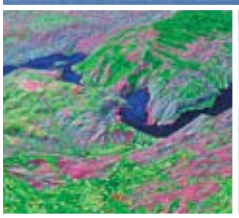
Volume 4

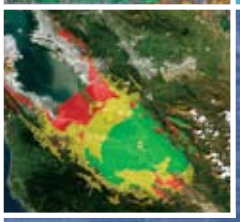
GIS in the Defense and Intelligence Communities









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Each article in this publication represents a real program or situation that is making a difference in defense and intelligence communities. Sharing experiences lessens risk, reduces cost, and fosters understanding of the road map toward seamless spatial information infrastructures in defense and intelligence organizations.

It is ESRI's intent to produce this publication at least once a year. For those interested in featuring a story in the next edition, contact Fred Woods at fwoods@esri.com or 909-793-2853, extension 1-1017.

Dear Colleagues:

I am delighted to introduce this fourth volume of *GIS in the Defense and Intelligence Communities*. This volume mainly focuses on the use of geospatial technology in the international arena: 10 out of the 15 stories were submitted by international organizations. This is exciting to me because it demonstrates how universal geographic information system (GIS) technology has become in defense.

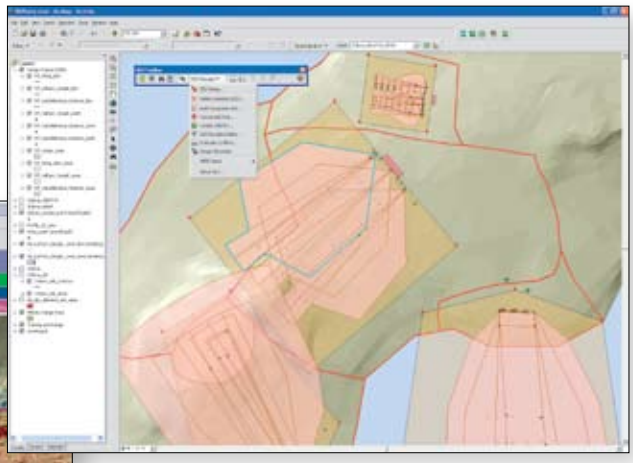
In previous volumes, the stories illustrated how GIS was used in many applications: command and control, intelligence and reconnaissance, installations and environment, logistics, and health. This new volume highlights the international reach of GIS in defense and intelligence, which is significant since many nations share common challenges and increasingly participate in multinational exercises and operations.

Three of the stories come from the North Atlantic Treaty Organization (NATO), one from the European Union Satellite Center, and six from other international organizations. These important articles illustrate how GIS supports ongoing operations and serves as a useful model for how technology contributes to national programs.

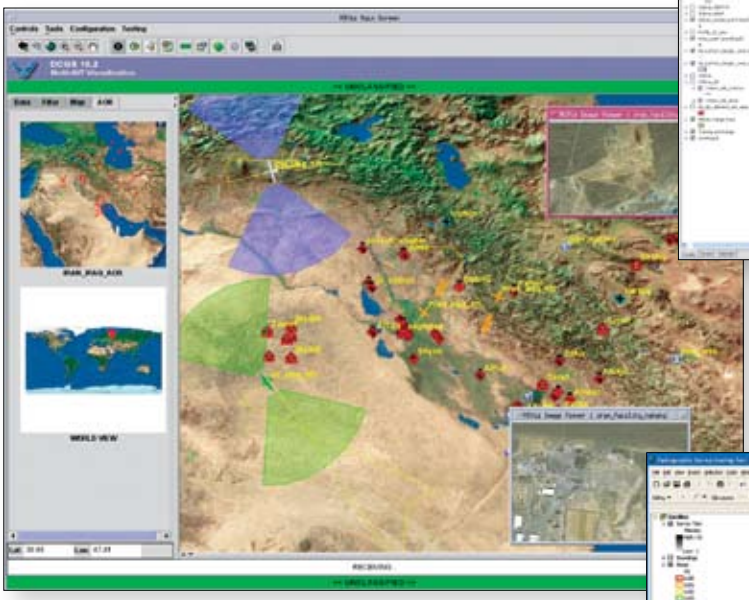
The information also helps organizations because they see successful models of wise applications of technology and sophisticated tools for making informed decisions. As you can see, distributing concepts and strategies has tangible benefits. It is interesting to reflect on the importance of publishing experiences like these. Taxpayers benefit because sharing knowledge reduces redundant programs and associated costs.

Warm regards,

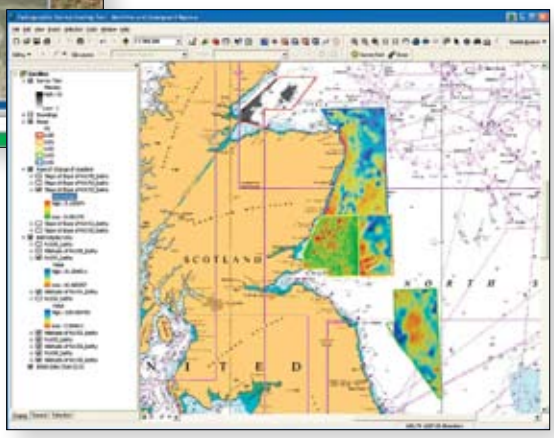
Jack Dangermond
ESRI President



Range Managers Tool Kit



US Air Force Distributed Common Ground System.



U.K. Maritime and Coastguard Agency

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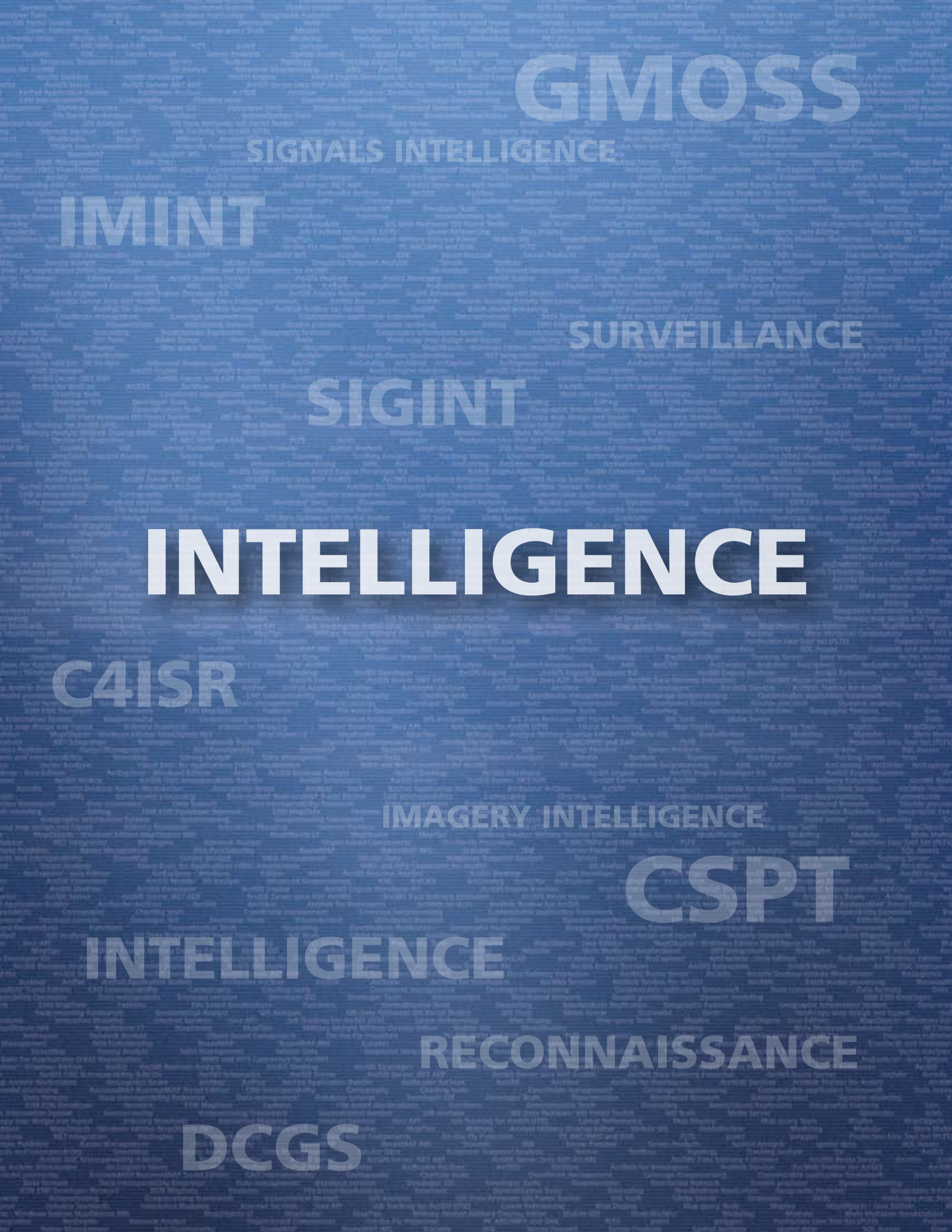
GMOSS
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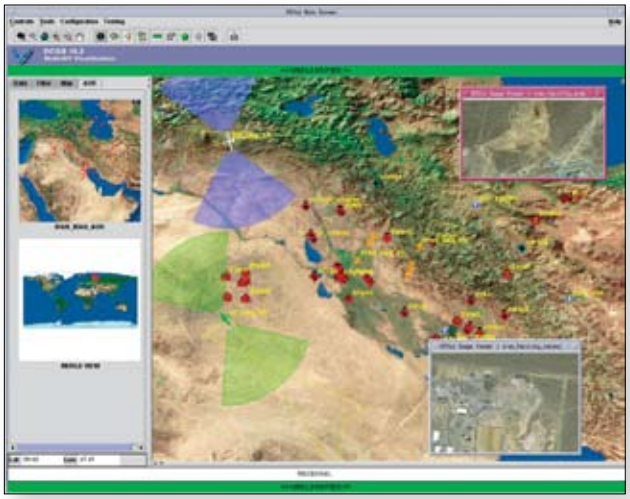
INTELLIGENCE
RECONNAISSANCE
DCGS

The Synergy of Networkcentric Technologies, GIS, and the Distributed Common Ground System's Integration Backbone (AF DCGS Block 10.2)

The past several years have proved the need for persistent intelligence, surveillance, and reconnaissance (ISR) for U.S. armed forces. They require real-time information to gain decision superiority and dominate the battle space.

The Air Force's (AF) major ISR system, largely made up of legacy components and known as the Distributed Common Ground System (DCGS), recently struck a major evolutionary milestone. The Electronic System Center's Intelligence Surveillance and Reconnaissance Integration System Program Office awarded the AF DCGS Block 10.2 upgrade contract to an industry team of major companies led by the Raytheon Corporation.



The AF DCGS 10.2 upgrade of the Air Force ISR DCGS System will enable networkcentric operations using the DCGS Integration Backbone (DIB) for the U.S. armed forces as each service develops its own system.

DIB can trace its lineage from the Chairman's Joint Vision 2020, Defense Planning Guidance, Quadrennial Defense Review and Service modernization and transformation efforts.

The Department of Defense (DoD) envisions DCGS as a globally integrated, distributed, and collaborative information technology enterprise. AF DCGS Block 10.2 will provide continuous, on-demand intelligence to achieve full-spectrum dominance so that American and Coalition forces can change the mission objectives in hours, minutes, or even seconds. The environment provides physical and electronic distribution of ISR data, processes, and systems.

The Raytheon-led team is working shoulder to shoulder with the U.S. Air Force to transform the current tasking, processing, exploitation, and dissemination (TPED)-based DCGS system into the task, post, process, and use (TPPU) model.

Current ISR systems feed data into platformcentric "stovepiped" tasking, processing, exploitation, and dissemination systems operating independently of each other. Because of this partitioning, commonality and interoperability are restricted between the services, which limits their ability to operate in a joint and coalition environment. AF DCGS Block 10.2 overcomes these obstacles.

With the introduction of the AF DCGS Block 10.2 DIB capabilities, current intelligence data is posted to the network for immediate use by analysts and war fighters and is integrated with other assets to produce situational awareness of the battle space.

ISR knowledge is presented to users in many ways, primarily through the use of a commercial Web-based architecture and technologies and integration, via the DIB, of multiple intelligence systems into a single, worldwide networkcentric enterprise, thus enabling interoperability and improved collection and delivery of ISR data. AF DCGS Block 10.2 Web-based technologies will transform ISR into an integrated element of DoD command and control systems.

The AF DCGS Block 10.2 DIB system's open architecture was developed so that any node or workstation within the Air Force DCGS organization can share intelligence across a worldwide network.

Access to the enterprise tools is a point and click away from any Air Force user's fingertips via the centralized Air Force DCGS portal. It is fully customizable according to the user's preferences and performance functions.

The Web-based ISR product developed for AF DCGS Block 10.2 to visually share and manage the federated data of the battle space is Multi-Int Visualization (MiViz). MiViz is purely browser based and was created in concert with the subject matter experts of the Air Force. Each provided priceless inputs into the development and use of the final product.

MiViz is a completely DIB-enabled product composed of enterprise-optimized source code and enterprise-enabled COTS geographic information system (GIS) software from ESRI. MiViz extensively employs ESRI® MapObjects®—Java™ and ArcXML™ to interface to the plethora of mapping server functions provided by ArcIMS® and ArcSDE®. This architecture is bounded by WebLogic Server® to expose all National Geospatial-Intelligence Agency (NGA) GIS products (CADRG, VMap, CIB, DTED, etc.) and ESRI GIS functions and analysis tools to users of the enterprise.

Interactive mapping functions provided by MapObjects—Java (e.g., pan and zoom) can be used without modifications out of the box. MapObjects acetate data layers are employed to create the extensive overlay system architected into the MiViz product. MiViz enhanced filtering features, along with acetate layers, allow the user to efficiently manage and filter all battle space data and optimize the displayable real estate quickly and efficiently.

Another AF DCGS Block 10.2 DIB- and GIS-enabled tool is the Meta Data Query Service. The Meta Data Query Service is a search engine designed for quick, efficient searching of metadata across the entire ISR enterprise. Data is retrieved via compound queries combining contextual, temporal, and geospatial criteria. Raytheon's chief systems engineer for AF DCGS Block 10.2, Stephen Yates, described it once as being like "Google® with a clearance."

The many interactions during the development process between software developers and subject matter experts (SMEs) and the use of enterprise-based ESRI GIS and DIB products have culminated in a powerful set of user tools—MiViz, Meta Data Query, and other Web-based products—which are easily learned and used by anyone. The intuitive point-and-click actions propel the user into completion of activities with decisive strokes.

As each service's DCGS system adopts DIB, intelligence data will be shared seamlessly across the entire ISR family of systems. Raytheon is currently working with the other services and government agencies, assisting them in deploying, employing, and architecting their systems with the DIB infrastructure, thereby facilitating the vision of future interconnectivity and sharing of all data across one DoD C4ISR enterprise.

From space to ground to under the sea, AF DCGS Block 10.2 is the foundation of the global ISR enterprise and will provide significant automation and data-sharing enhancements.

The AF DCGS Block 10.2 upgrade significantly enhances the speed at which war fighters can receive and share critical ISR information and improves the ability of the Air Force and its sister services to share that data, in real time, through a high-speed network.

The DIB enterprise is composed of a global network of fixed and mobile ground processing systems for ISR data collected from multiple sources including high-flying manned and unmanned aerial vehicles such as the U2, Predator, and Global Hawk. The system's primary function is to receive intelligence feeds from multiple sources at a common ground station where they are processed, stored, correlated, exploited, and disseminated to air operations centers (AOCs) and many other war fighting nodes to enable time-critical targeting.

The concept of AF DCGS Block 10.2 involves a federation of core sites, regional centers, forward operating locations, data relay sites, and elements of AOCs through the use of the DIB.

This collaboration is accomplished via the connecting of sites with high-capacity networks and best-of-breed applications. The AF DCGS Block 10.2 upgrade will enable interoperability from site to site at the data level and provide commanders in the field with an improved flow of intelligence information, enabling more effective, time-sensitive targeting. The new contract also expands the existing systems to include new Air National Guard sites. Under the AF DCGS Block 10.2 contract, upgraded DCGS systems will be delivered to various Air Force locations.

The current DCGS system consists of worldwide and regional sites including core locations and several remote bases. Enhanced by upgrades from the AF DCGS Block 10.2 program office, the current DCGS weapon system has been providing around-the-clock, near real-time ISR information to war fighters supporting Operation Iraqi Freedom (OIF) and Operation Enduring Freedom (OEF).

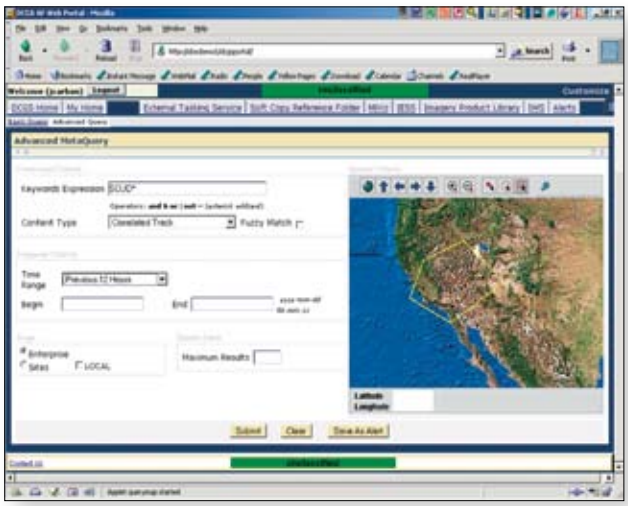
The AF DCGS Block 10.2 system will also incorporate developing sensor technology to better fight the enemies of today that employ hit-and-run operations or guerilla tactics.

In Operation Iraqi Freedom, fleeting targets were identified in near real time. Current systems provide limited target ID capabilities involving a substantial amount of human interaction. The AF DCGS Block 10.2 upgrade automates that process so information sharing in real time becomes routine. This is especially significant since, throughout the years, battle scenarios have become much more complex and require substantial coordination among the services and among United States forces and Coalition partners.

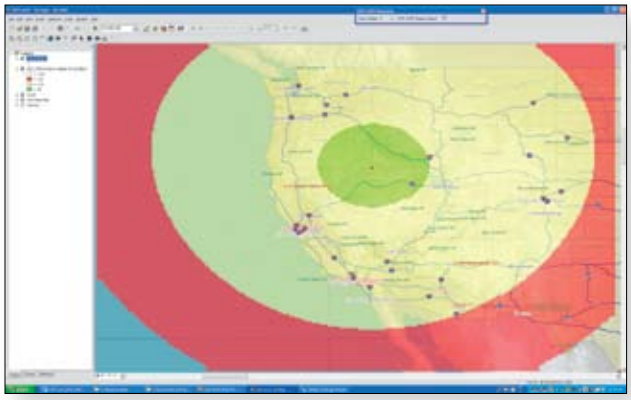
Distributed operations and distributed management planning are also core essential elements in the operations scenario. AF DCGS Block 10.2 is the core element of the system. The AF DCGS Block 10.2 upgrade makes it possible for enterprise-wide participants to be part of the mission planning processes.

Currently, each of the services is developing independent versions of a DCGS system. The U.S. Army, Navy, and Marine Corps are expected to procure common elements for their systems. A major goal of the AF DCGS Block 10.2 upgrade is to interconnect disparate ISR systems "machine to machine," to create a seamless interoperable system that effectively shares critical ISR data and standardizes operations, training, and system support. Fulfillment of these goals will bring the AF a big step closer to achieving real information superiority, now widely recognized as transformational war-winning capability.

This article was assimilated from many different sources. The technical product information, editing, and product discussions were provided by John N. Carbone, Senior Technical Lead for AF DCGS Block 10.2 Multi-Int Core.



Communication System Planning Tools



Introduction

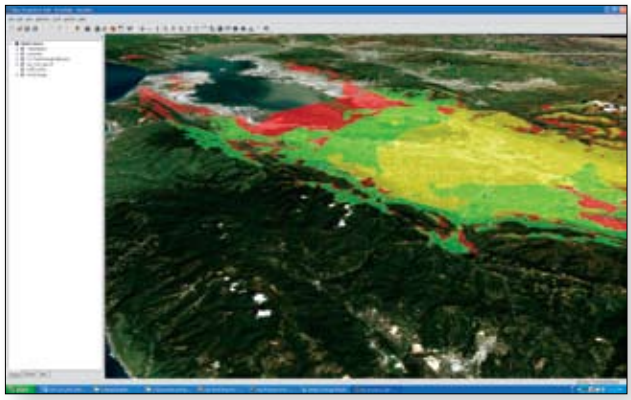
The Communication System Planning Tools (CSPT), also known as RF-Analyst in the defense community, was developed by the U.S. Department of Commerce, National Telecommunications and Information Administration (NTIA), Institute for Telecommunication Sciences (ITS) for the Department of Defense. The tools were developed so that the power of GIS, which has become a critical part of defense planning and analysis, can incorporate existing and planned electromagnetic wave prediction models. The CSPT extensions to ArcGIS® can be run either as stand-alone applications or within existing applications that need to add communication system analysis and planning to their application output.

Overview

The purpose of the CSPT extensions is primarily to support analysts in the performance of their mission within the military domain. The extensions are intended to be sufficiently intuitive in their use so the analyst can operate them efficiently with little or no training. There are three CSPT extensions:

1. CSPT_LFMF—The low frequency/medium frequency (LFMF) extension of CSPT covers the spectrum from 150 KHz to 2 MHz and uses the ITS System 3 LFMF model.
2. CSPT_HF—The high frequency (HF) extension of CSPT covers the spectrum from 2 MHz to 20 MHz and uses the ITS ICEPAC HF model.
3. CSPT_VHF—The VHF/UHF extension of CSPT covers the spectrum from 20 MHz to 20 GHz and uses a wide variety of models that are well known and widely used including Longley/Rice, TIREM, Walfisch/Ikegami, and IF77.

The CSPT extensions can be used as stand-alone applications or activated as part of the process flow of any other application. The extensions incorporate a simple wizard toolbar that provides access to the basic functions of communication system analysis and a full menu toolbar that gives the analyst access to many more advanced and complex analysis capabilities. Analysis outputs are saved and exported as layer files for easy reuse and incorporation in other applications or reports. The CSPT_VHF extension is capable of performing analysis for large areas (thousands of square kilometers) or small areas (less than one square kilometer) and can perform coupled outdoor-to-indoor and indoor-to-outdoor building analysis in urban areas.



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Capabilities

Each extension of the CSPT suite has input requirements and capabilities suitable to that part of the spectrum. In general, the higher the frequency of the application or model, the more detailed the input data in support of that application needs to be. This is one of the greatest strengths of GIS for this type of application suite. Geographic information systems can import data of any type and resolution and can seamlessly present this data for use in an application.

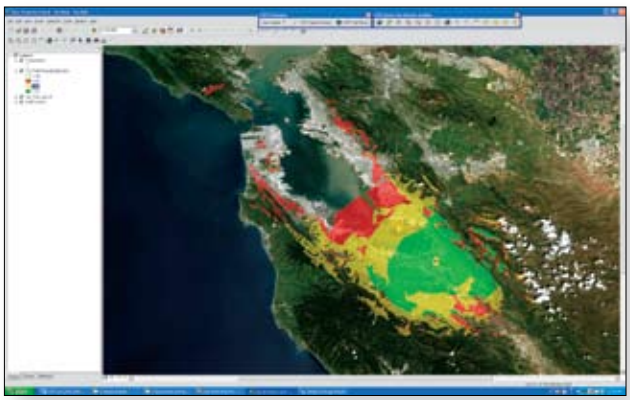
The LFMF and HF extensions of the CSPT suite generally do not need terrain data, although the LFMF extension can use it. These extensions have onboard databases for ground conductivity and dielectric constants, and they incorporate existing antennas or the ability to input antenna information. The HF extension allows the user to run many scenarios in batch mode, varying many input parameters in each scenario. This allows the analyst to see outputs that can be a function of a parameter or even time varying.

The VHF extension of the CSPT suite can use the ArcGIS Military Analyst extension to import data; it also allows the user to import data from one of many onboard databases that ship with the ESRI GIS product. The simple wizard menu of the CSPT_VHF extension guides the user in the definition of transmitter parameters, receiver parameters, antenna data and output units, and signal level contours. The analyst can also specify a distance out for analysis and a start and stop azimuth. The full menu toolbar additionally allows the user to construct scenarios such as interference analysis, overlap studies, multiple transmitter composites, point-to-point links, and coupled outdoor-to-indoor or indoor-to-outdoor building penetration scenarios. Analysis results can be exported directly into visualization tools such as ArcGlobe™, allowing the analyst very useful visualization of the results of an analysis.

Benefits

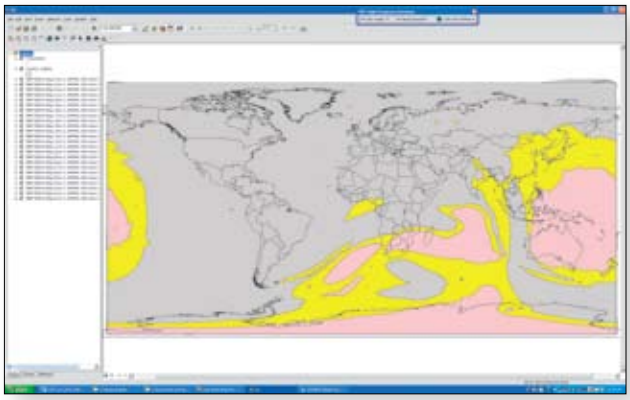
The many benefits of the CSPT extension suite include

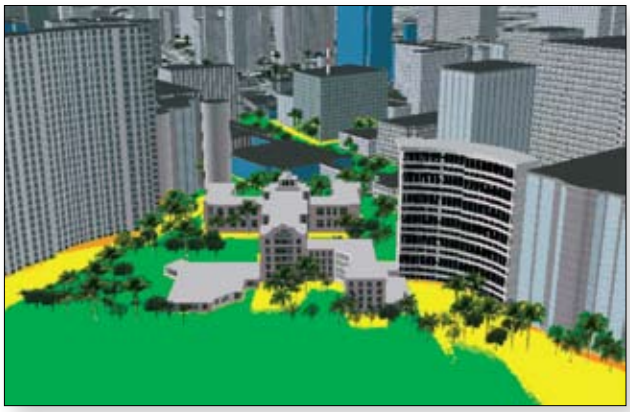
- Ease of learning and use with many onboard help menus
- Choice of simple wizard or full menu approaches to analyses for the beginner or more advanced user
- Ability to be run as a stand-alone application or embedded in other existing applications
- Capability of importing many datasets needed for electromagnetic wave models such as terrain, buildings, imagery, antennas, and transportation infrastructure
- Saving of output results in easy-to-export analysis areas, geodatabases, and layer files
- Seamless exportation of data into ArcGlobe at the push of a button for improved visualization



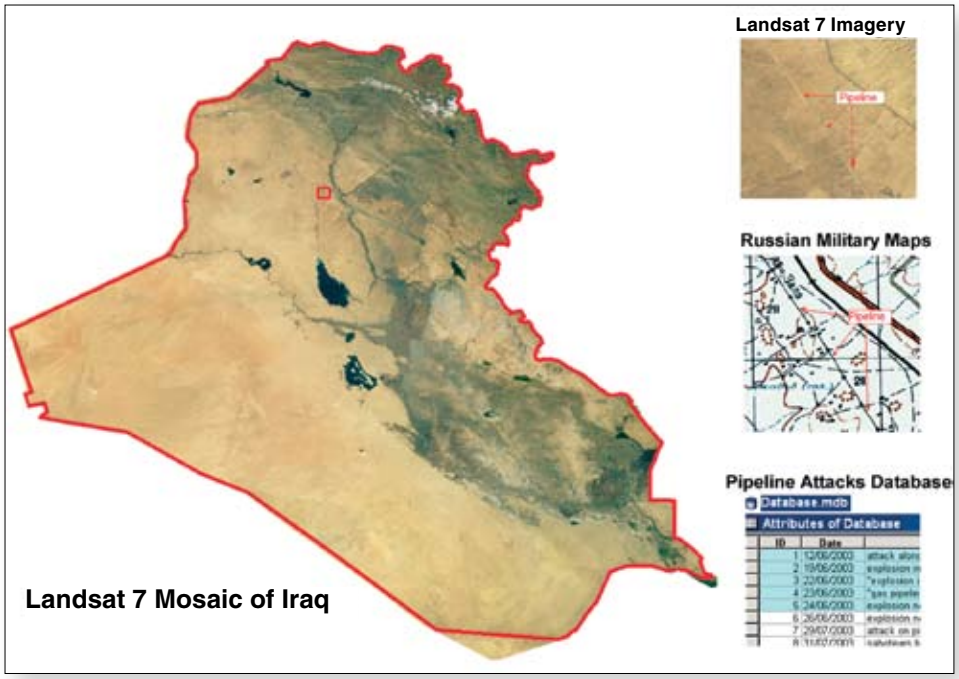
Summary

CSPT are a simple, intuitive, and flexible suite of extensions for communication system planning and analysis that can run as stand-alone applications or be embedded in existing applications within the ESRI family of ArcGIS 9.x products including ArcMap™ and ArcGlobe. The analyst can create simple transmitter coverages or more advanced and complex analyses such as interference studies, overlap evaluations, point-to-point link analysis, and coupled indoor/outdoor analyses. The main purpose of CSPT is to provide analysts with a simple means of incorporating communication system planning and analysis within other applications in the performance of their mission.





Geospatial Trends of Pipeline Attacks in Iraq: A Proposal to the GMOSS Network



The large number of attacks on the pipeline system and oil installations in Iraq is a clear indication that terrorist groups have selected these targets as the most relevant ones to undermine the Iraqi economy, prevent reconstruction in the country, and destabilize the peace efforts. The incidence of these attacks in related installations such as oil terminals (e.g., Basra) can have a wide impact on international oil supplies. Furthermore, this strategy is used extensively by terrorists worldwide.

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A database of attacks on pipelines (oil and gas) and related installations in Iraq, dating from June 2003 until recently (more than 300 entries), is being developed from different open sources and can be made available by the European Union Satellite Centre (EUSC) to the Global Monitoring for Security and Stability (GMOSS) network. This database together with the mapping of these infrastructures (from imagery and maps) will display these attacks geospatially to derive relevant security information such as the pipeline sections under more intense attacks, relationship of these attacks to border proximity (Syria, Iran), and frequency of these attacks. The conclusions of this task could also help to develop security strategies such as more intense security surveillance on the ground and electro-optical (EO) monitoring for the more vulnerable sections of the pipelines.

Other available data includes Landsat and SPOT mosaics, Russian military maps, and Joint Operations Graphic (JOG) maps.

Additional GIS layers could be developed to generate more relevant results (areas of activity of certain terrorist groups, proximity of the population to the oil and gas fires following pipeline attacks, etc.).

This proposal could integrate several GMOSS WPs such as feature extraction, change detection, data integration and visualization, infrastructure monitoring, damage assessment, and population and border monitoring.


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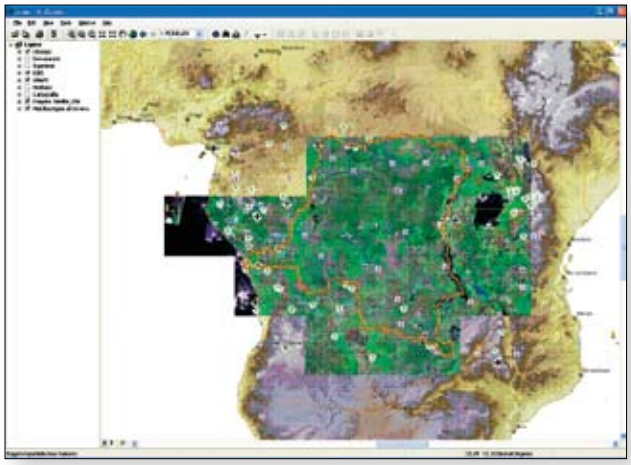
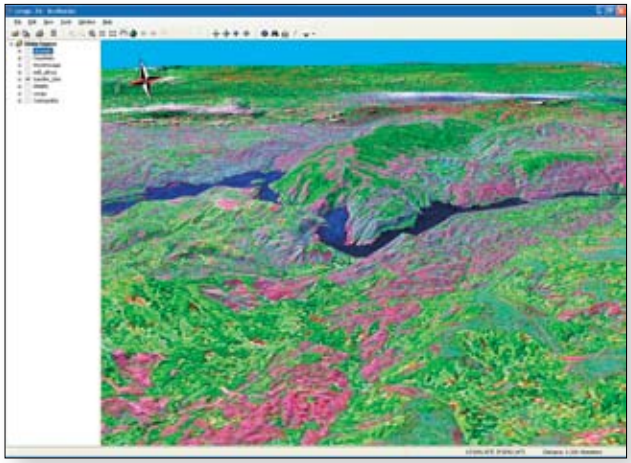
Geographic Information Support to Portuguese Marines in Congo



ArcReader™ 2D Exploitation of Data



ArcReader 3D Exploitation of Data

Democratic Republic of Congo, Africa, held presidential elections in July and October 2006. The United Nations Organization (UNO) established a mission to observe and preserve peace and public order, avoiding confrontation between leaders' supporters. Portugal contributed with Special Forces of the Navy—the Portuguese Marines.

Preparing such a mission, with no specific area of interest but with the need to be prepared for all scenarios and locations, included the gathering of all available environmental and geographic information. This task was mainly performed at the Portuguese Hydrographic Office. A distributable geographic information system was assembled with data compiled from a variety of sources that related to several themes. These included georeferenced raster maps, digital vector maps, satellite imagery, high-resolution digital terrain models, gazetteers, airfields, roads, tracks, railroads, urban areas, administrative limits, and rivers. It also included 6.3 GB of environmental data such as soil type, forest fires, earthquakes, precipitation, population density, and vegetation.

The system was delivered in DVD-ROM, and a Web version was made available on a private network. The DVD version also includes a 3D viewer for perspective data exploitation. Users were able to make flyby scenes on-site and get acquainted with terrain features.

Major identified benefits were the environmental awareness of the personnel being deployed in places they were not familiar with and fast and flexible access to geodata covering very large areas.

Contact Information

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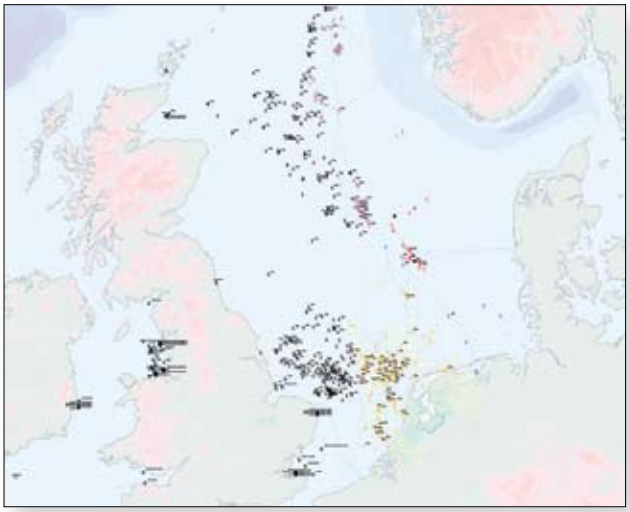
NATO Maritime Component Command HQ Northwood, UK, Supporting Maritime Situational Awareness

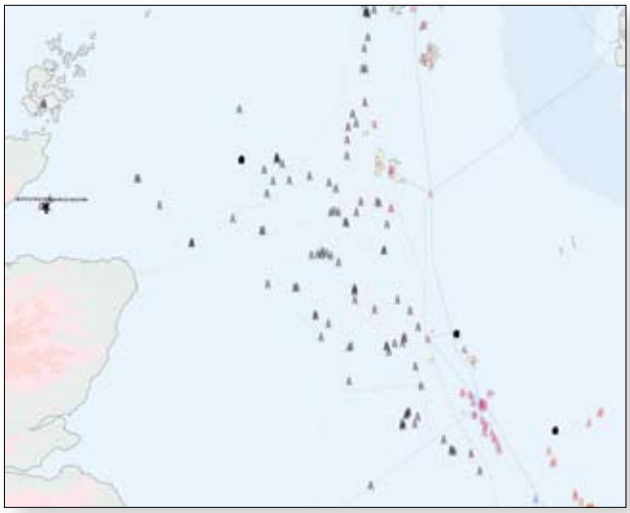
MCC HQ Northwood

As part of the ongoing mission of the North Atlantic Treaty Organization Maritime Component Command Headquarters (NATO MCC HQ) Northwood to promote peace, security, and stability within the North Atlantic, the Operations Division (N3) of the HQ is focused toward Maritime Situational Awareness (MSA) that's defined as "the effective understanding of anything associated with the Maritime Domain that could affect the security, safety, economy, or environment of the Alliance, its member nations, its Partners and other nations it chooses to work with."

An essential part of this MSA process is the 24/7 collection of maritime-specific data, including industrial infrastructure information, with various contributors providing data. ESRI ArcGIS 9.1 software is used extensively to maintain a visual database of much of the data collected. This data can be used by HQ staff for briefings/presentations, as exports are made in various formats from ArcMap or even combined with other maritime data and imported into other GIS-capable computer systems within the headquarters.



Maritime Data Collection



Oil and Gas Industry Data

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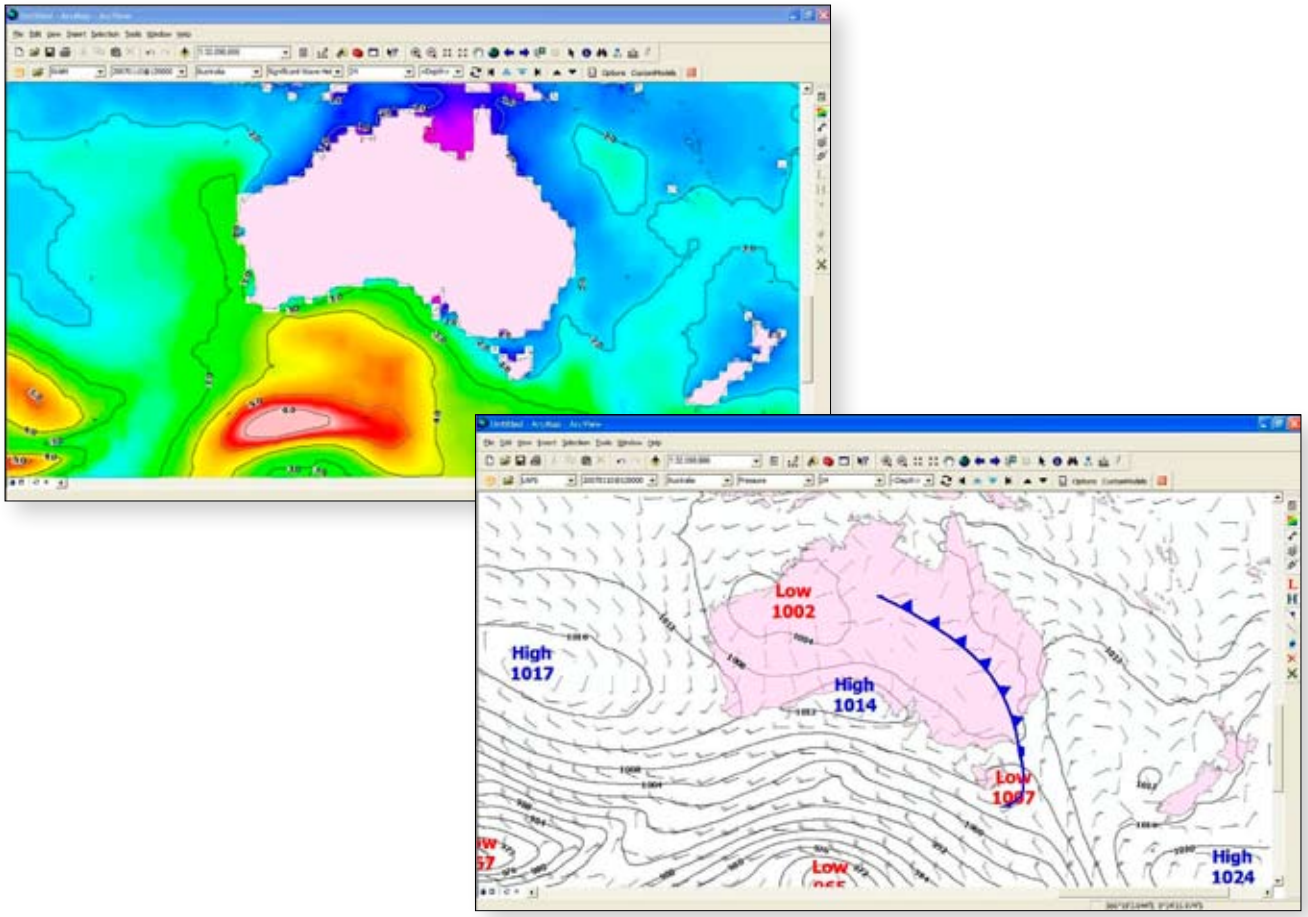
RAN Directorate of Oceanography and Meteorology: Providing Spatially Enabled Weather, Wave, and Ocean Forecasts



Overview

The Royal Australian Navy (RAN) Directorate of Oceanography and Meteorology, with support from ESRI Australia, Pty. Ltd., ESRI's distributor in Australia, has developed a capability to spatially enable numerical weather, wave, and oceanographic forecast model data from the Australian Bureau of Meteorology (BoM) and provide these products to the Australian Defence Force via both a Web service and a custom desktop extension.

For units with Internet connectivity, the interactive Meteorological and Oceanographic Viewing Environment (iMOVE) is an ArcIMS software-based application providing a single interface to animated maps of forecasts supported by a range of background maps, climatological products, and historical and current observations.

For units with only occasional e-mail access, the model data is written to a file geodatabase as a raster catalog and features, zipped, and transmitted as an e-mail attachment. The custom METOCViewer extension then unzips and loads the data into ArcMap for annotation and viewing.

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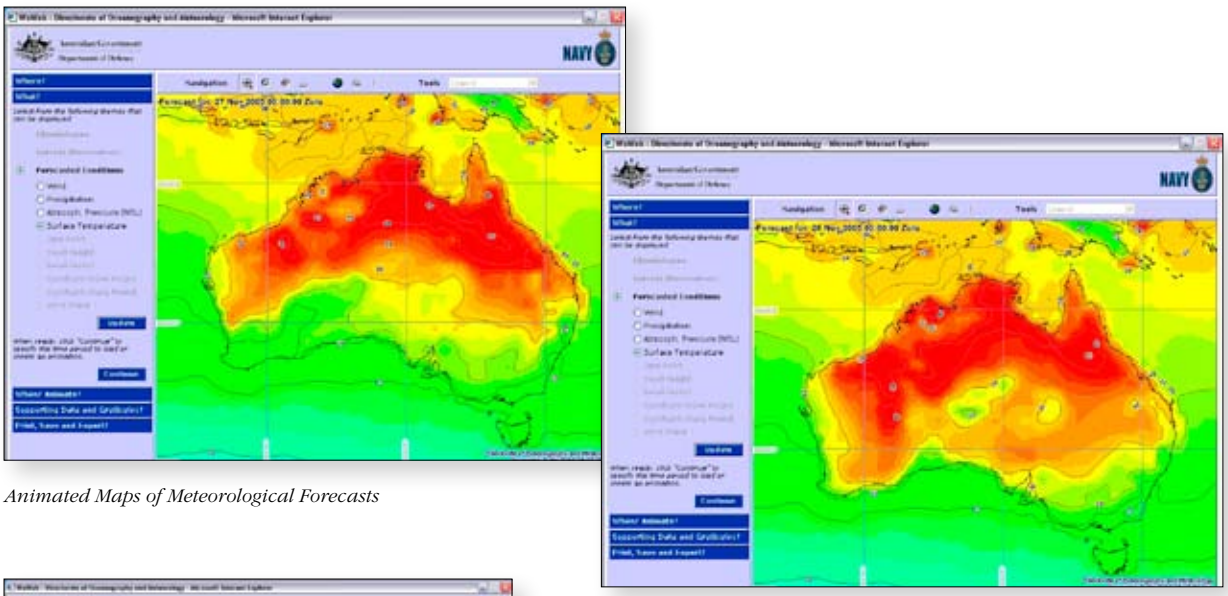
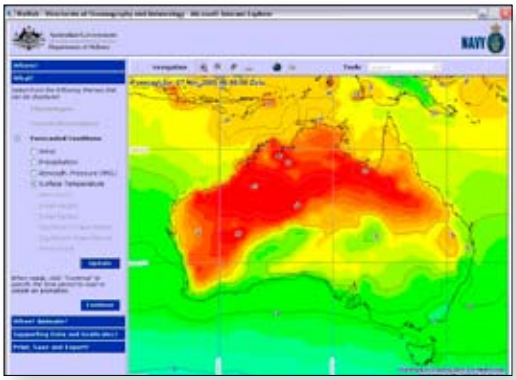
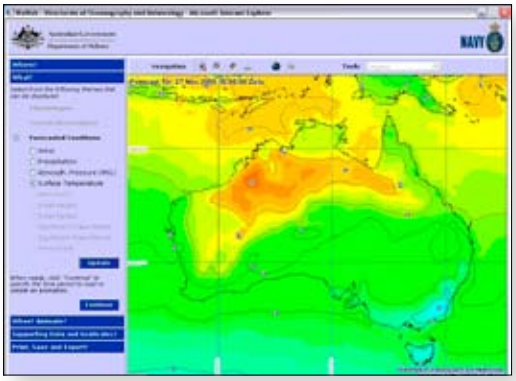
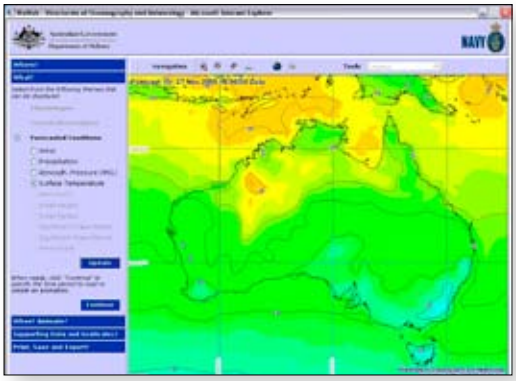


Animated Maps of Meteorological Forecasts







Capabilities

The Internet Map Server (IMS) interface

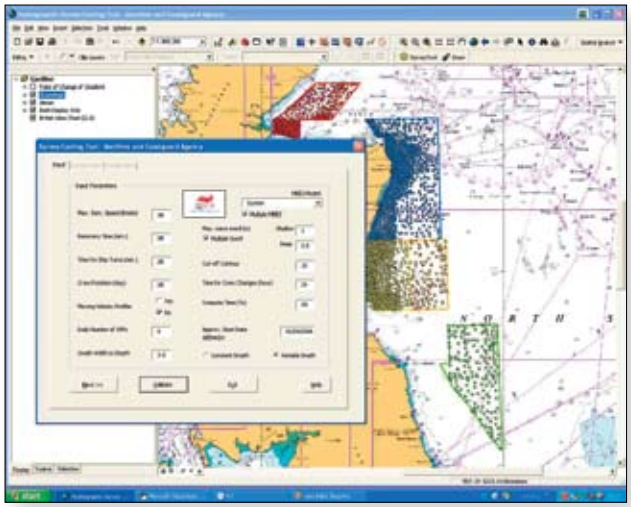
- Utilizes business logic to build a query based on where (location), what (models and parameters), and when (time or period)
- Distills gigabytes of data into intelligible graphic maps only hundreds of kilobytes in size
- Provides rapid access to modeled forecasts from BoM NWP supercomputers
- Allows animation or progressive time steps through forecasts
- Supports background situational awareness products such as nautical charts, maps, elevation models, and gazetteers
- Exports maps in image formats including GeoTIFF
- Has an interactive interface with zoom, pan, and preset areas of interest
- Is able to incorporate Web Map Server (WMS) or other ArcIMS image services

The METOCViewer extension is fully integrated with ArcGIS Desktop and may be used to display model data, weather observations, and weather satellite imagery with full weather symbology.

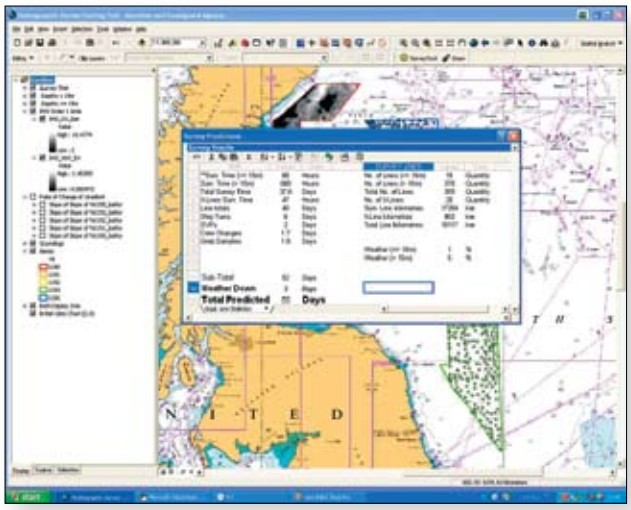
Benefits

Both iMove and METOCViewer provide meteorological products to the METOC officer wherever deployed via limited bandwidth defense communication networks, displaying tailored parameter-based views with minimal impact on the network bandwidth. The application is ideal for gaining situational awareness based on regional weather patterns, and resulting images can be exported for use in command briefings or as GeoTIFFs in other command and control systems.

Maritime and Coastguard Agency Case Study toward a More Efficient Tendering Process



Hydrographic Survey Casting Tool



Hydrographic Survey Casting Tool with Bathymetry

The Client

With 97 percent of all United Kingdom (UK) trade by weight traveling by sea, a vibrant fishing community, and many using beaches for leisure and sport, the Maritime and Coastguard Agency (MCA) has a remit to ensure "Safer Lives, Safer Ships, Cleaner Seas" on and around 10,500 miles of UK coastline. Headquartered in Southampton, the geographically dispersed, 1,170-person staff of MCA is responsible for implementing the government's maritime safety policy, which aims to prevent loss of lives along the coast and at sea, ensure that ships are safe, and prevent coastal pollution.

The Challenge

One of the key deliverables for MCA is the provision of survey information to maintain nautical charts (marine maps for mariners) through the Civil Hydrography Programme (CHP). The aim of CHP is to ensure that UK waters are adequately surveyed for safe passage of shipping in and around the coastal waters of the UK.

The 2004 survey season saw the first use of multibeam echo-sounding technologies to gather bathymetric depth information for inclusion in nautical charts. Although this technology provides greater efficiencies, it has made it difficult for MCA when responding to contractors tendering for work. The previous method of single beam survey made it relatively easy to estimate the cost of work on a km^2 basis. However, the introduction of different multibeam sensor models, used on different ships and operating in different sea conditions, means that quotes for work now vary dramatically from contractor to contractor.

MCA needed a solution that would enable the agency to validate contractors' bids in an informed, consistent, and fair manner to ensure that the £5 million survey budget is spent in the most efficient and effective way. Furthermore, it was necessary for the solution to provide a method for agreeing on payment for changes to the survey program that occurred midcontract.

Contact Information

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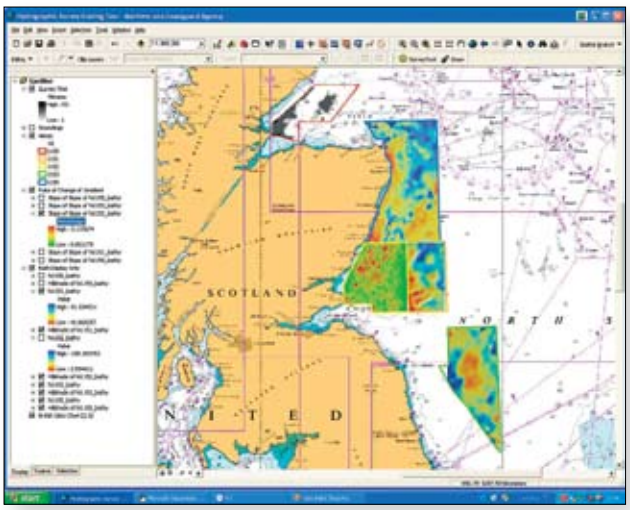


Survey Casting Results

Solution and Capability Delivered

The resulting survey costing tool allows a number of geospatial datasets and parameters to be analyzed to generate an estimated cost of survey. ArcGIS Spatial Analyst utilizes data including

- The type of echo sounder proposed by the contractor. The survey tool can be configured to take into account proposals that use different survey tools in shallow and deep survey areas. The tool creates a grid of the survey area based on the swath width of the sensors.
- The user-defined survey area polygon. This polygon is used to clip out the data required to perform the analysis. Clipping the data reduces the processing overhead. Data, including a grid based on soundings, is resampled to ensure that the pixel size matches that of the sensor swath width.
- Temporal information such as the maximum survey speed the ship may attain without degrading quality of survey data, downtime for crew rotation, and ship turns.
- The maximum, mean, and standard deviation of wave heights in the survey area. This information, provided by the Meteorological Office, enables the calculation of the likely downtime a survey vessel may experience per calendar month, depending on area and time; for example, a smaller ship won't be able to operate in rough seas.

All the spatial grids are added to allow a cost to be assigned to each pixel. This in turn allows the calculation of estimated survey cost. A map of the number of survey lines required to complete the survey, along with statistics on how the estimate has been generated, is automatically populated within a Microsoft® Excel spreadsheet. This spreadsheet forms the basis for contract negotiations between MCA and survey contractors.

Benefits

The use of the survey costing tool has enabled MCA to analyze the datasets required to create accurate estimates for the commissioning of hydrographic surveys. The costing tool allows MCA to

- Manage contract variations with an agreed-upon costing methodology. This prevents contractors from over-quoting for variations (due to the fact they know they are guaranteed the work).
- Quickly determine the cost of proposed survey areas in advance (thereby ensuring that the "cost" in the cost-benefit equation is known precisely when choosing areas to survey).
- Analyze quantifiable and repeatable results rather than the old subjective, manual method of determining costs for surveys; it is also infinitely quicker in providing a result.
- Gather support for business cases it puts forward for additional funding for hydrography.

The Future

The survey costing tool could be made available to sister organizations around the world. Due to the parameter-driven nature of the application and its development in ArcObjects™, the tool is easily customizable to allow for localized environmental factors.

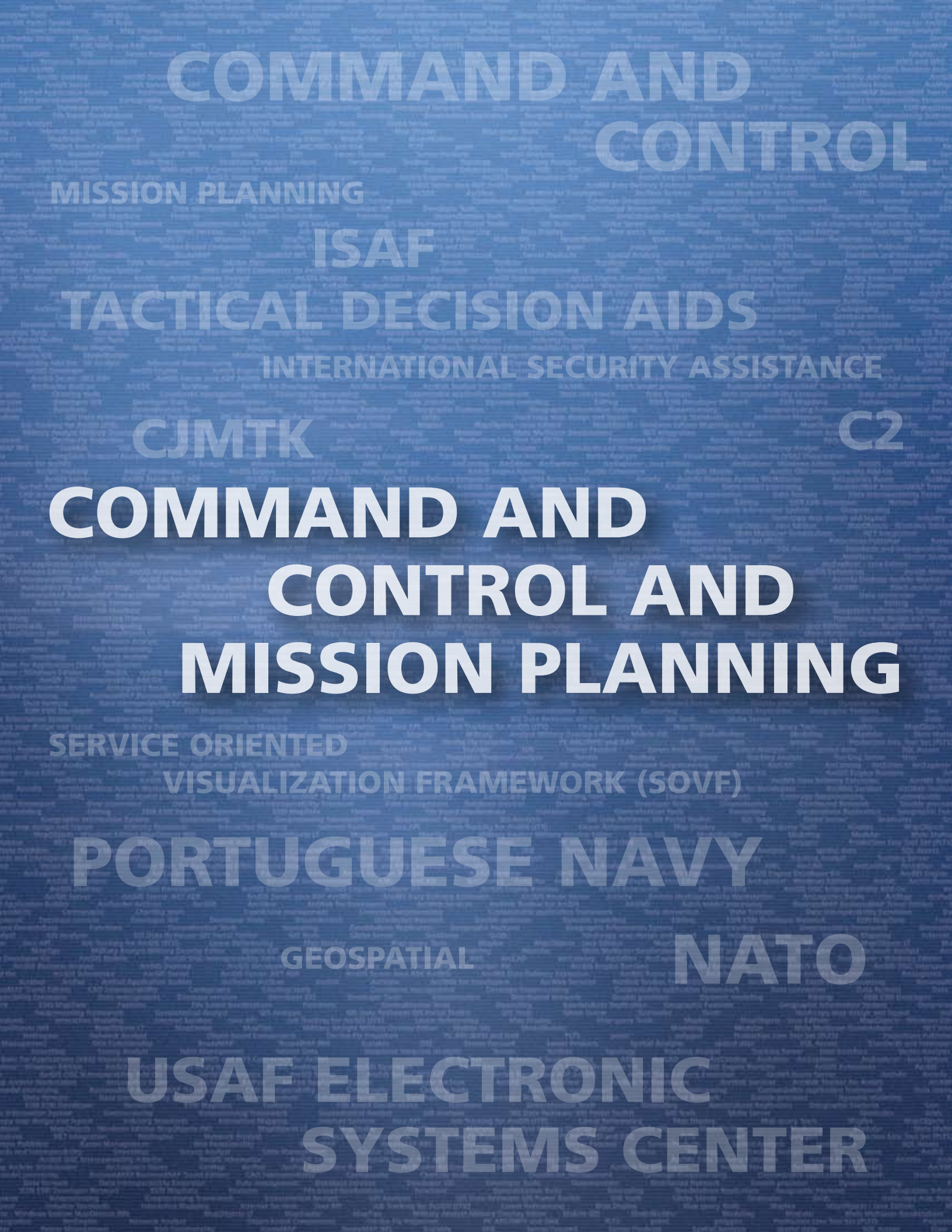
There are plans for the costing tool to be enhanced to calculate risk to the mariner of not surveying a particular area (based on the depth of water, the amount of marine traffic, the age of the existing survey data, etc.). The tool could thus calculate risk and cost, and an algorithm could therefore be written to determine where MCA should survey to maximize the benefit from its budget.

The Technology

The survey costing tool has been built using core functionality of ArcInfo® and ArcGIS Spatial Analyst. ArcObjects with Visual Basic® was used to bring the required tools together and expose them in a unified user interface.

mca
Maritime and Coastguard Agency

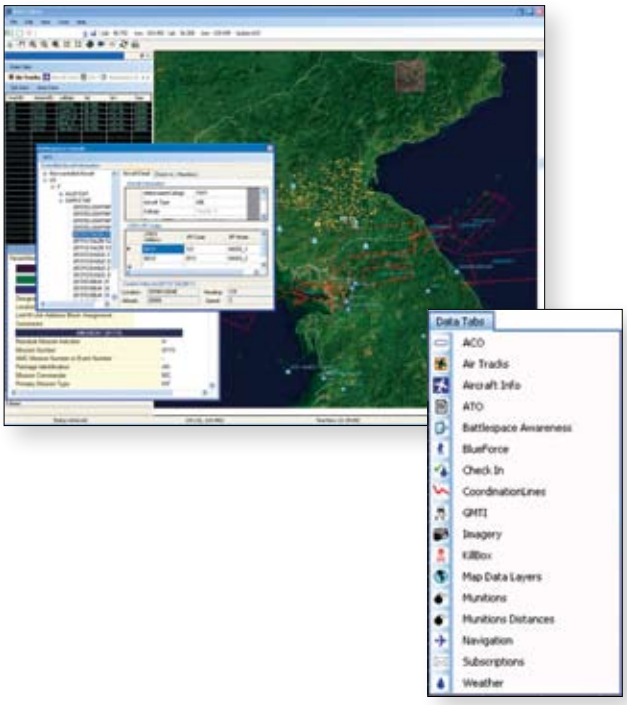
www.mcga.gov.uk/hydrography


COMMAND AND CONTROL
MISSION PLANNING
ISAF
TACTICAL DECISION AIDS
INTERNATIONAL SECURITY ASSISTANCE
CJMTK
C2
COMMAND AND CONTROL AND MISSION PLANNING
SERVICE ORIENTED VISUALIZATION FRAMEWORK (SOVF)
PORTUGUESE NAVY
GEOSPATIAL
NATO
USAF ELECTRONIC SYSTEMS CENTER

Electronic Systems Center: Providing Shared Situational Awareness over Airborne Networks through Airborne Web Services

Airborne networking of military weapon systems is a critical capability needed for netcentric operations on the modern-day battlefield. The 753rd Electronic Systems Group (ELSG) at Hanscom Air Force Base, Massachusetts, is leading ongoing research and development efforts in the airborne networking technology area for command and control (C2) mission applications. A key program significantly contributing to risk reduction for developing future military C2 applications for airborne networks is the Airborne Web Services (AWS) program.

AWS is a collaborative effort between the 753rd ELSG, 751st ELSG (Joint STARS), and 551st ELSG (AWACS) with support from MITRE and government contractors ProLogic and SAIC. ProLogic developed the shared situational awareness end user application using CJMTK/JMTK and SAIC developed the Airborne Web Services and data interfaces.



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CJMTK/JMTK was utilized by ProLogic to develop the primary visualization client for AWS and has been a key enabler to rapidly developing the program's visualization capabilities. Leveraging prior research and development work with CJMTK/JMTK on ProLogic's Service Oriented Visualization Framework (SOVF) technology, this system follows design guidelines from the Department of Defense (DoD) Net-Centric Enterprise Solutions for Interoperability (NESI).

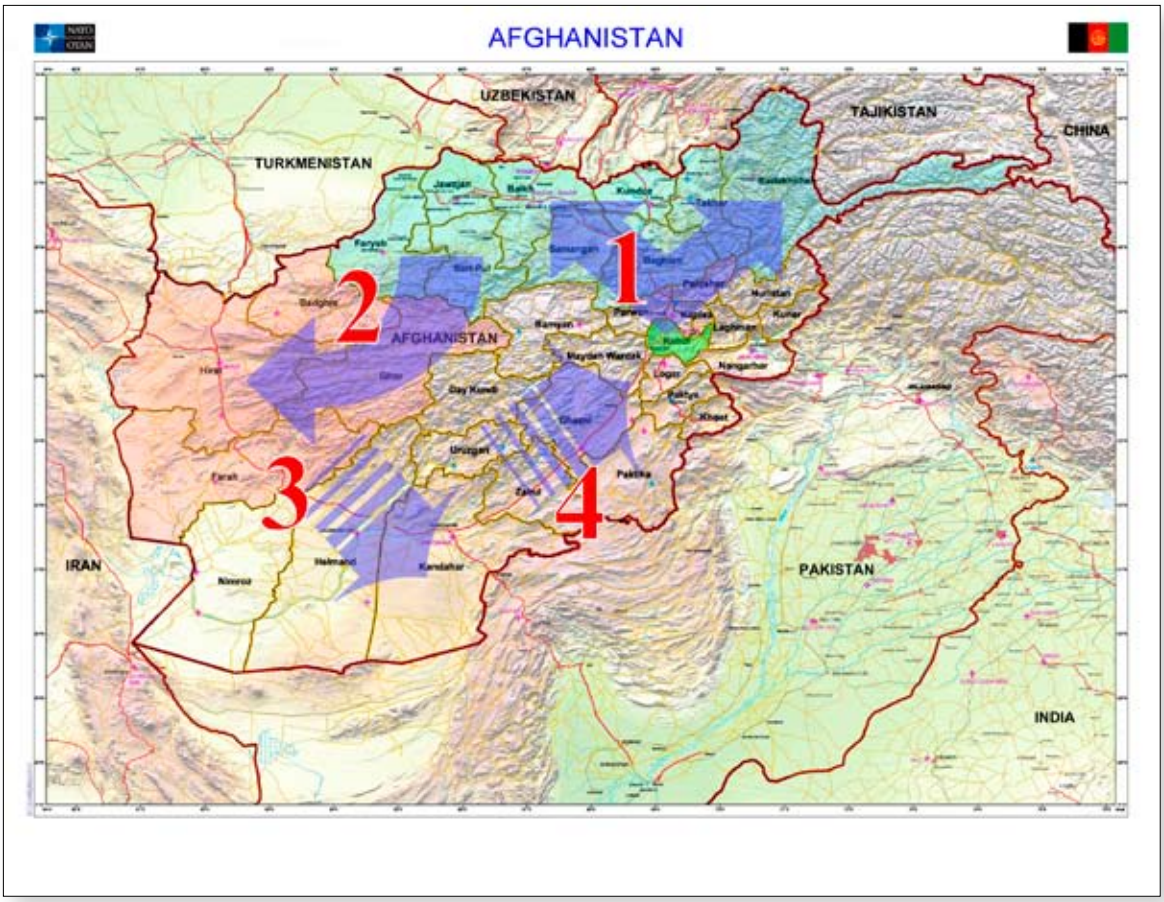
AWS services provide shared battle space situational awareness information, satisfying requirements for in-flight E-8 Joint STARS and E-3 AWACS air battle managers along with commanders and controllers on the ground in the Combined Air Operations Center (CAOC). AWS applications include visualization of

- Air tasking orders (ATOs)
- Airspace control orders (ACOs)
- Blue and red force tracking
- Ground moving target indicators (GMTI)
- Imagery (SAR, NITF)
- Kill boxes
- Coordination lines (FLOT, FSCL, FEBA)
- Air tracks
- Munitions
- Check-in
- Navigation
- Weather

Many AWS features are designed to help automate the AWACS and Joint STARS air battle manager's workflow. The resulting capabilities enhance decision support for C2 operations and time-sensitive targeting (TST). This increased situational awareness and improved workflow are specifically designed to reduce timelines in the kill chain.

AWS was highlighted in the U.S. Air Force Chief of Staff's large-scale directed Joint Expeditionary Force Experiment (JEFX) 06 as part of an AWACS effort demonstrating netcentric warfare using the Tactical Targeting Network Technology (TTNT) data communications system. AWS was also demonstrated in late 2006 during Airborne Networking live fly risk reduction experiments on the Paul Revere 707 aircraft operated by MIT Lincoln Labs.

NATO ISAF Operation through GIS Evaluation



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"Afghanistan is mission possible," said North Atlantic Treaty Organization (NATO) secretary-general Jaap de Hoop Scheffer at the NATO Summit held in Latvia November 28–29, 2006. The operation, conducted by NATO forces since 2001, is positively changing the country.

NATO's International Security Assistance Force (ISAF) in Afghanistan was established following the Bonn Conference held in December 2001 after the Taliban regime was ousted. Afghan opposition leaders attending the conference began the process of reconstructing their country by setting up a new government structure, the Afghan Transitional Authority.

The ISAF mission is NATO's first and largest ground operation outside Europe, currently involving more than 30,000 troops from 35 different countries (including all 26 NATO nations). ISAF's mandate followed the decision taken by all Allies to invoke, for the first time in NATO's history, Article 5 of the Washington Treaty. The operation has a peace-enforcement mandate under Chapter VII of the United Nations (UN) Charter and in accordance with the Bonn Conference of December 2001.

Planning for an operation to be conducted in a country with very particular geography was highly challenging for key decision makers. Afghanistan is a landlocked highland with approximately the same latitude and size as Texas, USA. The lowest point (Amu Darya) is at 258 meters below sea level, and the highest point (Noshaq) is at 7,492 meters above sea level. The country covers an area of approximately 650,000 sq km; its maximum width from east to west is about 1,240 km, and its length is 565 km from north to south.

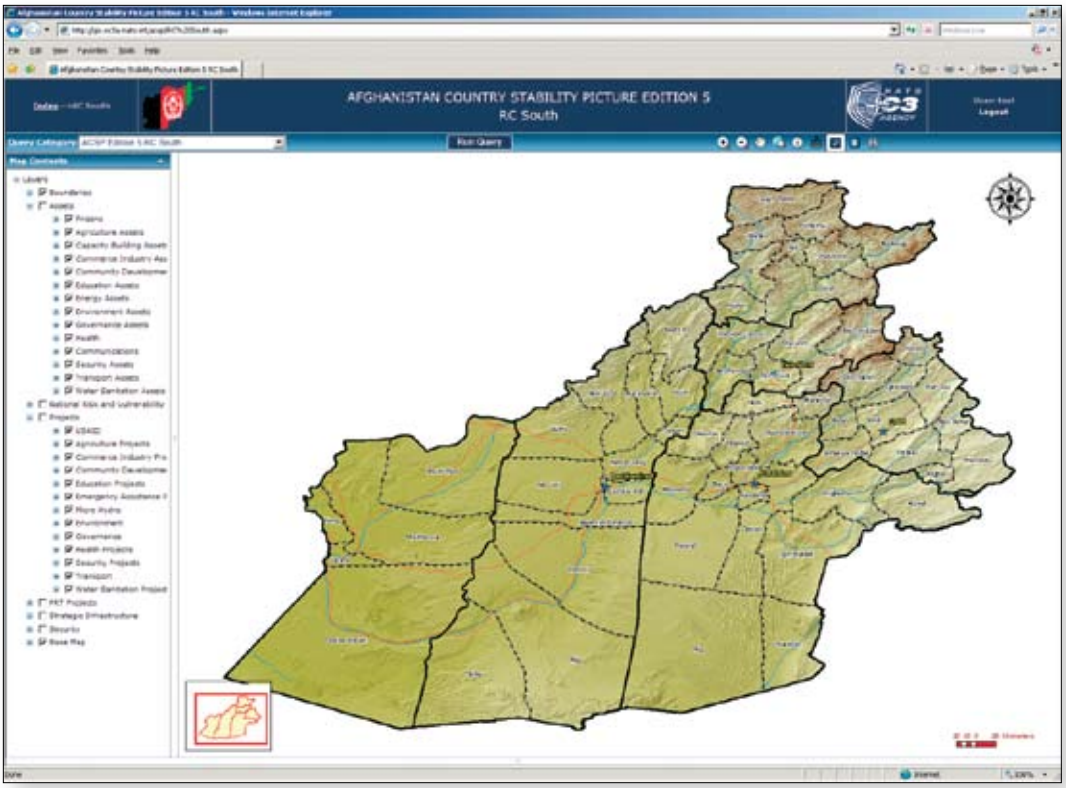
NATO approached the geographic barriers by establishing a starting base in the capital province of Kabul. Expansion continued to take place toward less hazardous provinces in the north identified as Stage 1 and followed approximately 11 months later by a second block of provinces in the west of the country labeled Stage 2. In each stage, a regional command was established, together with a logistic support base known as Forward Support Base (FSB). Provincial reconstruction teams (PRTs) were also set up to facilitate the implementation of the operation's mandate.

PRTs were located at reasonable distances from each other, taking into consideration the country's geographic complexity, its accessibility, and the estimated associated risk. As a matter of fact, the more insecure provinces of the south and east in Afghanistan require a higher number of PRTs to cover almost every province in Stages 3 and 4.

The map represented shows one of the GIS products developed by the geostaff of NATO Headquarters, Situation Centre, Brussels, Belgium, to support key decision makers. This GIS product has been developed using ESRI ArcGIS software and has been chosen to portray the deployment progress of the ISAF operation for use by public media.

NATO uses GIS capabilities on a daily basis to plan, monitor, and assess current operations. A large number of GIS products is constantly being produced, at different levels of classification, to ensure an accurate understanding of the forces deployed in relation to the territory and its associated risks. Consequently, NATO is pursuing the standardization of GIS applications throughout the headquarters, joint commands, and deployed units. The support provided by these systems to the chain of command is unquestionably essential for the success of NATO's operations.

NATO's Afghanistan Country Stability Picture Portal



The ACSP Web client interface shows the Region South. On the left side is the table of contents with all the layers available for this area.

Overview

The Afghanistan Country Stability Picture (ACSP) is a geographic database—whose creation effort is led by the North Atlantic Treaty Organization (NATO) International Security Assistance Force (ISAF)—of more than 45,000 reconstruction and development projects across Afghanistan. It holds information about different Afghan National Development Strategy sectors like education, good governance, health, agriculture and rural development, infrastructure and natural resources, private-sector development, security, and social protection. The data held in the ACSP comes from three primary sources: government of Afghanistan (GOA), provincial reconstruction teams (PRTs), and nongovernmental organizations (NGOs).

The ACSP geospatial Web portal was developed and published on the Internet by NC3A Geo-Team at the beginning of 2007. The portal is used by NATO, NGOs, and GOA for optimization/monitoring of reconstruction efforts and is updated at three-month intervals.

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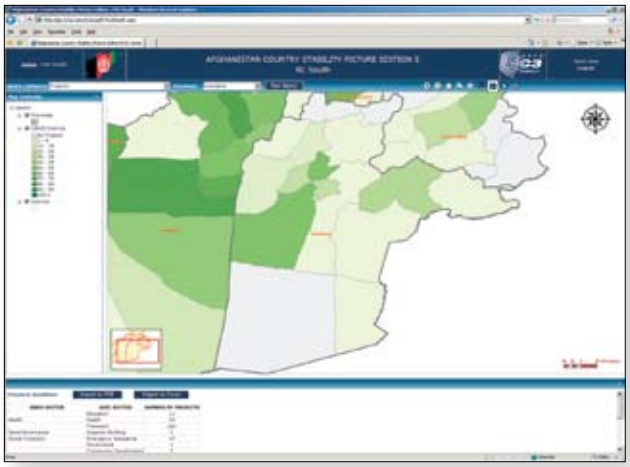
The ACSP Web client interface shows the Identify results on the bottom of the page.



The ACSP Web client interface shows the nonspatial information and the ability to export it to a PDF document or to Excel (on the bottom of the page).

The ACSP Web client interface shows the city of Kandahar as a result of a Gazetteer search (on the bottom of the page).

Capabilities

The ACSP project is divided into six regions. The user has access to different links depending on the area of interest: Region Centre (capital), Region South, Region North, Region West, Region East, and Country Wide (all Afghanistan). For all these regions, the user has access to spatial and nonspatial information as well as predefined GIS analysis.

Through the intuitive interface, the user can easily access all the information required. With the identification tool, it is possible to access information about the objects on the map.

Easy use of predefined spatial queries allows fast visualization of specific reconstruction projects and their impact on the region. There is a tool to export those queries as maps, reports, or any other information to a PDF document or Microsoft Excel spreadsheet.

Finding a specific location in Afghanistan is easy using the Gazetteer. It contains more than 135,000 names, and the map will zoom to and center on the chosen location.

Benefits

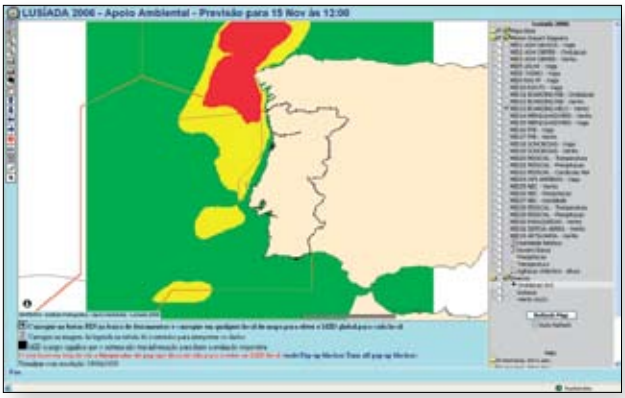
- ACSP is available on the Internet to NATO, NGOs, and GOA and is the only database (DB) that provides a consolidated picture of all reconstruction projects in Afghanistan.
- Complex spatial queries are transparent for the user and are executed on the server side.
- Non-GIS experts can use the tool easily.

Summary

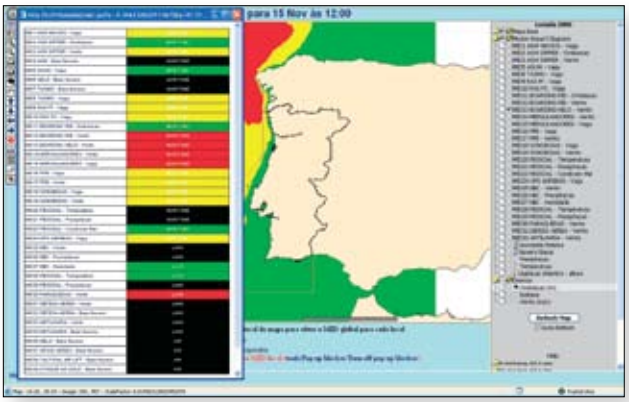
The purpose of the ACSP portal is to provide an easy and effective tool for consulting and querying the ACSP database on the Internet. This spatial database incorporates all reconstruction project-related information obtained from different sources in a standardized and harmonized format.

The application was built on ESRI ArcGIS Server.

Geospatial Tactical Decision Aids



Geospatial Variation of MID (boarding Helo)

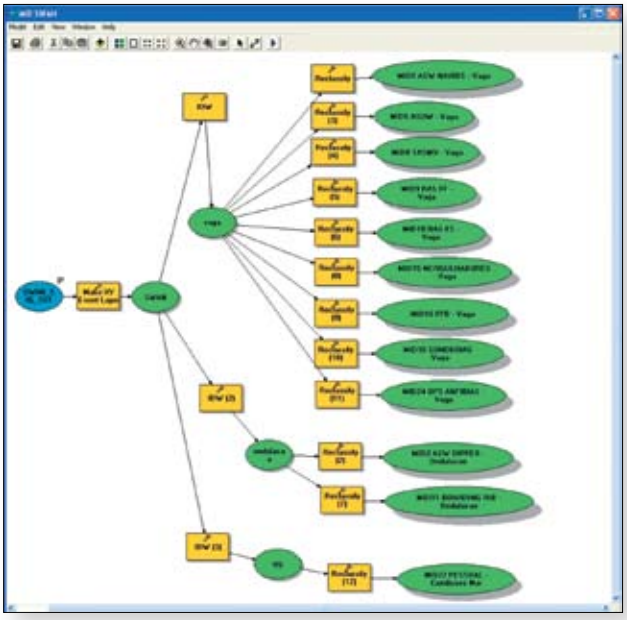


MID table for a point of interest (in the exercise area). Black means no information was available to create MID.

Mission impact diagrams (MID) are fast-reading tactical decision aids that translate how predicted environmental conditions will affect the use of weapons, sensors, platforms, and personnel in a specific theater of action. Traditional MIDs are tables that list each factor of interest and use a color code (e.g., green, yellow, or red) to describe the expected environmental impact. Although adequate for a small area of operation where environmental conditions are similar, these tables are not suitable for large areas of operation or for small areas where conditions are known to be variable from place to place.

To support a major Portuguese military exercise, a geospatial-based MID system was developed and implemented. This system covered land, sea, and air factors in an area larger than the exercise itself. Results from meteorological (ALADIN) and oceanographic (WW3 and SWAN) prediction models were imported daily and processed by desktop GIS to produce all considered geospatial MIDs. These MIDs were then made available through a private military network by a geospatial interactive Web page. Users were able to see how the impact of a certain factor would vary through the area of interest and were also able to interactively view and retrieve the traditional MID table for each geographic location (pixel).

Major benefits provided to MID analysis include going from spot table to geospatial variation and the ability to get the MID table for any spot of interest, providing the decision maker with environmental impact knowledge.



Example of the Processing Model to Generate Sea State-Related MID

Contact Information

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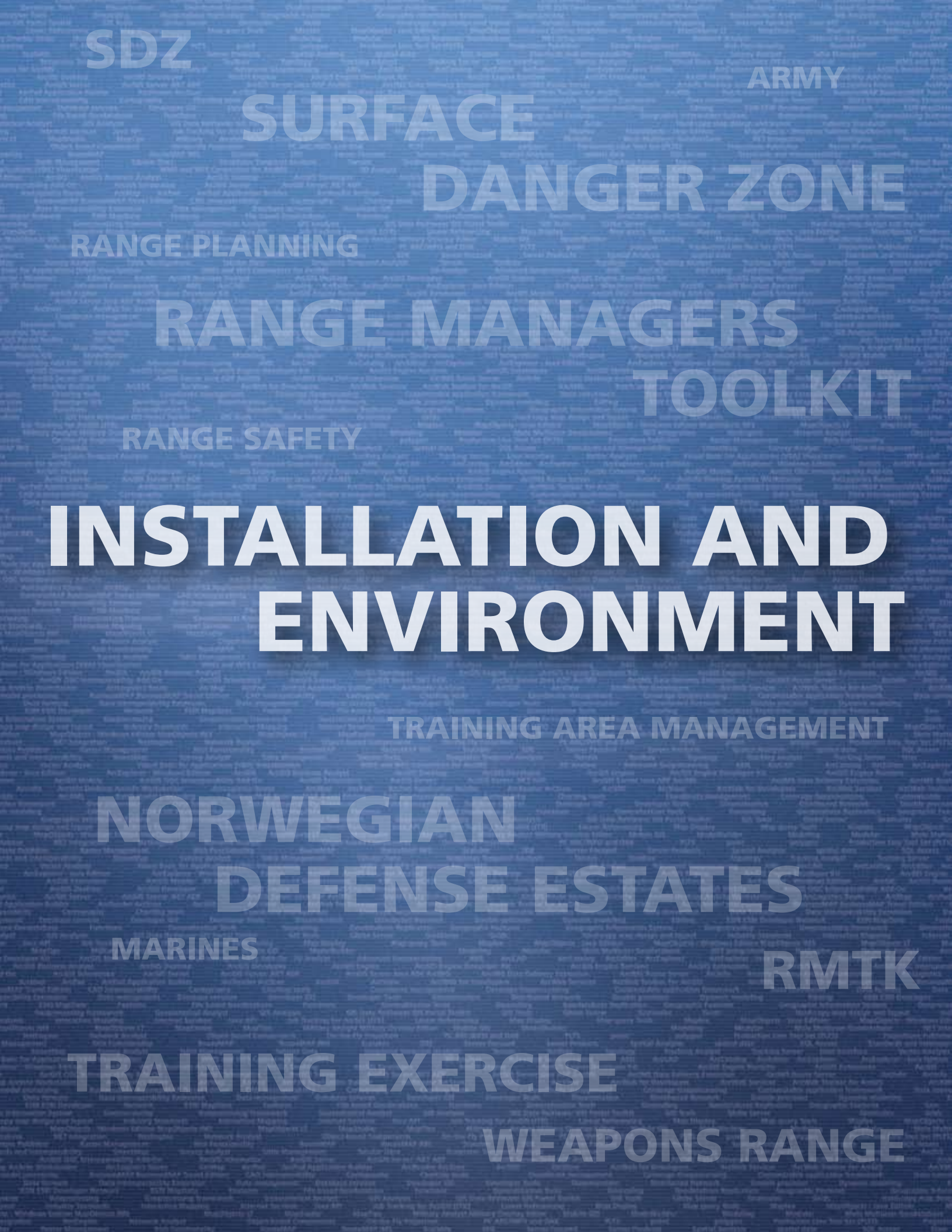
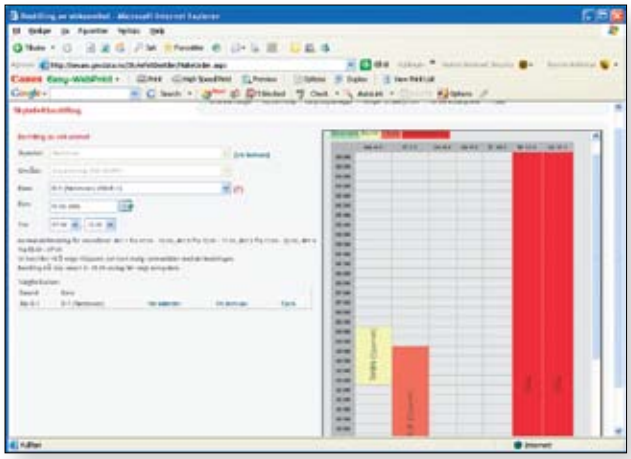

SDZ
ARMY
SURFACE
DANGER ZONE
RANGE PLANNING
RANGE MANAGERS
TOOLKIT
RANGE SAFETY
INSTALLATION AND ENVIRONMENT
TRAINING AREA MANAGEMENT
NORWEGIAN
DEFENSE ESTATES
MARINES
RMTK
TRAINING EXERCISE
WEAPONS RANGE

Online Shopping of Training Areas and Shooting Ranges



Online Scheduling Calendar

The Norwegian Defence Estates Agency has, in cooperation with Geodata AS, ESRI's distributor in Norway, developed a new and innovative system for ordering and administering weapon ranges and training areas for the Norwegian Armed Forces. The system's visual concept is inspired by Internet online shopping systems, and it has been integrated in the administration of Norway's newest training facility called the Weapons Range and Training Area East Norway, located approximately a 2.5-hour drive from Oslo.

By implementing a Web-based solution inspired by online shopping, the Norwegian Defence Estates Agency is demonstrating its willingness to use new and innovative methods to administer the weapon and training areas in an efficient manner. In addition, the system makes it easier for the armed forces to make sure that their training activities are in compliance with existing environmental standards put forth by the Norwegian Pollution Control Authority (SFT) and other authorities. The new system enables the military planner to easily order various weapon ranges and training areas and provides the military facility administrator with complete oversight and control in accepting or rejecting these bookings. After a completed exercise, the same planner uses the system to produce a postexercise report documenting relevant data and any discrepancies that occurred during the exercise.

The system provides the military planner with access to relevant maps and data about the various training areas and facilities. This includes military regulations and overall availability and an activity calendar. This information is available to everyone connected to the Norwegian Armed Forces intranet.

Technology

The database is integrated in an Oracle® database. ArcGIS is utilized to establish and edit the geodata, and ArcSDE is used to administer the data. The application itself has been developed with ArcGIS Server.

Ordering and Booking

After the military planner has considered his options, he then logs on to the system and enters the booking system himself. In the first part, he chooses where he geographically wants to execute his training. At this stage, he may choose between booking specific ranges and facilities or defining his own training area. He must also select the correct time and date for his training in the available online calendar detailing the chosen facilities. Based on the user's choices, the system then displays what kind of ammunition may be used in the selected area/range, and the user makes his choice of ammunition based on this menu. It is also possible for the user to choose specific target areas and positions within the various ranges. Based on this information, the system produces a map showing the potential danger areas created by the exercise along with an overview of current restrictions, for example, with regard to environmental regulations. The system also alerts the user of any other bookings that may affect or be affected by his choices.

Before completing his order, the user may post other relevant information connected to his exercise, for instance, whether or not aircraft will be involved.

Once completed, the order is sent to the military facility administrator for confirmation or rejection. Note that the military planner will be able to book a range or area despite the fact that it may overlap other exercises. It is up to the administrator to make the final decision on who gets permission to go ahead with his exercise. The user may also access the system again at any time to cancel or edit his order. As mentioned earlier, after training, the planner may update his exercise profile with new relevant information.

Forsvarsbygg

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Administration

Through this new system, the administrator has full control over the status of all present and future activities in the weapon ranges and training areas. It is the job of the administrator to review all requests put forth by the users and, based on this information, either confirm or reject the bookings. The administrator is also able to make changes to the details of each order to resolve overlaps and prevent different exercises from being in conflict with each other, thereby maximizing the use of the various weapon ranges and training areas.

The administrator must uphold and enforce certain training restrictions throughout the year. One of these is a restriction that prohibits military activity during certain weeks. By putting these dates (which may change from year to year) into the system, the administrator efficiently blocks all bookings in the selected period, thereby making it impossible to break official regulations.

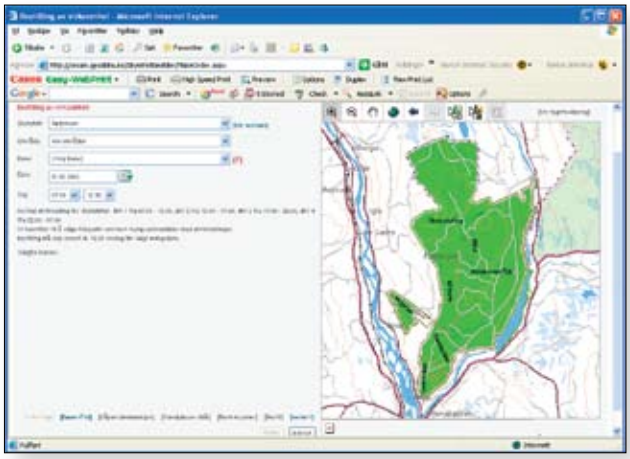
In addition, the administrator has constant access to a large number of reports such as weekly and daily schedules, security maps, and activities that demand notification in the press.

System Administration and Maintenance

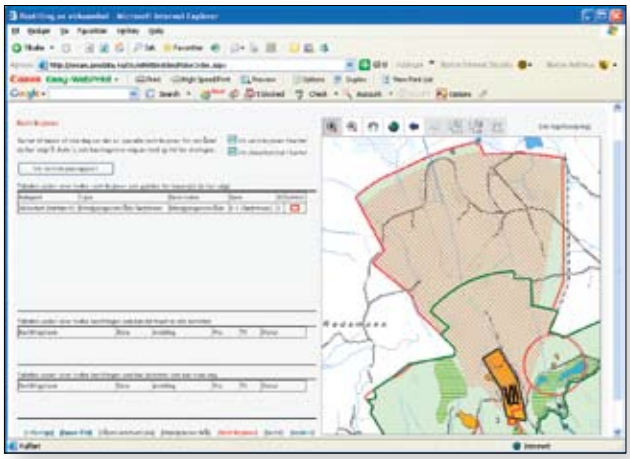
There are specific tools for the administration of the system itself, which is the responsibility of the military facility administrator. These tools make it possible to upload new military instructions, up-to-date exercise maps, and changes in the geodatabase. A set of how-to guidelines is available for this purpose.

Conclusion

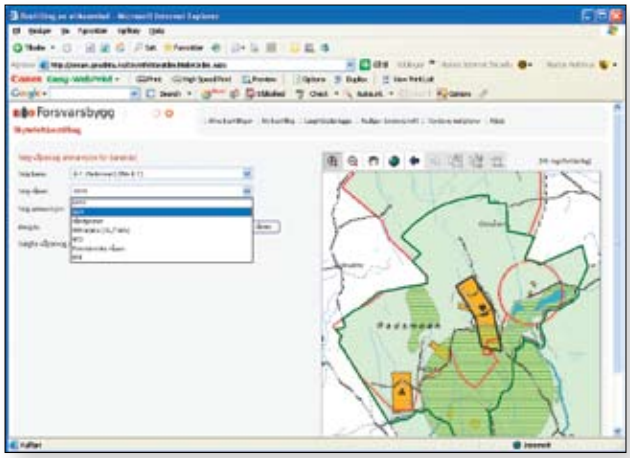
This system is currently in use in the Weapons Range and Training Area East Norway, and the feedback from users has so far been positive. It is, therefore, the long-term ambition for the Norwegian Defence Estates Agency to implement this unique system in all its weapon ranges and training areas across the country. Such an implementation will maximize and streamline the training capacity available to the armed forces. At the same time, this will make it possible to present the public with an up-to-date overview of which areas are out of bounds due to military exercises at any given time. Such information may be given via electronic billboards at the outskirts of each training area.



Training Areas and Weapon Ranges Planning and Ordering

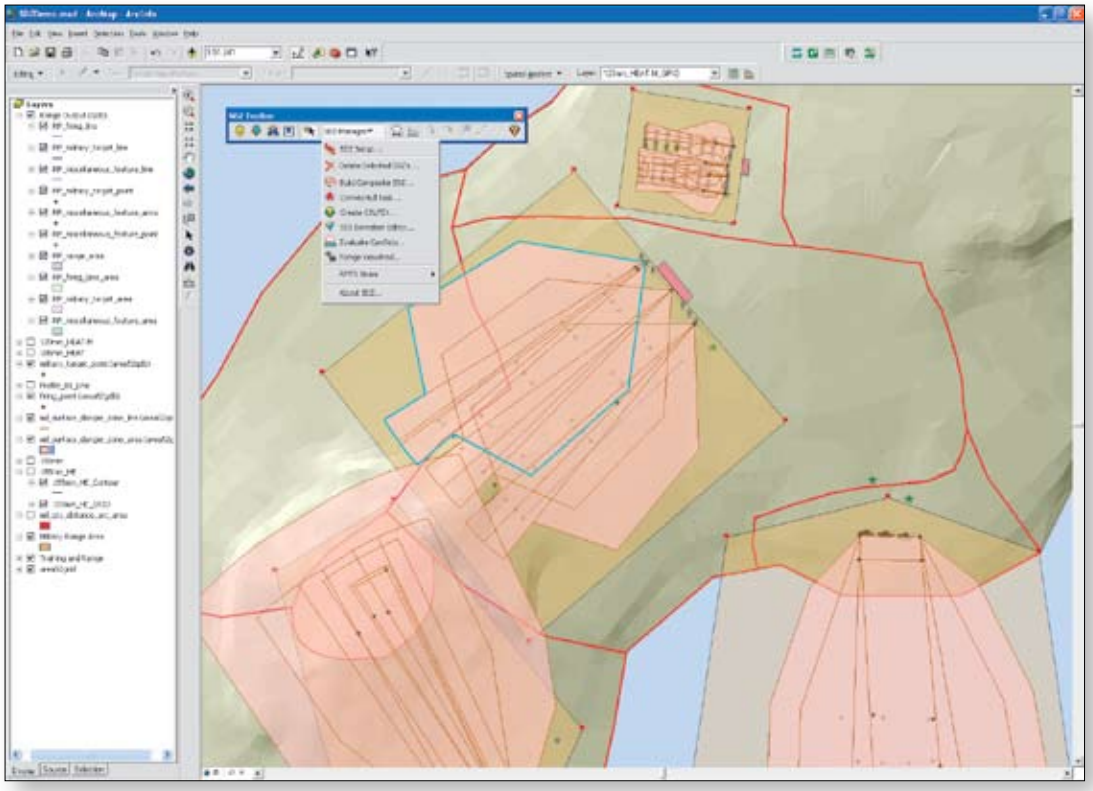


View of Surface Danger Zones (SDZs) for Weapon Ranges



Weapons and Ammunition Planning and Ordering

U.S. Army/U.S. Marine Corps Range Managers Toolkit



Surface Danger Zone (SDZ) Tools

The Range Managers Toolkit (RMTK) is a desktop and Web application containing a set of tools that supports the range safety and planning organizations for the U.S. Army and Marine Corps. RMTK provides critical functional capabilities that support the planning and development of new ranges and the planning of individual and combined live fire training events. RMTK is available as a set of toolbars in ArcGIS Desktop and ArcIMS and is currently being migrated to ArcGIS Server.

The core capability of RMTK is the creation of Surface Danger Zones (SDZ) for any weapon in the army and marine inventory. The SDZ generator is a wizard-driven tool that collects information about weapons, ammunition, and target and firing conditions and creates unique SDZ features. There are a number of supporting tools that let users edit and analyze SDZs to perform functions such as verifying that targets are visible from firing positions; identifying environmental, boundary, and physical constraints; truncating downrange portions of SDZs to account for terrain backstops; calculating noise contours; and combining SDZs into a combined arms live fire exercise/combined arms exercise (CALFEX/CAX).

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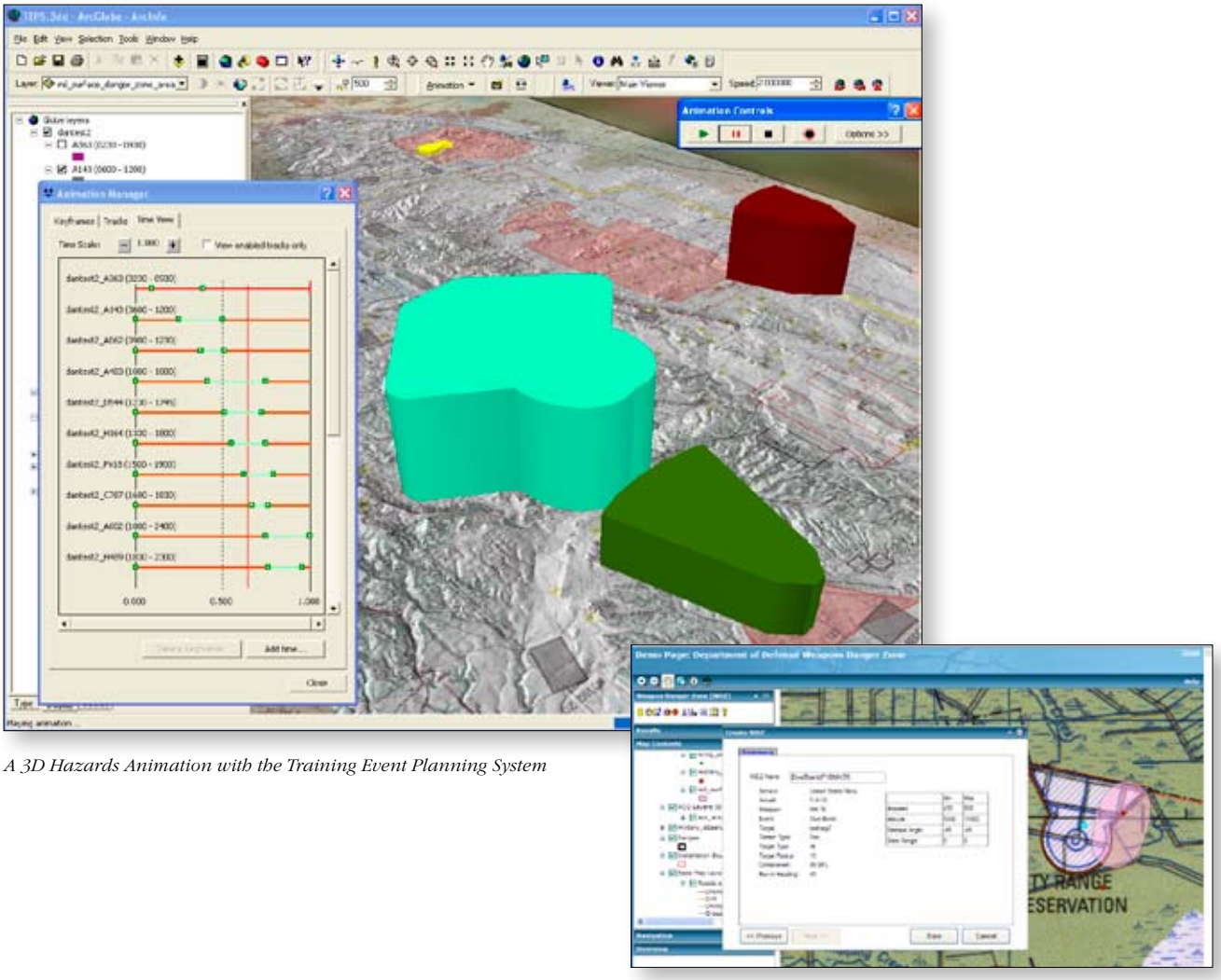


A 3D Hazards Animation with the Training Event Planning System

Weapons Danger Zone (WDZ) Tool on ArcGIS Server

The Training Event Planning System (TEPS) component creates 3D SDZ animations in ArcGlobe. The animations portray vertical and horizontal hazards as ranges go active and inactive over time.

The Noise tool supports situational awareness by modeling noise contours based on weapon, munition, location, and atmospheric conditions for various live fire exercises. Range officers can then evaluate potential noise issues in the context of other spatial data and take appropriate steps to mitigate complaints.

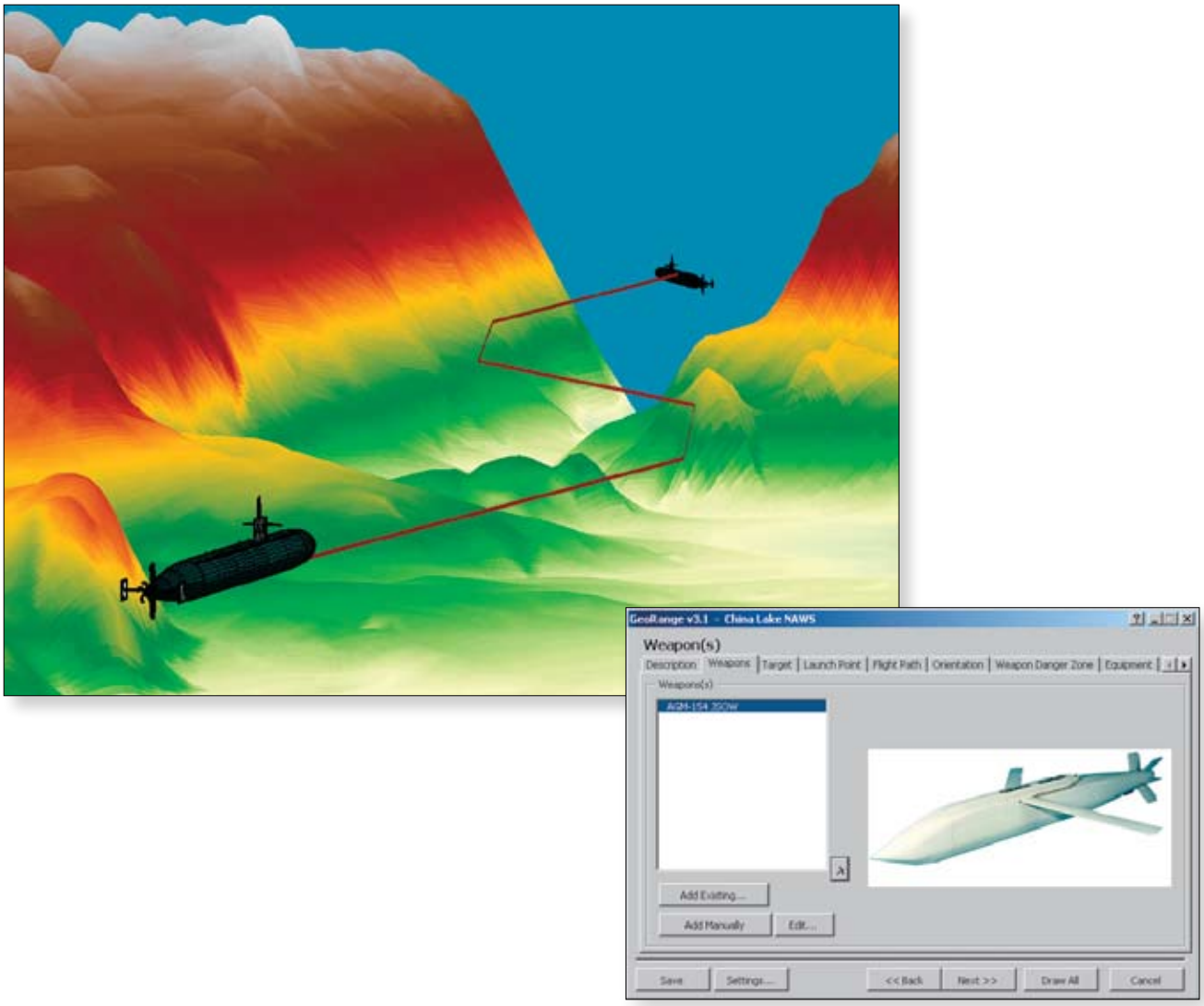
The Laser Range Certification (LRC) tool automates the process of certifying ranges for safe laser operations using airborne and ground-based laser platforms.

The On Range Ammunition Handling Tool (ORAHT) is designed for safely locating temporary storage areas based on explosive safety arcs. The application lets users identify a mixture of ammunition types and volumes for storage; alerts for incompatibilities; and calculates for worst-case safety distances for personnel, facilities, and transportation regulations.

The Range Development and Planning (RDAP) tool component supports the range modernization process and Range Complex Master Planning (RCMP) efforts as the Army responds to changing training requirements. RDAP allows users to locate range templates from TC25-8 Training Ranges onto available land and edit the templates to fit both local land restrictions and training requirements.

The newest addition to RMTK, the Weapons Danger Zone (WDZ) tool, supports the creation of danger zones for air to ground weapons platforms. This component has wizard-driven user interfaces similar to those in the SDZ tool, providing support for rotary, fixed-wing, and unmanned aerial systems.

GeoRange—Revolutionizing Weapons Testing and Training for Military Ranges



Overview

A key function of U.S. military ranges is to provide an area for testing weapons and training troops. Many factors need to be considered when planning training and testing events; therefore, range planning tools are needed. The primary goal for training troops and weapons testing is to minimize cost and environmental damage, deconflict use, and maximize safety while achieving the goals of the test or training event. Achieving these goals is easy with GeoRange. With GeoRange, military range managers can plan and conduct weapons tests and training events for scenarios that include surface-to-surface, air-to-surface, surface-to-air, air-to-air, and subsurface-to-air events using a simple wizard interface.

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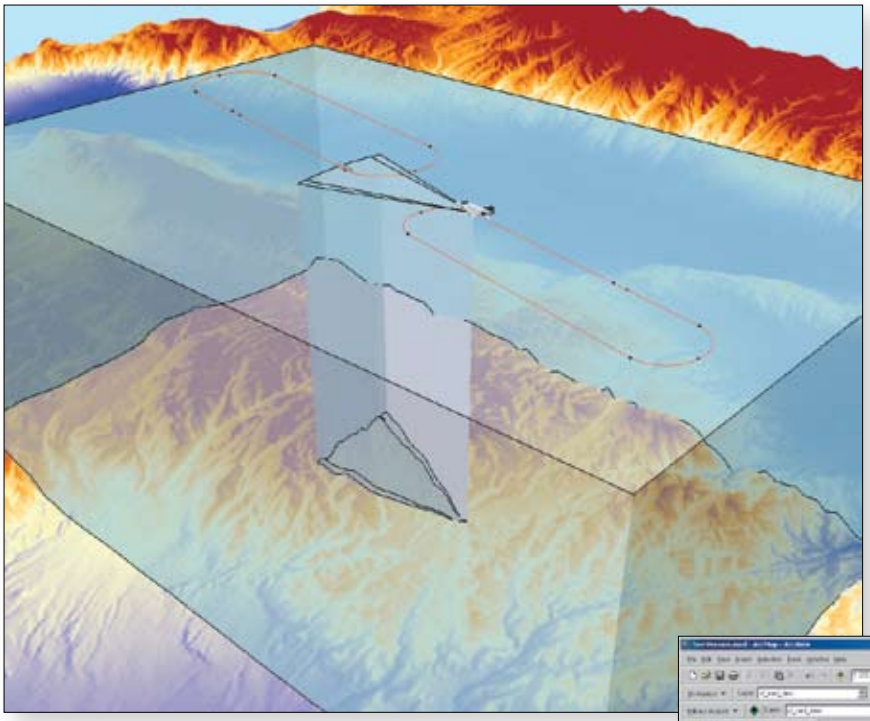
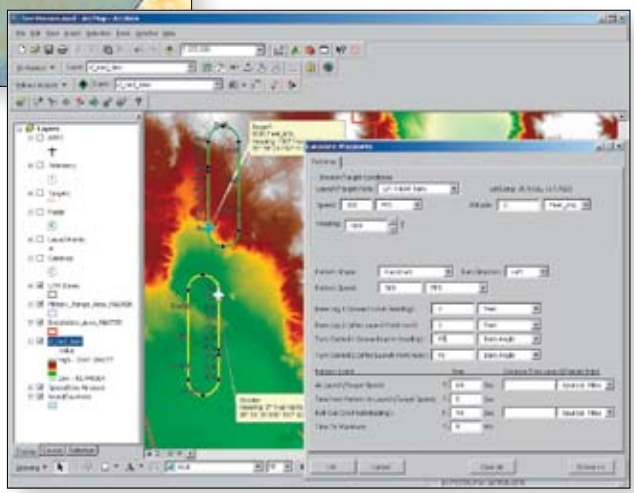




Capabilities

With GeoRange, range test managers and planners can map targets, launch and firing points, flight paths, and other features necessary to plan the event. The available features include

- Creation of targets, launch points, and flight paths
- Creation of shooter boxes based on aircraft type and weapons systems
- Creation of flight paths/lines of fire to include S curves, racetracks, open loops, and trajectories
- Prediction and modeling of command destruct flight termination system (FTS) and missile debris and fragment buffers
- Determination of time tics and master arm points for test and training scenarios
- Creation of weapon danger zones
- Modeling of additional equipment such as radar, cameras, and Keneto Tracking Mounts (KTMs)

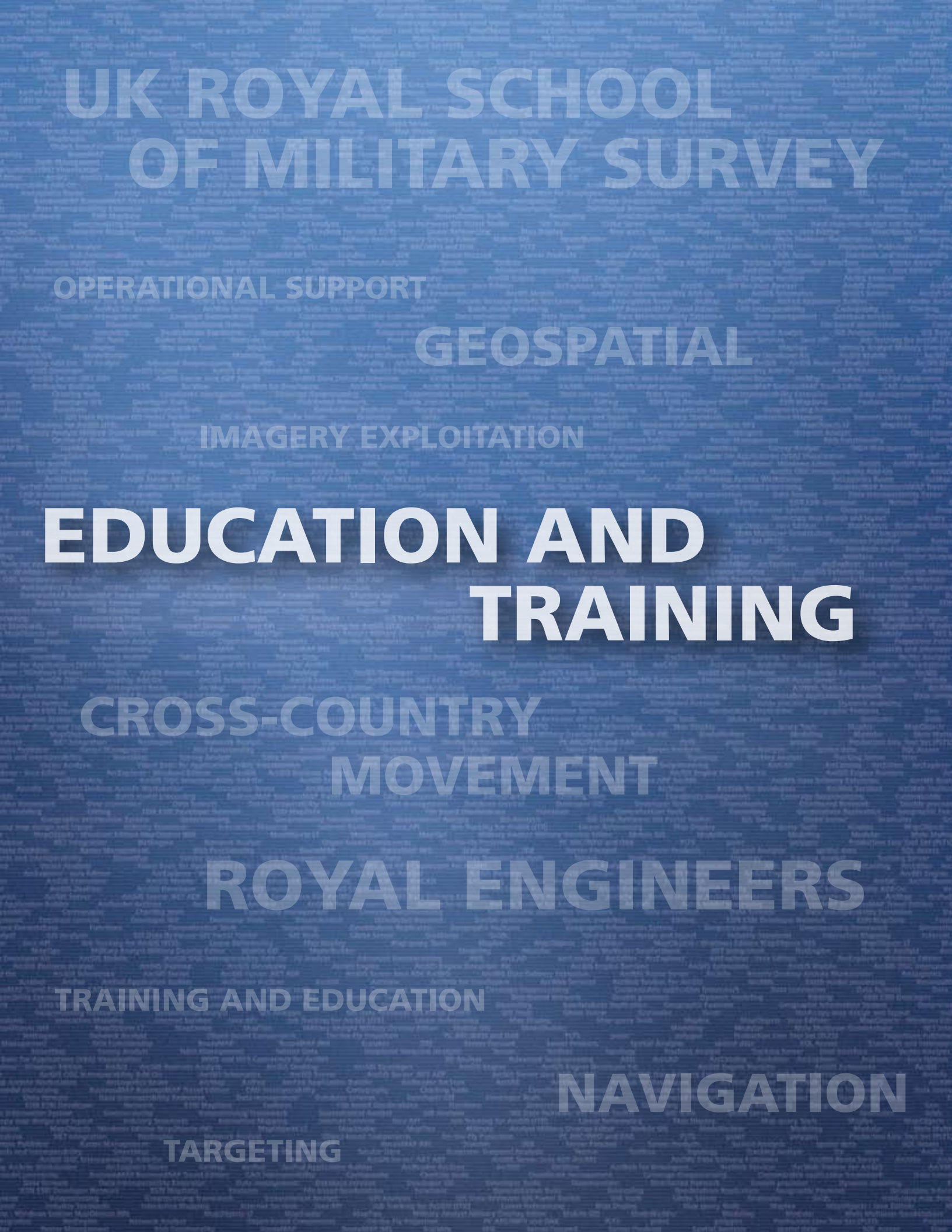
Benefits

With these tools, the U.S. Navy's China Lake Test and Evaluation Group is able to make highly accurate maps in less time. For example, before GeoRange, a test manager would take days to enter hundreds of flight waypoints for a cruise missile test. Now, the process takes only minutes, allowing test managers to focus on planning the entire test and logistics for the test event.

Conclusion

GeoRange is an easy-to-use GIS-based application that range managers, testers, and decision makers can use for planning range training and testing activities. With GeoRange, nearly any range event can be mapped, then used in a variety of ways to make the range run more efficiently and safely.

GeoRange can also be used for mission planning, environmental assessment, and fleet exercises.


UK ROYAL SCHOOL OF MILITARY SURVEY
OPERATIONAL SUPPORT
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IMAGERY EXPLOITATION
EDUCATION AND TRAINING
CROSS-COUNTRY MOVEMENT
ROYAL ENGINEERS
TRAINING AND EDUCATION
NAVIGATION
TARGETING

Geospatial Training and Education at the Royal School of Military Survey, UK

A 3D Model of Denison Barracks

Overview

The Royal School of Military Survey (RSMS) is the United Kingdom (UK) defense geospatial training and education center of excellence. As a federated element of the Defence College of Intelligence (DCI), RSMS offers training and education across the full spectrum of geospatial domains including geospatial information collection, management, exploitation, and presentation. RSMS prepares Royal Engineer (Geographic) (RE [Geo]) officers and soldiers for geographic operational support. RSMS also leverages staff expertise and resources to support UK Ministry of Defence (MOD) research and development.

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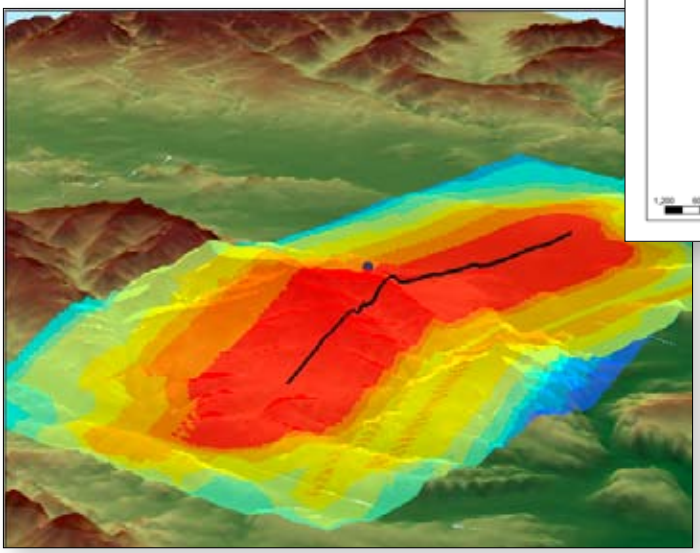
RE Geographic—Officers

RE (Geo) officer training and education are achieved through the internationally renowned Army Survey Course (ASC). ASC is a modular master's program accredited through Cranfield University. The course aims to provide students with the knowledge and skills, both technical and managerial, required by professional geographic officers in support of the defense community. It is specifically aimed at those responsible for the specification, design, and operation of geographic systems in defense. Modules include (1) Analytical Techniques, (2) Positioning, (3) Reference Systems, (4) Image Processing, (5) Imagery Exploitation, (6) Spatial Analysis, (7) Information Systems, (8) GIS Software and Systems, (9) Spatial Data Presentation, and (10) Defence Geographic Requirements. To bring the disciplines together in an operational support context, the students also complete a syndicated group project.

Research

Students complete a defense-related individual advanced research project focused on real-world geospatial issues as part of their master's degree. Example research projects include (1) probabilistic line of sight, (2) helicopter sound propagation prediction, (3) fusing of bathymetric and topographic elevation data, (4) tactical base camp vulnerability assessment, (5) cross-country movement assessment and development, (6) use of synthetic aperture radar for military terrain analysis, (7) use of Ikonos imagery for land-cover classification, and (8) hyperspectral imagery band combination investigation for military land-cover classification.

Tactical Base Camp Vulnerability Assessment



Helicopter Sound Prediction

False Color Radar Image

RE Geographic—Soldier

The training and education of RE (Geo) soldiers is principally achieved through basic and advanced technician courses that are followed by further management training courses at appropriate stages in their careers. Successful completion of the basic and advanced courses leads to the awarding of a Science Foundation degree in Applied Computing (Defence Geospatial Information) from Sheffield Hallam University. Core mandatory training and education are delivered to all three technician trades through basic and advanced courses, which are supplemented by trade-specific elective modules. Table 1 provides a summary of the modules undertaken by RE (Geo) technicians. Between the basic and advanced courses, technicians gain valuable on-the-job training in operational units, which contributes toward their Science Foundation degree.

Group Project

The group project during the advanced course brings together RE (Geo) technicians from all disciplines to consolidate much of the taught material in an operational geospatial support context. As an example, a recent group project investigated urban modeling and exploitation techniques and issues.

Geospatial Capture, Exploitation, and Presentation Activities

	Data Technician	Terrain Analyst	Production Technician
Basic Course	Geospatial Information Dissemination Map Science Geospatial Data Fundamentals of Geospatial Imagery Application of Information Systems Personal Effectiveness and the Professional Working Environment Working in the Operational Environment		
	Spatial Data Creation Feature Extraction from • Geospatial Imagery • Terrestrial Surveying • Satellite Surveying	Intelligence Preparation of the Battlespace Terrain Information Exploitation Spatial Analysis Visualisation	Product Origination Colour Imaging Systems Medium Format Printing Fundamentals of Print Processing and Finishing
	Experiential Learning in Unit		
Advanced Course	Analysing the Working Environment Advanced Professional Working Environment and Future Developments Project Management Systems Management Group Project		
	Database Design and Implementation Supervised Classification of Multispectral Imagery		Advanced Process Printing Cartography Quality Systems Colour Science
	Advanced Geospatial Imagery Exploitation Positioning	Advanced Terrain Factors Network Analysis Surface Analysis Advanced Spatial Analysis	

Defense Courses

RSMS also provides a wide range of geospatial training courses to UK Ministry of Defence. Many of the courses are also open to other nations. The range of courses includes (1) geospatial imagery courses for exploitation and targeting; (2) GIS courses from staff to advanced user level; (3) a core terrain analysis course; (4) GPS, navigation, and map reading instructor courses; and (5) offset lithographic courses.

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