12.9 WEATHER EVENT SIMULATOR IMPLEMENTATION AND FUTURE DEVELOPMENT

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1. Introduction

In August of 2001, the National Weather Service (NWS) Training Division began implementing the first phase of a new training tool called the Weather Event Simulator (WES) throughout the NWS (Magsig and Page 2002). The WES allows forecast offices to playback archived events and practice warning decision making as if in real time using operational warning and forecasting technology, namely the Advanced Weather Interactive Processing System (AWIPS). The WES is considered as an interim step toward full operational playback and simulation capabilities until this training functionality is developed within the AWIPS program.

In the first phase of the WES implementation, a standalone Linux workstation was purchased for every NWS office. An install CD was developed by the Warning Decision Training Branch and distributed by the Cooperative Program for Operational Meteorology (COMET) Branch, both members of the NWS Training Division. The first installation consisted of version 1.0 of the WES software authored by the WDTB (Fig. 1), a short note by WDTB on tips for effective simulations, a two-user license of Informix for Linux, a copy of the AWIPS Build 5.1.1 software provided by the Systems Engineering Center and the Forecast Systems Laboratory, local archiving software, and a severe weather case provided by COMET. Following the installation of WES1.0, WDTB and COMET have developed training to assist local training officers in integrating WES into their training programs. The training development has focused on a combination of web-based teletraining, simulation guides, and enhanced simulation capabilities. WES is continuing to evolve into an integral part of the NWS Training Division's multi-faceted training program.

2. Web-based Teletraining

For the first level of training on how to use this new technology, WDTB and COMET collaborated on a web-based teletraining session that was delivered NWS-wide from February-May 2002. The training session contained three parts, background on the WES program, elements of effective simulations, and local archiving information. WDTB delivered the first two parts of the session describing WES and its use, and COMET delivered the session on local archiving.

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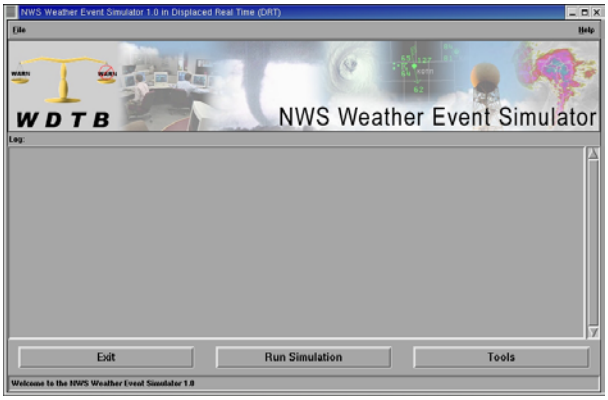

Figure 1. WES user interface.

2.1 *WES Program Background*

At the core of the WES concept is the "Train as You Fight" approach to using technology optimally to develop experience and expertise needed in NWS forecasting and warning operations. The WES was designed to use operational software on a standalone workstation that is dedicated to training. Offices were given background on the components of WES, and the philosophy of its intended use as it relates to NWS Instruction 20-201, which instructs all NWS forecasters to complete at least two appropriate WES simulations prior to the start of each significant weather season (minimum of two significant seasons) as determined by the local office management.

2.2 *Elements of an Effective Simulation*

The elements of an effective weather simulation are based on concepts pioneered by the education community (Shank 1997), where effective simulations were found to contain the key elements of context, meaningful task, feedback, and support. These ideas were applied to NWS warning operations and combined with the WDTB's workshop simulation experience by Ferree et al. (2001). One of the keys for the NWS to optimize the use of WES in training is to match different organized simulation types to learning objectives. The teletraining session introduced a combination of simulation types that are relevant to warning operations: Real-time, Interval Based, Situation Awareness, and Virtual Reality. Real-time simulations focus on

developing time-critical routines and skills to analyze data, not the actual decision making. The Interval Based simulation uses a few key decision points to focus on the decisions made and the decision making process. Situation awareness simulations focus on the ability to perceive, comprehend, and project warning-related inputs in a warning environment. Virtual Reality simulations focus on handling the stress of managing challenging warning workloads containing an array of unexpected distractions that can happen in an operational environment.

2.3 *Local Archiving*

The WES1.0 installation contained local archive software written by Ron Miller at the Spokane NWS office (Page et al. 2002) that could be installed on a local archive machine connected to the AWIPS network. A second archiving software package for WES was subsequently developed by Paul Kirkwood at Southern Region Headquarters that contained an option to archive to CD and DVD media. Within the teletraining session, COMET focused on explaining the process of how to set up archive capability in the local office and use either one of these archiving software options.

3. WES Simulation Guides

To assist local training officers at each office in integrating effective WES simulations into the local training plan, WDTB developed a series of four simulation guides released from February-May 2002 that illustrate how to run effective simulations on severe weather cases containing primarily hail, wind, and tornadoes from different regions across the country. The materials were written to be used “as is”, or they can be used as a template to tailor the simulation to local learning objectives. The training was designed for a three to four hour long one-on-one training session, where a training officer at a local forecast office administers, evaluates, and provides feedback to a local trainee. COMET has used these guides as templates to develop simulation guides for other cases as well.

Each simulation guide follows a similar format applied in varying ways to the four severe weather cases. A brief introduction describes the contents of the guide, how to use the guide, how to choose a simulation, and an overview of the significant features of the event. Every simulation guide contains at least four different prepared simulations that are on average about fifteen pages in length, including supporting evaluation materials. The prepared simulations are based on the simulations identified in the teletraining sessions with the addition of a case-study simulation that focuses on a static review of a particular element of a severe weather case.

The format for the prepared simulations includes an introduction, a pre-simulation briefing, the simulation, the post-simulation briefing, and the trainer evaluation guide. The introduction contains the training objectives (e.g. demonstrate how to weigh information and handle uncertainty in the warning decision making process), and it outlines the responsibilities of the trainer and trainee. The pre-simulation briefing allows the trainee to become familiar with the environment, and it also allows the trainer to evaluate the trainee’s environmental assessment prior to issuing warnings. The simulation component is used to allow the trainer to evaluate the trainee’s ability to address the pre-stated learning objectives in the context of warning operations. The post-simulation briefing is used to evaluate the successes and failures of the warning process and evaluate how the lessons learned can best be applied to local warning operations. Finally an extensive trainer evaluation guide contains considerations for evaluation points and a breakdown of significant features in the warning inputs on a radar volume scan by volume scan basis for every storm with severe characteristics in the simulation domain.

While training officers in the NWS have now been exposed to a variety of simulation approaches for severe convective weather, there needs to be more simulation development on other significant warning events such as flash flooding and winter weather. Developing effective simulations for these weather types is somewhat limited by the AWIPS tools available in the WES1.0 release. The first release does not contain many AWIPS hydrology tools nor the recently released Flash Flood Monitoring and Prediction System (FFMP) 2.0 (Filiaggi et al. 2002) that has been designed to relate radar precipitation estimates to flash flood guidance on a basin scale. WES1.0 also does not contain the AWIPS Watch Warning Advisory software (Sperow et al. 2000) that NWS forecasters use to create winter weather products.

A new simulation format may need to be developed for flash flooding and winter weather simulations because of differences in the warning process. While the context of flash flood forecasting and warning is similar to that of other severe convective weather, the process involves a much more detailed knowledge of local terrain and problem runoff areas. Winter weather simulation guides will also require a different approach to simulations because the time scales are different (hours) compared to severe convective weather (minutes). WDTB is planning to develop a simulation guide for flash flooding and a simulation guide for winter weather.

4. Enhancements to WES1.0

WDTB has developed an upgrade (WES1.1) to WES1.0 with assistance from COMET and forecast offices. WES1.1 contains an updated version of the WDTB WES1.0 software with fixes for problems with the first release, and it also contains the more recent AWIPS Build5.2.1. The planned release of WES1.1 is in the fall of 2002.

In addition to the software upgrade in WES1.1, WDTB has been working to incorporate FFMP2.0 into the WES processing model with some assistance from COMET and AWIPS developers. Simulations with FFMP2.0 functionality have been demonstrated on Hewlett Packard (HP) hardware in WDTB's warning decision making workshops in 2002, but implementing the functionality in WES is awaiting the porting of FFMP processors to the Linux platform used by the WES.

5. Discussion

The first phase of the Weather Event Simulator has focused on: 1) delivering fundamental warning-related case playback and simulation capability to all NWS offices and 2) training on how to effectively incorporate WES into a local training program. WDTB and COMET have provided a combination of live web-based teletraining and a series of simulation guides to training officers to assist them in making the most of this new capability. Preliminary feedback from NWS training officers indicates the WES is being used in many different ways to enhance local training and research (Ferree et al. 2002). The Training Division of the NWS continues to be committed to making WES an integral part of a multi-faceted training program.

The WES has begun to meet an immediate need in operational forecasting and warning in the recent modernization of the NWS. With new technology containing a diverse suite of analysis and dissemination tools, the need to be become skilled at effectively and efficiently using new technology in forecasting and warning operations has emerged as a substantial training issue. This need is essential for watch and warning operations due to the time-critical nature of operations and the immediate impact on lives and property. While the first phase of the WES has focused on severe weather forecasting and warning operations, the need for full operational playback and simulation functionality is apparent for many other aspects of NWS services, ranging from hydrology, to aviation, to gridded forecast preparation.

The WES has formed a "Train as You Fight" foundation to begin training in the context of forecasting and warning operations using a few key components of the modernized weather service. As operational forecasting and warning technology continues to evolve, the development of key training components must outpace the infusion of the new technology to ensure optimal integration into operations. In the interim period while the AWIPS program begins development on implementing case review and simulation functionality in the operational software build process, WDTB will continue to upgrade the WES as appropriate to support its mission of developing training to support warning decision making in the NWS. The development and implementation of the WES program has illustrated the underlying need for a strong connection between the operational community, the training community, and the development community within the NWS.

6. Acknowledgements

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