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# Flooding Model Used to Assess Impacts of Climate Change in Boston

## THE INSIDE STORY

- Oceanographic Forecasting System
- COASTMAP NetCDF extension for The Royal Australian Navy
- Personnel News
- New Faces
- CHEMMAP Delivered to Cedre
- Upcoming Conferences

ASA, in conjunction with Rite Solutions of Middletown, RI, recently simulated the possible extent of coastal flooding in downtown Boston resulting from climate change. The Boston area is especially susceptible to flooding because of its extensive coastline, many rivers and streams, concentrated coastal development, and vulnerability to hurricanes and nor'easters. The city has already experienced a 0.3 m increase in relative sea level over the last 100 years and can expect an additional increase of 0.6 m by the end of this century. Higher sea levels add to the base elevation of a storm surge, resulting in more areas at risk from flooding.

The study considered the flooding expected from a 100-year storm. To incorporate the effects of sea level rise the storm was assumed to occur in the year 2100. Storm surge elevations were provided by the US Army Corps of Engineers. Sea level rise predictions came from the Canadian Climate Center. These estimates were combined to determine future flood elevations which were displayed as a three-dimensional (3D) animation of the flood's advance.

The flooding was animated by importing high-resolution LIDAR elevation data into Rite Solutions' Rite-View™ 3D simulation software. Both MrSID images and 3D representations of buildings were draped over the elevation data to provide a realistic depiction of downtown Boston. The animation showed initial

flooding of the financial district and the North End neighborhood of Boston; as the surge overtopped the Charles River Dam, extensive flooding was also predicted in Boston's Back Bay neighborhood.

The animation was commissioned by the National Environmental Trust and used in a press conference presenting the results of *Climate's Long-Term Impacts on Metropolitan Boston (CLIMB)*. The CLIMB project is a multi-sector analysis of how global warming will affect key socio-economic activities typical in major urban centers. The animation received coverage on CNN, Good Morning America, and other local and national news networks.

For more information contact Kelly Knee, [kknee@appsci.com](mailto:kknee@appsci.com).



Above: CNN news coverage of Kelly Knee presenting results at a press conference in Boston on 15 February.

Left: Predicted flooding from a 100 yr storm in 2100 (with 0.6 meters of sea level rise) for downtown Boston. The translucent blue represents land features that would be underwater.

# Operational Oceanographic Forecasting System

An oil tanker runs aground and begins leaking oil. A pleasure boat is lost at sea. Medical waste is found washed ashore. Common to all these situations is the need to predict the path of objects at sea. To do this requires forecasting environmental conditions such as winds and currents. Operational weather prediction models have been used successfully since the 1950's. However, forecasting ocean variables is still a major challenge. ASA South America is meeting this challenge for the waters along the coasts of Chile, Argentina, Brazil, and Venezuela.

ASA South America (ASA SA) have implemented a robust 3-dimensional hydrodynamic model for the northern and southeastern coasts of Brazil, the continental shelf of Argentina, and the coast of Chile. Now navigation safety, oil industry operations, and port & harbor activities can rely on a sophisticated system to synthesize atmospheric forecasts, real-time data, and remote sensing information to predict ocean variables.

The Brazilian oil company, PETROBRAS, is utilizing such advancements in their ocean related operations. ASA SA's forecasting system provides 72-hour forecasts of sea conditions for the southeastern coast of Brazil, in the Campos and Santos Oceanic Basins, to PETROBRAS. The results are available in NetCDF or OPeNDAP format and can be accessed via Client Direct Access or a web browser. The forecasts are simulated on a server at ASA SA's office, initialized with temperature and salinity data from global circulation models and atmospheric forecasts from several sources.

Further advances in Operational Modeling and Forecasting Systems are underway in association with the University of São Paulo's Ocean Numerical Modeling Laboratory (LABMON), and sponsored by a grant from the Research Support Foundation of the State of Sao Paulo (FAPESP). Currently, ASA SA is developing computational methods to: (1) allow short-range open-ocean forecasts, (2) generate boundary conditions to extend the predictability of coastal and regional subsystems, and (3) improve the mechanisms to provide products online from ASA's servers directly to the end users.

For more information on the South American operational forecast model, please contact Eduardo Yassuda, eyassuda@appsci.com.br.

## Accessible with Client Authentication via

- World-wide web
- COASTMAP
- Client direct access



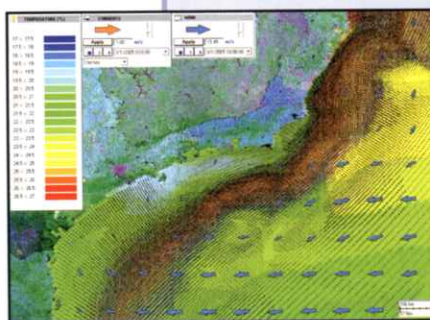
## Operational Modeling Server

### Data Formats

- netCDF
- OPeNDAP
- Animated Gif

### Data Available

- Current Field
- On-demand forecast
- Event specific prediction modeling (oil or chemical spills, well blowouts, search & rescue).
- World-wide metocean databases
- Secure client specific databases



## Data Use

- HYDROMAP or other hydrodynamic models
- OILMAP or other oil spill models
- SARMAP or other search and rescue models
- CHEMMAP or other chemical spill models
- WQMAP or other water quality models
- COASTMAP or other analysis tools

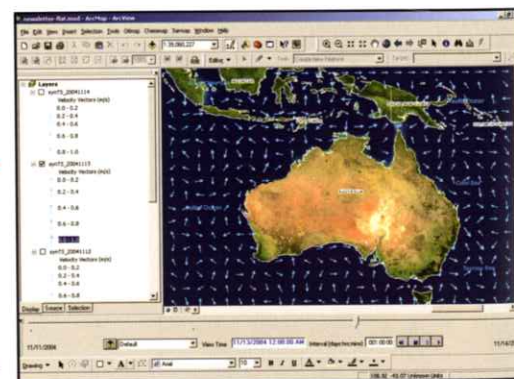
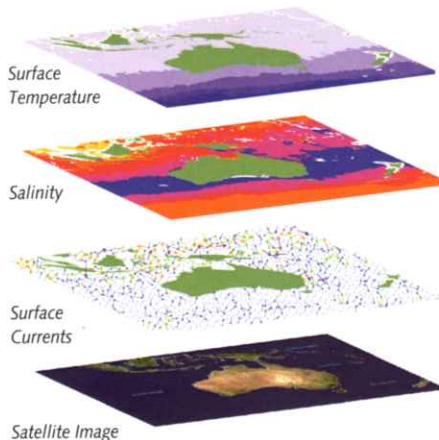
# COASTMAP NetCDF Extension for The Royal Australian Navy

ASA's staff in the USA and Australia are developing and testing a unique extension for ArcGIS 9.0 and are currently finalizing the supply of 8 licences of a NetCDF extension for the Royal Australian Navy (RAN). The COASTMAP NetCDF Layer Extension allows NetCDF data that is COARDS and CF compliant to be viewed in ArcGIS for RAN operations. This data is generated by the Australian Science Agency, CSIRO, and Australian Bureau of Meteorology (BOM).

The COASTMAP NetCDF custom layer and Time Toolbar extension allow RAN staff to manage, display, animate and analyse both scalar (salinity, temperature, elevation) and vector (current and wind data) data in its native NetCDF format.

The next phase of the project has begun to extend the extension to include OPeNDAP support of the CSIRO and BOM data.

For more information please contact Sasha Zigic: szigic@apasa.com.au.



Above: CSIRO and BOM animated surface currents in ArcGIS 9.0 using the COASTMAP NetCDF layer and Time Toolbar extension.

# PERSONNEL

**Craig Swanson** was appointed by Rhode Island Governor Donald Carcieri to serve a two year term on the Scientific Advisory Committee to the Rhode Island Bays, Rivers, and Watersheds Coordination Team.

In February, **Scott Langtry** gave a briefing on the SARMAP model to the Western Australian Water Police, as a follow-up to assistance provided with that model by Asia Pacific ASA to locate an elderly couple lost at sea off metropolitan Perth.

During the first week of February, **Matt Ward** delivered and conducted training for version 1 of the Boundary Condition Toolbox to the Naval Oceanographic Office. The Boundary Condition Toolbox is an ESRI ArcGIS 9.0 extension designed to access global and local operational databases such as bathymetry, tide stations and hydrodynamic model grids.

7-8 February, **Linda Gagne** attended a workshop in Columbia, Maryland entitled *Building Effective Government Cost Proposals*.

**Eoin Howlett, Malcolm Spaulding, Deborah French McCay** and **Jiganesh Patel** made presentations and participated in discussions at the workshop and conference: Gulf of Mexico Integrated Science — Tampa Bay Study, 8-9 February, in Gulfport, Florida.

**Craig Swanson** participated in the EPA-sponsored workshop on Water Quality Modeling for National-Scale Economic Benefit in Washington, DC on 9-10 February. The invitees discussed water quality models for both freshwater and marine systems including model requirements and approaches relative to evaluating economic benefits, and made recommendations to EPA's Office of Water.

**Roddy Thomas** attended the Sea to Sea Regional Environmental Forum and Workshop in Cairo, 14-16 February. Sponsored by PERSGA and UNEP, the forum focused on three main themes: Integrated Coastal Zone Management, Biodiversity and Nature Conservation, and Reduction of Maritime Pollution in the Red Sea. Roddy presented a Poster Display co-authored by **Matthew Ward**: "The Integration of Global Ocean Observation System (GOOS) and Other Related Data in Support of a Range of Monitoring & Response Model Prediction Applications".

On 18 February **Nicole Whittier** attended an LNG seminar entitled *Managing LNG Risks*, provided by ioMosaic Corporation. The focus of the seminar was LNG hazards, regulations, and managing risks.

**Paul Hall** attended the second Quality Assurance of Real-Time Ocean Data workshop (QARTOD-II), hosted by the National Ocean Service (NOS) Center for Operational Oceanographic Products and Services (CO-OPS), in Norfolk, Virginia from 28 February to 2 March. The meeting focused on issues relating to the QA/QC of real-time data measuring ocean currents and waves. At the meeting, Paul presented a talk titled "Coastal HF Radar and Operational Search and Rescue Modeling" describing ASA's recent work for the US Coast Guard Research and Development Center.

**Sasha Zigic** was invited to present at the National Plan Marine Chemical Spill Response Course held in Glenelg, South Australia, 2 March. The presentation titled "Decision Support Tools for Chemical Spills - Chemical Plume and Spill Modelling" covered ASA's hydrodynamic (HYDROMAP) and chemical (CHEMMAP) models and their use for planning and response. Following the presentation, CHEMMAP was used as part of desktop exercise to examine the potential impacts from a hypothetical styrene spill at the mouth of Bass Strait.

In March, **Scott Langtry** delivered an OILMAP update and provided training to Woodside Energy Ltd operating within the Australian Bureau of Meteorology. As part of this update, Scott installed tidal data files to support OILMAP operations in Bass Strait, Australia.

Professor Kuo-Tung Chang from Kaohsiung University, Taiwan and his student Shih-Chieh Hsu (Jay) visited ASA's Narragansett office the week of 14 March. During his visit Professor Chang and Jay worked with **Eric Anderson, Jiganesh Patel, Tatsu Isaji, Matt Ward, and Nicole Whittier**. Professor Chang is using OILMAP and WQMAP in support of his student training, and will be adding CHEMMAP and HYDROMAP in the coming months.



**Marc Zapata** from Asia Pacific ASA's Queensland office is spending the next three months supporting the Perth office of Asia Pacific ASA.

**Sasha Zigic** was a participant at the annual ConocoPhillips Indonesia Incident Management Team training held in Jakarta. Sasha presented "Fate and Effects of an Oil Spill on Water" and "Trajectory Modelling (OILMAP)". Sasha also presented "Response Trajectory Modelling" to the Incident Management Assist Team from the ConocoPhillips Asia-Pacific region.

**Nicole Whittier** was invited to speak at the RI Harbor Masters Association meeting on 31 March. Participants from the Harbor Masters, Governor's Office, Law Enforcement, and the U.S. Coast Guard met to discuss issues related to Port and Harbor Security. Nicole presented an overview of ASA's experience and software tools for modeling LNG spills on water.

**Eoin Howlett** is working with Jonathan Cornelius at Antigua Barbuda Search & Rescue (ABSAR). ASA has donated SARMAP to ABSAR. ABSAR assists in logistical support for missing vessels in the waters surrounding Antigua and Barbuda and plays an active roll in providing medical and rescue services for the Antigua Race Week and the Antigua Classics Regatta.



## New Faces

**Felipe das Neves** and **Daniel Zacharias**, both meteorologists, have joined ASA South America's modeling team. Felipe will be working in Rio de Janeiro and Daniel in São Paulo. Both are already engaged and up-to-speed on the operational modeling project where ASA South America is providing met ocean forecasts in the South Atlantic.



Daniel Zacharias



Felipe das Neves

**ASA** and RealWeather of Newport, RI are working together to provide integrated meteorological and oceanographic forecasts for Narragansett Bay sailors this summer. The project will allow users to receive the Daily Bay forecast by email as well as tidal charts at NarragansettBayMap.com. For further information, contact Susan Genette at RealWeather (forecast@realwx.com) or Eoin Howlett (ehowlett@appsci.com).

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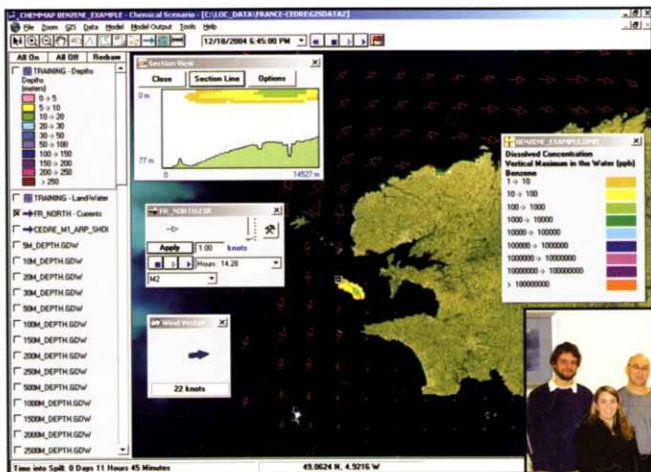
## CHEMMAP Delivered to Cedre

The Center of Documentation, Research, and Experimentation on Accidental Water Pollution (Cedre), France, has recently taken delivery of CHEMMAP. CHEMMAP is a three-dimensional chemical dispersion model. It predicts the trajectory and fate of a wide variety of chemical substances, including floating, sinking, soluble and insoluble chemicals and product mixtures. CHEMMAP is integrated within a GIS framework making it easy to evaluate potential contamination with respect to geographical data. Other features include the incorporation of spatial databases, the ability to color code spill trajectories by chemical fate, create concentration contours of each fate over time, and display time-series data of concentrations for a particular location or throughout the whole area of contamination.

The system was delivered to Cedre in support of their national remit for training, planning and emergency response operations in French territorial waters. The agreement includes the delivery of a CHEMMAP software license, 2 day training course, and the provision of predicted water circulation data for the English Channel, Bay of Biscay, and the Mediterranean Sea. In addition a variety of tools were provided to allow Cedre to directly import a range of third party hydrodynamic and GIS data to assist their support services and associated R & D activities.

Nicole Whittier and Roddy Thomas carried out a training program at Cedre's offices in Brest. Attendees included Emergency Response Coordinators, biologists, chemists, and GIS specialists.

For more information please contact Nicole Whittier, [nwhittier@appsci.com](mailto:nwhittier@appsci.com).



Left: Hypothetical CHEMMAP simulation off the coast of Brittany, France.

Below: Cedre's CHEMMAP training attendees.



## Upcoming Conferences

**Matt Ward** will be attending the Joint Services Environmental Management Conference in Tampa, FL from 11-14 April.

**Andrea Gallo** from ASA South America has been invited to participate in the IBP (Brazilian Institute of Petroleum) technical review panel for the environmental requirements of the Brazil's 6th oil and natural gas licensing round, distributed by the Brazilian Environmental agency (ELPN/IBAMA).

**Matt Ward** will be attending the Department of Homeland Security Research & Development Conference in Boston, MA from 27-28 April.

**Deborah French McCay** and **Nicole Whittier** will be presenting at the 2005 International Oil Spill Conference, 15-19 May at the Miami Beach Convention Center in Miami Beach, Florida. **Eric Anderson**, **Eduardo Yassuda**, and **Scott Langtry** will also be attending.

**Craig Swanson** will be presenting a paper, Southport Harbor Hydrodynamic and Pollutant Transport Modeling Study, at the 2005 TMDL conference of the Water Environment Federation 26-29 June in Philadelphia. The paper will be presented in the session on Bacteria TMDL Modeling and Source Tracking focuses on the use of backward tracking models to estimate source locations.



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