

J6.3 DEVELOPMENT OF AN SQL DATABASE WITH REAL-TIME JAVA MAPS FOR THE NJ WXNET

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1. INTRODUCTION

The Office of the NJ State Climatologist (ONJSC) at Rutgers University has created a flexible, dependable system for users to view NJ weather and climate data. The ONJSC maintains a centralized web site for users to access weather stations from different networks throughout New Jersey, as part of the New Jersey Weather and Climate Network, or NJ WxNet. A Structured Query Language (SQL) database has been constructed to accept weather data from a host of different sources in real time. This database serves as the archive for Java maps rendered on demand through the user's Java-enabled web browser. The maps are designed using our Strategic Weather Object-Oriented Remote Display system, or SWOORD.

SWOORD has been designed by the ONJSC to deliver a comprehensive suite of weather products in real time. The SWOORD system's capabilities range from simple plotting of station data to complex point-interpolation maps. An intuitive, user-friendly interface and animation support are just two of the many features available for users to visually interpret NJ WxNet data. Constructed using Java, the SWOORD system is compatible with any operating system and works within virtually any web browser.

NJ WxNet data is provided via a centralized, real-time resource for New Jersey weather and climate data. A selected array of products are available via the NJ WxNet web site for public use. Any number of customized products for specific user groups can be generated utilizing the SWOORD system in collaboration with the ONJSC. Key user groups targeted by the ONJSC throughout the development of the SWOORD system include public-safety officials, transportation officials, educators and the general public. The issues faced while creating an automated, computer-based archive for weather data will be discussed in depth, as well as the progress to date.

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2. THE NJ WXNET

The NJ WxNet is a collection of data from weather stations in and around New Jersey. The NJ WxNet helps to fulfill the three-fold mission of the ONJSC: Data, Research, and Education related to the weather and climate of New Jersey. This network of networks has been designed to operate in real-time, with hourly updates collected and archived from participating stations. To date, the NJ WxNet consists of the NJ HomeNet, a network of approximately two dozen stations reporting a variety of variables from the backyards of volunteers in mostly the northern half of the State, and the ten commissioned National Weather Service Automated Surface Observing Stations (NWS ASOS) located in New Jersey. The New Jersey State Police Office of Emergency Management (NJSP OEM) has allocated funds for approximately ten new stations to be installed by Jan 2002 in mostly the southern half of the State to increase coverage of the NJ HomeNet.

The ONJSC is actively pursuing hourly access to over 70 other, existing stations from a wide variety of sources. The NJ Department of Transportation operates approximately 30 sites along state roadways, the South Jersey Resource and Conservation Development council operates 18 sites in southern New Jersey, and the NJ Turnpike Authority has recently installed 9 stations. The Davidson Lab at Stevens Institute of Technology operates 3 stations along the NJ coast complete with underwater sensors for ocean and tidal monitoring, the Meadowlands Environmental Research Institute collects data from stations in the New Jersey Meadowlands area, several Rutgers Cooperative Extension research farms are known to house weather stations, and the Rutgers Institute for Marine and Coastal Sciences supports a weather station at their Tuckerton research laboratory. The NJ Fire Service branch of the NJ Department of Environmental Protection (NJDEP) has received funds to install four new stations in the Pine Barrens for fire weather monitoring. Finally, the NJDEP has earmarked funds for the ONJSC to install approximately 10 new stations in watersheds for drought monitoring.

The greatest strength of the NJ WxNet lies in its variety of data sources. With the expected

inclusion of data from the 30 NJDOT stations and 10 new stations by winter 2001, the NJ WxNet will become the largest, most comprehensive single source for NJ weather and climate data. The variety of communication methods employed among the stations ensures that if, for example, the phone lines are inoperable, the NJ WxNet will still collect data from those stations reporting via other methods. All participating agencies recognize the value of having access to other New Jersey weather stations through the NJ WxNet, especially if their own stations ever fail to communicate.

The ONJSC has recognized the difficulty associated with adhering to world instrumentation standards for representativeness throughout such a geographically diverse area, especially in the highly urbanized areas, where a square acre of relatively flat, open land simply cannot be found. While issues such as quality control and data archiving are difficult due to the variety of stations, the NJ WxNet has been developed at a fraction of the cost and within a fraction of the time necessary for the purchase and installation of a new, standardized, statewide network. Potential user groups are just as varied, with strong interest expressed by New Jersey educators, farmers, utility officials, transportation officials, public safety officials, researchers and the general public. Therefore, the ONJSC required a flexible, durable database and data display system for NJ WxNet data.

3. SEDVAS: A COMPLETE DATA SYSTEM

The ONJSC has developed the Spatial and Environmental Data Visualization and Analysis System (SEDVAS) to collect, archive, and display NJ WxNet data. The goal of SEDVAS is to create a flexible system for the communication, archival, and dissemination of hourly weather data in real time. A rich suite of software tools have been developed to ensure that products such as dynamic, color-filled maps and tables are delivered on demand to the user via the World Wide Web.

The backbone of SEDVAS lies in the MySQL database that operates from two mirrored machines with RAID drives to help ensure high speed and reliability. The database has been designed specifically to store large volumes of data from a large number of sources and stations. Automated software routines regularly poll the weather stations operated by the ONJSC for the latest information to feed into the database. Data

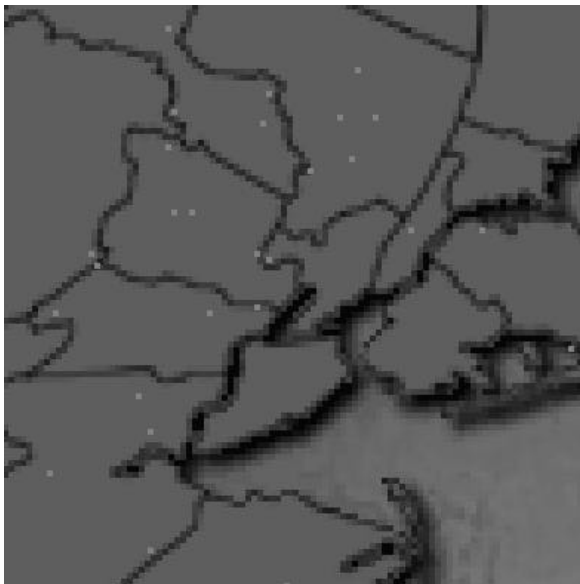
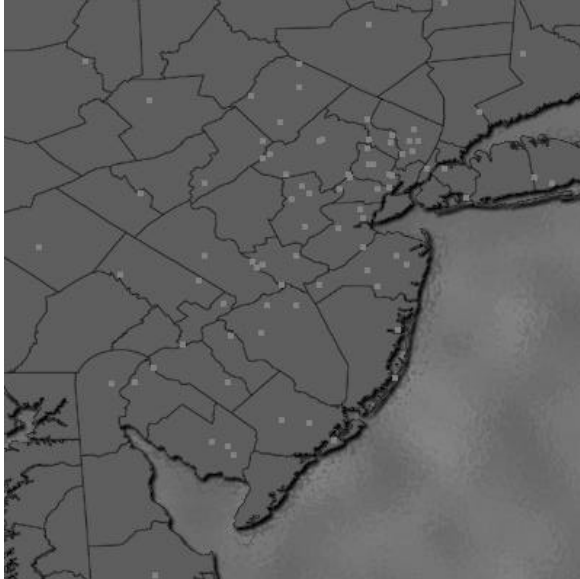
from other stations and networks are sent via FTP to the ONJSC. Unique quality control mechanisms have been created to immediately handle outliers before they enter the database. A more complex quality control system will soon serve to analyze data for possible instrumentation degradation and other factors. A dynamic console surrounds the SEDVAS data display area to provide easy, intuitive access to all available features. Current and archived NJ WxNet data can be accessed via the World Wide Web through maps produced by Java software developed at the ONJSC, however SEDVAS is more than a tool for storing and displaying New Jersey weather and climate data. It is a complete spatial data storage, maintenance, delivery and interpretation tool that can be adapted to land areas beyond NJ and fields beyond weather and climate.

4. SWORD: JAVA DATA DISPLAY SOFTWARE

The Strategic Weather Object-Oriented Remote Display System (SWORD) is the data display component of SEDVAS. Users can query the SEDVAS database via SWORD to graphically render weather variables on demand. Built completely in Java, SWORD will operate within any operating system and within any Java-enabled browser. SWORD offers real-time data display thanks to its unique interpolation capabilities designed to render color-filled maps within one second. A custom-built rendering engine delivers high quality anti-aliased maps that support zooming and scrolling functions, thus enabling a more localized perspective simply by clicking or dragging your cursor, as seen in Figures 1 and 2. Station locations, station information, and animation are also among the features of SWORD to be developed by early 2002.

5. SEDVAS APPLICATIONS

SEDVAS and the SWORD system have been developed with the end user in mind. User feedback from a variety of potential users performing extensive beta testing has been encouraged to further the overall reliability of the system. SWORD maps utilizing NJ WxNet data via SEDVAS can be provided to the public via the Internet without users having to download additional software or operate from any particular system or browser. Dynamic features both within and around the map's display area have been designed for access by simply dragging your cursor over a particular area or by clicking to



Figs. 1+2 Sample SWOORD maps produced by ONJSC.

gather more information in as few steps as possible. NJ WxNet data provided by SEDVAS will be the main component of weather data interpretation training workshops provided by the ONJSC. Educators, public-safety officials, transportation officials, and others will benefit from hourly weather updates for monitoring purposes and through case studies derived from data archives. Researchers requiring more exhaustive queries will benefit from the centralized SQL database. NWS personnel dependent upon

accurate, reliable data reports will receive a supplement of observations to use in conjunction with ASOS data through their own AWIPS data display system.

6. CONCLUSION

Many developments, both expected and otherwise, have given rise to the NJ WxNet. Ten ASOS stations were commissioned in New Jersey as part of the NWS modernization efforts within the past decade. As NJ State Climatologist, the first author purchased the communication hardware and software from a private network in 1998 to continue an hourly, volunteer weather network that has become the NJ HomeNet. Dr. Robinson and Mr. Duvall have since located over 70 existing weather stations that will likely become a part of the NJ WxNet within the next year, including at least 20 new stations installed and operated by the ONJSC.

By the summer of 2000, co-author Chad Shmukler began to develop the SQL database and other software components for SEDVAS. By the spring of 2001, co-author Keerat Sharma began to develop what has become the SWOORD system for viewing NJ WxNet data provided via SEDVAS. Within two years, ONJSC staff have produced the most comprehensive collection of New Jersey weather and climate data with a complete communication, archival, and display system expected to be released for public use via the World Wide Web by 1 Jan 2002 through the ONJSC web site at: <http://climate.rutgers.edu> .

7. ACKNOWLEDGEMENTS

The authors would like to acknowledge Dean Adelsoji Adelaja at the New Jersey Agricultural Experiment Station within Cook College, Rutgers University for providing baseline ONJSC support to develop the NJ WxNet, as well as the NJSPOEM, the NJDEP, and the NJDOT for providing NJ WxNet support. The authors also express their thanks and appreciation to the NJ HomeNet volunteers and those agencies providing data for the NJ WxNet. The ONJSC is a part of the New Jersey Agricultural Experiment Station and is situated within the Center for Environmental Prediction at Cook College, Rutgers University.