BIOGRAPHICAL INFORMATION

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Specific Responsibilities

Mr. Humphrey is an instructor for GIS for Emergency Response classes and Oil Spill Management classes at the National Spill Control School, Texas A&M University in Corpus Christi, TX. He also conducts tabletop and deployment drills and training exercises for oil spill prevention and response and assists organizations with contingency planning using GIS and related emerging technologies.

Past Experience

Mr. Humphrey served on the State of Texas GIS Standards Committee from 1991-1992. He served as a GIS Programmer/Analyst for the Texas General Land Office from 1992-1994, helping to deploy the leading-edge oil spill prevention and response GIS and spill trajectory model still used by the GLO today. After the GLO, Mr. Humphrey worked for ESRI in the San Antonio Regional Office and was founder and CEO of his own GIS products and services company called GEOWAREHOUSE from 1995-2001. He has taught GIS for oil spill prevention and response at the National Spill Control School since 1994.

Educational Information

B.S. in Geography from Texas A&M University College Station, TX

GIS FOR OIL SPILL PREVENTION & RESPONSE

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ABSTRACT

Since the Exxon Valdez oil spill, there has been an increasing interest in the use of Geographic Information Systems for oil spill prevention and response. While GIS has been maturing as a technology for many years, many organizations are still grappling with paper maps within their EOCs. Making sense of all the information coming into the EOC during any situation can be chaotic, but GIS can make it much easier to communicate what is happening to high-level decision-makers, the general public and the media. GIS is also a fabulous integrating technology, bringing together a wide variety of data types and formats within a single map environment.

The National Spill Control School at Texas A&M University in Corpus Christi, TX, was recognized by the U.S. Congress in 1990 in order to serve as the premier education center for oil spill and HAZMAT technology training. A brief history of the growth in the use of GIS for oil spill response will be provided.

An overview of the current and emerging GIS technologies for oil spill prevention and response will be presented. Topics include GPS and digital cameras for field inventories and damage assessment, vehicle tracking, realtime weather data for GIS, integration of other technologies including visual intelligence, CAMEO/ALOHA, HAZUS MH and more.

The future of GIS for oil spill response includes the concept of the “Virtual EOC”. A discussion of what is required in order to implement such a system will be included.

EVOLUTION OF GIS FOR OIL SPILL RESPONSE

Early Days of GIS for Oil Spill response

In the past, GIS was used primarily for cartographic production only. This included hard copy maps and atlases depicting various vector data sources such as shorelines, Environmental Sensitivity Index, Resources at Risk, access points and other critical base map layers. GIS has been featured prominently during major spill drills and exercises since the early 1990s. GIS allows for simulated conditions and responses and can track the events as they occur.

GIS Matures in the 1990s

In the mid-1990s, aerial imagery became more common as a base map layer, which really improved the depiction of coastal features. Prior to aerial imagery, the base maps that were available were mostly fifty-year-old USGS topographic maps and NOAA nautical charts. Since the coast is the most changeable part of the planet, many features shown on these maps were either greatly modified,

completely gone and often, totally new features had emerged. More recent base maps in the form of aerial imagery were rapidly adopted.

Initially, the GIS maps were compiled and printed or plotted out in hard copy format for distribution and use. Later, these same maps and atlases were offered in the form of Adobe .pdfs. This was all basically static map data. During spill events, these maps could be used to plan responses and in many cases, the plotted hard copy maps were used as a sketching pad in the Emergency Operations Center (EOC) or Incident Command location. Presentation-quality GIS maps have also been quite useful in public meetings and media events.

CURRENT STATE-OF-THE-ART

GIS as an Integrating Technology

Present technology allows GIS to take a much more active role in oil spill response. This includes more interactive applications and live status maps in the EOC. The idea is to use ***GIS as an Integrating Technology***. A wide variety of data can be compiled within GIS and the spatial relationships are best seen in map format. Just as television weathermen use maps and graphics to explain complex spatial relationships involving temperatures, winds, pressures and weather systems, GIS can be used in the EOC to overlay and analyze otherwise disparate data sources for communication and collaboration with non-GIS professionals. ArcGIS is being used for this application in the interest of maximum interoperability. (The new ESRI Interoperability Extension is featured in classes for 2005.)

GIS in the EOC/ICS

GIS in the EOC provides the opportunity to integrate other spatial models such as EPAs ALOHA (airborne chemical plume dispersion), NOAAs ADIOS (spills on the water) and FEMAs HAZUS MH (Earthquake, Hurricane, Flooding applications).

Each of these tools includes a map component and the output can be viewed in the GIS along with other relevant data layers. In the EOC, GIS provides a wonderful graphical status map, just like the big table-top maps in the old war movies. Only in this case, the map is interactive and constantly being updated.

Spill Trajectory Models

Oil spill applications often include custom spill trajectory models. These models are offered by several companies and many states have taken the initiative to create their own custom versions of trajectory models, which best reflect local conditions. All spill trajectory models have several things in common: Input is needed for the initial location of a spill, the type of spill, product spilled, realtime input of weather and tidal/current data and a depiction of the land/water interface. When run, these trajectory models produce a "plume" depicting the footprint of the oil and a forecast of the area that might be impacted. This is usually shown

for several future snapshots in time. These plumes can be viewed in the GIS, along with a multitude of other relevant data layers.

Emerging Technologies

Digital cameras are excellent for performing field inventories, damage assessment, cataloging of assets and documentation of responses. The digital images collected in the field are hot-linked to GPS locations within the GIS. In the past, this required several manual steps and thousands of dollars worth of equipment. Now, the process is much more streamlined and can be done for a few hundred dollars. Even non-GIS personnel can capture valuable data before, during and after a spill. For responding organizations, having access to photos of boat ramps, beach access points, etc. can make the difference as to the size and types of equipment that can be used in that particular location. Oiled shorelines and wildlife can be documented during damage assessment and then cleanup activities can be tracked

Aerial video is a rapid data collection method and by encoding GPS location and time stamps into the audio tracks, a moving location map can follow the camera on playback. Any point along the shoreline can be selected and then the video is played back from that location. Video can be captured at many stages before, during and after a spill.

The whole new field of Visual Intelligence has blossomed recently. In addition to hot-linked digital pictures and video, other types of visual data sources have emerged. Oblique aerial imagery that is geo-referenced and measurable can be overlaid with other GIS data layers. Since this imagery is taken from an angle, it allows the user to look under piers and clearly shows any shoreline terrain features. Realtime surveillance video cameras can be also hot-linked to the map and viewed at the click of a mouse. These Visual Intelligence tools are becoming more important especially in port areas, where both oil spill as well as Homeland Security concern exists.

One factor that affects almost any emergency response is the weather. Winds, tides and currents can drive a spill plume in a variety of directions, so knowing something about the actual state of the weather is vital to planning an appropriate response. The passage of a cold front or squall line can completely change the direction of oil movement. Realtime Weather data is readily available now from both government and commercial sources through satellite-delivered and Web-based data portals.

Dispersants and Bio-Remediation

In recent years, the application of oil dispersants and oil-eating microbes has produced some success. These are highly-restricted and regulated techniques and special permission is required from the appropriate state and federal agencies in order to apply them. GIS is used to plan and evaluate these applications. By tracking the locations of the aircraft or boats used to apply the

products using GPS, a record of when and where the products were applied is automatically created. One airborne dispersant application company actually has GIS in the cockpit in order to see how the actual flight is comparing to the flight plan and in order to later demonstrate where the dispersants have been applied. Just like mowing the yard, the pilot can see any "missed spots" and then correct the flight plan accordingly. All the while, building a shape file of the area covered.

On-Line Data Portals

Another development that has aided GIS for emergency response is the establishment of on-line data portals. There are many government and private sector GIS data portals now offering a wide variety of data including environmental, transportation, traffic, property ownership and other valuable map layers. A word of caution about using on-line data sources - have a backup plan. If Internet access is impaired or unavailable, then so is the data that you may have grown accustomed to accessing on-line. Alternative sources and methods should always be available.

Keep it Rugged and Simple

When evaluating the use of emerging technologies in an emergency response environment, everything needs to be rugged and very easy to use. Often, volunteers and other non-GIS personnel will be called upon to perform data collection or damage assessment. So the more user-friendly the tools are, the better.

All-Hazards GIS

The post 9/11 concerns over Homeland Security brought another revision to the training. Many of the same GIS technologies that were being used in oil spill response could be applied to a variety of other Emergency Responses.

For example, many of the same base map layers used for oil spill response can also be used during a hurricane response. So the construction of an "All-Hazards" GIS for coastal areas is a wise investment that does double-duty. Now, the NSCS offers both an Oil Spill-specific GIS training within the scope of the five day Oil Spill Management Class, as well as a new three day generic GIS for Emergency Response class, covering other types of disasters.

THE FUTURE

Virtual EOC Concept

The future includes a completely mobile GIS and the concept of the Virtual EOC. Mobile technologies allow for many GIS applications to go on the road. One lesson learned from the events of 9/11 is the fact that fixed, central locations for EOCs may not be ideal. The New York City EOC was located in World Trade Center Tower #2 and was lost in the disaster, just when it was needed most. The concept of allowing first responders to move about and yet remain connected is the goal of the Virtual EOC. Instead of everyone scrambling to the central EOC

location, users would go about their business either in the field or their main offices and collaborate with others virtually.

Ubiquitous Broadband

The prospect of ubiquitous broadband Internet access will enable the concept of the "Virtual EOC" to become a reality. In many parts of the U.S., this is already possible, but broadband connectivity will be an issue that certain parts of the world will be working on for quite some time. Satellite providers can fill in some of the gaps, but these satellite solutions have problems of their own, including latency (delay) and line-of-sight issues. On a local or regional basis, if broadband or Wi-Fi access is an option, then the Virtual EOC can be implemented as an alternative to centralized "bat caves" and crowded and noisy mobile command trailers.

For more information on the National Spill Control School, go to http://www.sci.tamucc.edu/nscs or call 361-825-3333.