# 6.9 PROTOTYPE INTERNET MAP SERVICE ACCESS TO NATIONAL WEATHER SERVICE (NWS) REAL-TIME METEOROLOGICAL DATA

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## 1. INTRODUCTION

The National Oceanic and Atmospheric Administration's (NOAA) National Weather Service (NWS) has begun exploring the use of Internet Mapping Service (IMS) technology to disseminate hydrometeorological weather data as a way to improve the service provided to American taxpayers. As advances in Internet technology (communications, hardware, and software) and the demand for access to weather data continue, the NWS is considering use of Internet Mapping Services as one way to provide weather data to NWS users.

This paper provides an overview of a prototype IMS effort within the NWS. A brief history of the effort, a description of the prototype site, and expected future NWS plans for IMS use will be discussed.

## 2. HISTORY

During the latter half of the 20th century, the NWS completed a major initiative to modernize its operations. Improved hardware and software systems were fielded to observe, evaluate, and predict weather conditions. Because of the pace of technological change, the NWS continues to regularly infuse the latest science and technology into its operations. While one could discuss any aspect of NWS operations that benefit from this regular infusion of science and technology, this paper will focus on the benefits that IMS brings to the dissemination of hydrometeorological data.

Most of the hydrometeorological data used within or produced by the NWS is inherently geographic in nature. It is clear that such information could effectively take advantage of geographical information system (GIS) technology which would allow users to manipulate, process, and display geospatial data. Both operations and research and development could be improved by making use of GIS technology to explore and interpret hydrometeorological datasets. Combining the the use of desktop GIS technology with the dissemination technologies available on the Internet yields the very definition of Internet Mapping Services. In short, IMS provides limited GIS capabilities over the Internet, and, in addition, provides desktop GIS platform users the ability to directly integrate NWS information into their own operations via IMS services.

Recognizing the potential of IMS to not only provide displays of weather data, but also to provide access to the raw data itself, the NWS chartered its first team to explore IMS possibilities in 2001. The team focused on the use of IMS with respect to water resources information (2002, NWS Water Resources Internet Mapping Team). The team's findings highlighted benefits of using IMS across the NWS. NWS management chartered a follow-on team to build upon this first team's efforts. This second team--the IMS Integrated Work Team (IWT)--tapped representatives from beyond the hydrologic community within the NWS and also began to explore specific potential IMS opportunities for the NWS. Questions, such as whether or not to develop an in-house product or to adopt a commercial off the shelf (COTS) approach, were considered.

In the Spring of 2003, the IMS IWT reported their findings to NWS management. The team requested, and received, approval to develop a prototype IMS site. This initial IMS site was focused to provide emergency managers, and others, with weather data associated with land-falling tropical systems in the southeastern United States during the latter half of the 2003 hurricane season. The limited geographic region, targeted user community, and specific weather data were carefully chosen. The NWS wanted to enter the IMS arena strategically so this initial site was designed to meet the needs of emergency managers with heavy use of GIS data in their operations. Once we assess our performance with this prototype, the NWS will make a decision on whether to move beyond this initial effort to a more complete IMS service for a broader segment of our user community.

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## 3. PROTOTYPE DEVELOPMENT

Initial prototype development was accomplished with contractor support using ESRI's ArcIMS software. While ArcIMS is being used heavily in this prototyping effort, the NWS continues to explore other commercial and/or open source IMS solutions for long-term planning.

## 4. DATA LAYERS

Numerous hydrometeorological datasets from sources throughout NOAA and the NWS are available to access via the prototype IMS site. A substantial effort was necessary to decode data from their native format into formats that can be shared from within an IMS service.

### 4.1 Hurricane Information

First and foremost on the site are graphical representations of the forecast advisories issued by the National Hurricane Center's (NHC) Tropical Prediction Center (TPC) indicating the forecast track of the tropical cyclones, with an overlay showing the average historical error swath associated with the forecast track.

### 4.2 Warnings and Watches

Warning, watch, and advisory information from the local forecast offices is presented in easy to read color-coded form to serve as a portal to more localized information available within text products produced at local NWS forecast offices.

### 4.3 Satellite Imagery

Current infrared satellite images provided by NOAA's National Environmental Satellite and Data Information Service (NESDIS) are displayed on the IMS site as "geotiff" images.

### 4.4 Precipitation

Quantitative precipitation forecasts (QPF) are provided by the NWS' Hydrometeorological Prediction Center (HPC). Analyses of observed precipitation are from the NWS' Southern Region River Forecast Centers (RFCs).

### 4.5 Flooding

An outlook identifying areas with potential for significant river flooding created by the NWS' RFCs and integrated by HPC is provided. Additional layers provided by Southern Region RFCs include current river stages and forecasts. Hydrographs can be accessed from the latter two layers.

### 4.6 Wind

Wind forecast information is being decoded from the NWS new National Digital Forecast Database (NDFD) and depicted showing the expected maximum forecast wind speed for 12 and 24 hour periods.

### 4.7 Background

To provide geographic frames of reference, layers that include county boundaries, major roads and larger rivers are included.

## 5. USER INTERFACE

The graphical user interface (GUI) was not the out-of-the-box configuration available from within ArcIMS, but rather one that has successfully been used by NOAA's National Ocean Service (NOS) Coastal Services Center. The NWS is firmly committed to working with sister NOAA agencies in order to move NOAA toward an enterprise GIS architecture.

Key features of the GUI include: (1) a viewing pane, (2) a tool bar, (3) an expandable list of layers, and (4) a section used for navigation hints and to provide requested information.

The viewing pane, shown in Figure 1, includes a state map of the southeastern United States, an infrared satellite image of Hurricane Isabel, its past and forecast track, and a shaded area indicating the uncertainty of the forecast track.

Above the viewing pane is a row of icons that comprise the tool bar. Clicking one of these icons allows the user to zoom in or zoom out of the viewing pane. Another icon allows a user to pan across the area in the viewing pane.

Another icon allows the user to query specific layers. For instance, for the layer showing watches and warnings, invoking the query icon and clicking on a point on the map reveals a table listing all the active watches, warnings and statements for the selected county.

The image shown in the viewing pane can be sent to a printer by selecting the print icon from the tool bar.

There are two help buttons. The first provides general information about the features of the site. The other button refreshes the instructions in the information section below the viewing pane. This second button is necessary because information provided by using the query icon also uses the information area below the viewing pane.

Finally, there is a feedback icon where the user can help the NWS better understand user needs by providing comments and suggestions.

The left side of the Web page provides an expandable list of available layers. The user indicates the layers to be shown in the viewing pane by checking the box and, after clicking the "Refresh Map" button, an image incorporating the requested layers is provided. When necessary, layer legends are included below the layer names.

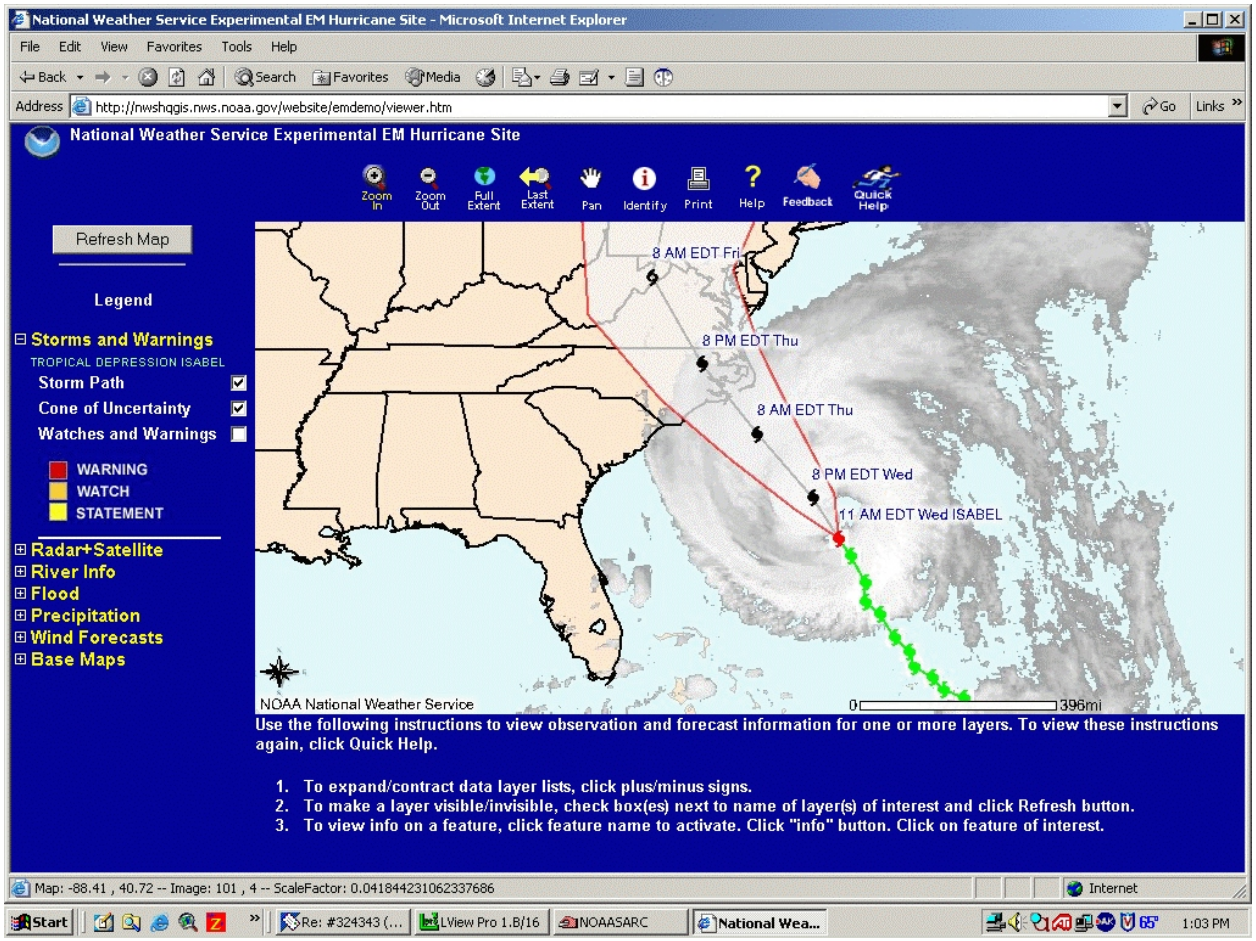


**Figure 1.** Example of user interface showing past and forecast hurricane track, cone of forecast track uncertainty, and infrared satellite image prior to landfall of Hurricane Isabel.

Clicking on a layer name makes it 'active' (pink bar shown in Figure 2) and allows the user to query the selected layer for additional information. For example, making the layer that includes river stages active allows the user to access additional information. As shown in Figure 2, clicking on a specific location results in the display of information below the viewing pane in the information pane at the bottom of the Web page. The information displayed is a table including the gage location name, the river name, a category describing the severity of flooding, the flood stage, the observed stage, and the observation date and time. The last column in this table is a link to the current hydrograph for the gage location. At most gage locations, the hydrograph includes forecast river levels for the next five days.

## 6. FEEDBACK

The IMS prototyping activities within the NWS are being conducted under the auspices of the agreed-upon experimental product design process that the NWS uses to gather external comment. There is a product description document that clearly lays out the intent of this IMS prototype to our users, complete with a feedback process to collect commentary on the utility of this proposed method of serving NWS data. Using the Warning Coordination Meteorologists (WCMs) at the field forecast office in the southeastern United States, this effort has been carefully advertised within the emergency management community to ensure they are aware of the efforts we have undertaken so that they can provide necessary feedback for the NWS.

## 7. FUTURE DIRECTION

The results of the prototyping efforts will be a major driving force for the future direction the NWS takes toward making broader use of IMS technology. Not only does the service aspect of the prototype need to be assessed, but tough hardware and software questions will need to be reconciled for the NWS to make appropriate plans for broader use of IMS beyond the prototype phase.

Throughout the prototyping efforts, we have been identifying additional datasets (e.g. radar data) that could be contained in future iterations of IMS sites for the NWS.

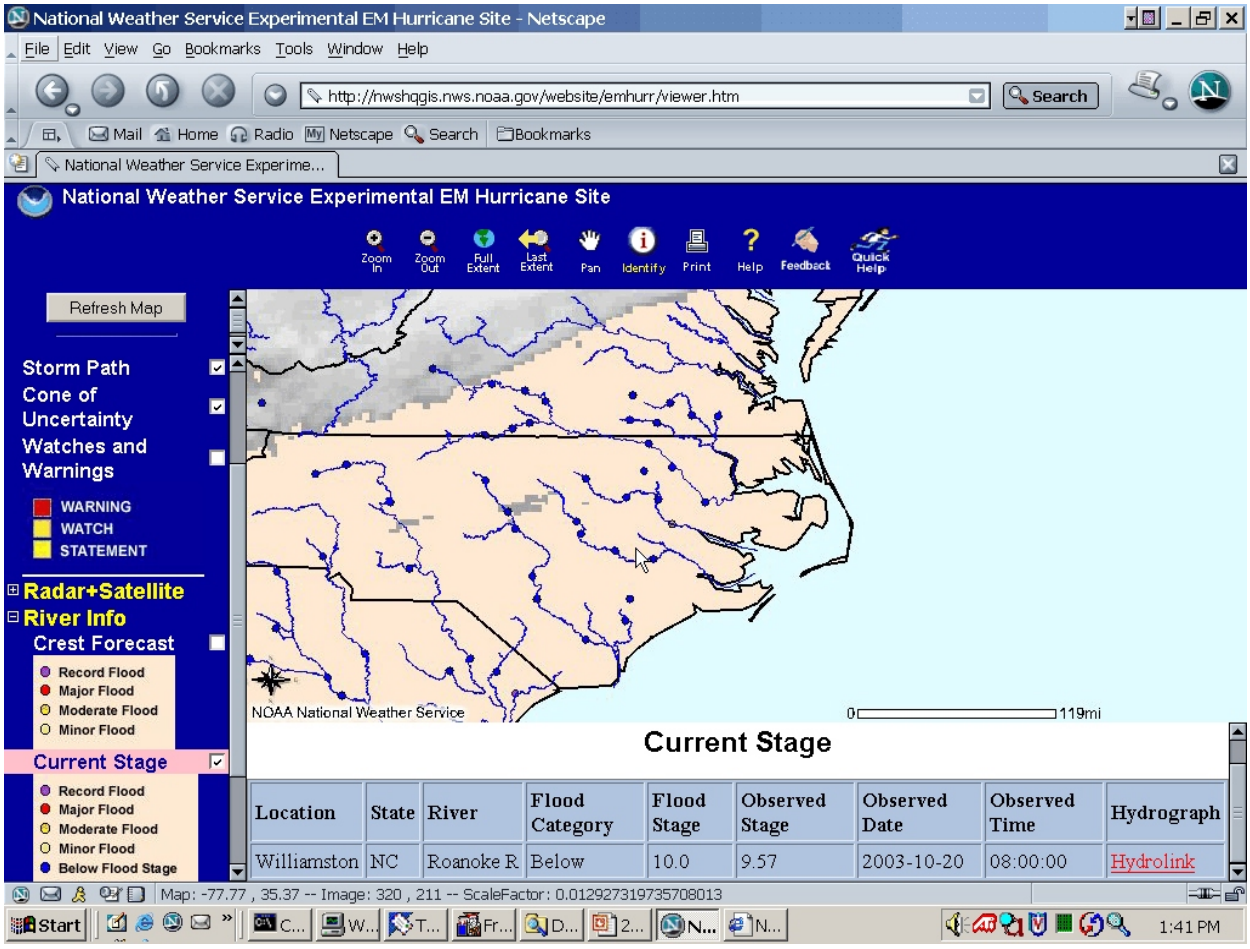


**Figure 2**. Example of information displayed when interrogating features from the current river stages layer.

Lastly, we will be assessing our capabilities to load balance our IMS services across the various web farms within the NWS and to ensure compatibility with current and planned NWS architecture.

## 8. ACKNOWLEDGMENTS

The primary author wishes to thank all the co-authors and past team members not listed for their past and future contributions to the effort to secure an IMS foothold within the NWS. Thanks to their tireless efforts, the future of IMS within the NWS looks to be just over the horizon.

## 9. REFERENCES

2002, NWS Water Resources Internet Mapping Team, see http://weather.gov/oh/rfcdev/WaterResources.htm