J3.20 EFFECTIVE USE OF AWIPS WARNING SYSTEMS AT NWS TAMPA BAY, FLORIDA

Barry S. Goldsmith* and Ronald F. Morales
National Weather Service Office, Ruskin, Florida

1. INTRODUCTION

In May, 1999, the first build of AWIPS was installed at the NWS Office in Ruskin, Florida. AWIPS was designed to consolidate warning and forecast operations (Litton/PRC, 1999), which had previously been prepared and disseminated through personal computers and the Automation of Field Operations and Services (AFOS) system (National Weather Service, 1984).

AWIPS, as delivered, provided a way of combining numerous data sources into a single workstation. This allowed forecasters a more rapid method of analyzing and evaluating information, hence facilitating the forecast process. AWIPS also contained an array of applications software designed to improve forecast and warning services. However, the software was equivalent to an unfinished piece of wood furniture; functional, but needing craftsmanship to increase it's worth.

One of these applications, known as WarnGen, produces short fused warnings and forecasts. WarnGen uses both graphics and text. Graphics include a polygon and associated tracking arrow, denoting the expected area and times for hazardous weather occurrence (Fig 1). Text messages are created by forecaster selections from a dialog window (Fig 2).

Beginning in May, 2000, WarnGen was locally modified to meet customer needs. In August, 2000, WarnGen became the official method used to issue short fused warnings. Additional modifications have made it invaluable to effective short fused warning, and even some forecast, services. These services include both land and marine based products.

Time is crucial when issuing and disseminating short fused hazardous weather informationa. NWS Tampa Bay now has the ability to issue concise, well-worded short fused weather messages in seconds, with just a few clicks of a mouse. Objective and anecdotal evidence suggests great improvement in short fused product efficiency - a key tenet in achieving the NWS mission.

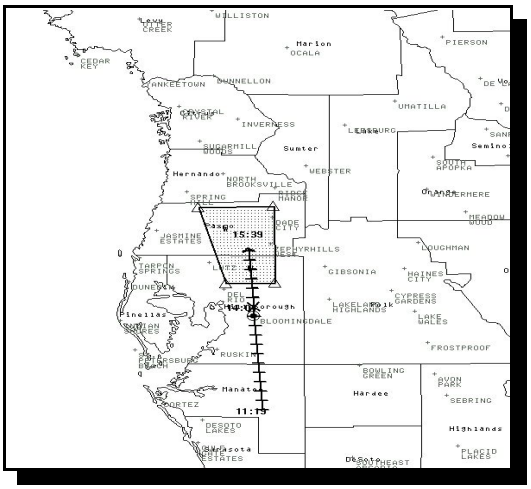


Figure 1. WarnGen box and track example, Tampa Bay region.

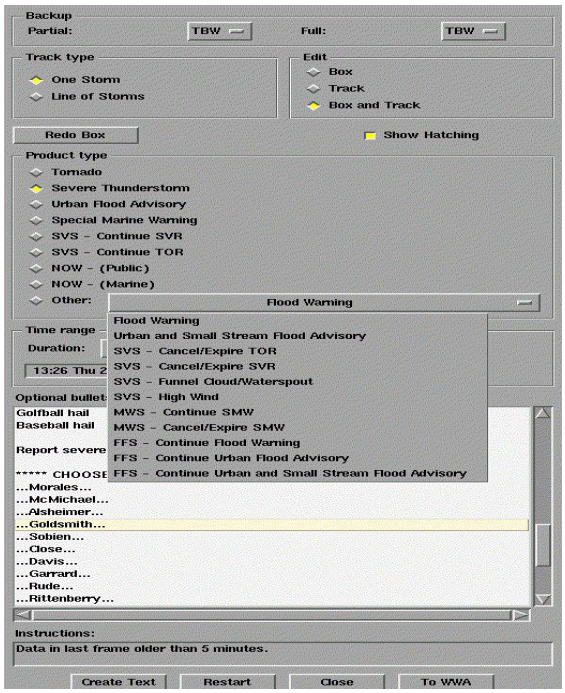


Figure 2. WarnGen dialog box, NWS Tampa Bay. Note limited number of selectable products, designed to ease forecaster use.

*Corresponding author address: Barry S. Goldsmith, National Weather Service, Ruskin, FL 33570; e-mail barry.goldsmith@noaa.gov

2. SHORT FUSED WARNING AND FORECAST SERVICES IN THE NEW MILLENIUM

2.1 Before AWIPS: WISE and XNOW

Prior to AWIPS installation at NWS Tampa Bay, short fused warnings and supplemental statements (Table 1) were issued using the Weather Information and Statement Editor (WISE). WISE was an effective text messaging system.

Table 1. Short fused products issued with WarnGen.

AWIPS Product	WMO code	Product Description
MIATORTBW	WFUS52	Tornado Warning
MIASVRTBW	WUUS52	Severe Tstm Warning
MIAFFSTBW	WGUS72	Urban/Small Stram Flood; follow up statements for these and flood warnings
MIASMWTBW	WHUS52	Special Marine Warning
MIASVSTBW	WWUS52	Severe Weather Statement; several types: 1) warning update; 2) funnel cloud/waterspout; 3) sustained high wind.
MIANOWTBW	FPUS72	Short term forecast
MIAFFWTBW	WGUS52	Freshwater flood warning
MIAMWSTBW	FZUS72	Marine Weather Statement

However, it was a stand alone program, which ran on a personal computer. Though connected to AFOS by a dedicated line, it was subject to communication glitches which could delay transmission. Issuing warnings with WISE involved interrogating WSR-88D information via the Principal User Processor (PUP) (Andra, et. al, 1994), then invoking WISE on a separate computer. This process could be rather inefficient. AWIPS has solved this problem by combining radar data, tracking information, and text generation on a single, smaller workstation.

XNOW was used for many non-warning short-fused products. XNOW was easy to use, and a favorite of many forecasters. However, output consisted of text messages only. In the age of digital graphics, such a program is becoming obsolete. WarnGen provides a graphical display of specific warning areas for NWS forecasters. A formatted string of latitude and longitude points is appended to the text message; this allows external users, such as broadcasters, to create their own graphical display of warning areas.

2.2 During AWIPS: WarnGen

WarnGen software consists of two types of code: Script files and text templates. Script files (Welch, 1997) define all graphics products, including background mapping and dialog windows. Text templates perform two functions: First, they work with the scripts to produce the desired location information (i.e., cities, counties, tracking time and distance, and polygon definition); second, they produce straight text information, such as weather elements and calls to action.

The WarnGen package, as received by NWS Tampa Bay, required a great deal of modification in order to best serve the customers of the west central Florida peninsula.

Most adjustments were made to the text templates. Changes included default terminology for event type, tracking methods, calls to action (CTA), and forecaster identification.

Event type (i.e., thunderstorm) was adjusted to handle single cells, multiple cells (clusters), and lines. Selectable event elements, such as hail size and magnitude of wind gusts, were added. Tracking methods were simplified to create concise messages. This included eliminating secondary references to storm location, and reducing the total number of cities and towns to be affected by the storm. CTA were simplified to one or two sentences indicating necessary precautions to remain safe.

Other templates have been developed for short fused products which are issued more often in the west Florida peninsula than in other locations around the nation. For example, short term forecasts (NOW) can be issued in seconds using WarnGen during episodes of strong convection. These NOW products provide precise information on what is commonly known as the “what”, the “where”, the “when”, and the effects. The “what” is the weather element (i.e., a thunderstorm), the “where” is a list of trackable cities and towns; the “when” specifies the duration of the weather element, and the effects include individual sub-elements (i.e. as heavy rain, small hail, or gusty winds), and associated CTA. Figure 3 shows the text product.

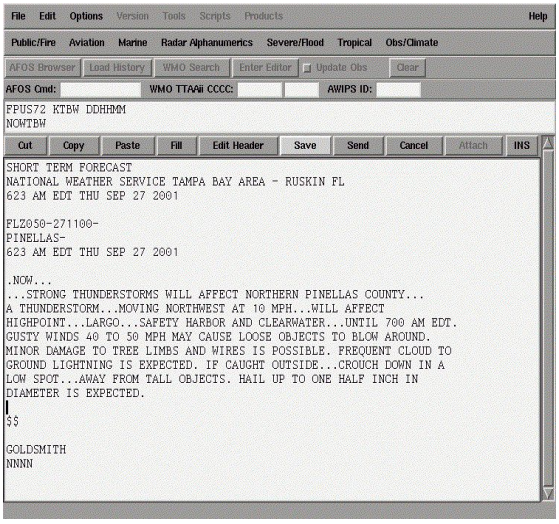


Figure 3. Convective short term forecast text created by WarnGen with optional bullet selections

Several other short fused templates were created to satisfy customer needs. They include severe weather statements for funnel clouds and near shore waterspouts, and severe weather statements for non-convective high wind, whether due to frontal passages or strong coastal storms.

3. Short fused site-specific marine products: The Sub-zones project

Since the 1980s, coastal marine warnings and statements have been issued for site-specific locations along Florida's west coast. Rather than issuing warnings for a lengthy coastal water zone (over 100 n mi of shoreline), warnings are tailored for smaller (generally 20 n mi long) areas, which include specific shoreline points and individual county references.

However, when AWIPS was first installed, the associated background maps included entire marine zones. This forced the staff to continue using WISE when issuing marine products in order to maintain consistency.

In autumn 2000, new background maps were created to virtually match the site-specific locations previously used in WISE. To do this, the default zones for the near shore (0 to 20 n mi) waters were "cut" into several slices. Tampa Bay waters were also divided, and Charlotte Harbor was broken off. In all, the number of near shore marine zones increased from 4 to 22 (Fig 4).

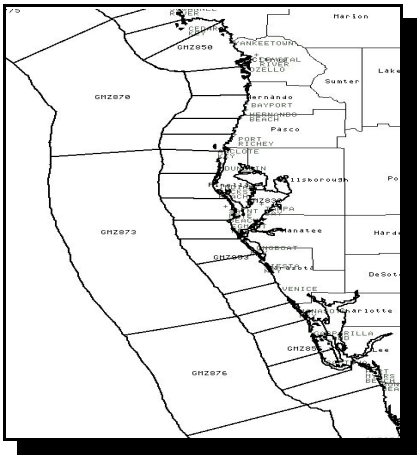


Figure 4. Marine sub-zones used for short term marine products, NWS Tampa Bay.

A WarnGen polygon and track covering a small portion of the near shore zones will create a default text message with only that portion referenced in the product header (Figures 5 and 6). Note that individual sub-zones remain part of the larger assigned zone number, as not to impact customers who rely on these numbers to receive marine weather messages. Only the text and graphic depiction are changed.

As of this writing, NWS Tampa Bay is the only location in Florida using this WarnGen configuration.

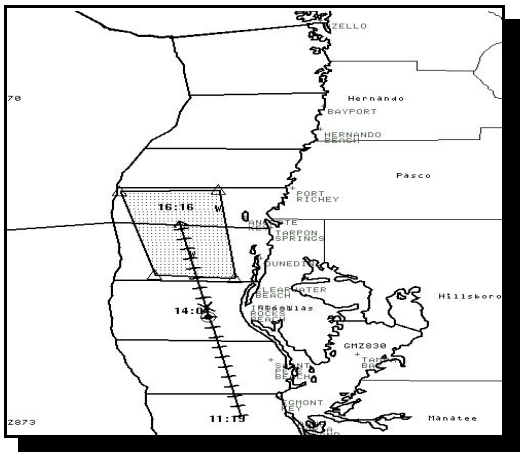
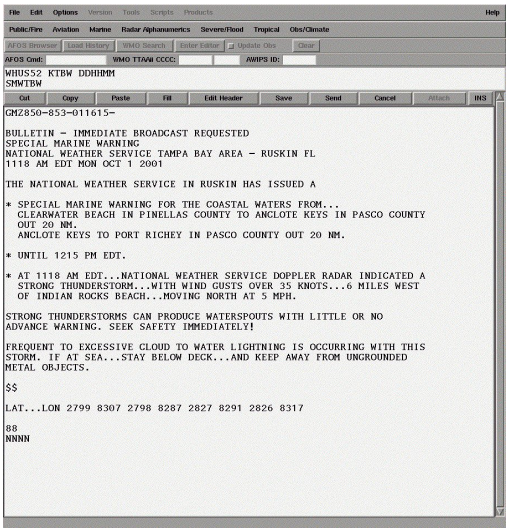


Figure 5. Example of WarnGen box and track for a special marine warning.



```
WHUS52 KTBW DDHHMM
SMWTBW

GMZ850-853-011615-

BULLETIN - IMMEDIATE BROADCAST REQUESTED
SPECIAL MARINE WARNING
NATIONAL WEATHER SERVICE TAMPA BAY AREA - RUSKIN FL
1118 AM EDT MON OCT 1 2001

THE NATIONAL WEATHER SERVICE IN RUSKIN HAS ISSUED A

* SPECIAL MARINE WARNING FOR THE COASTAL WATERS FROM...
  CLEARWATER BEACH IN PINELLAS COUNTY TO ANCLOTE KEYS IN PASCO COUNTY
  OUT 20 NM.
  ANCLOTE KEYS TO PORT RICHEY IN PASCO COUNTY OUT 20 NM.

* UNTIL 1215 PM EDT.

* AT 1118 AM EDT...NATIONAL WEATHER SERVICE DOPPLER RADAR INDICATED A
  STRONG THUNDERSTORM...WITH WIND GUSTS OVER 35 KNOTS...6 MILES WEST
  OF INDIAN ROCKS BEACH...MOVING NORTH AT 5 MPH.

STRONG THUNDERSTORMS CAN PRODUCE WATERSPOUTS WITH LITTLE OR NO
ADVANCE WARNING. SEEK SAFETY IMMEDIATELY!

FREQUENT TO EXCESSIVE CLOUD TO WATER LIGHTNING IS OCCURRING WITH THIS
STORM. IF AT SEA...STAY BELOW DECK...AND KEEP AWAY FROM UNGROUNDED
METAL OBJECTS.

$$

LAT...LON 2799 8307 2798 8287 2827 8291 2826 8317

88
NNNN
```

Figure 6. Associated text for special marine warning, Fig 5.

4. Seamless short fused products via NWR-2000

NOAA Weather Radio (NWR), the "Voice of the National Weather Service", is of vital importance in disseminating hazardous weather information to the public. For decades, this process was done manually. The process included human voice recordings, on tape and digital chips, but also manual activation of warning tone and Specific Area Message Encoder (National Weather Service, 1999) alerts. NWR operated satisfactorily in times of benign weather or during isolated hazardous weather. However, even the most skilled of NWR operators had trouble keeping up when hazardous weather was frequent and rapidly changing.

The problem was rectified with NWR-2000 (National Weather Service, 1999). NWR-2000 uses state-of-the-art computing technology to automatically produce broadcast-ready text messages which are "read" by a synthesized voice. NWR-2000 also will automatically issue warning tones and SAME codes. In addition, NWR-2000 is designed to translate, collate, and disseminate

numerous messages to several transmitters immediately, a process that was seldom accomplished by a single human operator.

Unfortunately, the potential of NWR-2000 could not be realized until many adjustments were made. These adjustments included: Modification of the software used to produce radio messages, rigorous testing of WarnGen text phrasing, and confirmation that messages were broadcast on the correct transmitters in a timely fashion. The software is known as Console Replacement System (CRS) AWIPS Formatters Enhanced (CAFE). CAFÉ runs exclusively in AWIPS, eliminating delays in transmission.

CAFÉ was fully operational by late spring, 2001. The marriage of CAFÉ, NWR-2000, and WarnGen has allowed short fused hazardous weather messages to be broadcast virtually seamlessly within 15 seconds, on average, after they are transmitted on AWIPS.

5. Anecdotal and Objective Service Improvements

Prior to WarnGen, warning forecasters routinely had to refer to paper maps to determine cities and towns needed for short fused hazard messages, especially when providing the initial storm location. CTA statements were limited, and in some cases too wordy. Most importantly, older warning systems were somewhat more unstable, subject to more frequent failures or dissemination delays.

WarnGen has eliminated these problems in most cases. Short fused hazardous weather warnings for pulse severe thunderstorms can be produced and disseminated in seconds, rather than minutes, without sacrificing the product's integrity or accuracy.

After a reasonable learning curve adjustment, improved lead times were noted at NWS Tampa Bay since the implementation of WarnGen. Statistics from August and September of 2000, when WarnGen was newly implemented, compared with those from May and June 2001, showed average lead time for all severe weather events increasing from 7.3 minutes to 10.2 minutes.

Though it cannot be proved that WarnGen played a role in increasing lead times, most forecasters would likely agree that composing a warning for a rapidly developing storm has never been faster.

6. Summary and Conclusions

AWIPS has greatly enhanced the NWS mission of providing timely and accurate short fused warning and forecast services across the nation. However, a great deal of effort is required by local offices to tailor their systems to best fit customer needs. At NWS Tampa Bay, a substantial amount of work has been accomplished in AWIPS improvement. Many of the initial changes were driven by customer service needs. These included overhauling WarnGen, creating marine "sub-zones", and converting NWR-2000 operations to CAFÉ.

The short fused warning and forecast system will continue to improve as AWIPS improves. The current system employed by Tampa Bay utilizes WarnGen to quickly create concise, accurate, and site-specific text messages for all our customers. NWR-2000 broadcasts these messages nearly instantaneously. Little or no manual editing is required in most cases, freeing operational staff to concentrate on monitoring rapidly developing hazardous weather.

Anecdotal and objective evidence at NWS Tampa Bay suggest that AWIPS warning systems have had a positive effect on the NWS mission for the Florida peninsula Gulf Coast. Future improvements will allow NWS Tampa Bay - and all offices across the nation - to truly provide the "world's best weather services" to American citizens.

7. Acknowledgements

Special thanks to Charlie Paxton for reviewing the manuscript; George "Bud" Fislar and Tony Harper for graphical and technical support.

8. References

Andra, D., V. Preston, E. Quoetone, D. Sharp, and P. Spoden, 1994: An operational guide to configuring a WSR-88D principal user processor, Operations Training Branch, Operational Support Facility, Norman, OK.

Litton/PRC, 1999: AWIPS: A Powerful System for Weather Professionals. Litton/Planning Research Corp, McLean, VA, 16 pp.

National Oceanic and Atmospheric Administration, 2000: Storm Data and Unusual Weather Phenomenon. NOAA, U.S. Department of Commerce, 250 pp.

National Weather Service, 1984: AFOS Handbook, Version 4. NOAA, U.S. Department of Commerce.

National Weather Service, 1999: NOAA Weather Radio Transmitters, Specific Area Message Encoding. NOAA, U.S. Department of Commerce, 30 pp.

National Weather Service, 1999: NOAA Weather Radio: the voice of the National Weather Service. NOAA, U.S. Department of Commerce, 7 pp.

Welch, Brent, 1997: Practical Programming in Tcl and Tk, 2/e, Prentice-Hall Publishing, 688 pp.