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INLAND TROPICAL CYCLONE WIND FORECASTS FOR PENINSULAR FLORIDA

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1. INTRODUCTION

The National Hurricane Center (NHC) prepares and distributes tropical cyclone (TC) advisories for the general public and other users. The TC advisories contain direct or indirect measurements of the current maximum sustained wind (MSW), defined as the "one-minute average at an elevation of 10 meters with an unobstructed exposure", and forecasts through 72 hours (OFCM 2001). In addition, the advisories indicate the current and forecast 34, 50, and 64 kt MSW radii for each quadrant of the TC, defined as the "largest radii of that wind speed found in that quadrant."

Capitalizing on the expertise of the NHC forecasters and to ensure forecast consistency, these advisories are heavily utilized by individual National Weather Service (NWS) Forecast Offices (WFOs) to produce local public, marine, and aviation forecasts, as well as weather statements for TC-related hazards. While the NHC wind guidance (MSW and radii) is sufficient for marine and coastal exposures, the wind fields are often biased when applied to inland areas owing to the lack of compensation for surface roughness (i.e. "obstructed" flow). However, to remain consistent with NHC forecasts and absent a consistent inland wind reduction factor, Florida WFOs routinely use the wind guidance unmodified to generate local forecasts, often leading to an over-statement of inland wind speeds and duration. Subjective analyses of recent central Florida TC events indicate the forecast MSW values are obtained primarily in peak wind gusts.

As the NWS transitions from traditional text based forecast products to a new generation of grid-based products over the next several years (Ruth 2002), the need for more accurate depictions of inland wind forecasts will become paramount. Given the transition to site specific and time specific graphical forecast products, forecasters must manually compensate for wind differences between marine and land exposures and other inherent TC asymmetries, rather than to simply extrapolate fixed wind radii guidance from sea to land.

2. WIND GUIDANCE MODIFICATIONS

To convert wind measurements from marine exposure to that of standard open terrain (surface roughness; z0=0.03 m) Powell et al., 1996 applied the relationship between friction velocity and the gradient wind to two different roughness categories with the same gradient wind. Further, assumptions of surface roughness for gale (34 kt) and hurricane (64 kt) conditions can be made to adjust wind radii forecasts over water to open terrain equivalents (Powell, personal communication). Such modifications yield a reduction of the 34 kt (63 kt) contour to 25 kt (53 kt). Using such wind radii reductions over land could provide a first step towards reducing expansive inland high wind zones. Further modifications may be necessary to account for varied surface roughness.

3. TROPICAL CYCLONE GABRIELLE (2001)

Tropical Storm Gabrielle moved from northeast across the Florida peninsula on 14 September. NHC 34 kt wind radii guidance is shown in Fig. 1, encompassing much of the peninsula. Consistent with the NHC guidance, text forecasts for interior central Florida indicated winds of 35 to 45 mph with higher gusts during passage of the center during the afternoon and evening.

Data from central Florida ASOS (16 sites; Fig. 2) revealed sustained winds (2-min mean) remained below 34 kt at all inland locations, and only briefly exceeded 34 kt at three coastal locations. Punta Gorda (35 kt) and Sarasota (41 kt) on the Gulf coast, and Daytona Beach (38 kt) on the Atlantic coast reached gale force for less than an hour. The inland wind situation represented by TC Gabrielle has occurred several times within central Florida over recent years. TC Gordon (1994) and Erin (1995) crossed the peninsula with strong winds near the coastline, but much weaker winds over the interior. TC Irene and Floyd (1999) remained over the Atlantic, with winds over the central Florida interior much weaker than wind radii guidance (Kelly et al. 2000).

Conservative reductions applied to wind radii values, as described in section 2, should allow for a better representation of the actual winds across interior peninsular Florida. Such modifications could be used by the WFOs as a starting point to provide more accurate local wind forecasts for interior locations while still remaining consistent with NHC advisories. Close coordination between adjacent forecast offices and NHC will ensure a consistent and accurate wind forecast transition from the coastal plain to the interior peninsula.

4. GRAPHICAL WIND FORECASTS

NWS Melbourne developed an experimental suite of hazardous weather products for TC situations during the 2000 hurricane season (Spratt and Sharp 2001). The graphics are manually produced to geographically highlight 'hazards'. Due to favorable user feedback, the project will be expanded to all Florida NWS offices for the 2002 hurricane season. Fig. 3 reveals how the threat for inland winds can be depicted over a portion of the Florida peninsula.

Beginning in 2002, Florida NWS offices will begin to produce graphical gridded forecast fields for multiple parameters, including wind speed and direction (tentatively 3 h intervals to 48 h). The wind speed forecasts will be initialized within AWIPS/GFE with model guidance of choice or a wind radii field provided by NHC, and manually edited to take into account local effects, TC asymmetries, inland wind reductions, etc. Then final products will be uploaded to NWS web pages and made available to a multitude of users (see example in Fig. 4).

The combination of traditional text forecast products, the graphical TC hazard suite, and plentiful gridded forecast graphics will provide the user with an unprecedented set of detailed weather output for decision-making and action during future TC situations.

5. DISCUSSION

The poster will illustrate the technique for wind radii speed determinations, and will compare NHC (wind) forecasts during TC Gabrielle with the modified guidance and archived observations. Local forecast examples (textual and graphical) will be used to depict the impact such modifications would have made in realtime during Gabrielle. Finally, gridded wind field forecasts and graphical threat depictions of inland winds will be shown to illustrate the utility of the new and enhanced NWS product suites.

6. REFERENCES

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Spratt, S.M. and D.W. Sharp, 2001: Graphically Depicting the Hurricane Local Statement, Minutes of the 55th Interdepartmental Hurricane Conference, OFCM, Orlando, FL, pp B221-B226.

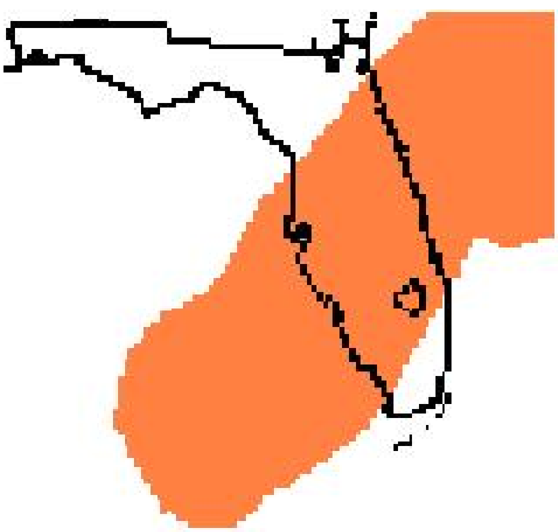


Fig. 1

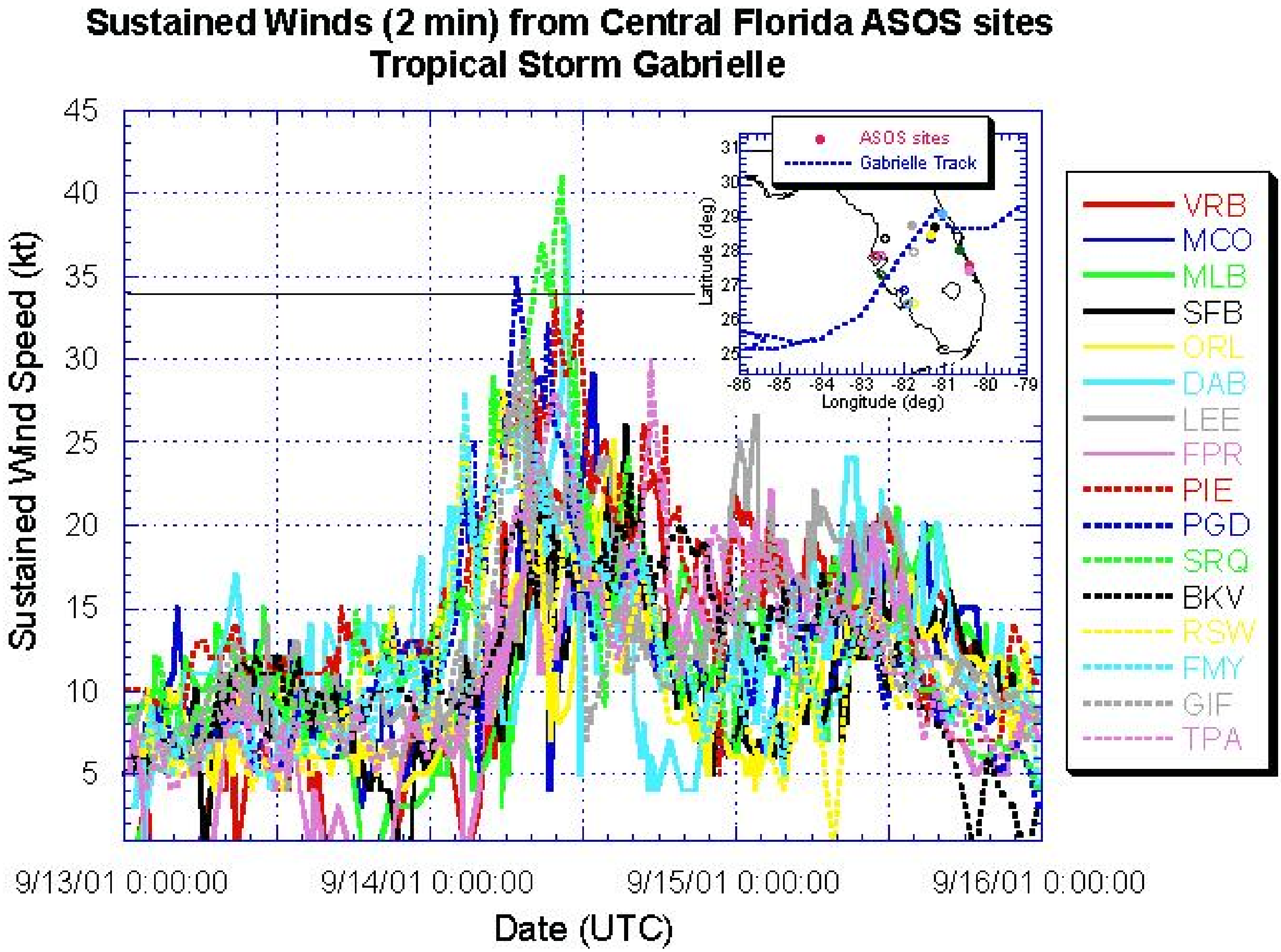

Sustained Winds (2 min) from Central Florida ASOS sites
Tropical Storm Gabrielle
Sustained Wind Speed (kt)
45
40
35
30
25
20
15
10
5
9/13/01 0:00:00
9/14/01 0:00:00
9/15/01 0:00:00
9/16/01 0:00:00
Date (UTC)
ASOS sites
Gabrielle Track
Latitude (deg)
Longitude (deg)
VRB
MCO
MLB
SFB
ORL
DAB
LEE
FPR
PIE
PGD
SRQ
BKV
RSW
FMY
GIF
TPA

Fig. 2

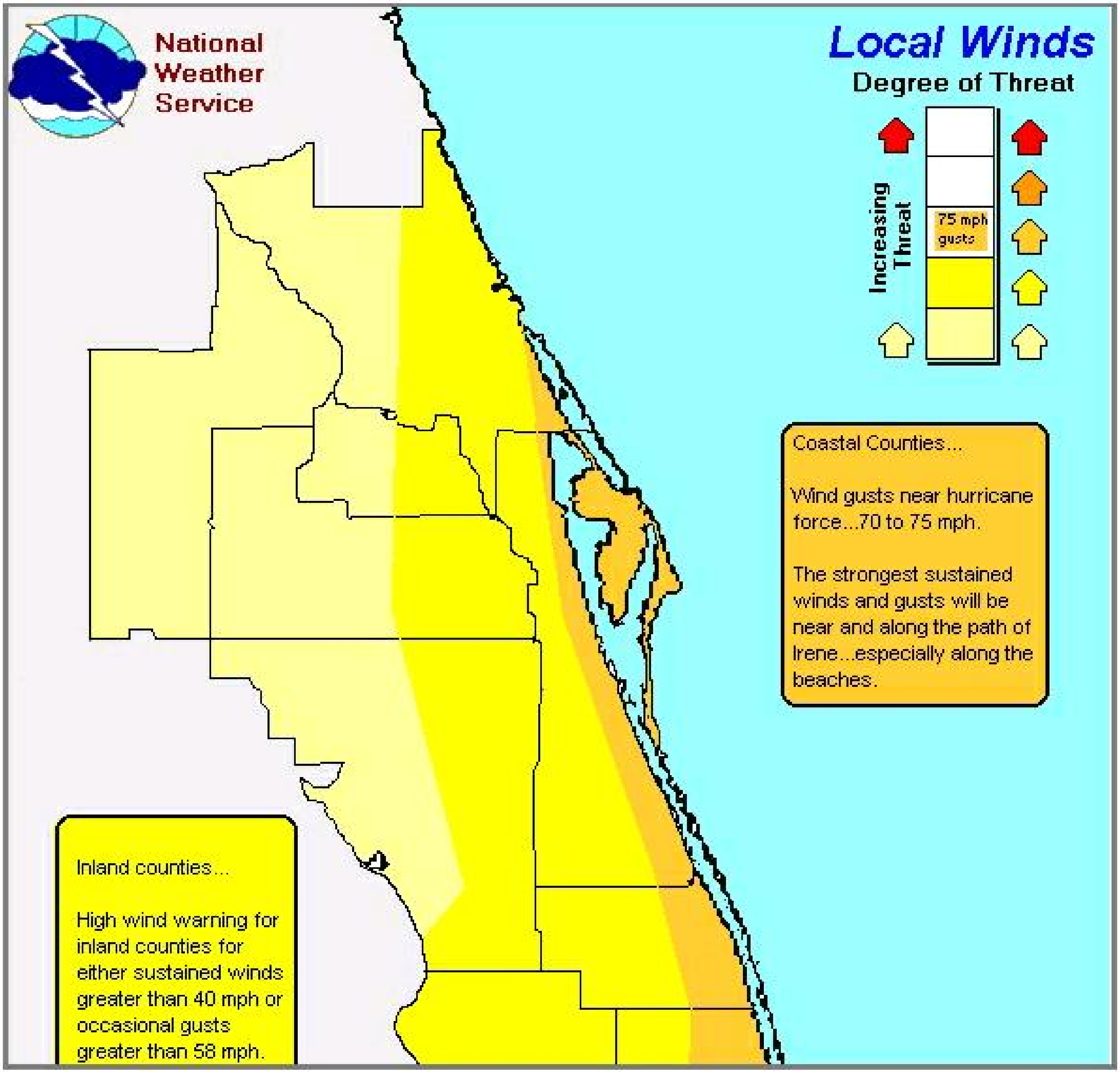
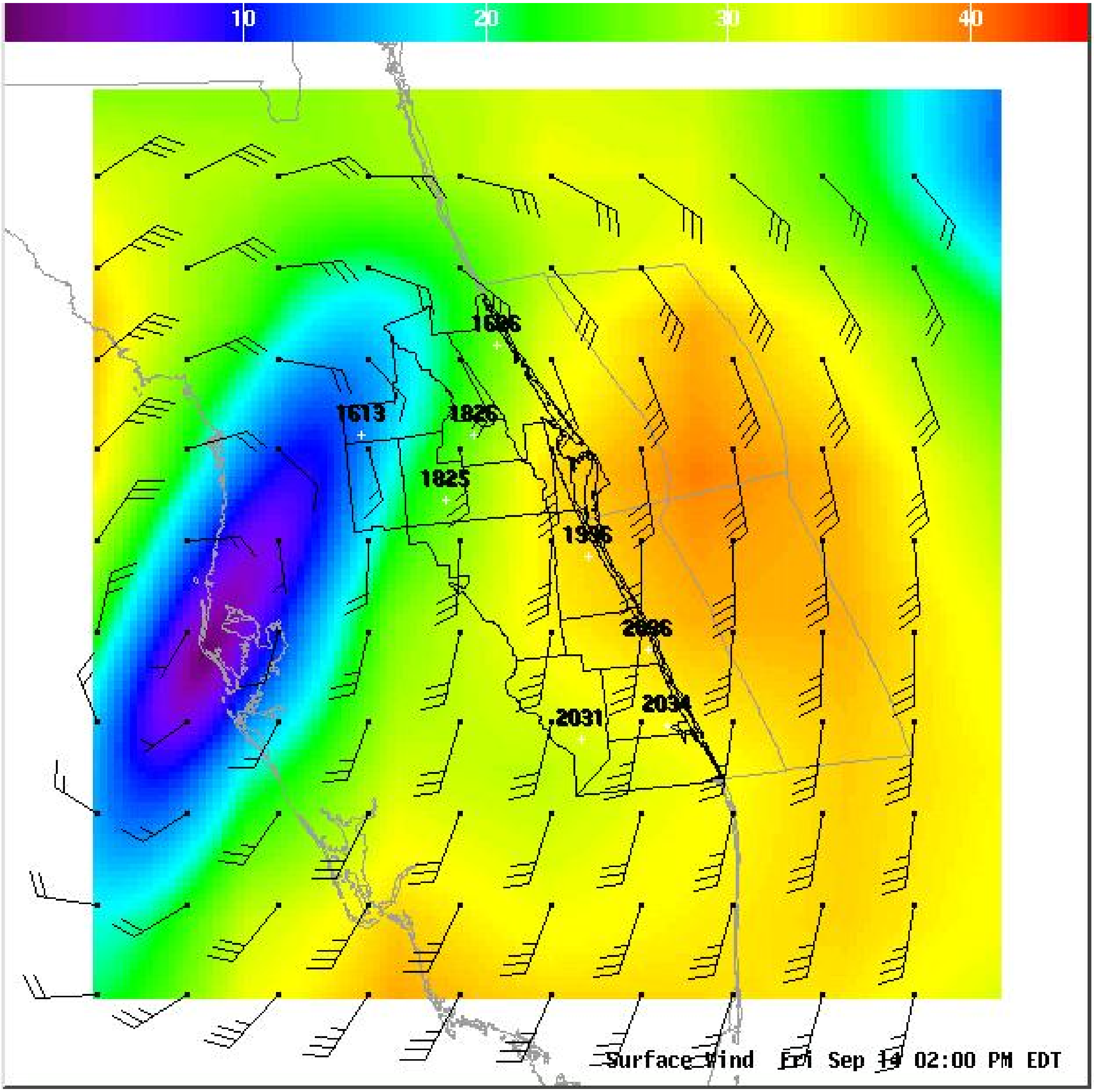

National
Weather
Service
Local Winds
Degree of Threat
Increasing
Threat
75 mph
gusts
Coastal Counties...
Wind gusts near hurricane force...70 to 75 mph.
The strongest sustained winds and gusts will be near and along the path of Irene...especially along the beaches.
Inland counties...
High wind warning for inland counties for either sustained winds greater than 40 mph or occasional gusts greater than 58 mph.

Fig. 3



10
20
30
40
1613
1825
1825
1996
2006
2031
2034
Surface Wind Fri Sep 14 02:00 PM EDT

Fig. 4