6.10 MOTION TRACKER- USING INTERNET MAP SERVERS AND JAVA TECHNOLOGY TO PROVIDE NEAR-REAL TIME MAPPING OF MOVING OBJECTS- RESEARCH VESSELS AND MARINE MAMMALS

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1. INTRODUCTION

MotionTracker is a NOAA project that proposes to extend the existing capabilities of the ShipTracker project to provide web displays for a variety of moving objects, including animals and ships. ShipTracker currently provides access to near real-time locations and environmental data collected by NOAA's fleet of research vessels in the Pacific and Atlantic Oceans. The system leverages services provided by ESRI's ArcIMS software and runs in the JAVA environment. It provides a web interface for accessing the scientific data and general information about the ships' locations and working conditions and successfully demonstrates that tracked objects can be mapped in near real-time for display of location and current at-sea conditions.

Creation of an ArcIMS based web site allows for the display of scientific data and general information about the ships' locations and working conditions. This project required development of tools to get near real-time display of tracked items (in this case a ship) into a GIS to allow for display, analysis and rapid generation of web pages.

The ShipTracker project successfully demonstrated that tracked objects can be mapped in real-time for display of location and current at-sea conditions. The same concepts have been applied to create near real time mapping of instrumented marine mammals and moored and satellite tracked buoys. Within the marine mammal user community, there is interest in real time access to marine mammal track data to understand mammal migration patterns and foraging behavior. Additionally, a near real-time display could also provide critical information for responders in the event of an oil spill or other man-made disaster. Currently, we are applying concepts from the ShipTracker project to map instrumented marine mammals and moored and satellite tracked buoys.

This paper details the current implementation of ShipTracker. It further describes the next generation of this system that will provide the more encompassing Motion Tracking Internet Map Server.

2. SHIPTRACKER 1.0

The ShipTracker website homepage displays a map showing the location of selected ships in the NOAA fleet. A user can query for data from a specific ship by name, by specifying an area of the ocean by latitude/longitude, or by clicking on the map. Once a particular ship is identified, the website displays a ship-specific page detailing the most recently reported location of the ship and other environmental data collected of the past several days.

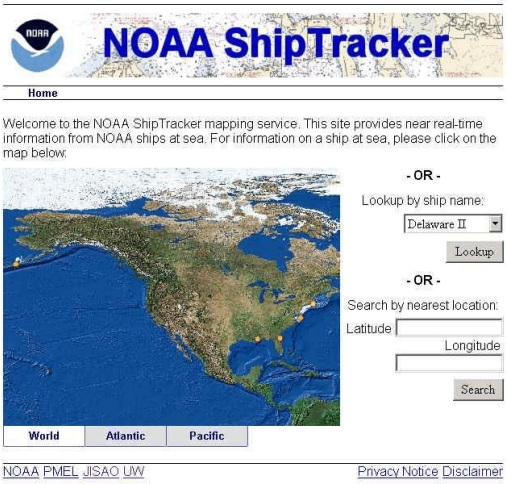

Fig. 1. ShipTracker Page

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The summary page for a specific ship displays a map showing the ship's most recently reported location and trackline. The width and opacity of the trackline decrease with observation age, providing a visual cue as to where the ship has been and how fast is it moving. The page also presents a summary of the most recently observed environmental conditions measured by the ship's instruments. This information can vary depending on the needs of the research project currently using the ship.

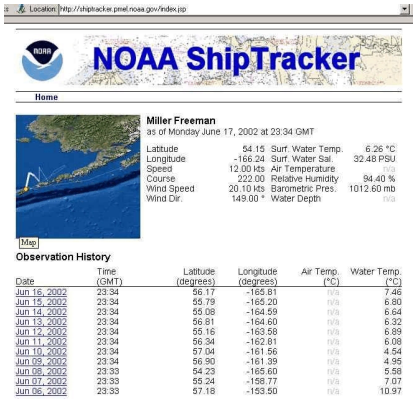

Fig 2. Individual Ship Page

2.1 SHIPBOARD COMPUTING

On board each vessel, the Scientific Computer System (SCS) software, developed by NOAA's Office of Marine and Aviation Operations (OMAO), processes the data acquired by various scientific instruments. SCS is networked throughout each ship and the SCS NT Client can access data from remote stations located anywhere on the ship. It has the capability of transmitting, ASCII data strings via RS-232 cable or Ethernet.

For the benefit of ShipTracker, SCS is configured to generate a "current conditions" message giving values of selected sensors at a user-selected interval. SCS packages this data within a standard email message and stores it for transmission to shore. Approximately two or three times a day, the communications software in each NOAA ship bundles pending email messages into a single file and transmits the file to receivers on shore via Inmarsat or Cell phone. Upon reaching the receiver, the aggregated data is parsed and individual email messages are routed to their appropriate destinations (one being an email account monitored by the ShipTracker system).

Another standard system, SEAS, provides a backup system for delivering data describing current conditions.

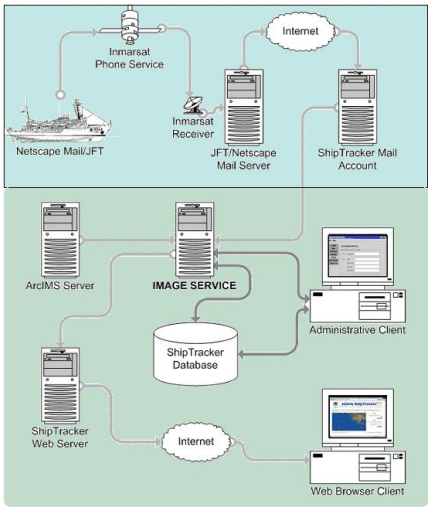

Fig 3. Architecture

2.2 SHORE-BASED PROCESSING

When the ShipTracker system receives a "current conditions" email message, it examines the data and, after some quality checks to avoid duplicate and spurious entries, stores the data in the ShipTracker database. Currently ShipTracker uses MySQL for its database due to its simplicity and generous licensing terms.

After receiving and processing the pending SCS messages, the message processing system notifies the portion of the ShipTracker system that supports the interactive website to regenerate the image maps and update its data caches..

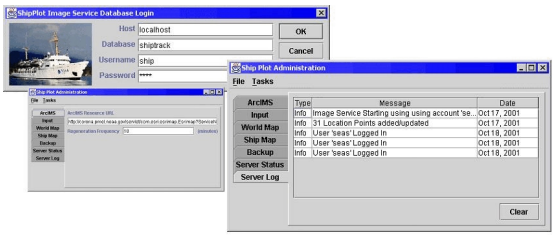

Fig. 4 JAVA based GUI for Administration - an option in ShipTracker 1.0

2.3 Map Server

ShipTracker leverages the capabilities of ArcIMS 3.1 running under UNIX for generating map images displayed on the website. ArcIMS obtains the underlying images for the maps from topography and bathymetry data stored in the shapefile format. The sizing of the maps varies as a function of ship location and trackline. The system adds graphics depicting ship locations in the "acetate" layer. Placing the ship graphics in the acetate layer enables dynamic regeneration of map images by avoiding some of the ArcIMS 3.1shapefile indexing limitations.

ShipTracker makes requests to the ArcIMS software via XML using the ArcXML dialect. ArcXML specifies the details of the image being requested. The software requests new images from ArcIMS each time new ship data is processed by the system.

An XML file provides the specific details of configuration of the system, including locations of various system resources and file locations. Additionally, various components of the system communicate using XML messages posted over HTTP protocol. Administrators have the ability to reconfigure the system while it is running through the use of this protocol. Graphical administration interfaces are under development to make administration of the system convenient.

The website itself is hosted by the Apache Tomcat server. It is a mixture of Java Server Pages, JAVA Servlets, static HTML pages and images created by the Map Server. For dynamic data, it relies upon a middleware application server that caches the most recent ship data. The website software and middleware communicate through the XML protocol mentioned above. The middleware in turn obtains ship data directly from the database.

3.0 MotionTracker- Moving from ships to mammals and drifters

ShipTracker has allowed the developers to experiment with ways to provide users with updated ship positions. The application is currently being reworked to take any ARGOS formatted mail message and create the same type of display options. In the case of Beluga whales, an ARGOS message is sent with location data, time and depth several times a day. The messages currently sit in a FTP directory and are downloaded, formatted and quality controlled and put into a database manually. MotionTracker is currently reworking the core software and data models into a more generic framework in order to use multiple instrument types and metadata such as Beluga ARGOS messages.

MotionTracker will provide enhanced capabilities such as querying historical data, retrieving depth information for mammals and other parameters of interest. One request from the user community is the ability to download the data as an ArcView compatible shapefile that will allow researchers to display the data on their own desktop GIS.

4.0 Conclusions

The ability to map and track moving objects in real time by use of Internet Map Servers has been often times clunky and time consuming. By creating an application that combines JAVA technology to retrieve data, format and update the database and create acetate layers to overlay into a Internet Map Server, data can be updated in near-real time. The ShipTracker model serves as a good jumping off point for developers to rework the data model to work with other tracked and drifting objects such as beluga whales, sea lions and drifting buoys.

5.0 Acknowledgements

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6.0 References

For more information about the Pacific Marine Environmental Laboratory, please visit the PMEL home page at http://www.pmel.noaa.gov

For more information about the NOAA Fleet and the Office of Marine and Aircraft Operations, please visit the OMAO homepage at http://www.moc.noaa.gov/