8B.4 INTEGRATION OF THE WARNING DECISION SUPPORT SYSTEM-INTEGRATED INFORMATION INTO THE NOAA STORM PREDICTION CENTER

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1. INTRODUCTION

The National Severe Storms Laboratory and the University of Oklahoma have developed an integrated software package for the analysis of real-time radar, satellite, and numerical weather prediction model data, known as the Warning Decision Support System – Integrated Information, hereafter "WDSS-II" (Smith et. al. 2003, Stumpf et. al. 2003) The NOAA Storm Prediction Center (SPC) is in the process of implementing the WDSS-II software into experimental operational use, for improving convective watch lead time (severe thunderstorm and tornado), analysis of on-going severe convection, and interrogation of historical case studies by the operational forecast and research staff. The WDSS-II system contains the ability to generate "severe storm domains", or data grids on the order of 1000km x 1000km x 20km, that merge real-time data together into a quality controlled framework for data analysis and 4-D visualization. The SPC will evaluate data from user-configured domains using the WDSS-II graphical user interface environment, to provide a high resolution and very detailed analysis of real-time weather data over a portion of the United States. Central to this analysis is NEXRAD Level II data, transmitted via the Collaborative Radar Acquisition Field Test (CRAFT) project (Droegemeier et. al. 2002). This applied research involves moving that data, and metadata generated via WDSS-II analysis products, over a network to a WDSS-II visualization machine located in SPC operations. However, the configuration of severe storm domains and the WDSS-II system, along with the generation of metadata from the system, is a complex process that requires detailed knowledge of the system and of multiple software packages. Therefore, a simple and flexible quasi-operational software package was created for SPC forecasters to configure the entire WDSS-II system using a Java-based GUI located on a remote machine. This software dynamically transmits configuration data over a network to a server, executes scripts to re-configure that server, and transmits data to a visualization system in SPC. Thus, we created a communications management system for the WDSS-II software, and developed the necessary data management software for efficient communication of large and complex amounts of WDSS-II data over the network. This system allows the WDSS-II software to be used in a national scope, rather than just for a single, permanent domain or a single radar site, which is typical of most users of the software.

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This ability to configure a domain for anywhere in the country extends the flexibility of WDSS-II to quickly (within a few minutes) and dynamically re-configure the entire system to a completely new domain for anywhere over the United States.

2. EXPERIMENT DESIGN

To extend WDSS-II for use on a national scale, several pieces of software needed to be designed and integrated together. WDSS-II uses different software programs for different tasks, and a communications management system was designed to allow each piece of software to "talk" to each other and dynamically reconfigure itself based on simple user input. Since some components of the system need to be stopped and restarted when a new domain is configured and launched, a completely "behind the scenes" software package was developed to take care of the complex tasks of managing and configuring the dozens of programs and tasks within the entire system. Fig. 1 illustrates the basic flowchart for how data flows into the various pieces of software.

One of the most important pieces of software designed for the project includes the Java-based graphical user interface program that allows a user to define the location of "severe storm" domain. Written using Java, Mr. Kevin Manross created the software and interfaced it with the WDSS-II configuration system. When a user clicks on the moveable square (see Fig. 2 for a screenshot of the software), it can be moved anywhere over the conterminous United States and positioned for a particular area of interest. Clicking on the "Submit" button starts the "behind the scenes" process of sending the new domain information (lat/lon, the radar IDs, etc.) to a central server, which then stops and restarts various data feeds and reconfigures the entire system to begin processing the new domain. Algorithms are executed to compute data for each individual radar, and additionally for a single, large merged domain. Other components of the software use Perl and csh scripts, as well as XML data files, to dynamically reconfigure the complex system.

Currently, only a single 1000x1000x20km domain is available for configuration via the Java-based GUI, and this size is limited only by the hardware available. The server that computes the data for the SPC grid is a fast dual processor computer, and it can handle processing data for a domain that contains five to six radars at a time. More domains could be made available with additional computers, or a larger domain could be configured for a more powerful computer (four processors, for example). The system is therefore scalable, and indeed, tests are planned to run a domain for the entire conterminous United States, which is perhaps the most ideal domain as data from all radars would be available as one large grid.

3. INTEGRATION INTO SPC

The SPC plans to use several components of the WDSS-II 4-D graphical user interface to interrogate radar data, and derived products from that data. The radar data currently utilized in day-to-day SPC operations is NEXRAD Level III (NIDS) data which contains the lowest four tilts of each radar; additionally, several national-scale mosaics are also available. Given that NEXRAD Level II data contains the full digital volume scan from each radar, and that WDSS-II displays this data, derives algorithm information from it, and digitally merges it into a single mosaic product on one domain, WDSS-II offers the potential to enhance convective-scale analysis and forecasting and to provide SPC with new advanced technology that has traditionally not been previously available.

Several algorithms and graphical display packages exist within WDSS-II, and the overall goal of this project is for SPC staff to experiment and evaluate the system on a day-to-day basis and as time permits for potential use in issuing forecast products, and for local research on severe storm environments. For example, the merged domain component of the WDSS-II algorithm suite contains several products of interest: “rotation tracks”, which show areas of thunderstorm rotation, while the “merged reflectivity” algorithm contains both a composite mosaic and a height-slice mosaic (1km intervals) to illustrate areas of precipitation, and finally the “cell table” algorithm identifies particular cells and produces a table containing various cell attributes. The WDSS-II GUI has the ability to draw 2-D and 3-D cross sections using some of the products as well, and when integrated with the many other algorithms and the ability to display other real-time data (RUC model data, for example), the entire WDSS-II system is a powerful tool for real-time data interrogation that will be evaluated by the SPC staff.

4. FUTURE RESEARCH

The future of this project lies in developing more software to analyze and display the vast amounts of information that is generated by WDSS-II algorithms for experimental deployment in operations, research, and verification. For example, the cell tracking algorithm provides information on each individual cell that is identified; this information could be constructed into a database that: 1) can be converted into a format that is displayable using SPC’s primary workstations and N-AWIPS software, 2) is utilized in research projects and case studies, and 3) is used in “algorithm verification” of SPC’s product suite (severe weather watches, convective outlooks, and mesoscale discussions). Additionally, WDSS-II is ideally suited for developing custom algorithms using data from both single sites and the merged domains, and therefore it is envisioned that unique algorithms could be generated that integrate near-storm environment data with both radar and satellite data, to provide increased information on various weather threats. For example, an algorithm that alerts the forecaster to the potential for convective initiation could be developed, as well as one for identifying storm type (supercell, bow echo, MCS, squall line) or for when a particular storm type is beginning to transition to another type (supercells merging into a squall line, for example). Finally, WDSS-II has the ability to provide on-the-fly generated snapshots of the display GUI, and write these images to disk as they are created in real-time; sending these images, along with algorithm detection information, to a web site for public viewing will likely be explored in the next phase of the project.

5. ACKNOWLEDGEMENTS

The authors wish to thank the NOAA High Performance Computing and Communications (HPCC) program for funding this project during FY04. Additionally, we thank Karen Cooper, Kurt Hondl, Travis Smith, and Kevin Kelleher from NSSL for their leadership and technical expertise in configuring the computers used in this project, as well as for their advice on the system and project configuration. Jay Liang and Doug Rhue from SPC were instrumental in integrating the computer systems into the SPC infrastructure and for providing technical support.

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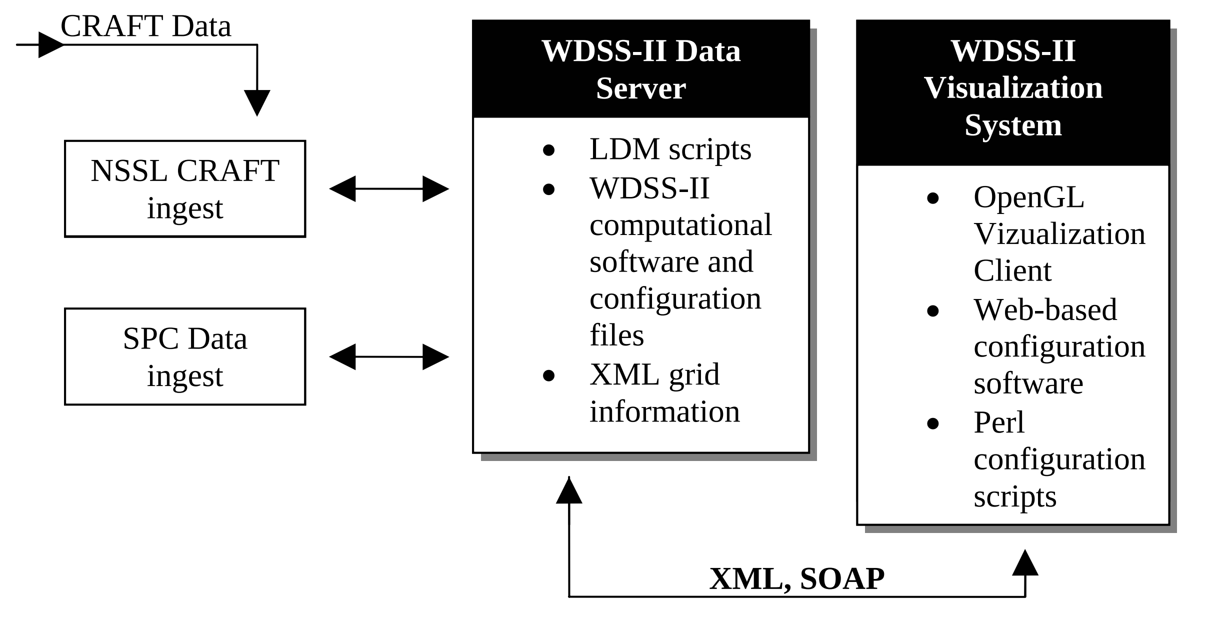
Figure 1: Organization of the software system



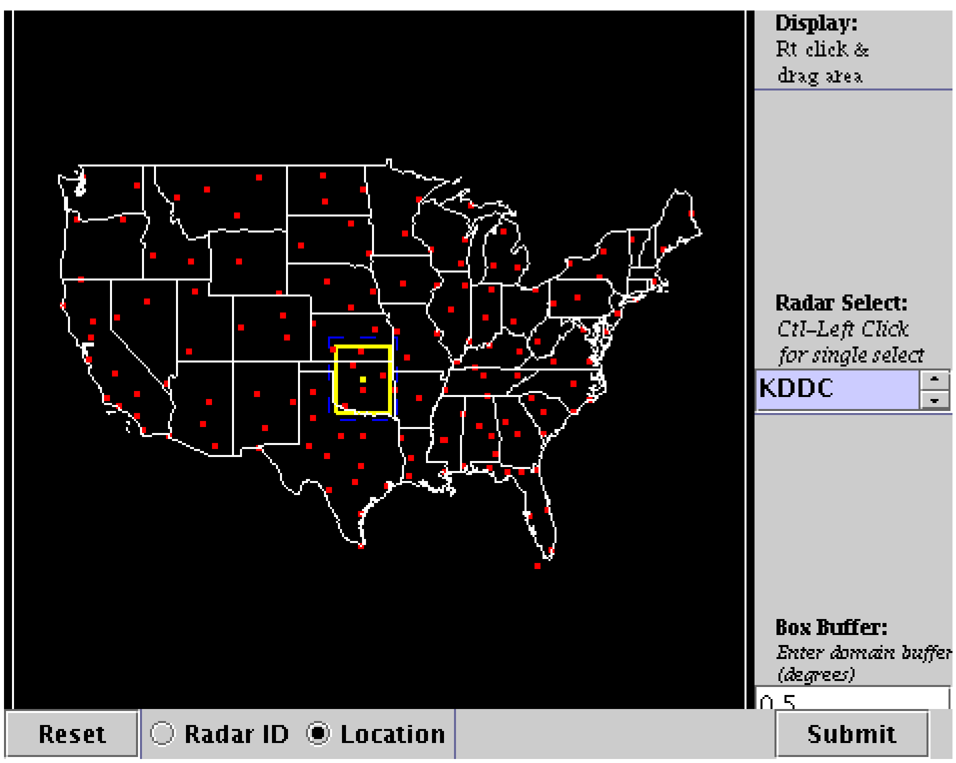


Figure 2: Screen capture of the Java graphical user interface system, developed for the project for configuration of a domain anywhere over the conterminous United States. The yellow square can be moved to an area of interest, and WDSS-II algorithms will be configured to generate data over that area once the “Submit” button is pressed.