EMSA – A Prototype Method for Maintaining Weather-Related Situational Awareness Within Emergency Operations Centers

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1. INTRODUCTION

Emergency Management (EM) officials have the difficult responsibility of protecting their citizenry in the presence of any number of (potential) disaster situations. At times, these situations are induced by the direct impacts of hazardous weather such as severe local storms and tornadoes, flooding rain, heavy snowfall, etc. In other situations, such as during wildfires or toxic plume releases, weather can have indirect but significant influences on the character of the corresponding emergency response. It is important for emergency managers to not only be aware of looming threats, but to also maintain continuous awareness of the evolving threat trends. It is imperative that emergency managers keep their personnel well-informed of relevant meteorological and hydrological concerns without detracting from primary attentions. A strategy for conveying weather information should therefore support the full range of obligations from incident planning to tactical maneuvering. Information should be pertinent and easy-to-understand, while the delivery method itself should be expedient. Situational Awareness (SA) displays traditionally offer the best approach since they can provide graphical (visual) depictions for hazardous weather monitoring. Yet, it remains a continuous challenge for non-meteorologists to know exactly what to display in context of current or potential threats. Since the desire exists for emergency operations centers (EOCs) at city and county levels to have optimally configured SA displays, the Weather Forecast Office (WFO) in Melbourne, FL (MLB) has prototyped an Emergency Management Situational Awareness (EMSA) display capability where forecasters can routinely lend their expertise toward that end. This is consistent with the National Weather Service's effort to grow decision support services under its Weather-Ready Nation initiative.

2. EMSA DISPLAY

EMSA is a web based display system currently in use within several county EOCs across east central Florida as hosted by MLB. EMSA is comprised of three display elements (Fig 1) that provide EOCs with up to date information on evolving weather situations. The main window (Fig 1a) displays images selected by MLB meteorologists which are assembled into a continuously rotating loop. The individual images within the loop will refresh as new graphics become available from the originating entity. The loop is made up of any number of images and graphics. Images may be sourced locally from MLB such as graphical weather blogs (Volkmer et.al., 2012) and/or graphicasts, and hazardous weather outlook graphics (Sharp et. al., 2000). Options for image selection also include national center products from the Weather Prediction Center (WPC), the Storm Prediction Center (SPC), or the National Hurricane Center (NHC). WSR-88D radar imagery, satellite imagery, hydrologic gauge data, and various weather analyses can also be incorporated into the loops. Selections are deliberately made by engaged meteorologists residing at the WFO; by those most aware of the evolving weather concerns for a particular EOC.

The second element (Fig 1b) resides in the upper right hand corner of the display and highlights the watch/warning/advisory (WWA) and statement information that is currently in effect for a county in question. The information is derived directly from the official NWS warning dissemination web site at alerts.weather.gov. A set of background scripts poll county data from this web site and then retrieves any WWA information. The data is color coded based upon the severity of the statement. The color red highlights warnings, orange – watches, yellow – advisories, and a light salmon color depicts general statements. The information contained in this window readily highlights the most significant WWA that is in effect for the county as well as its duration.

The third element of the EMSA display (Fig 1c) is located in the lower right corner, and contains the Twitter feed from MLB. Twitter is often used by WFOs to provide storm reports, clarify information disseminated in other official products, and provide general interest messaging such as record reports, historical weather facts and SKYWARN information.

In operation, the EMSA provides a cohesive overall display depicting relevant meteorological information for maintaining SA within an EOC. The displayed information is controlled and optimized by MLB, and represents a daily service for basic decision support. When emergencies do occur, configurations can be further optimized accordingly. EMSA display products update automatically to keep SA as fresh as possible.

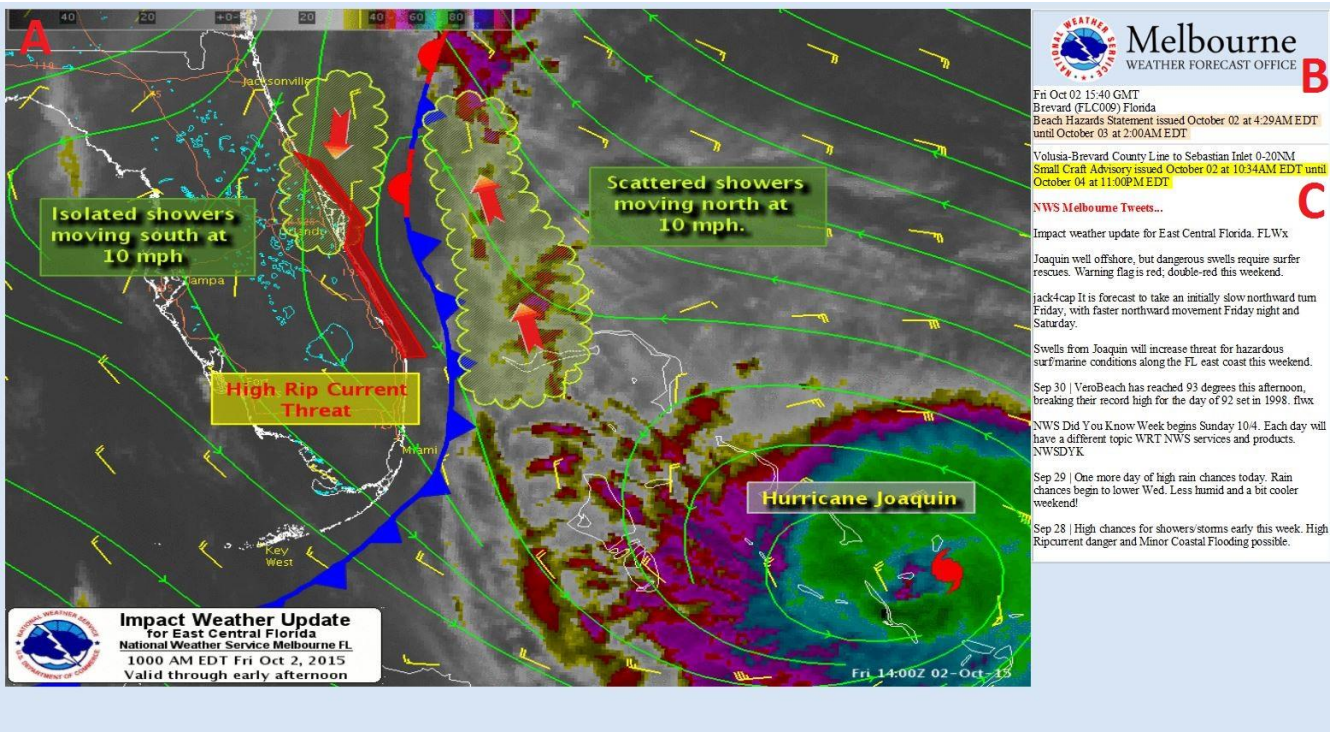

Fig. 1. Sample EMSA display comprised of three main components. A) the main window of a series of looping image graphics. B) Watch, Warning and Advisory section. C) WFO Melbourne Twitter feed.

3. EMSA SOFTWARE INTERFACE

A unique capability of EMSA is the way it allows forecasters to quickly select products suitable to providing meaningful SA. This is accomplished through a graphical user interface (GUI). The EMSA Display Configuration GUI is comprised of TCL/TK and Perl scripts that run within the Advanced Weather Interactive Processing System (AWIPS) framework. AWIPS is the operations system used by all NWS WFOs for monitoring and interacting with numerous meteorological data sets, and producing the entire suite of official forecasts and warnings. Since the EMSA Configuration GUI runs on the main computer system, its disposition can be easily evaluated and optimized for use; for both the host WFO and supported EOCs. Importantly, EMSA is portable for use at other WFOs and their EOCs.

The Display Configuration GUI for EMSA is shown in Fig 2. Through simple mouse clicks, WFO meteorologists can choose from among many different types of graphical products for inclusion within the main display loop. Selection choices include locally produced images such as graphicasts and blogs, as well as graphical representations of daily Hazardous Weather Outlooks, etc. In addition, national center forecasts and outlooks from NHC, WPC, and SPC can be chosen for inclusion. Other choices include observational graphics, such as radar and satellite imagery, as well as hydrological river stage information. MLB forecasters can also choose to display various diagnostic fields from a mesoscale objective analysis system (Blottman et. al., 2001) that is run locally and has a domain coverage area that encompasses the state of Florida. This powerful option provides critical analyses for such sensible weather elements as heat index and wind chill. Both of these options can be very beneficial to the SA requirements of an EOC who are tasked with making critical decisions as to the safety of their constituents and response personnel.

Some county EOCs have requested that certain products always be included within their displays. In these instances, EOCs often find that having reliable graphics depicting the absence of a hazard to be of comparable value as to when the threat actually exists (e.g. heat index maps for protecting field personnel during the hot summer months). To accommodate, select graphics are automatically included within a particular county EMSA display. As a result, forecasters don't need to remember unique requests for particular counties. This keeps the EMSA Display Configuration GUI simple by only requiring one tool interface for configuring multiple county/city displays. Pre-configured background code takes care of any EOC-specific requirements as maintained by system administrators.

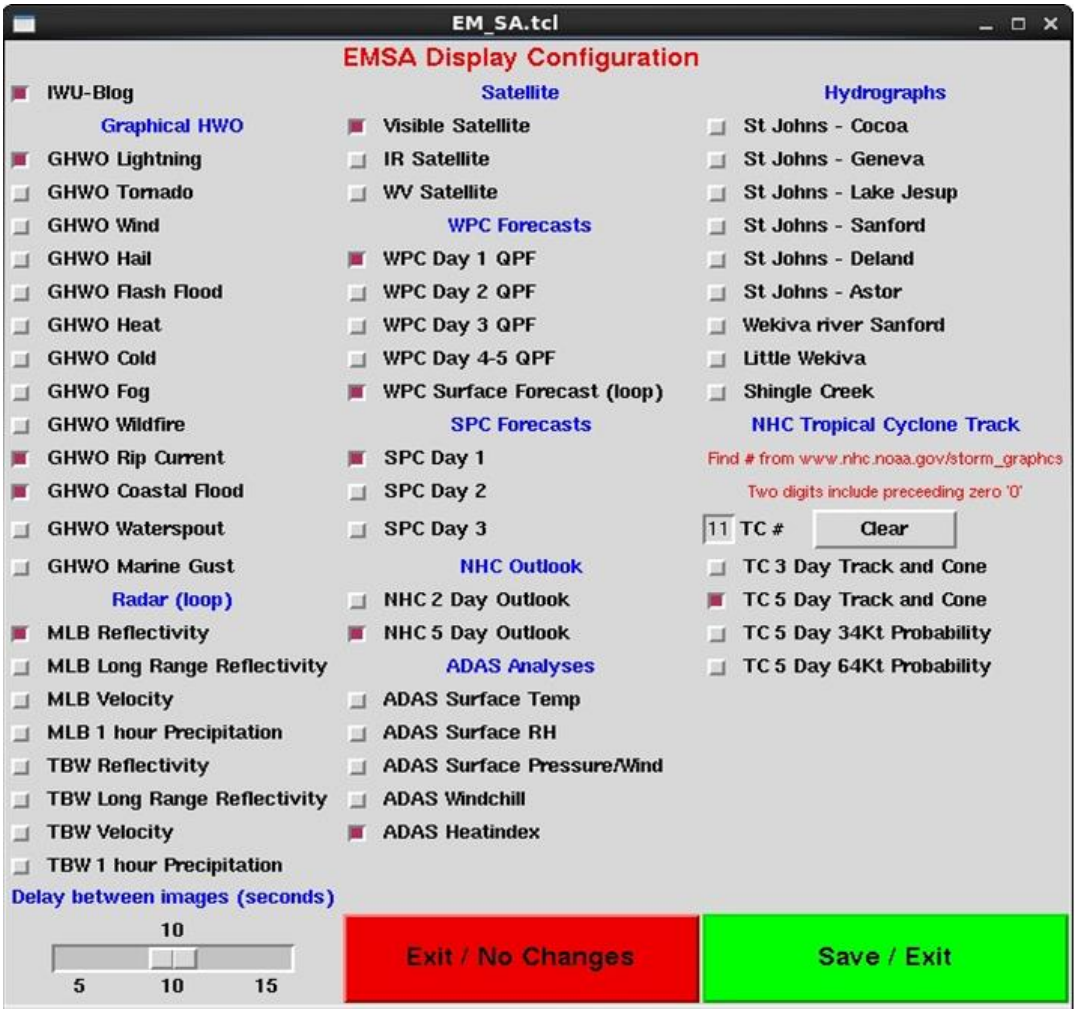

Fig. 2. The EMSA display GUI with sample configuration selections.

The GUI also allows for setting the dwell, or the time delay between displayed images. The operator can choose a speed most appropriate for the situation and product types. The update interval for the display is automatically determined based on the number of products chosen through the interface, the number of images automatically preconfigured at the request of an EOC, as well as the dwell setting in the GUI. The number of seconds for each full refresh is based on the equation:

RI=2*D*(P+PP)

Where:
RI = display **R**efresh **I**nterval in seconds
D = **D**well rate in seconds
P = number of **P**roducts selected in the GUI
PP = number of **P**reconfigured **P**roducts required by a county

This strategy ensures that longer cycles with more images are sure to display all selected graphics when compared to shorter cycles. In each case the entire loop set will update after displaying through two complete cycles.

4. BACKROUND APPLICATIONS

The EMSA display is further assmbled by several programs that run in the background to either format graphics chosen through the EMSA Display Configuration GUI or to produce content contained on the right hand section of the display. Scripts utilizing the Linux Convert utility, an Open Source program for manipulating images (ImageMagick.org, 1999-2016), can be used to crop or resize imagery, and relocate legends or titles (Fig 3). This capability is used for several of the national center products such as quatitative precipitation forecasts from WPC or convective outlooks from SPC. Since EMSA is designed to accommodate localized SA monitoring, charts are cropped and legends are moved to focus on the geographical area of interest. This same strategy is used for radar imagery. While radar loops from the NWS national radar web site are used wholesale within the overall EMSA loop, zoomed in

radar maps are created with the Convert utility to center on a particular county and the immediate surrounding area.

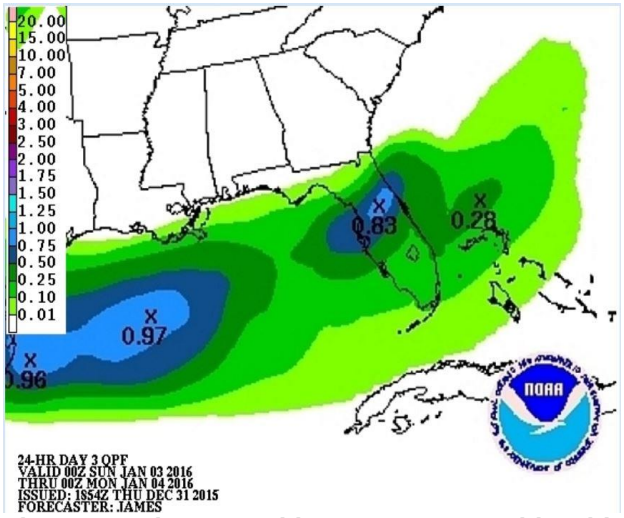

Fig 3. Sample zoomed in WPC QPF graphic with relocated legends.

Computer scripts written in the Perl language gather WWA information from the online alerts.weather.gov web site, the official web dissemination site for NWS products on the internet. Scripts poll this site at regular intervals to gather and format textual WWA information. This raw data is then formatted, color coded, and embedded as text statements within the web page (Fig 4). Warnings are highlighted in red, watches in orange, advisories in yellow and other statements in a light salmon color. The presence of warnings right on the EMSA display keeps staff apprised and the color coding draws attention immediately to what is most important.

Fig 4. Sample WWA section of EMSA.

Other Perl scripts running in the background poll the MLB Twitter feed. Social media sites such as Twitter are often used by WFO to provide rapid succinct updates on developing situations (Fig 5). This information may include storm reports from spotters in the field, rain reports, and record reports. With the inclusion of the Twitter feed incorporated within the county EMSA, EOC officials do not have to go to another location for Twitter posts from the local WFO. Public messaging is more consistent, having a wider collective reach.

Fig 5 Sample Twitter feed section of EMSA.

5. SUMMARY

The EMSA display is a remotely configured SA monitoring tool experimentally used by several county level EOCs across east central Florida. The display is a web page consisting of looped weather-related images, a county specific colorized table of WWA information, and MLB's Twitter feed. A unique aspect of EMSA is in the way WFO meteorologists interface with display configurations through software residing on the AWIPS computer system.

Through simple button selections, the web page can be dynamically configured for unique display within any of several EOCs throughout the county warning area. This brings the ability for NWS meteorologists to have direct interaction with the SA posturing within a given EOC. Forecasters make selections from a listing of graphical products such as Storm Prediction Center convective outlooks, Weather Prediction Center rainfall forecasts, and WFO graphicasts and graphical hazardous weather outlooks. The listing also includes radar and satellite imagery options, as well as current analysis and forecast depictions of various weather elements. The choice of graphics to display is expandable to

accommodate future customer demands, such as supporting the display of HYSPLIT dispersion model output, etc.

The EMSA interface allows for the expertise of WFO forecasters to routinely deliver SA and decision support information directly to monitoring stations within EOCs. The EMSA display is also utilized within the WFO on one or more of the SA displays within the office. This self-monitoring has the added benefit of keeping WFO staff situationally aware, and to potentially indicate where associated technologies may have become operationally degraded and require troubleshooting. Feedback from the EM community has shown that EMSA has been a basic and effective messaging tool through a continuum of situations from routine daily operations to fast breaking high impact weather situations.

6. REFERENCES

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