

# *NOAA's nowCOAST: Developing a Java Connector-Based GIS Web Application*

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## **INTRODUCTION**

The National Ocean Service (NOS) Coast Survey Development Laboratory has developed a Geographic Information System (GIS)-based Web portal called *nowCOAST* (<http://nowcoast.noaa.gov>) to allow the nation's coastal community to quickly access online, real-time observations and NOAA forecasts for any region in the coastal United States including the Great Lakes. The portal provides users with one-stop access to selected real-time meteorological, oceanographic, river, and water quality observations as well as NOAA forecasts for a particular coastal area of interest.

*NowCOAST* provides access to this information through its spatially enabled database containing hyperlinks to thousands of pre-existing Web pages that display observations or NOAA forecast products at specific locations. By aggregating this information in a centralized database and displaying it in a dynamic user-controlled map via a Web browser, *nowCOAST* provides a new means for discovery of on-line, real-time information for coastal areas throughout the United States.

## **DESCRIPTION OF PORTAL**

*NowCOAST* serves geographic positions of observing network station and forecast point and zone locations from a GIS database. Included are the type of observations taken or forecasts produced at each site, and hyperlinks to pre-existing Web pages that display this information. The *nowCOAST* interface allows users to quickly specify the type of observations or forecasts they want as well as their geographic area of interest.

*NowCOAST* uses Arc Internet Map Server (ArcIMS) combined with Dynamic HTML (DHTML) and Java Enterprise Edition (J2EE) Web programming technologies including Java Servlets and Java ServerPages for its dynamic GIS mapping capability. *NowCOAST* is built upon the Java Connector API for ArcIMS, allowing for customization of the map

functionality and appearance within the J2EE framework. The Java Connector was selected over other similar ArcIMS technologies provided by ESRI, such as the ActiveX Connector and Servlet Connector, for its ability to be used on a variety of operating systems and Web servers, and the programmatic customization capability that it provided.

The *nowCOAST* site consists of a custom map interface based on the Java Connector that was designed to be highly lightweight and fast. Emphasis was placed on minimizing the amount of JavaScript and HTML that was required for the viewer to function in users' Web browsers compared with that of the template HTML viewer commonly used in ArcIMS websites. In addition to the map viewer, the portal includes a 'Databrowser' interface to allow the user to view and browse forward and backward through websites displaying the observations and forecasts that they locate through the map viewer. The Databrowser is J2EE-based and integrates directly with the map viewer Java Connector code. Detailed descriptions of the function and use of the map viewer and the Databrowser are given in later sections.

## **DESIGN AND DEVELOPMENT OF NOWCOAST**

The first version of *nowCOAST*, released in August 2002, was adapted from the template HTML viewer provided with ArcIMS. The HTML viewer design relies on the client machine to generate complete, properly structured Arc eXtensible Markup Language (ArcXML) requests in order to communicate with the *nowCOAST* ArcIMS Mapservice. This results in a large amount of JavaScript code that must first be downloaded to the client machine when the user accesses the site, and then subsequently must be executed by the client's Web browser each time the user interacts with the map. The initial code download can be lengthy on slower Internet connections, and any processing errors that occur with user interaction can lead to instability or cause the site to crash.



Fig. 1. The nowCOAST Map Viewer in a Web browser

Although the custom J2EE/Java Connector viewer design for the current *nowCOAST* site still incorporates some JavaScript code to capture user interaction with the map, the bulk of the processing takes place on the *nowCOAST* server using the Java Connector, which translates input from the viewer about user interaction into properly-structured ArcXML to send to the ArcIMS Spatial Server. This allows greater control over the request/response cycle that occurs as the user interacts with the site and lessens the chance that an error in execution of JavaScript code on the client will cause the site to crash. In addition, since the J2EE/Java Connector custom viewer requires download of significantly less JavaScript code than the HTML template viewer, the user experience with the site is improved over high and low bandwidth connections alike.

From a programmer's perspective, advantages to building a site based upon the Java Connector include easier customization of map behavior by working with the Java Connector API as well as the cross-platform compatibility of the Java language. Also, the server infrastructure needed to use the Java Connector, specifically a Servlet Engine such as Jakarta-Tomcat, is a dependency of the ArcIMS

software itself and already must be installed and configured on the server. This saves time on site administration by lessening the number of software packages that must be maintained to operate the site.

The only tradeoff of the J2EE/Java Connector-based viewer design is that processing load may be greater on the server than on a site using the template HTML viewer. This can be offset by allocating additional hardware resources to the server or taking advantage of administration techniques of ArcIMS and J2EE to maximize performance.

NowCOAST currently runs on a 2.2Ghz Intel Xeon server under Windows using the Apache 2.0.4x Web server, Jakarta-Tomcat 5.5.x Servlet Engine, and ArcIMS 4.0.1.

## THE MAP VIEWER

When a user opens the *nowCOAST* Web page in a browser, he/she is shown the map viewer (Fig. 1) with a default view of the continental U.S. as well as an introductory message with basic instructions on use of

the site superimposed upon the map. The instructions include the step-by-step process to obtain observations or forecasts, as well as tips about common usage problems that users have encountered with the site.

In addition to the introductory instructions, the *nowCOAST* map viewer consists of the map itself, the 'Jumpbar' menu above the map that provides quick step-by-step selection of data to view in the map, a set of useful Map Tools for direct manipulation of the map, and a Map Layers list to allow overlay of information from multiple GIS data layers in *nowCOAST*. Each of these components works interchangeably with the others, meaning that users have several options available to manipulate the map to view the exact data they would like. Two different methods to use *nowCOAST* to obtain real-time observations and NOAA forecasts are described in detail below.

#### SEARCHING FOR COASTAL INFORMATION WITH THE NOWCOAST MAP VIEWER: TWO METHODS

Because *nowCOAST* is intended for a broad user base, the map viewer includes two separate methods that can be used to obtain observations or forecasts, the first for those unfamiliar with GIS, the second for those with more experience with the technology.

The first method is the Jumpbar, which consists of four Web-standard 'pulldown' menus (Fig. 2) which allow the user to specify 1) the location (e.g. seaport, coastal state, estuary, marine sanctuary), 2) the information (i.e. specified type of observation, forecast

guidance, or forecast), 3) the variable (e.g. water level, air temperature, wave height, etc.), and 4) the time (specific forecast time or time period). The Jumpbar is located above the map and is designed to visually guide the novice user through this four-step process to specify the criteria they are interested in, then click on 'Go' to obtain a map with the resulting information. As described in the initial instructional message, the user is then able to click on any of the resulting observation stations or forecast points or zones to link to the website with the associated information. With six clicks of the mouse, the user can see the observation or forecast information.

The second navigation method, intended for those more familiar with GIS, consists of a combination of standard GIS mapping tools. First is a set of 'Map Tools' (Fig. 3) for working directly with the map. Tools such as Zoom In/Out, Pan, Identify, Select, Zoom to Lat/Lon, and Link to Data are provided in the toolbar. To assist users with these tools, instructional messages appear below the map when a tool is selected, and a separate help window with further instruction may also be opened. Second, *nowCOAST* offers a 'Map Layers' list, which is a catalog of the individual layers of GIS data within the portal. The Map Layers list provides the overlay functionality central to GIS. This is useful in *nowCOAST* for a user to visually compare spatial distribution of different types of observing platforms or forecast points and zones, for instance the distribution of weather observation stations, river observation stations, and NWS text-based surface weather forecast zones for a particular region such as the lower Potomac River watershed (See Fig. 4, next page).



Fig. 2. *nowCOAST* 'Jumpbar' Pulldown Menu Bar for Displaying Data on *nowCOAST* Map Viewer



Fig. 3. *nowCOAST* Map Tools Interface Located Below *nowCOAST* Map for Direct Manipulation of the Map and Interaction with *nowCOAST*'s Underlying Database

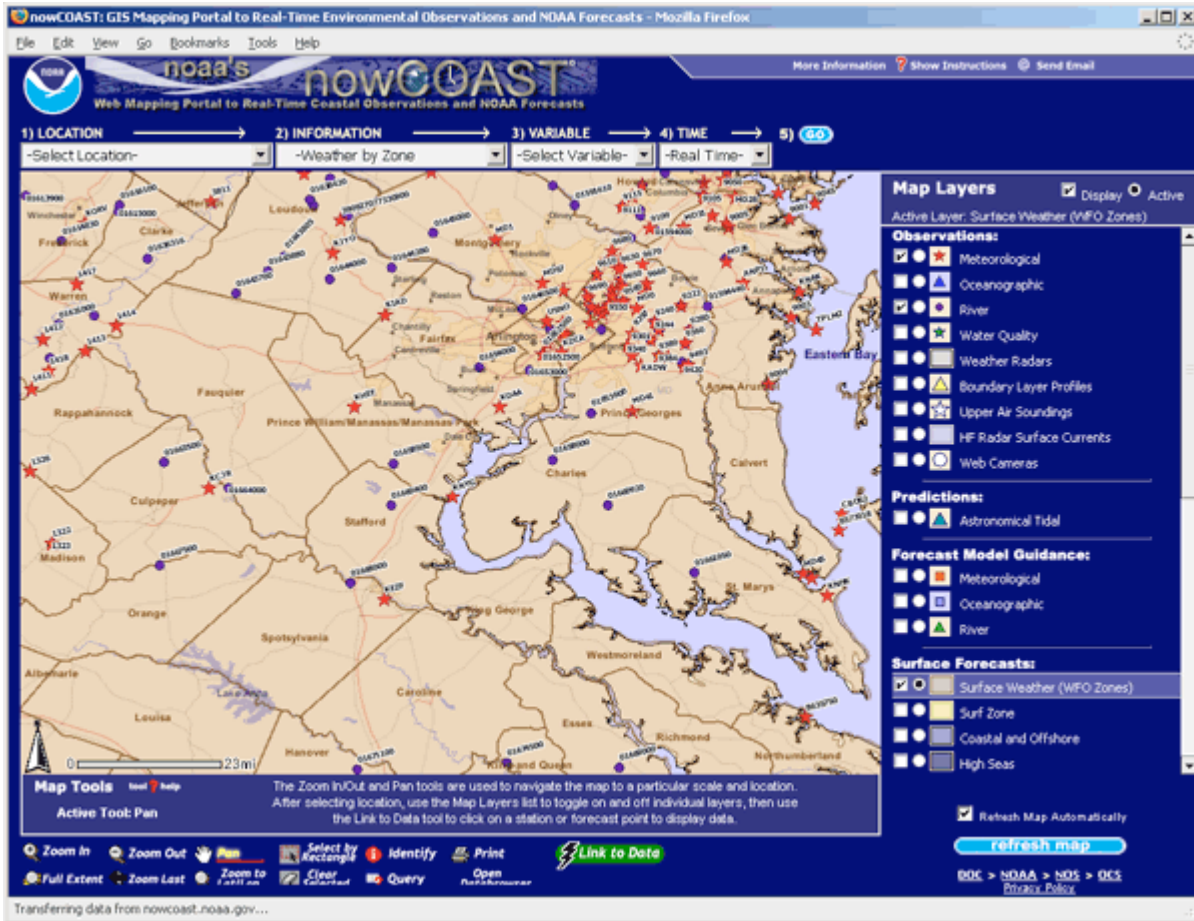


Fig. 4. nowCOAST Map Comparing Distribution of Weather and River Observation Stations Overlaid on top of NWS Surface Weather Forecast Regions in the Lower Potomac River Watershed

## THE DATABROWSER

NowCOAST provides direct hyperlink functionality to observations and forecasts at features on the map via the 'Link to Data' map tool. When the user clicks on a station or forecast zone, the Databrowser opens in a second browser window displaying the associated

Web page. The Databrowser both allows users to view Web pages linked to using the 'Link to Data' tool as well as tabular data output from queries to the portal's underlying data on observation stations and forecasts products using the 'Select by Rectangle', 'Identify', and 'Query' tools.

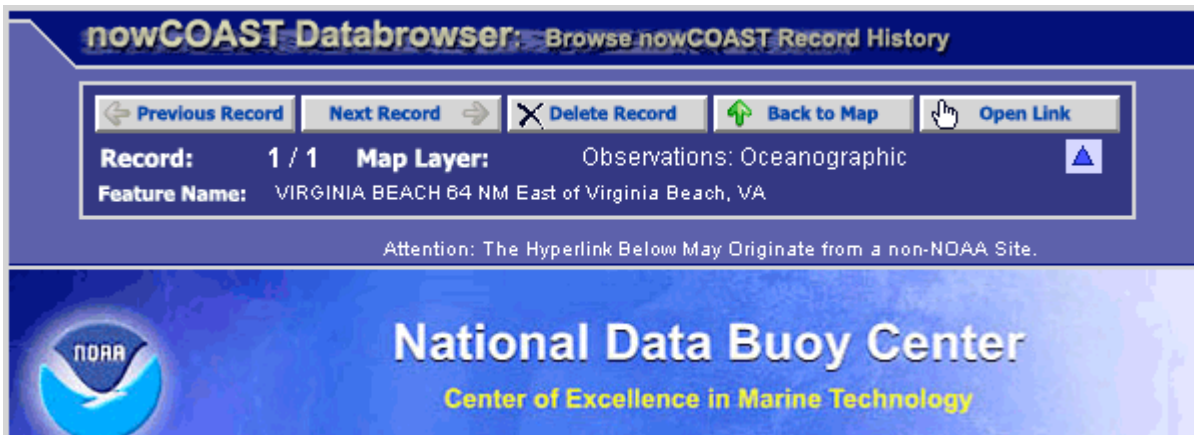


Fig. 5. The nowCOAST Databrowser Interface with NWS' National Data Buoy Center Web Page Displayed Below (partial view)



The Databrowser maintains a record of user interaction with *nowCOAST* throughout the duration of the user's session. When the user links to an observation station or forecast point or zone or queries the underlying *nowCOAST* data, a record is added to the Databrowser with this information. Users are then able to browse back and forward through this record, delete an individual record, print any dataset returned from the *nowCOAST* database, or open a new window with only the live forecast or observation Web page. These features give the user control over the information they obtain through *nowCOAST*, allowing them to retain only records of interest and compare observations taken at one location versus another, or compare an observation against a forecast, all within one browser window.

## SUMMARY AND FUTURE PLANS

*NowCOAST* is designed to be a planning aid for recreational and commercial mariners, coastal managers, emergency responders, marine educators and researchers, as well as beachgoers and other groups of recreational coastal users to discover and display real-time information.

Presently, *nowCOAST* provides live hyperlinks to selected existing websites that display real-time information. In the future, it will leverage the increasing amount of weather-related observations and NOAA gridded forecast products available in GIS formats. *NowCOAST* will display selected forecast fields from the NWS National Digital Forecast Database (NDFD), such as maximum and minimum temperatures, wind speed and direction, and wave height. Other NOAA gridded products may also be added to the portal following the NDFD. These include the National Digital Guidance Database (NGDG), output from NOS operational estuarine forecast systems, and NOAA sea surface temperature analyses.

*NowCOAST* is also being enhanced to display weather-related raster imagery including visible cloud imagery from NOAA GOES satellites, and NWS composite NEXRAD radar imagery for the continental U.S.

Plans also call for providing users with the capability to perform limited spatial analysis of gridded analyses

and forecast fields and display the results in the Databrowser. An example might be to query a specific location anywhere in the continental U.S. for a forecast of selected variables from the NDFD. The user would click on a location on the map, select variables to display, specify a time window, and receive a graphical display or tabular data output in return.

These enhancements to the data offerings within *nowCOAST* will be accomplished via connection of the *nowCOAST* MapService with an Oracle 9i/Arc Spatial Database Extension (ArcSDE) database. Spatial datasets will be stored in ArcSDE binary format.

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## FOR FURTHER READING

Wengren, M., J. G. W. Kelley, M. Kennedy, and M. Westington, 2005: NOS' NowCOAST: A Web Mapping Portal to Real-Time Coastal Observations and NOAA Forecasts. 12.4 *Preprints, 21<sup>st</sup> International Conference on Interactive Information Processing Systems (IIPS) for Meteorology, Oceanography, and Hydrology.*

More information available online at <http://nowcoast.noaa.gov/help/techinfo.shtml?name=techinfo>.