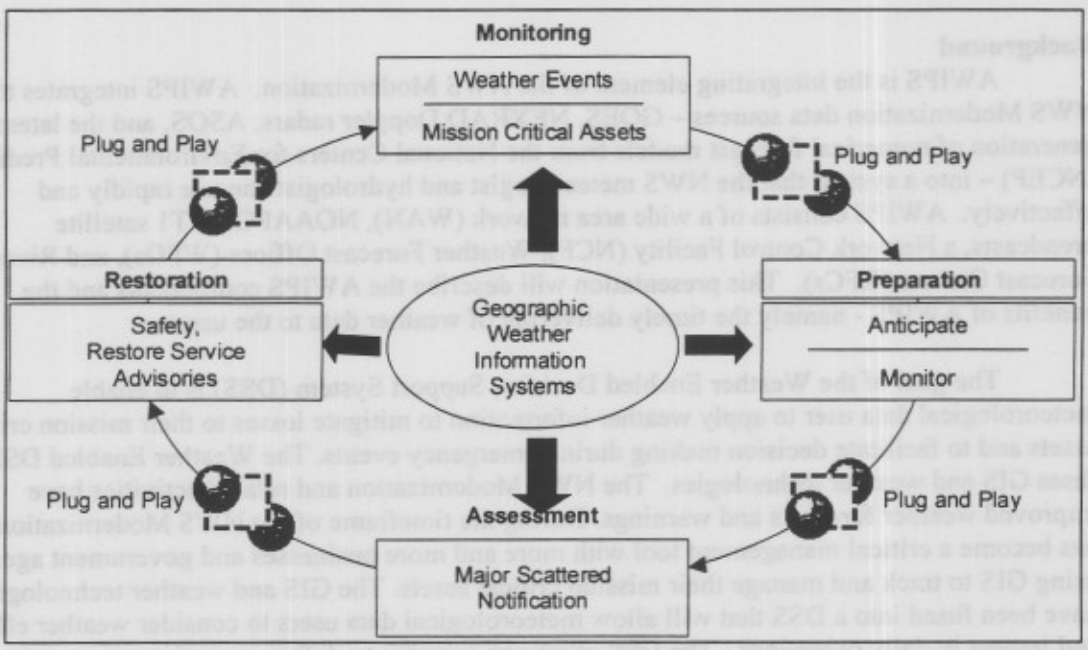

Figure 1
GeoWeather Solution™ Comprehensive Decision Support Cycle

These four phases are further described as:

Monitoring: - Mitigation

- Long lead times (5days) out
- Short term (National Weather Service Watch/Warning/Advisories)
- Widespread destruction (Hurricanes)
- Narrow focused (Tornadoes)

Preparation: - Preparedness

- Put Forces early into Field

- Contact Cities and Towns to 3 days in advance to ensure lines of communication
- Analyze Strategic Areas to prioritize for pre-deployment
- Alert mutual assistance providers and contractor crews
- Implement an Emergency Operation Plan for Restoration
- Anticipate/Monitor where worst effects will be
- Employees checking service equipment, filling vehicles and Emergency generators with fuel tanks and putting readiness procedures into place.
- Order Supplies and Materials
- Arrange for Food and Housing in Advance.

Assessment: – Recovery

- Assess Threat Category
- Identify Effects - Major, Scattered
- Dispatch & Facilities Management
- Notification - Public Safety Information
- Assess Restoration Priorities
- Public Awareness Advisories - Press Releases
- Post Emergency Monitoring
- Continued and additional Weather effects on Area
- Additional Weather Monitoring over next few weeks for continued threats {assessment/preparation} of assets.

Restoration: - Response

- Alert
- Notification
- Law Enforcement
- Fire/Rescue
- Medical

Note that while this decision support cycle addresses emergency management, the same decision support cycle can be adapted to other industries and government sectors.

GeoWeather Solution™ Integration Framework

In order to support the decision-making process, it is quickly realized that most of the environmental data are geographically located or registered. A Geographic Information System, among the conventional GIS, expert system, and fuzzy logic artificial intelligence system, has become the natural choice of system to facilitate the decision support cycle. In addition, most industries have their mission critical assets managed with a GIS system. The integration between the Weather Information System, in our case the AWIPS, and the GIS becomes the critical issue.

There are several strategies and approaches to integrate Weather Information Systems and GIS system. They range from simple pre- and post-processor linkage through shared data files to highly coupled Weather enabled DSS. The design of GeoWeather Solution™ has been highly modular to allow easy configuration. For a problem-specific weather information and decision support system, functions such as data capture and preprocessing and interactive analysis can conveniently be separated: they support different users with different tasks. This layered functionality concept (Figure 2) leads to coupled GIS and weather functions, such as map display, including animation of highly dynamic weather data, and weather analysis. The integration would

merge the two systems, such that the weather system becomes the one of the analytical functions of a GIS, or the GIS becomes yet another option to generate and manipulate parameters to provide additional display options.

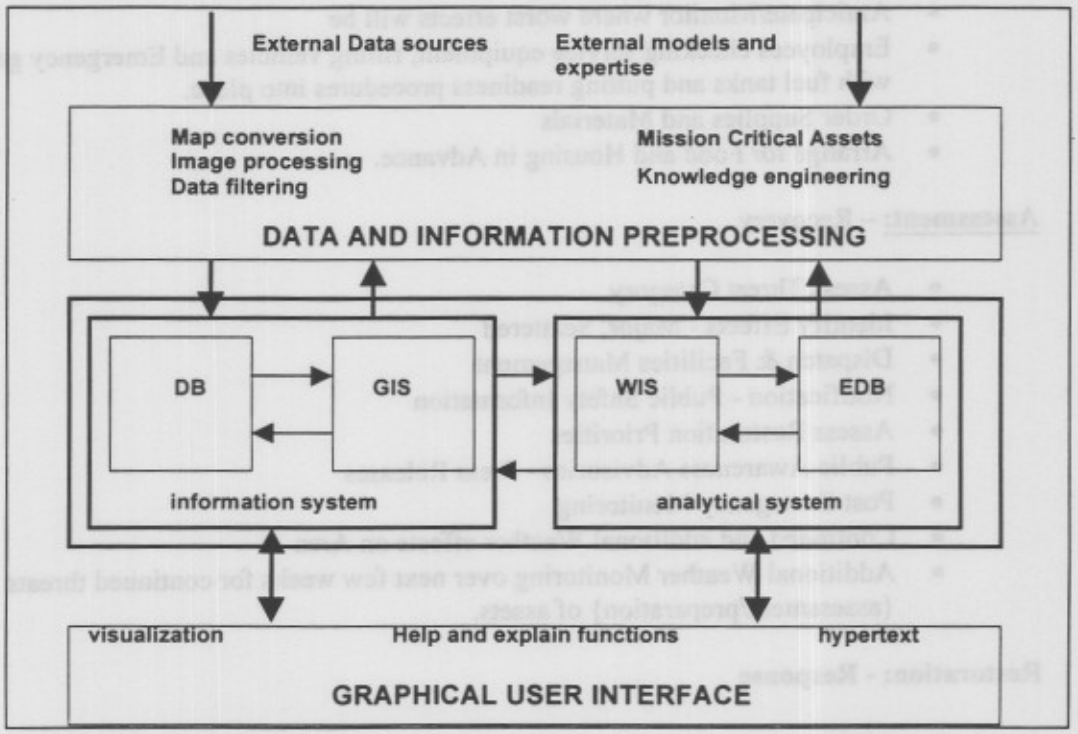

Figure 2
GeoWeather Solution™ Integration framework

Summary

Industry and government must continue to leverage the National Weather Service modernization. The GeoWeather Solution™ DSS accomplishes this by fusing GIS and weather technologies into a decision support system to allow non-meteorologists to consider weather effects and impacts in daily planning and operations. The system allows an operator to define a weather event {E}, threshold of importance, or criteria {C} and an action [A] to recommend in response to the event. When the DSS determines the weather event and threshold have been met, the system initiates the specific action. For example, an operator may define the weather event as Temperature [E]. The criteria [C] might be, 'greater than 80 degrees". The resulting action [A] might be, "Run load forecast model and advice the result to power broker." This Event/Criteria/Action, or E/C/A approach and its integration in the GIS environment, is the core of the GeoWeather Solution™ DSS. This technology based approach will help emergency management personnel address the Decision Support life cycle of monitoring, preparation, assessment and restoration.