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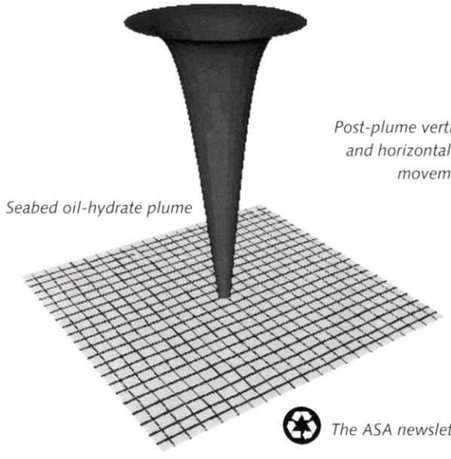
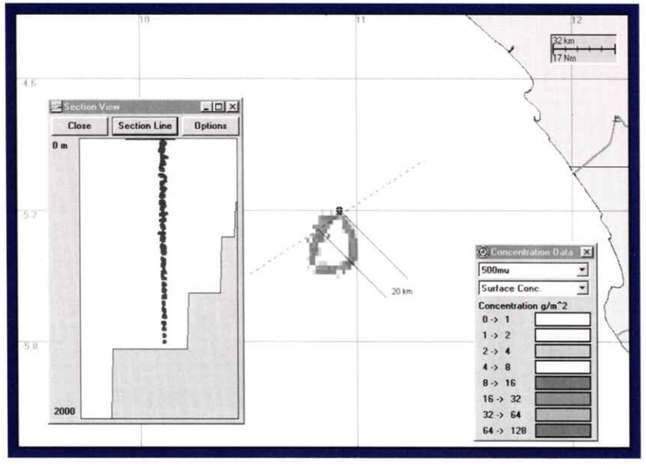
Oil Spills in Deep Water

As oil exploration and production move to deeper waters off the continental shelves, we need to be able to evaluate the potential release of oil and gas from these deep wells. The accident most feared in oil exploration is a "blowout." The drilling bit progresses downward, penetrating many different sediments layers and rock formations, to eventually find a reservoir containing oil and gas. If the pressure in the formation is sufficient, a blowout can ensue and a mixture of oil and gas is released from the seabed. The hydrostatic pressures for these deep wells (water depths of over 1,000 m) is very large and causes the released gas (predominantly methane) to react with the water to form gas hydrates. The formation of hydrates deprives the gas plume of its buoyancy and results in the oil-hydrate plume taking longer to reach the sea surface than for a conventional, shallow water, sub-sea oil release.

Standard oil spill models, that focus on surface transport processes and that do not explicitly include gas hydrate formation will not be able to successfully track the movement of these deepwater blowouts. In order to predict the movement and fate of the oil, the model system must predict the movement of the near sea bed oil-hydrate plume, including gas hydrate formation; the upward movement of oil and hydrate particles in the water column; and the evolution of the oil particles as they are advected by the three dimensional current field.

ASA has recently expanded OILMAP's capabilities to include a deep water plume model. With this extension, OILMAP can predict the evolution of the oil-hydrate plume near the sea bed, the three dimensional distribution of oil and hydrate particles in the water column as the oil and hydrates are advected and dispersed by the current and turbulent fields, and the near surface transport of oil once the oil particles reach the sea surface. This model system has been successfully applied to potential deepwater release scenarios off the West African coast for a number of major oil companies. The deep water blowout model development has been led by Dr. Malcolm L. Spaulding, ASA principal and Dr. Raj Bishnoi, University of Calgary, Alberta, Canada.





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Internet Data Distribution Helps the Public Monitor the Environment

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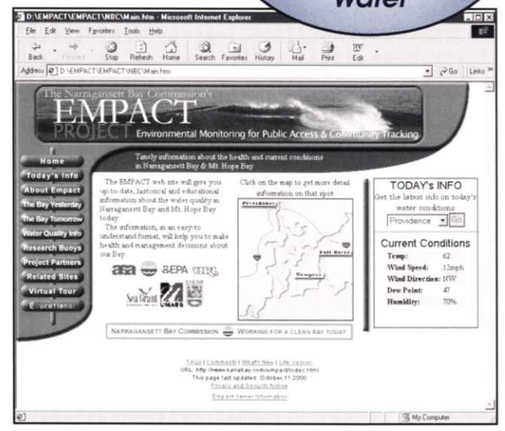
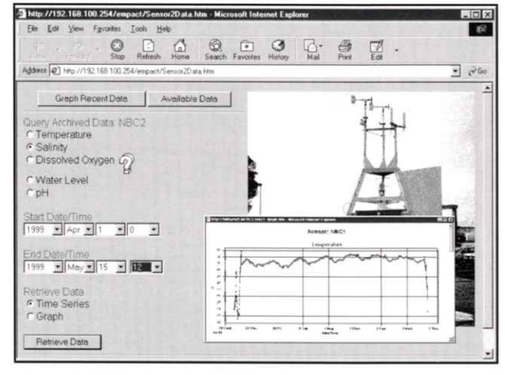
One of the challenges of using the internet efficiently is determining how to filter the vast amount of data available and use it to answer everyday questions.

For those of us who want to monitor our favorite stock, or look for cheap airline tickets, the web has certainly made this easier. However, in the area of environmental data, the task remains daunting.

In 1996 President Clinton directed the U. S. Environmental Protection Agency (EPA) to create a program to provide citizens up-to-date environmental information about their community in easily accessible and understandable ways. The result of this initiative is a program called EMPACT (Environmental Monitoring for Public Access and Community Tracking) that is implemented at the local and regional level with grant money provided by the EPA. A local EMPACT project is a way for communities to organize the collection, processing, and storage of environmental information and to distribute that information through web sites, information kiosks, newspapers, fliers, and town meetings. The rationale for the program is that by providing relevant environmental information at the community level, people can begin to make more informed decisions about their health and safety. For example, before planning a trip to a local beach one can visit an EMPACT web site to see the most recent water pollution levels at the beach or to see what beaches are closed due to pollution from storm water runoff.

An EMPACT project studying water quality in Narragansett Bay has recently started under a $500,000 grant received from the EPA by the Narragansett Bay Commission (NBC). ASA is a partner with NBC and is focussing on the design of the web page and development of software tools to interactively access data collected at monitoring sites located throughout the Bay. One of the goals of the project is to make environmentally-related information understandable to everyone. Not always an easy task for scientists! One of the partners is the Office of Marine Programs (OMP) at the University of Rhode Island. OMP will provide educational information to assist in the understanding of the underlying science. The web site will provide a central source for environmental information that will serve the needs of the general public, primary school and high school students, and also scientific research and higher education institutes. Timely information will be available from a number of instruments in the water that transmit measurements of temperature, oxygen level, salinity, pH and depth. A visitor to the Narragansett Bay EMPACT site will see the monitoring sites on a detailed map of the Bay, and by clicking on a site, be able to view a graphical display of the latest measurements or transfer archived data to their own computer for analysis. The web interface will provide background information and explanations of why the data being collected are important; the significance of the values being measured; and links to other sources of related information. The intent is for the site to become a place where information about Narragansett Bay water quality can be readily accessed, explained and understood. ASA's models for the bay will also be linked so that predictions for the future may be made based on present information. This can help a user answer questions such as, "If the rainfall today is 1 inch, what can I expect for water quality at my beach tomorrow?"





The project is scheduled to be complete by December 2001. If you would like to know more about the EMPACT project, please contact Henry Rines at ASA (hrines@appsci.com).

Chemical Spill Regulations

The transportation and use of chemicals continue to increase, as does concern over the potential impacts from releases of toxic substances. The U.S. Coast Guard is currently developing regulations that will address the implications of hazardous substance releases in the marine and fresh water environments. These regulations are required under the 1990 Oil Pollution Act (OPA) and are currently undergoing a public review process. The proposed regulations define the response plans that will need to be prepared for all marine transportation-related facilities and tank vessels carrying hazardous substances. These response plans are to include an impact analysis for a worst case discharge and will pre-identify the areas where impacts to human health and the environment could occur. The plans will also identify worst case planning volumes, endpoints, and distances to endpoints. An endpoint is a threshold defining a hazardous condition, such as an exposure level, dose or pollutant concentration. The proposed regulations state that dispersion modeling will be necessary to assess the potential risks and develop response strategies. The proposed rules state that dispersion modeling capabilities will need to be available within 2 hours of a spill, along with air and water sampling resources, and readiness of various response equipment.

This regulation would not be the first of its kind. International treaties, including the MARPOL and the International Bulk Chemical Code, address hazardous spill response requirements. In 1999, the International Maritime Organizations (IMO) approved a new regulation that required all ships of greater than 150 gt that carry noxious liquid substances (NLS) to have an approved Emergency Response Plan in place by 1 January 2003. The Emergency Response Plan is to be based on guidelines developed by the Marine Environment Protection Committee (MEPC). The Protocol on Preparedness, Response and Co-operation to Pollution Incidents by Hazardous and Noxious Substances, 2000 (OPRC-HNS Protocol) was adopted by the IMO in March 2000. The draft guidelines are similar to those provided for response to oil spills. In 1996, IMO adopted the International Convention on Liability and Compensation for Damage in Connection with the Carriage of Hazardous and Noxious Substances (HNS) by sea, which provides for a compensation and liability regime for incidents involving these substances.

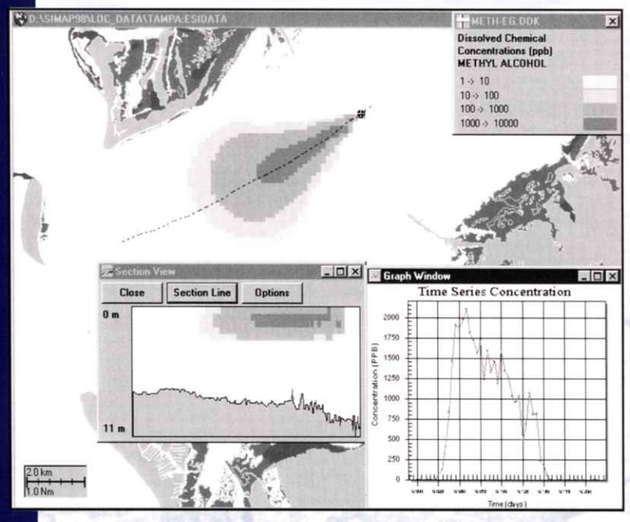
Dr. Deborah French at ASA has been reviewing the proposed regulations, "Oil spills get a lot of media attention and are a big concern for the public. However, these regulations address the fact that chemical spills can have as much if not more impact. Our goal is to develop technology to help industry meet these guidelines as efficiently as possible"

CHEMMAP: **An integrated response and impact analysis tool for chemical spills.**

CHEMMAP can be used to answer the following questions:

- Where will the chemical go after it is released and how fast will it disperse?
- What concentrations in the water and sediments are to be expected over time after the release?
- How far away from the release site will concentrations exceeding threshold(s) of concern (endpoints) reach?
- What is the expected exposure of organisms in the water and sediments?
- Over what area or volume does the exposure to organisms (dosage) exceed levels of concern?
- What is the potential for contamination and loss of fishery resources?
- How much of the material spilled into water will evaporate/volatilize to the atmosphere? How fast and where will that occur?
- What is the potential exposure to humans and wildlife?

CHEMMAP predicts the trajectory, fate, and impacts of a wide variety of chemical substances, including floating, sinking, soluble and insoluble chemicals and product mixtures. Applications for CHEMMAP include contingency planning, spill response, drills and education, evaluation of point source discharges, environmental impact and risk assessment, cost-benefit analysis, and natural resource damage assessment. The model may be run for a hindcast/forecast of a specific release, or be used in stochastic mode to evaluate the probable distribution of contamination.



Personnel

On 10-11 July **Deborah French** and **Henry Rines** provided training to the National Pollution Funds Center (NPFC) on the Type A Natural Resource Damage Assessment Models developed by ASA. These models are included in US regulations (CERCLA and OPA '90). The NPFC of the US Coast Guard administers the Oil Spill Liability Trust Fund that provides monies for response and natural resource damage claims.

On 24-28 July **Deborah French** participated in the annual Natural Resource Damage Assessment training/workshop in the Florida Keys for NOAA's Damage Assessment Center Rapid Assessment Program (RAP) and its contractors. This year the focus was on potential for injury and restoration of coral reefs and seagrass beds.

Craig Swanson and **Matthew Ward,** along with Ivan Valiela of the Boston University Marine Program, presented project findings at a public meeting held on Nantucket Island on 10 August. The project used ASA's WQMAP system to simulate tidal circulation, flushing and nitrogen loading within Nantucket Harbor. The project objective was to develop a modeling system to assist the town in protecting and enhancing water quality in the harbor.

Craig Swanson and **Henry Rines** participated in the U.S. EPA National Environmental Monitoring Technology Conference held in Boston 19-20 September. They hosted the ASA display that included a poster entitled Development of Real Time Monitoring and Modeling Systems. The poster included a description of our COASTMAP real time monitoring and modeling software system and described highlights of some of our recent projects.

Craig Swanson, along with Marci Cole of the Boston University Marine Program, held a kickoff meeting on 22 August for the general public to describe a new ASA project on Nantucket Island, Computer Modeling of Miacomet Pond. The project was designed to determine how to minimize the large range of pond levels that cause adjacent road and basement flooding and occasionally result in the pond nearly emptying.

Craig Swanson presented a talk entitled Circulation and Pollutant Transport in Narragansett Bay, coauthored with Dan Mendelsohn and Matthew Ward, at the OCEANS 2000 conference held 11-14 September. Although the conference was hardware-oriented the talk about ASA's modeling experience in Narragansett Bay engendered a lively question and answer period about model applications and the importance of calibration.

Scott Veitch recently participated in the Autonomous Undersea Vehicle competition which brought together teams including the University of Rhode Island, MIT, Cornell, the Naval Academy, and the Stevens Institute of Technology. The competition was hosted by the Association for Unmanned Vehicles Systems International (AUVSI) and was held on July 9-11 in Orlando, Florida at Disney World's Coronado Springs (www.auvsi.org/auvcomp.htm). Scott was one of four members of the URI design team.

The goal of the competition was to design an autonomous underwater vehicle capable of searching for and retrieving a target using an acoustic and optical source for fixed references. The team divided the work to accommodate every aspect of the design. Rich Bashour and Ryan Freke, both juniors in Ocean Engineering, were tasked with the mechanical aspects of the pressure housing design and hydrodynamics. Jaki Foran, a senior in Marine Affairs, was responsible for all travel and media arrangements. Scott, a senior in Ocean Engineering, was given the task of signal acquisition and processing.

After days of rigorous testing, late nights, and constant sensor calibration, the University of Rhode Island team took first place in the competition. Runners up were MIT and Cornell with a tie for second, and the US Naval Academy for third. The team website can be found at http://www.oce.uri.edu/auvwww.oce.uri.edu/auv.

Eoin Howlett presented a paper at the OCEANS 2000 conference held 11-14 September. Dredgemap: A GIS-based Dredging Model System was co-authored with Chris Galagan from ASA and Billy Johnson and Jim Clausner from the U.S. Army Corps of Engineers. The paper discussed advances in the dredging models and their integration within a new GIS-based interface.

Roddy Thomas attended MEPEX/MEMAC 2000 Conference in Bahrain, 24-26 September, which focussed on oil spill response and contingency planning in the Middle East. Roddy presented a paper entitled Next Generation Software Tools in Support of Emergency Spill Response, Spill Impact Analysis and Damage Assessment.

Army Corps of Engineers personnel from ERDC (Formerly the Waterways Experiment Station), Vicksburg, Mississippi, and several district offices attended a training course in the SSFATE computer modeling application which ASA and ERDC personnel have recently developed. The model system allows the user to define dredging scenarios for three kinds of dredging operations and predict the movement and settling of sediments disturbed during the dredging operations. **Eric Anderson, Eoin Howlett, Tatsu Isaji, Chris Galagan,** and **Deb French** assisted in the training sessions.

Back row: Pam Horner, Detroit District Lauran Warner and Jeff Dillon, Seattle District, Mark Lulka, New York District, Larry Oliver, Jay Mackay, and Don Wood, New England District Chuck Dickerson, ERDC, Philip Payonk, Wilmington District front row: Mark Eberle, Philadelphia District, Jenine Gallo, New York District, Billy Johnson and Doug Clarke, ERDC