UTILIZATION OF THE GFE IN SEVERE WEATHER RECOGNITION AT THE TAMPA BAY AREA NATIONAL WEATHER SERVICE

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1. Introduction

During the convective season in west central Florida, mesoscale features dominate the variations in day to day weather. Numerous parameters must be taken into account on any given day to correctly assess the atmosphere's potential for severe weather. This is compounded during times when tropical storms or hurricanes threaten the area as time saving measures become paramount to produce proper atmospheric analysis and quality products.

The Tampa Bay Area National Weather Service (NWS) has taken the initiative to combine the versatility and expansive functionality of the Graphical Forecast Editor (GFE) with known severe weather indices and forecast parameters to create a Severe Weather Recognition (SWR) strategy. This allows forecasters to quickly pinpoint significant weather threats for the day, allowing time to examine other pertinent meteorological variables. The NWS Tampa Bay Area has developed SWR strategies within the GFE for precursor recognition of hail, damaging wind, and tornadoes.

2. Graphical Forecast Editor

With the development of Interactive Forecast Preparation Systems (IFPS), new avenues of product development have been introduced which will continue to aid forecasters in the forecast process. Among the pioneers of IFPS is the Forecast Systems Laboratory (FSL) in Boulder, CO where programmers are instrumental in the NWS Rapid Prototyping Project (RPP). RPP allows forecasters at the field level and developers at FSL to interact directly to produce the most up to date software available.

One of the more important and advantageous features of the GFE is the development of Smart Tools which is further enhanced through RPP (Hansen, 2001). Smart Tools allow forecasters to create, maintain, and modify their own edit tools which incorporate forecast techniques specific to the local forecast area (LeFebvre, 2001). A Smart Tool is a Python based computer program which converts complex meteorological equations and concepts into simplified grid data, which are then used by forecasters.

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It was recognized by FSL early on that by creating a framework through GFE that is open-ended, the flexibility created with Smart Tools will allow completion of future tasks and functions with relative ease. The Tampa Bay Area NWS has taken full advantage of these concepts by using GFE Smart Tools to automate several time-consuming tasks. Gordon and Albert (2000) provide a review of SWR strategies for recognition of factors associated with hail, damaging wind, and tornadoes. Within the GFE, damaging wind scenarios are stratified into bow echo and microburst prediction strategies. Tornado scenarios are divided into Supercell, localized, and tropical system influences. The tropical system influenced tornado and microburst prediction strategies are shown. While the performance of the associated checklists is outside the scope of this paper, we believe that GFE Smart Tools greatly increase the efficiency of severe weather prediction strategies.

3. Microburst Prediction Strategy

Great strides have been made to understand wet microbursts over the past two decades (Roeder, 1998). This has fostered development of several operational techniques which aid recognition of favorable microburst regimes. These techniques have traditionally been written checklists that require a modified morning sounding and time and diligence on the part of the forecaster. When incorporating model soundings through 24 or 48 hours, checklist completion becomes less likely. Many NWS offices have determined that the workload issue does not allow a checklist to be done at all, while other offices have a scaled-down version which saves time but may decrease the usefulness of the data obtained. Other methods of forecasting favorable microburst days include the use of GOES sounder products. While alleviating the time issues, the quality of the sounder data has proved less useful on local levels than that of checklists.

GFE Smart Tools have allowed the Tampa Bay Area NWS to combine the positive attributes of a timely micoburst prediction product with those of a quality one through the use of Smart Tools. Scripts have been written into the code that perform calculations using model grid data and the microburst checklist formulas. The checklist used for the GFE output grids is a modified version developed by the NWS Jackson, Mississippi and altered slightly to fit a consistent GFE Smart Tool methodology (Table 1.) Several parameters and indices such as CAPE, Lifted Index, Precipitable Water, and 500 mb temperature are included in model grids. However, additional scripting is necessary determine the remaining parameters.

Table 1. Microburst prediction checklist with parameters and corresponding Low, Moderate and High Thresholds. Values associated with thresholds are summed to determine category.

Microburst				
Parameter	Units	Low Threshold	Moderate Threshold	High Threshold
Value		1	2	3
Equilibrium Level	m	13000	13700	14300
CAPE	Jkg^{-1}	2500	3500	5000
Precipitable Water	mm	356	457	508
T500	C	-4.9	-5.6	-9.0
Lowest Lifted Index		-6	-8	-9
T850-T500	C	26	27	28
V700	deg. ms^{-1}	040-090 6	270-310 6	310-040 6
V500	ms^{-1}	040-090/6	270-310/6	310-040/6
DD500	C	17	18	19
DD300	C	17	18	19
Theta-e (sfc) -Theta-e (minimum)	C	13	20	30
Totals		12	24	36

Within the Smart Tool framework, a value (0,1,2,3) is assigned corresponding to a negligible, low, medium, or high potential for each parameter threshold, The Smart Tool then sums parameter threshold values to determine the category for microburst threat for that particular time frame. Output grids on the GFE analyze the threat for every 3 or 6 hours each day. This gives the forecaster additional flexibility to see atmospheric changes through the course of the day.

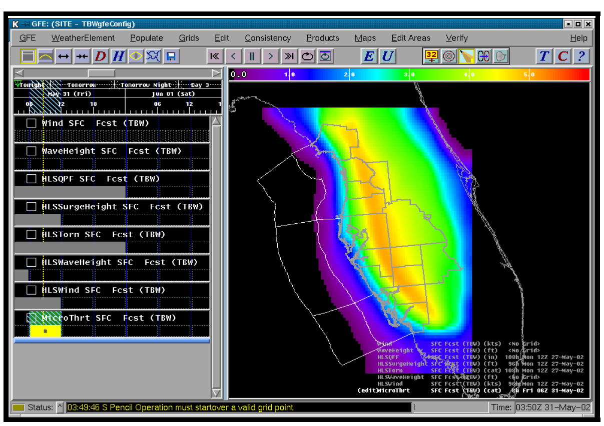

Figure 1. The GFE interface and associated 6 hour output grid for microburst prediction.

Typical color enhancements shown on the GFE grid may be multi-shades or different shades of color from yellow, to orange, to red depending on the corresponding microburst prediction value (figure 1.)

By calculating the 10 parameters listed in Table 1, and producing grids through GFE, enormous time constraints are eased providing to two main rewards. 1) SWR is greatly enhanced for the forecaster including how that severe threat will change throughout the day and 2) By alleviating the time taken to complete a checklist, the forecaster may use the time saved to view other severe weather parameters or complete other shift duties.

4. Hail Strategy

Hail development is well correlated with strong updrafts and cold mid-atmospheric temperatures (500-400 mb.) Thermodynamic instability and divergence are the basis for strong updrafts in this strategy. Table 2 shows the components for this strategy.

Table 2. Hail prediction checklist with parameters and corresponding Low, Moderate and High Thresholds. Values associated with thresholds are summed to determine category.

Hail				
Model Parameter	Units	Low Threshold	Moderate Threshold	High Threshold
Value		1	2	3
CAPE	JKg^{-1}	1000	2000	3000
T500	C	-7	-10	-13
T400	C	-18	-21	-24
Freezing level	m	4000	3500	3000
V850	ms^{-1}	15	20	25
V700	ms^{-1}	20	25	30
V500	ms^{-1}	35	40	45
V300	ms^{-1}	35	45	55
V200	ms^{-1}	40	50	60
Totals		9	18	27

5. Tropical System Tornado and HLS Strategy

In addition to forecasting warm season convection on a daily basis over west central Florida, tropical systems routinely threaten the area. Although convection may be limited as tropical systems approach , forecaster time constraints arise with the multitude of required responsibilities. In these situations the issuance of quality products in a timely manner is crucial in keeping the public properly informed of changing conditions.

The NWS Melbourne, FL office recognized this need and acted on it through the use of a Graphical Hurricane Local Statement (gHLS) (Pendergrast, 2000). Anecdotal and objective evidence has shown the gHLS is not only more comprehensive than traditional text versions, but requires less time to compose (Pendergrast, 2000). However, while the gHLS as developed was versatile, it still required considerable manual input from the forecaster. The NWS Tampa Bay Area used the gHLS framework and applied GFE to these concepts to develop a SWR strategy for tropical system tornado threat. Similar to the Microburst Prediction Strategy, Smart Tools use model grids within the GFE to produce SWR tropical tornado threat grids (Table3.) The output image derived from the grid and incorporated into a GFE produced web page is shown in Figure 2. Using these methods allows users to quickly recognize the potential hazards from approaching tropical systems, and to act on these hazards in a timely manner by issuing quality, easy to interpret public products.

Table 3. Tropical system tornado prediction checklist with parameters and corresponding Low, Moderate and High Thresholds. Values associated with thresholds are summed to determine category.

Tropical Tornado				
Model Parameter	Units	Low Threshold	Moderate Threshold	High Threshold
Value		1	2	3
CAPE	JKg^{-1}	500	1000	1500
V925	ms^{-1}	15	20	25
V850	ms^{-1}	20	25	30
V700	ms^{-1}	35	40	45
V500	ms^{-1}	35	45	55
V300	ms^{-1}	40	50	60
Totals		6	12	18

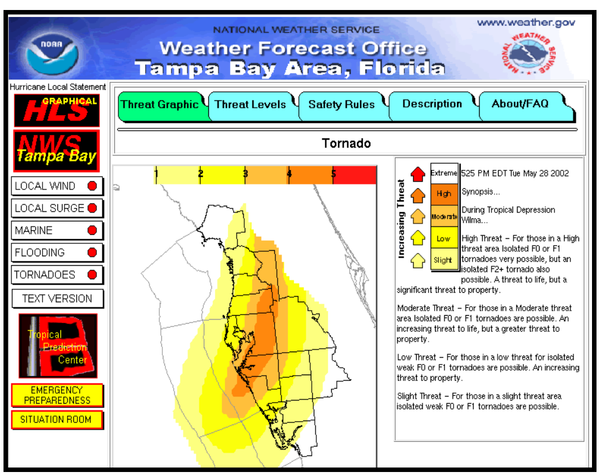

Figure 2. Tornado threat output image derived from grids and incorporated into a GFE produced web page.

6. Conclusion

This paper describes a series of techniques that enhance the severe recognition process through the use of GFE and associated Smart Tools at the Tampa Bay Area NWS. Three areas of study depicted involve the microburst prediction strategy, hail prediction strategy, and the tropical system tornado strategy incorporated into the graphical hurricane local statement, In these processes, the GFE automates normally time-consuming forecaster tasks. While these methods have shown great promise for future operations, it is recognized that limitations with model grid data as well as the current Smart Tool script format will keep forecaster intervention paramount.

As these methods improve, the advances shown at the Tampa Bay Area NWS in the severe recognition process will prove to be important in other meteorological disciplines such as hydrology and winter weather. By being an open ended system with great flexibility, GFE has already shown great promise for future operations.

7. References

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