Developing Spatial Literacy in Coast Guard Officers

Captain Michael Alfultis, Ph.D.
U.S. Coast Guard Academy
Department of Science

Abstract

The National Academies have defined Spatial Literacy as constituting proficiency in terms of spatial knowledge and skills, spatial ways of thinking, and spatial capabilities. Defined in this way, spatial literacy and proficiency in geospatial technologies such as Remote Sensing & Geospatial Information Systems have become increasingly important skills for U.S. Coast Guard officers. To meet this need for spatially literate officers, the Coast Guard Academy Science Department began offering an Introduction to Geospatial Sciences course for students in its Marine and Environmental Sciences (MES) major in the spring of 2003. To further develop the spatial literacy of students in the MES major, the Science Department faculty have embarked on an effort to examine the development of spatial literacy in a more systematic fashion across the MES curriculum. Future efforts and activities are aimed at examining the development of spatial literacy across the entire Coast Guard Academy curriculum

Key Words

Geospatial Information Systems, Geographic Information Systems, GIS, geospatial sciences, spatial literacy

Introduction

Whether it involved safely navigating their vessel, locating vessels in distress, managing vessel traffic in/out of major ports, or responding to casualty and marine pollution incidents, U.S. Coast Guard watchstanders and command cadre have long had to concern themselves with acquiring, displaying, and analyzing geospatial (e.g., location) information for decision making. However, the advent of new technologies and an increased emphasis on Maritime Domain Awareness have dramatically increased the importance of spatial literacy and proficiency in geospatial technologies as vital skills for effective mission accomplishment.

The National Research Council (2006) defines "spatial literacy" as constituting proficiency in terms of spatial knowledge and skills, spatial ways of thinking, and spatial capabilities. They go on to say,

> "Spatially literate students
>
> - have the habit of mind of thinking spatially—they know where, when, how, and why to think spatially;
> - practice spatial thinking in an informed way—they have a broad and deep knowledge of spatial concepts and spatial representations, a command over spatial reasoning using a variety of spatial ways of thinking and acting, have well-developed spatial capabilities for using supporting tools and technologies; and
> - adopt a critical stance to spatial thinking—they can evaluate the quality of spatial data based on their source, likely accuracy, and reliability; they can use spatial data to construct, articulate, and defend a line of reasoning or point of view in solving problems and answering questions; and they can evaluate the validity of arguments based on spatial information." (National Research Council, 2006, p. 20)

Defined in this way, spatial literacy and proficiency in geospatial technologies such as remote sensing and Geospatial Information Systems (GIS) have become increasingly important skills for Coast Guard officers. These technologies are necessary components to fulfilling the Coast Guard's Maritime Domain Awareness, Intelligence, and Command and Control mission requirements, have become a integral part of our Deepwater platforms and Sector Command Centers, and are used for situational awareness and effective communications during every phase of emergency/disaster planning/response. As such, Coast Guard personnel will increasingly need to be more proficient in these technologies, and the need for "spatially literate" personnel will continue to increase for the foreseeable future.

Recognizing the need to develop "spatial knowledge, spatial ways of thinking and acting, and spatial capabilities" (National Research Council, 2006, p. 7) in the Coast Guard's future decision makers, the U.S. Coast Guard Academy's Science Department has embarked on an ambitious effort to infuse and integrate spatial literacy across the entire curriculum of its Marine and Environmental Sciences (MES) major. The overall goal of these efforts is not to develop Geographic Information System (GIS) technicians fully proficient in the use of GIS. Rather, the aim of these efforts is to develop "spatially literate" Coast Guard decision-makers with knowledge and skills in the use of geospatial technologies for emergency planning and response, facilities management, and operational resource management and decision-making.

The Need

Geospatial technologies such as remote sensing and GIS have become increasingly important on all levels – from the National strategic level to the organizational strategic level down to unit operational and tactical levels.

National Strategic Level

On the National Level, the President's Geospatial Information Integration e-Gov Initiative and the Office of Management and Budget's (OMB) Circular A-16 "Coordination of Geographic Information and Related Spatial Data Activities" emphasize the importance of the effective and economical use and management of spatial data for the benefit of the government and the nation. The A-16 Circular affirms the need for a National Spatial Data Infrastructure (NSDI) to acquire, process, distribute, use, maintain, and preserve spatial data (Office of Management and Budget, 2002). While serving as Associate Director for Information Technology and Electronic Government of the OMB, Mark Forman, issued the following statement before the U.S. House of Representatives Committee on Government Reform (Subcommittee on Technology and Procurement Policy) on June 7, 2002;

> "Geospatial data is the backbone for homeland security and government management initiatives across all levels of government. It is the information that identifies the geographic location and characteristics of natural or constructed features on the Earth. This information may be derived from remote sensing, mapping, charting, surveying, the Global Positioning System, environmental monitoring, or statistical data. It is critical that geospatial data assets are: 1) created; 2) well maintained; 3) readily available to those who need them; and 4) interoperable. Examples of the application of geospatial data for homeland security include physical infrastructure locations, graphical depiction of building infrastructure and detail, and real time tracking of cargo delivery" (Forman, 2002).

In addition, the National Strategy for Homeland Security (HLS) lists Information Sharing and Systems as one of the foundations to the National HLS Strategy (Office of Homeland Security, 2002). Geospatial technologies are one of the core information acquisition and dissemination systems. Geospatial technologies provide critical support to all six of the Critical Mission Areas listed in the National HLS Strategy; Intelligence and Warning, Border and Transportation Security, Domestic Counterterrorism, Protecting Critical Infrastructures, Defending Against Catastrophic Threats, and Emergency Preparedness and Response (Office of Homeland Security, 2002). While serving as DHS' Chief of the Interagency Geospatial Preparedness Team (IGPT), Susan Kalweit issued the following statement before the U.S. House of Representatives Committee on Government Reform (Subcommittee on Technology, Information Policy, Intergovernmental Relations and the Census) on June 10, 2003;

> "These technologies used by our military – GPS, Geographic Information Systems, Remote Sensing, and visualization tools – are the same technologies that can be used to aid in our ability to detect, prevent, and deter terrorist activity; and to save lives and protect property in the event of all-hazards disasters. In short, geographic information technologies are as necessary to our defense in the War on Terrorism as they have been to our offense" (Kalweit, 2003).

Finally, geospatial technologies directly support Sections 3 (Maritime Information), 4 (Intermodal Cargo Security Plan, i.e., tracking ships and containers), 5 (Joint Harbor Operations Centers), and 9 (Research and Development) of the Maritime Transportation Security Act (MSTA, 2002).

U.S. Coast Guard Organizational Strategic Level

In addition, these technologies are becoming increasingly important to the U.S. Coast Guard as an organizational at the strategic level. The Commandant of the Coast Guard has called for increasing the Coast Guard's Maritime Domain Awareness (MDA) as vital to fulfilling our Homeland Security responsibilities.

> "Building MDA requires both a process and an infrastructure. In its most fundamental terms, the process consists of:
>
> - Collecting maritime data, information, and intelligence
> - Collating, correlating, analyzing, and interpreting the collected material
> - Providing effective assessment, actionable intelligence, and relevant knowledge
> - Disseminating intelligence to appropriate federal, state, local, private, and international stakeholders" (U.S. Coast Guard, 2002)

In order to achieve awareness in the maritime domain, the Commandant of the Coast Guard recently established the following strategic goals –

1. Increase the ability to sense and collect maritime data
2. Improve the fusion and analysis of maritime intelligence, and
3. Transform the sharing and dissemination of maritime information (U.S. Coast Guard, 2007)

Geospatial and remote sensing technologies will play a critical role in successfully meeting these goals, and Coast Guard watchstanders and decision-makers with technical competency in these geospatial technologies are needed in order to successfully leverage these technologies in support of these goals. In fact, the Coast Guard Commandant established “improving analytic capabilities” as one of the goals to improving the fusion and analysis of maritime intelligence, and highlight the need for “centers of intellectual capital and capabilities” in order transform the sharing and dissemination of maritime information (U.S. Coast Guard, 2007).

Unit Operational and Tactical Level

At the unit operational and tactical level, geospatial technologies are required for the successful mission accomplishment of every phase and at every level (first responders to State and Federal response centers) of emergency/disaster planning and response: Risk Assessment and Planning, Mitigation, Preparedness, Response, and Recovery. They have proven critical to maintaining situational awareness and effective communications before, during, and after events of national significance (Republican and Democratic National Conventions, the G-8 Summit, and Presidential Inauguration) and federal disaster response/recovery (Hurricanes Katrina and Rita). As a result, geospatial technologies are central to many current and planned operational, intelligence, and business information systems.

<u>Common Operational Picture</u>

First, the Coast Guard maintains both a Sensitive but Unclassified and a Secret level Common Operational Picture (COP). Hannah (2006) describes the COP as

> The COP is “common” because the same information is shared across computer networks and available for display in all Coast Guard command centers and mobile assets. “Operational” because the information displayed is relevant to U.S. Coast Guard (USCG) operations and is used to facilitate command and control and decision making. The COP is a “picture” because the information is presented on an interactive digital map. (Hannah, 2006, p. 65)

The COP is a shared display of friendly, enemy, and neutral vessel tracks (Figure 1); a decision maker toolset fed by a distributed and exchanged ship track and object database; and includes distributed data processing, data exchange, collaboration tools, and communications capabilities (Hannah, 2006).

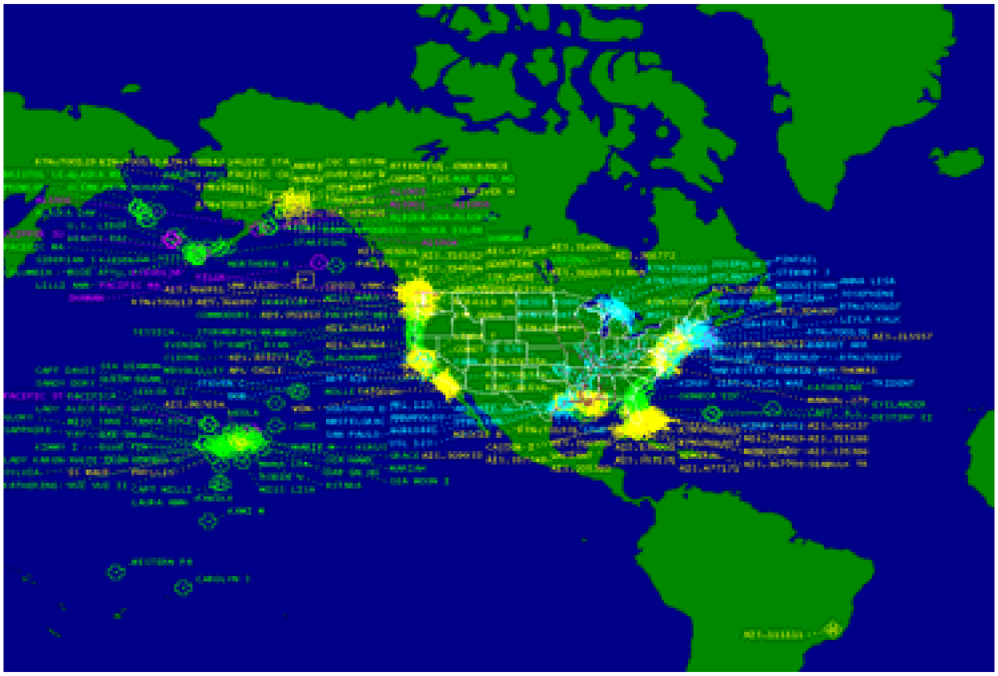

Figure 1. Example of Unclassified Common Operational Picture (COP)

Maritime Awareness Global Network

In addition, the Coast Guard Intelligence Directorate developed the Maritime Awareness Global Network (MAGNet) “to deliver strategic and technical intelligence to a broad array of users” (Mayer, 2006, p. 47). MAGNet uses a browser-based graphical user interface to collect and correlate vessel data. The MAGNet’s GIS allows users to analyze, and display the vessel data spatially. Similar to the COP, it also disseminates this information to multiple users at multiple levels (Mayer, 2006).

Hawkeye

Geospatial and remote sensing technologies are scheduled to be incorporated into Sector Command Centers through the Hawkeye System. The first prototype of this system, installed at Sector Command Center Miami, consists of port and coastal radar installations, electro-optical and infrared cameras, Automatic Identification System (AIS) base stations, and an integrated GIS desktop environment to spatially display the sensor data and manage the sensors (Noggle, 2006). In addition to Miami, Hawkeye systems are now installed in Boston, New York, Charleston, and Hampton Roads (Morris, 2006). The objective of the Hawkeye system is to leverage multiple remote sensing systems within a geospatial display to improve a Sector Command Center’s situational awareness within their area of responsibility. As such, Sector Command Center personnel will need to be familiar with the capabilities and limitations of these geospatial and remote sensing technologies.

Search and Rescue Optimal Planning System

The Coast Guard's Search and Rescue Optimal Planning System (SAROPS) has been developed using the Commercial Joint Mapping Tool Kit (CJMTK) architecture as a standalone GIS application (Figure 2). The SAROPS system contains tools which support all aspects of Search and Rescue (SAR) planning – situational awareness, search object drift, and effort (resource) allocation (Netsch, 2004). The SARTOOLS planning toolset developed for SAROPS determines the probable location of a search target using a Monte-Carlo particle simulation and realtime environmental information, displays search patterns, and includes tools for SAR case management (U.S. Coast Guard, 2006a). The GIS output from this system both guides SAR planners on where to send response units and provides decision makers a clear picture on the quality of search efforts to assist in case suspension decisions.

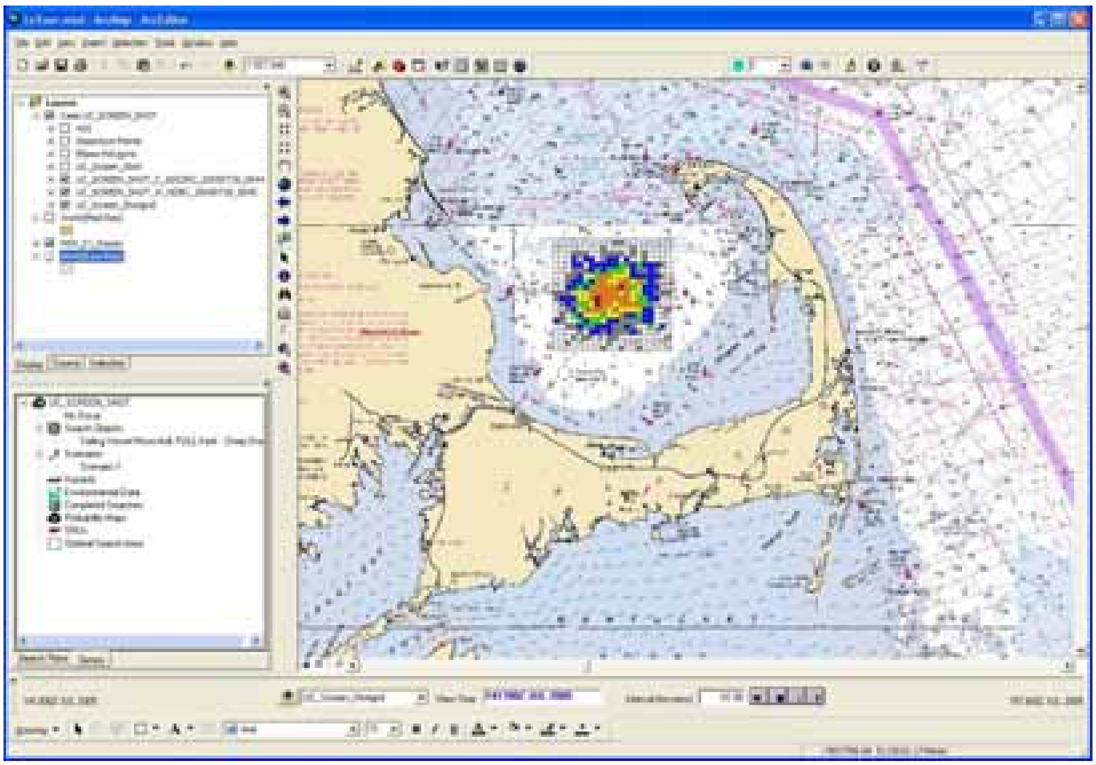

Figure 2. Example of SAROPS Spatial Display

Marine Information for Safety and Law Enforcement

In addition, geospatial technologies are increasingly being incorporated into Coast Guard business systems. For example, the Marine Information for Safety and Law Enforcement (MISLE) system is an operational activity management and consequence management system wherein each Coast Guard Sector Command Center manages Marine Safety, Maritime Security, Environmental Protection, Incident Management/Response, Incident Planning, and SAR "activities." MISLE consists of a database repository for all this information and a GIS viewer for displaying and analyzing the information in the database geographically (Figure 3)

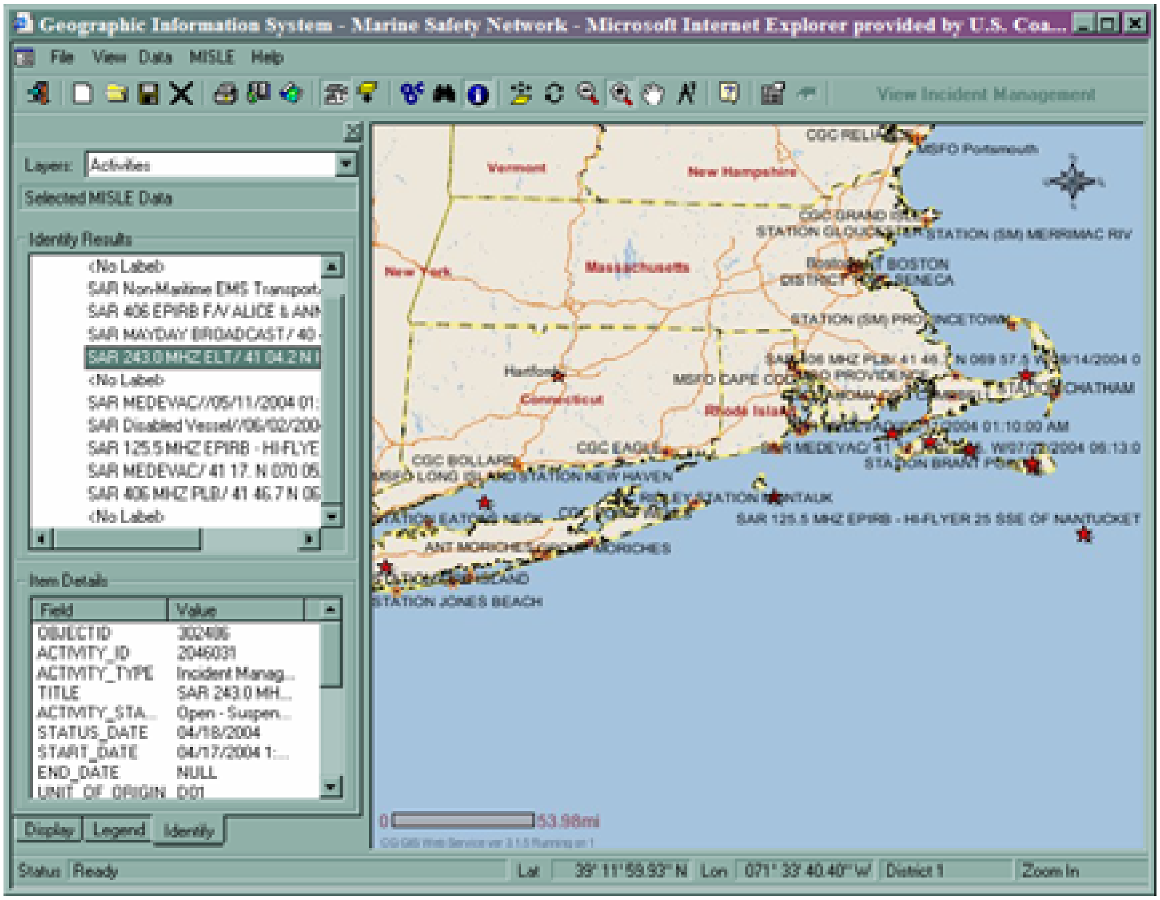

Figure 3. Example of MISLE Activities in the MISLE GIS Viewer

<u>Vessel Tracking Functions</u>

As the need for improved situational awareness increases, the ability to display near real-time AIS vessel positions and track lines relative to Port infrastructure and ongoing Coast Guard activities becomes increasingly more critical. These capabilities exist within the MISLE GIS viewer and will be incorporated in other Coast Guard Command and Control systems in the future. The MISLE GIS viewer provides an extensive capability to filter AIS track data, including pre-defined filters for vessel types, the status of Vessel Lookouts entered in MISLE, vessels carrying dangerous cargos, vessels with current operational controls, and an indication of Port State Control (PSC) safety targeting scores. Historical vessel positions and track lines can also be plotted, and user-defined geographic areas can be searched to identify all vessels that transited a specific area during a designated period of time. This also includes the ability to quickly display MISLE vessel details, Coast Guard activity history, and vessel arrival information (Figure 4) (Jager, 2007).

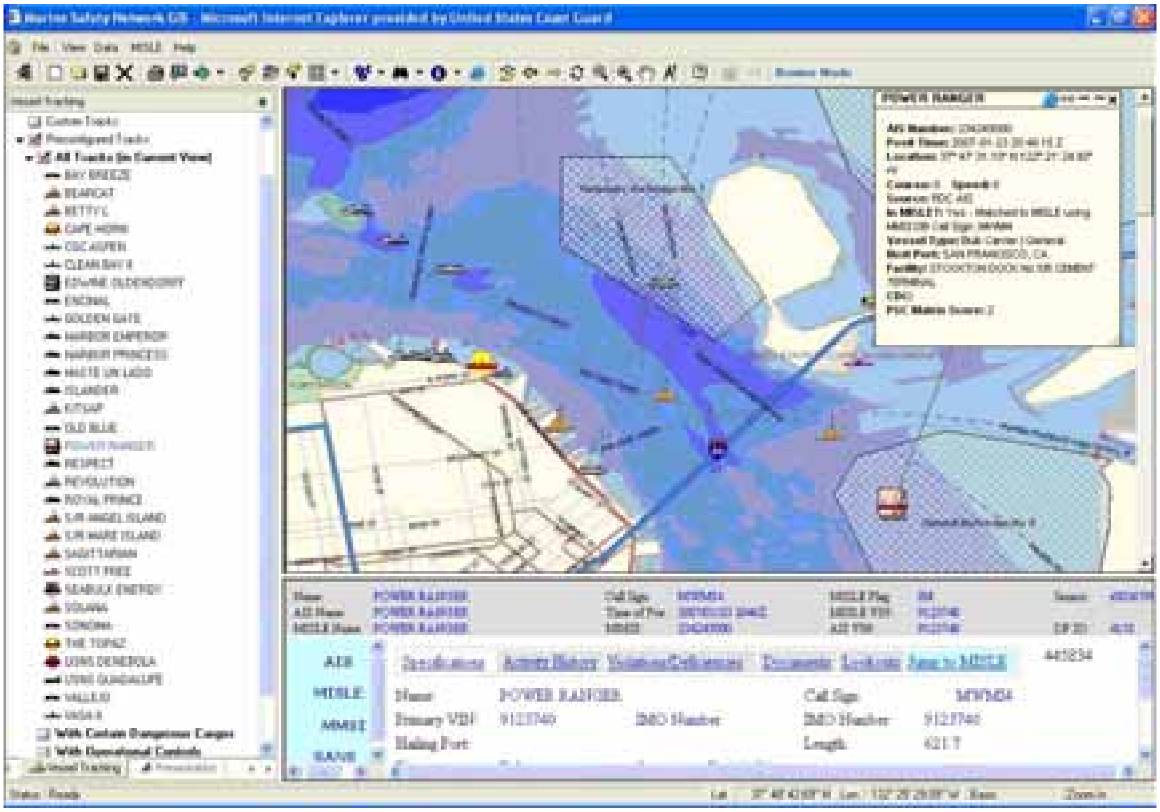

Figure 4. Example of near real-time AIS vessel positions in the MISLE GIS viewer.

<u>Capital Asset Management Portal</u>

Another example of incorporating geospatial technologies into Coast Guard business systems is the Capital Asset Management Portal (CAMP). CAMP was designed to provide users with a centralized location to access information that is securely pulled from multiple enterprise-level applications. CAMP's browser interface allows users to navigate via a geospatial display, common top-level buttons, and a hierarchical menu based on the Coast Guard's organizational structure. For any given level of the Coast Guard's organizational structure, an interactive map window displays the unit data spatially with a listing of the assets (shore facilities, surface, aircraft, vehicles, personnel) and projects listed alongside (Figure 5). The asset and project information is compiled from several of the Coast Guard's shore (SAM), aircraft (ALMIS), and surface (AOPS, FLS) information systems. Selecting any individual asset or project results in the retrieval of more specific information from the appropriate information system.

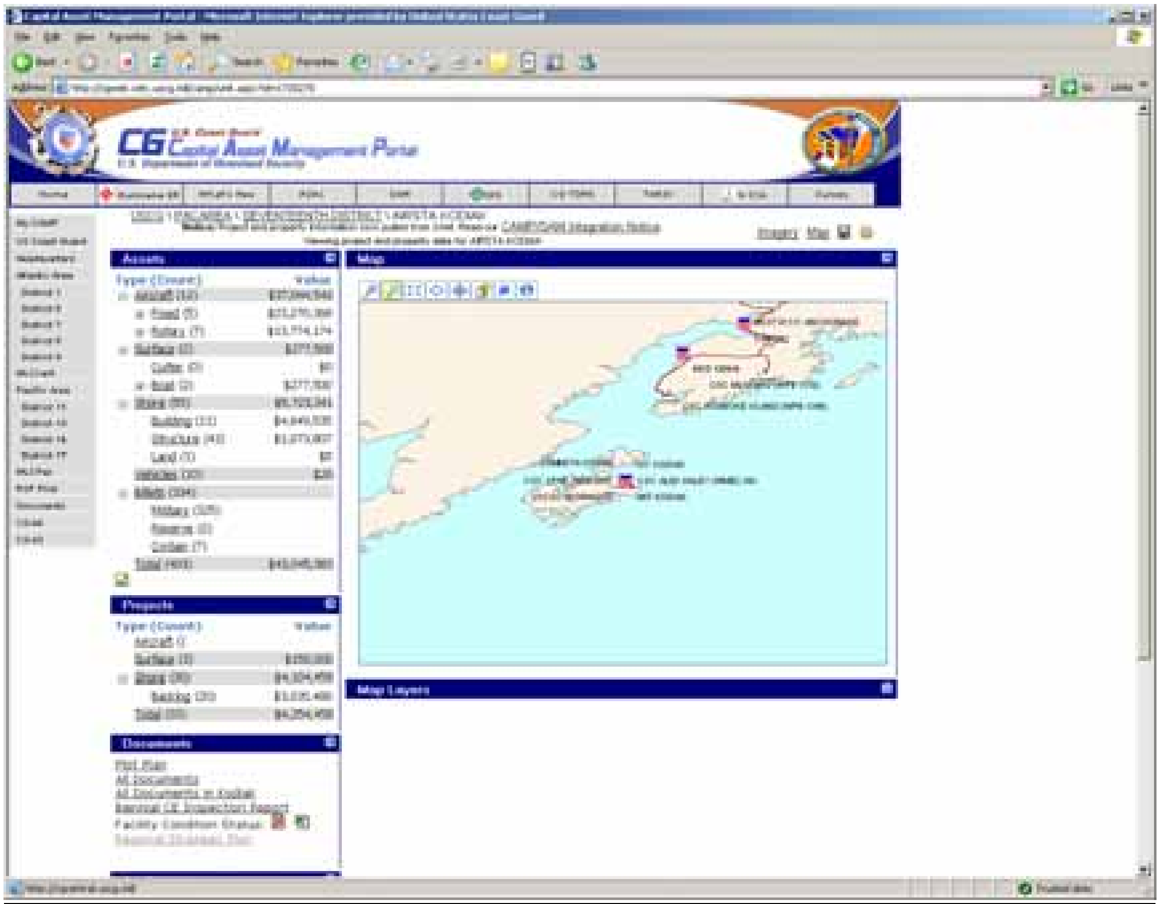

Figure 5. Example of CAMP geospatial display and associated asset data for Coast Guard Air Station Kodiak, Alaska.

Coast Guard Business Intelligence

The Coast Guard Business Intelligence (CGBI) system is another example of a Coast Guard business system which has incorporated geospatial technologies to display and interact with Coast Guard enterprise data. The CGBI system provides access to a number of Coast Guard enterprise data systems, standard measures of readiness (scorecards and data cubes) for every Coast Guard unit, and standard and custom reports. In addition to accessing this information via a series of tabs and menus, CGBI information can be accessed via a geospatial display (Figure 6). By selecting a Coast Guard Unit, the CGBI personnel, training, equipment, and infrastructure data/scorecards for that unit can be displayed.

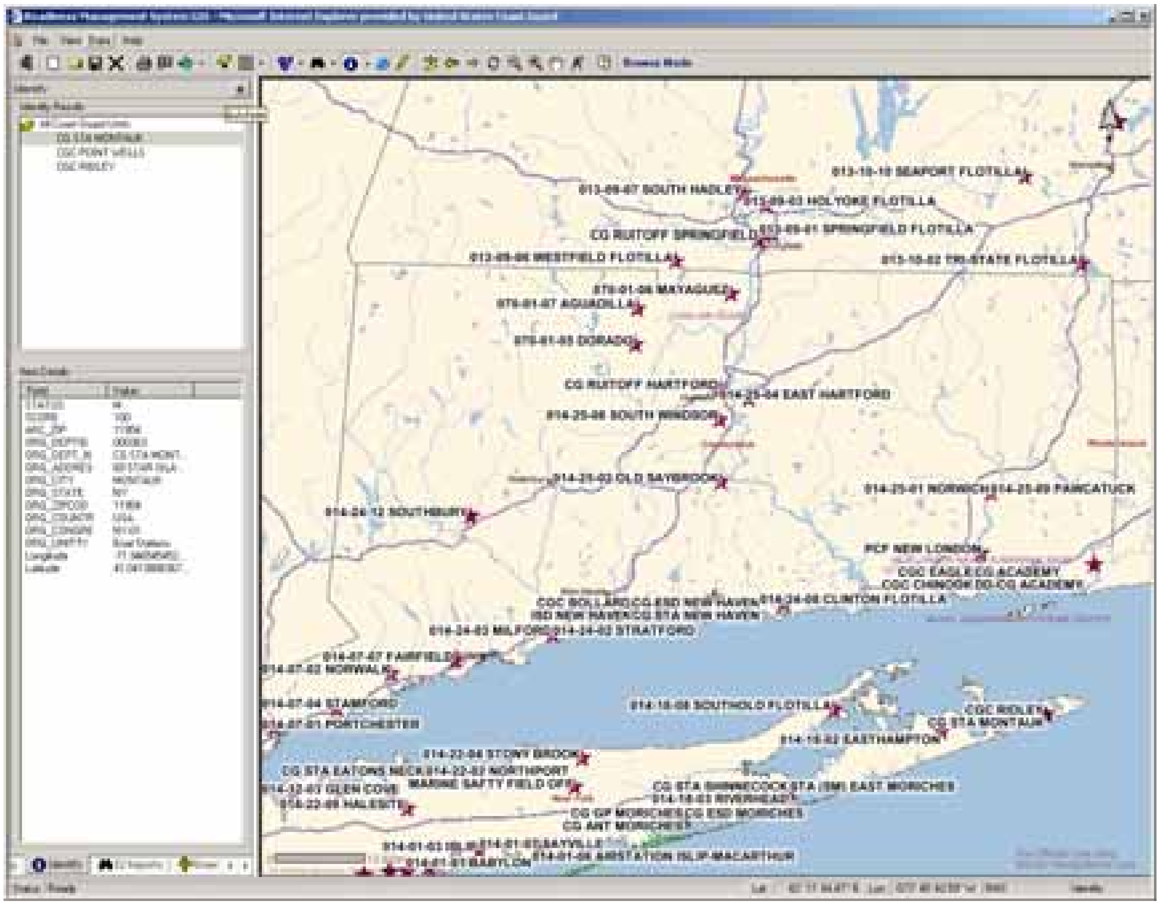

Figure 6. Example CGBI geospatial display of all Coast Guard units in Connecticut and Long Island.

Integrated Deepwater System

Finally, geospatial & remote sensing technologies within the Coast Guard will increase substantially as new Integrated Deepwater System assets become operational. Nearly every surface and airborne Integrated Deepwater System asset is scheduled to carry a complete suit of visual, infrared, & radar sensors.

> "The Coast Guard's strategic approach to maritime homeland security places a premium on identifying and intercepting threats well before they reach U.S. shores. This approach necessitates giving Coast Guard crews multiple opportunities to prosecute potential threats in a layered defense extending across the entire maritime domain of domestic waters, border and coastal areas and the high seas and foreign ports. To effectively push the borders outward, the service needs more capable assets with new technology for better surveillance (i.e, remote sensing), secure communications and more efficient command and control – and that is what the Integrated Deepwater System is designed to provide" (U.S. Coast Guard, 2006b).

In summary, geospatial and remote sensing technologies are necessary components to fulfilling the Coast Guard's HLS, MDA, Intelligence, and Command and Control mission requirements, have become and integral part of our Deepwater platforms and Sector Command Centers, and are used for situational awareness and effective communications during every phase of emergency/disaster planning and response by our local, state, and federal partners. Therefore, Coast Guard watchstanders and decision-makers will need to be proficient in the use of geospatial technologies such as remote sensing and GIS and be able to exercise spatial literacy (as defined by the National Research Council) in order to understand their effective use for mission accomplishment.

Meeting the Need

To meet this need for "spatially literate" Coast Guard officers, the Coast Guard Academy Science Department began offering an Introduction to Geospatial Sciences course to seniors in its Marine and Environmental Sciences (MES) major in the spring of 2003. This course introduces students to the fundamental concepts of Geographic Information Systems (GIS), including modeling the "real world" within a GIS, sources of spatial data, entering data into a GIS, editing this data within the GIS, GIS spatial data analysis techniques, and cartography. Relevancy of geospatial technologies to the Coast Guard is demonstrated throughout the course through the use of several Case Studies. The lab portion of the course emphasizes hands-on applications of principles discussed in lecture. Students are expected to apply GIS principles learned in lecture and lab portions of course in order to complete an end-of-semester GIS project. The overall goal of this course is not to develop GIS technicians fully proficient in the use of GIS. Rather, the aim of this course is to introduce future Coast Guard decision-makers to the theory and use of geospatial technologies for emergency planning and response, facilities management, and operational resource management and decision-making. Approximately 30 students a year have taken this course since 2003.

To further develop the spatial literacy of students in the MES major, the faculty within the Science Department have embarked on an effort to examine the development of spatial literacy in a more systematic fashion across the MES curriculum. First, upon reviewing the need for spatial literacy across the MES curriculum, it was realized that the existing Introduction to Geospatial Sciences course must be moved from senior year to first semester of the junior year. This will facilitate students applying their spatial thinking knowledge and skills in other courses in the MES major (Table 1), for independent research projects, and during internships. In addition, Science Department faculty are examining courses in the sophomore year of the MES curriculum for opportunities to introduce spatial concepts and activities to begin the development of spatial literacy knowledge and skills before their junior year (Table 1). Finally, plans are in place for the creation of an additional advanced geospatial sciences course to be offered as a free elective to seniors who have taken the introductory geospatial sciences course and are looking to further develop their spatial thinking, knowledge, and skills. Once all of this is put in place, spatial literacy will be fully incorporated across the MES curriculum.

Table 1. Examples of GIS Activities Across the MES Major

Year	Course	GIS Activities
Sophomore	Meteorology	Download weather data in GIS format and create a weather chart
Sophomore	Physical Oceanography	Geographic displays of oceanographic data Search and Rescue Case – displaying winds, currents, probable location(s) of search target, search patters
Sophomore	Marine Geology	Map of Home State Geology
Senior	Coastal Oceanography	Thames River Research Project – analysis and display of data
Senior	Marine Pollution	Planning and response to marine pollution incident
Senior	Hazardous Materials	Risk Assessment
Senior	Fisheries Management	Commercial fisheries management – maps of exclusionary zones

NGA-CGA Partnership

The National Geospatial Intelligence Agency (NGA) has been an avid supporter of these efforts since their inception. They have provided funds through their Service Academy Grant Program which have been used to purchase hardware and software, provide off-site and on-site training, and travel to conferences (Table 2). In addition, NGA's Office of the America's and Maritime Division have provided software, data, and guest speakers. NGA's support has significantly enhanced the quality and impact of the Coast Guard Academy's geospatial science education program.

Table 2. Impact of Funds Provided by NGA Service Academy Grant Program

NGA Service Academy Grant - $90K Over 4 Years
Provided: • Computer Hardware & Software • On-Site and Off-Site Training • Travel Funds
Supported: • GIS Course w/ Improved Pedagogy, Offered 6 Semesters • Four Research Projects supporting Coast Guard units • Training of 20 Faculty in four of five Academic Departments • Attendance at seven National Conferences
Impacted: • 200 Students • Five National Conference Presentations • Pedagogy of Science, Math, Humanities, & Civil Engineering Courses
Connected To and Advanced Coast Guard Academy's Strategic Goals • National Prominence • Institutional Excellence

Future Efforts

Although 30 “spatially literate” MES students now graduate from the Coast Guard Academy each year, the rapid incorporation of geospatial technologies into IT systems across multiple Coast Guard mission areas requires the development of spatial literacy knowledge and skills of students outside the MES major. In order to expand the development of spatial literacy to outside the Science Department, an Academy-wide geospatial system has been established through the procurement of data servers and Environmental Systems Research Institute (ESRI) Higher Education Site License. GIS functionality and data are now available to every faculty and student at the Academy. In addition, ESRI Instructor-led training was held at the Academy in the fall of 2006 to expose faculty in every Academic Department to the potential use of GIS in their particular area of interest. As a result of this training, geospatial activities have increased in Civil Engineering, Mathematics, and Humanities Departments at the Academy.

Looking forward, the Science Department hopes to take the lead in facilitating the development of spatial literacy of students outside the MES major, thus increasing the number of students graduating with these important skills and competencies above the 30 MES students who graduate each year. Additional future efforts and activities will include:

- Incorporation of several GIS-based activities into the Oceanography course taken by every student not in the MES major
- Expanded Course Offerings, Student Research, and Internship opportunities
- Creation of an Interdepartmental Geospatial Science Education Working Group
- Expansion of spatial literacy development across the entire CGA academic program.
- Establishment of GIS Web Services

Once these efforts and activities are in place, the Coast Guard Academy will have an effective system in place to develop the spatial literacy of all its graduates, thus meeting the Coast Guard’s need for officers proficient in spatial knowledge, thinking, and skills.

Conclusion

Because geospatial technologies are embedded across nearly all U.S. Coast Guard operational and business IT systems, it is doubtful that a single approach to geospatial education and training will be successful or meet all Coast Guard mission needs. Therefore, a “layered” approach in which geospatial education and training is delivered through multiple means is required –

1. Formal geospatial education as part of the Coast Guard Academy Undergraduate Service Academy Program
2. Pipeline training on GIS (in general) for officers and senior enlisted serving as senior watchstanders, supervisors, and program managers

3. Traveling “GIS Roadshows” to provide onsite unit training and support
4. Mission-specific GIS training embedded in several Coast Guard training schools
5. User Guides and Online Help for individual systems
6. OJT with “mentorship” of a local GIS “expert” (where the local GIS “expert” is provided through formal GIS education)
7. Tie-in GIS situation display training into the Coast Guard’s Incident Command System (ICS) Situation Unit Leader courses (under development), and prescribe a PQS to ensure qualified persons are assigned to that position during an incident.

Given the rapid rise in the use and importance of geospatial technologies for effective mission accomplishment across all Coast Guard mission areas, establishment of this “layered approach” to geospatial education and training must become an organizational priority.

References

Forman, M.A. (2002). Statement of Mark A. Forman, Associate Director for Information Technology and Electronic Government of the Office of Management and Budget, before the House Subcommittee on Technology and Procurement Policy (Homeland Security Testimony), June 7, 2002. Retrieved January 17, 2006 from http://www.cio.gov/documents/statement_mark_forman_06_07_02.html

Hannah, R. (2006). The Common Operational Picture. *Proceedings: The Coast Guard Journal of Safety and Security at Sea of the Marine Safety and Security Council, 63(3*) 65-68. Retrieved January 17, 2006 from www.uscg.mil/proceedings/

Jager, C. (2007). Personal Communication via e-mail.

Kalweit, S. (2003). Testimony of Susan Kalweit On a Map-related Data Infrastructure for Homeland Security Before the House Government Reform Subcommittee on Technology, Information Policy, Intergovernmental Relations and the Census, June 10, 2003.

Mayer, R. (2006). The Maritime Awareness Global Network. *Proceedings: The Coast Guard Journal of Safety and Security at Sea of the Marine Safety and Security Council, 63(3*), 47-49. Retrieved January 17, 2006 from www.uscg.mil/proceedings/

Morris, J. (2006). Looking into the Future of Hawkeye. *U.S. Coast Guard Engineering, Electronics, and Logistics Quarterly, 10(38), 3-4*.

MSTA. (2002). Maritime Transportation Security Act of 2002. Retrieved January 17, 2006 from http://www.uscg.mil/hq/g-m/mp/pdf/MTSA.pdf

National Research Council. (2006). *Learning to Think Spatially*. National Academies Press, Washington DC. 313 pp.

Netsch, R. (2004). The USCG Search and Rescue Optimal Planning System (SAROPS) via the Commercial/Joint Mapping Tool Kit (C/JMTK). Proceedings of the 24th Annual ESRI User Conference, August 9, 2004, San Diego, CA. Retrieved February 20, 2007 from http://gis.esri.com/library/userconf/proc04/docs/pap1185.pdf

Noggle, J.W. (2006). Project Hawkeye and the U.S. Coast Guard's First Sector Command Center. *Proceedings: The Coast Guard Journal of Safety and Security at Sea of the Marine Safety and Security Council 63(3*), 82-84. Retrieved January 17, 2006 from www.uscg.mil/proceedings/

Office of Homeland Security. (2002). *The National Strategy for Homeland Security*. Retrieved January 17, 2006 from http://www.whitehouse.gov/homeland/book/)

Office of Management and Budget. (2002). *OMB Circular A-16, Coordination of Geographic Information, and Related Spatial Data Activities*. Retrieved January 17, 2006 from http://www.whitehouse.gov/omb/circulars/a016/a016_rev.html

U.S. Coast Guard. (2002). *The Maritime Strategy for Homeland Security*. Retrieved January 17, 2006 from http://www.uscg.mil/news/reportsandbudget/Maritime_strategy/USCG_Maritme_Strategy.pdf

U.S. Coast Guard (2006a). SAROPS. Retrieved January 17, 2006 from http://www.uscg.mil/hq/c2cen/SAROPS.html

U.S. Coast Guard. (2006b). Alignment (of Integrated Deepwater System) Under Department of Homeland Security. Retrieved January 17, 2006, from http://www.uscg.mil/hq/g%2Da/Deepwater/program/dhs.htm

U.S. Coast Guard (2007). *The U.S. Coast Guard Strategy for Maritime Safety, Security, and Stewardship*. Retrieved March 9, 2007 from http://www.uscg.mil/comdt/speeches/docs/CGS-Final.pdf

Author Information

Michael A. Alfultis
Head, Department of Science
U.S. Coast Guard Academy
27 Mohegan Avenue
New London, CT 06320-8101
860-444-8632
860-444-8627 (fax)
Michael.A.Alfultis@uscg.mil