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Graphically Depicting Threat Assessment Information for Flood Situations in East Central Florida

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1. Introduction

The National Weather Service (NWS) office in Melbourne, Florida has piloted an experimental project that uniquely presents the daily "Hazardous Weather Outlook" (HWO) product in graphical format. The purpose is to complement the official text version of the HWO, exploiting both the communication and display capabilities of the Internet. Due to the diversity of threats, as well as the chance for multiple coincident threats, the text version (alone) is often insufficient to properly express all weather concerns. As a result, the text HWO may become overwhelmingly large in order to accommodate detail, or overgeneralized to accommodate product length manageability. This is especially true during situations when (flash) flooding is a threat. Many times, a quantitative precipitation forecast (qpf) for multiple inches of rainfall does not translate well in order to accurately express the actual (flash) flood threat. Although the qpf forecast is a primary ingredient when assessing (flash) flood potential, a thorough assessment also requires information regarding preexisting conditions and local geography across the forecast area. With this in mind, it is often difficult to specifically and adequately address the (flash) flood threat within an alphanumeric product, therefore lending itself well to graphics (Figure 1).

In most areas of the country, (flash) flooding is considered as rapid flooding that occurs in a very short period of time. Most (flash) floods are caused by excessive rains from slow-moving thunderstorms, showers and thunderstorms repeatedly moving over the same area, focused precipitation along stalled frontal systems, or torrential rains from hurricanes (or any tropical system). They can also be caused by dam breaks or release waters from ice jams (not a Florida problem). Topography, soil condition, and ground cover also play important roles in (flash) flooding. In most areas of the country, (flash) flooding occurs within several hours of the heavy rain event (usually within 6 hours). However, in east central Florida, the soil is generally porous with swampy drainage and absent mountain/valley terrain (also arroyos), making it difficult to generate a channeled "moving wall of water". Therefore, (flash) flooding often takes the form of "rapid inundation" in east central Florida (instead of "walls of water"),

and thus the descriptive term "flash" is generally removed from official National Weather Service products in Florida. (Note: The term "flash" will be left off for the remainder of our discussion.) Even though east central Florida frequently experiences high intensity rainfall events, localized/brief urban flooding is the most common form of flooding. Importantly, the infrequent occurrence of significant life/property threatening flooding is a function of both high rainfall intensity and longer rainfall duration in the presence of abundant tropical moisture. Of course, flooding rain from landfalling (or passing) tropical cyclones is a major concern since all of these contributing factors are usually maximized. Since flooding during a tropical event can be so devastating, this has prompted a parallel project to depict the Hurricane Local Statement (HLS) in graphical form. This initiative stemmed from the preliminary success of the graphical HWO in the shadow of the hazard situations presented by Hurricanes Floyd and Irene (1999). The desire is to better depict all associated threats, beyond the traditional wind and surge, that a tropical cyclone can place upon a given forecast area without being confined to the text HLS product only. The opportunity to more accurately portray the flood threat from a tropical cyclone is currently considered a high priority.

2. The Graphical Hazardous Weather Outlook

The experimental graphical HWO (gHWO) is composed everyday coincident with the textual HWO and is issued between 6 and 7 AM. Users consist of Emergency Managers, Law Enforcement, Water Management Districts, Media, other government agencies, and the public, with a subset of each serving as the customer feedback group. The intent is to provide decision makers with the necessary hazardous weather information for planning purposes early each day. Updates and amendments are made whenever necessary, but a routine update is provided at 11 AM each day during the central Florida warm/wet season to better depict the forthcoming afternoon convection. The graphical HWO consists of a combination of interactive text and web graphic products that individually address expected weather threats for the next 12 (up to 24) hours. Upon entering the main web page, the user is shown a control panel which indicates the hazard categories relevant to east central Florida (Pendergrast, et al., 2000). The hazard categories include THUNDERSTORMS (severe and strong), FLOODING, SEASONAL, MARINE, and WILD FIRE. The control panel acts as the center for navigation where the user can quickly view each threat category in separate web frames.

Each threat, to include flooding threat from heavy rain (Figure 2), is depicted by a Degree of Threat (DoT) and then a Threat Area Map (TAM). The DoT is separated into five ascending threat levels. For flooding, the levels are separated as follows: Level 1- Flood Threat, Level 2 - Moderate Flood Threat, Level 3 - High Flood Threat, Level 4 - Very High Flood Threat, and Level 5 - Extreme Flood Threat. Forecast concerns are governed by the confidence that flooding will occur within the county warning/forecast area and its subsequent coverage. Therefore, a function was developed to help forecasters make a reasonable determination of an appropriate maximum DoT for the day. The DoT function is expressed as C(AxB); where "A" is the percent Confidence (of flood occurrence), "B" is the percent Coverage (by county), and "C" is an Impact Coefficient. The product of Confidence x Coverage yields a range of

values between 0 and 1.0. The Impact Coefficient is then applied to heighten the threat level for increasing magnitudes as they relate to potential impacts to life and property. Empirical values of 1.0 (for 1x flash flood guidance), 1.25 (for 2x flash flood guidance), and 1.5 (for 3x+ flash flood guidance) are currently used (and under evaluation). The derived value is then compared to an empirically calibrated scale to determine the maximum DoT (Figure 3).

So far, presenting graphical flood threat information has been well received from our customer feedback group. As events take place, verification will play an increasingly important role in the refinement of flood threat assessment techniques. The expectations of our customers is already beginning to shift towards graphical products; we must meet the challenge.

Visit the gHWO website for a complete overview of the product.

3. The Graphical Hurricane Local Statement

During the 1999 hurricane season, NWS Melbourne became aware of the possibility of presenting the Hurricane Local Statement in graphical format. Similar to the textual HWO, the textual HLS (issued every 3 to 6 hours) often became rather long when attempting to address certain elements with detail, while at other times too vague when attempting to keep the product within a manageable length. Both dilemmas subtract from the usefulness of the product for our users. Hurricanes Floyd and Irene served as contrasting cases and collectively prompted the initiative to explore graphical depictions. Working each event retrospectively (as originally forecast), the framework for a suite of graphical products was made. Each tropical cyclone hazard was identified (Figure 4) with a method to compare hazards against one another to determine which would be of greater threat to east central Florida. This approach focuses on the impacts of the tropical cyclone on a given forecast area and does not try to manipulate the defining traits of the storm. That is, it maintains the Saffir-Simpson scale as the appropriate method to categorize the strength of the storm without ignoring the potential impacts of its other associated hazards. Hazards such as flooding rain (and tornadoes) can be separately determined and addressed (Figure 5).

Visit the gHLS website for a complete overview of the product.

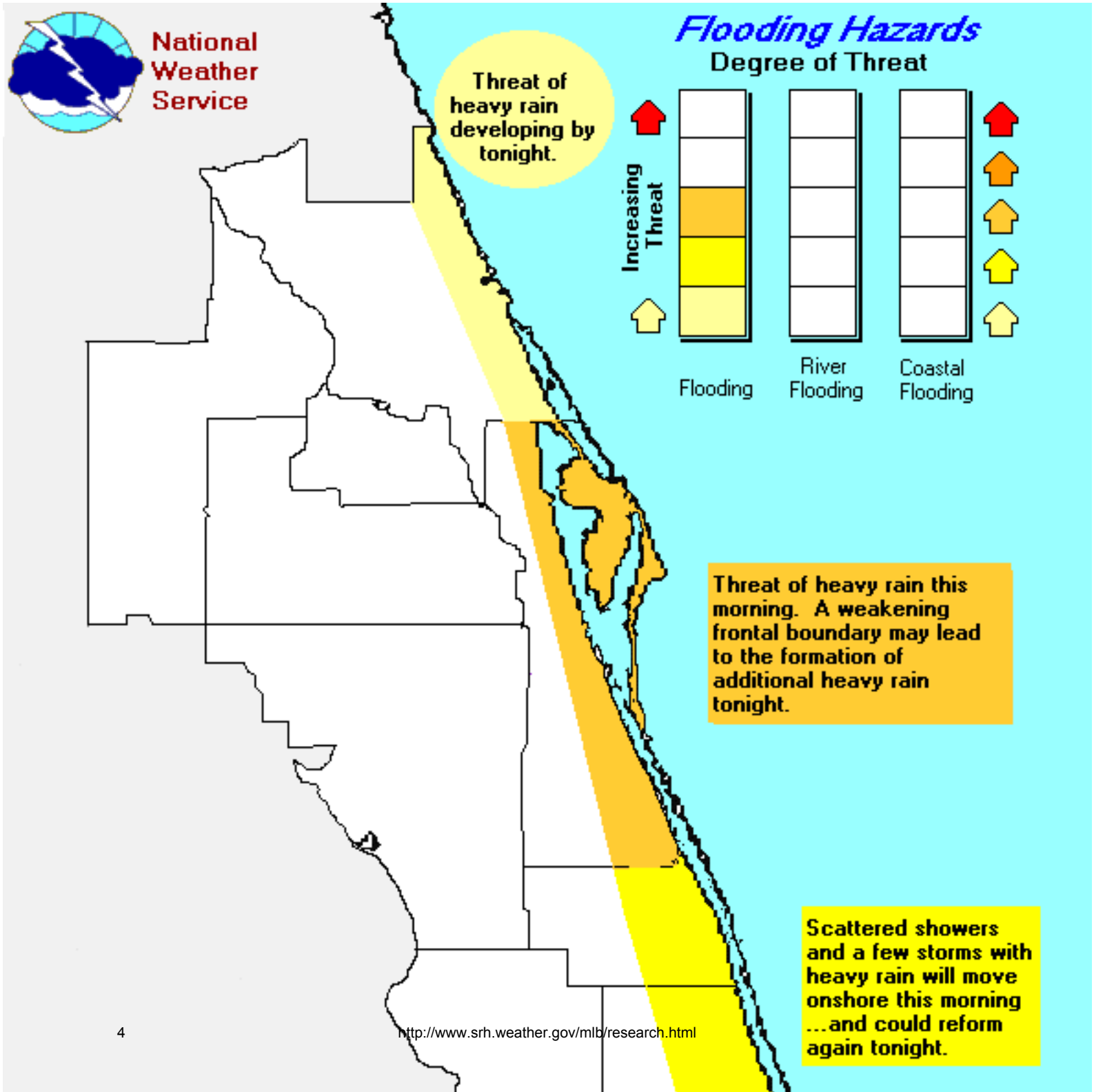
4. Summary

Little doubt can be cast upon the fact that there is growing demand by users for graphical forecast products. A major challenge is the attempt to make these products consistent issuance-to-issuance and forecaster-to-forecaster. An attempt has been made by NWS Melbourne to provide graphical hazardous weather information, particularly the threat of flooding rain, routinely and consistently, complementing both the textual Hazardous Weather Outlook and the Hurricane Local Statement. Several events have already occurred where flood threat information has been provided within the graphical HWO. During September (2000), the

graphical HLS was formally launched when Tropical Storm Gordon caused watches to be placed over part of the east central Florida coast. Graphics were issued to support the textual HLS and were considered more effective in threat depiction.

5. References

For reference listing, please visit the graphical HWO website.



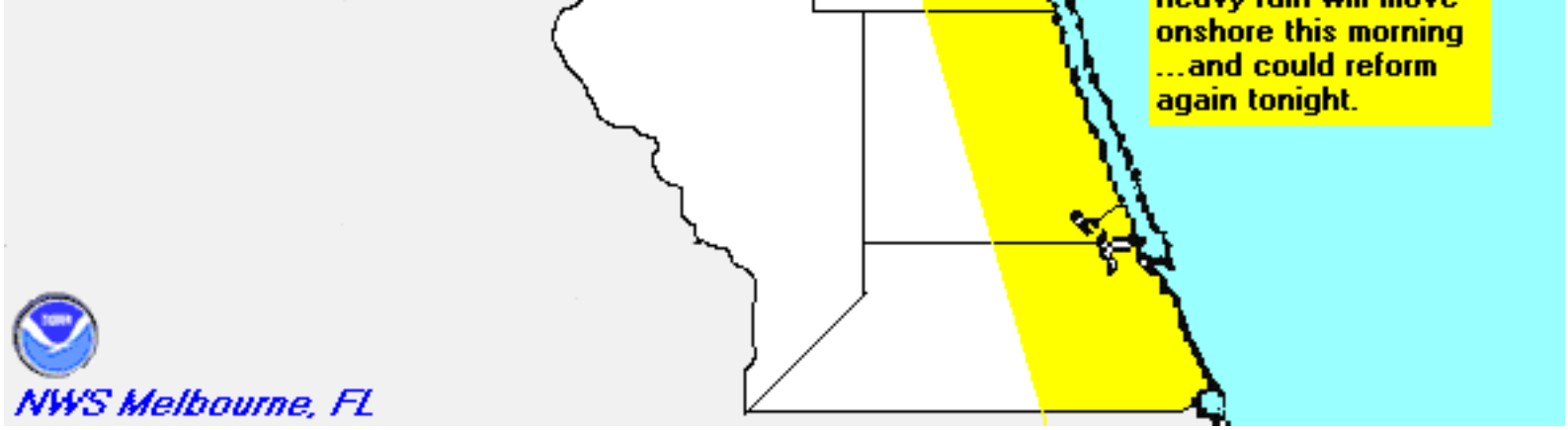
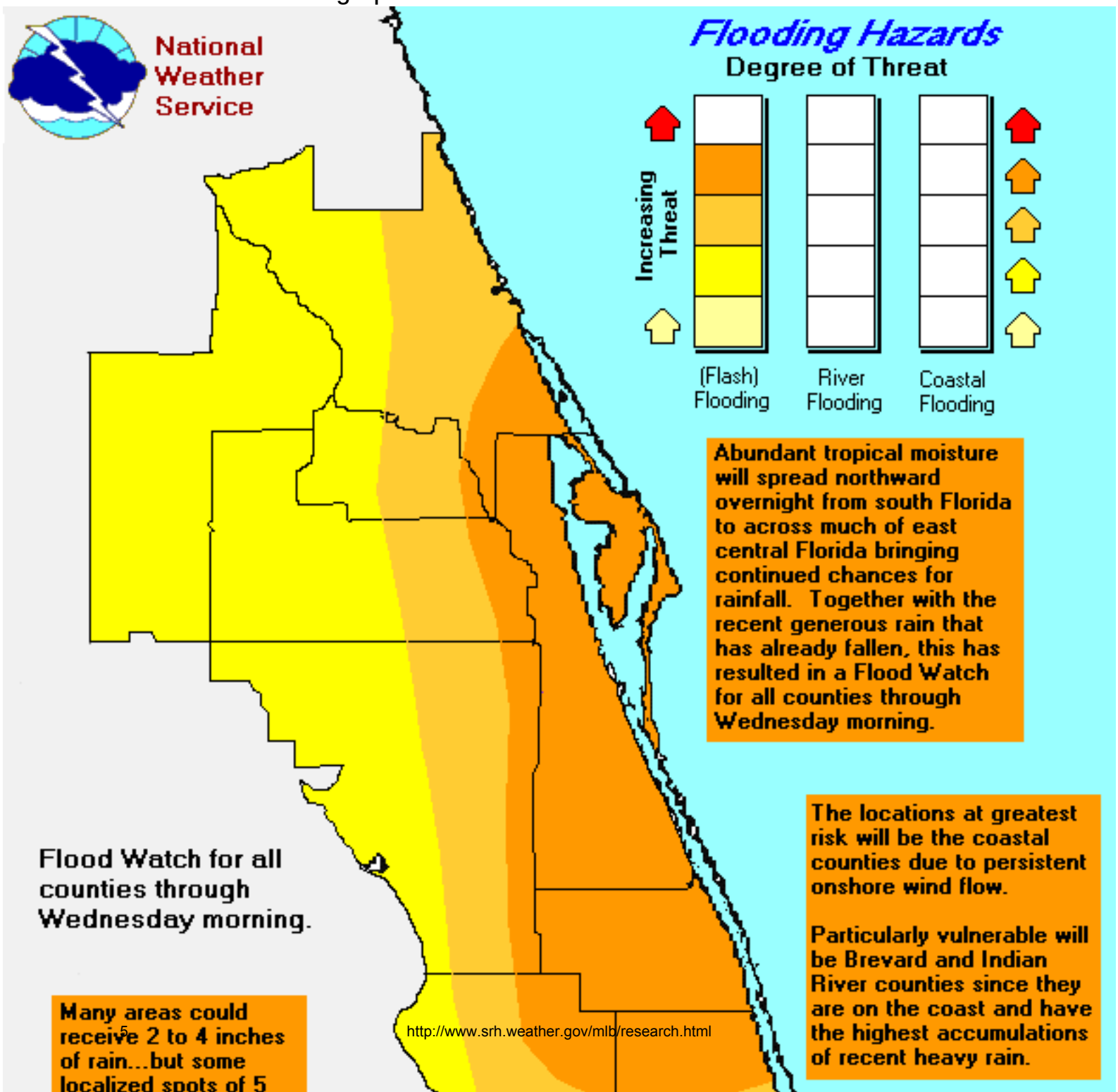


Figure 1. Example of a (Flash) Flood threat depiction from National Weather Service Melbourne's
graphical Hazardous Weather Outlook.



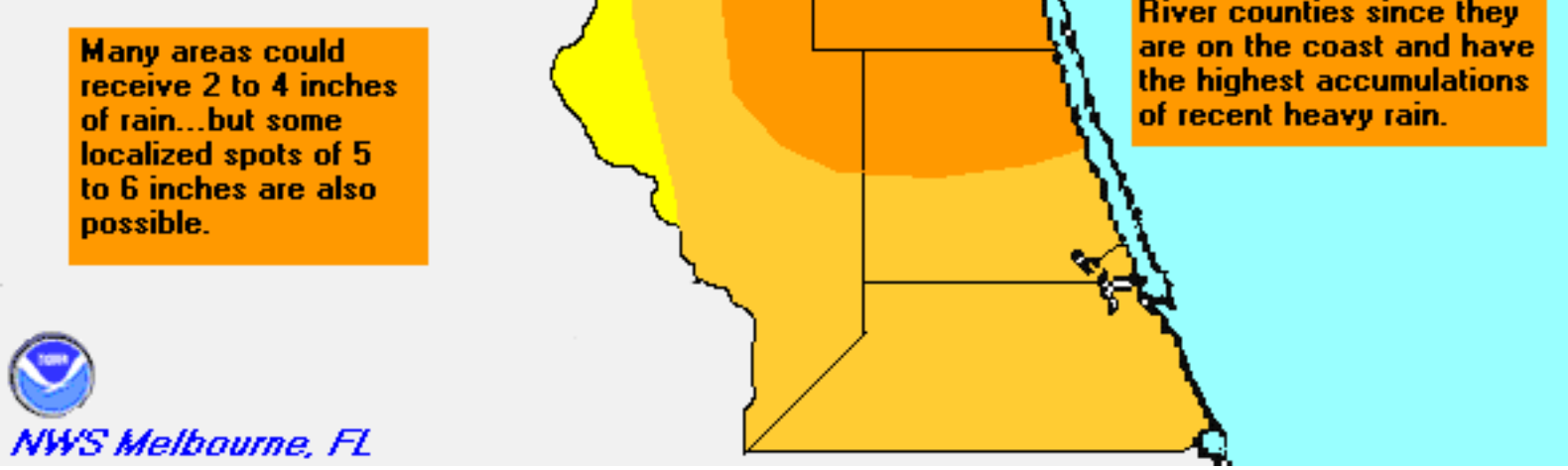


Figure 2. (Flash) Flood threat depiction on October 3, 2000. Note the Degree of Threat and how
this information is then represented on the Threat Area Map.

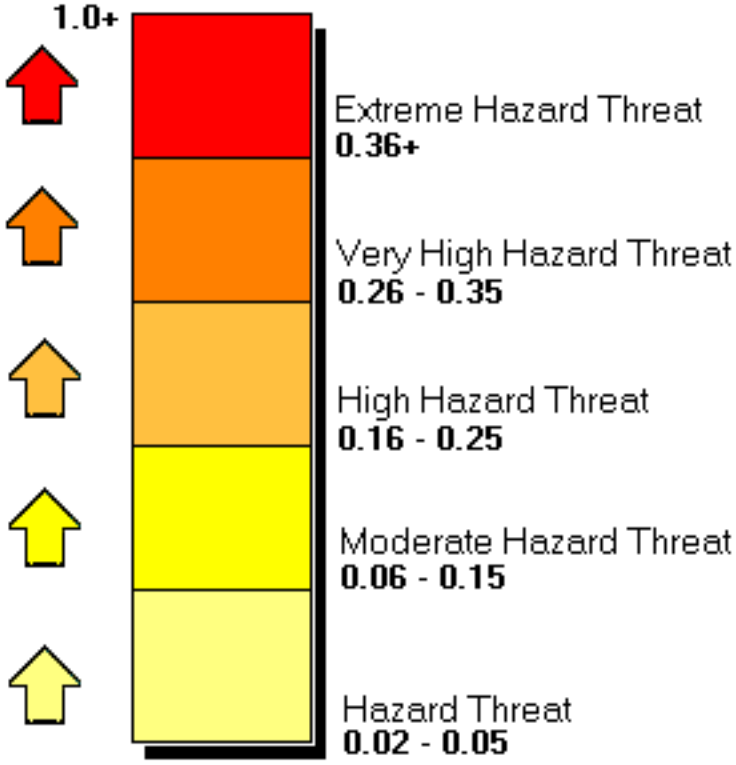


Figure 3. Empirically calibrated scale used to determine the maximum Degree of Threat for (Flash)
Flooding when composing the graphical Hazardous Weather Outlook for East-Central Florida.

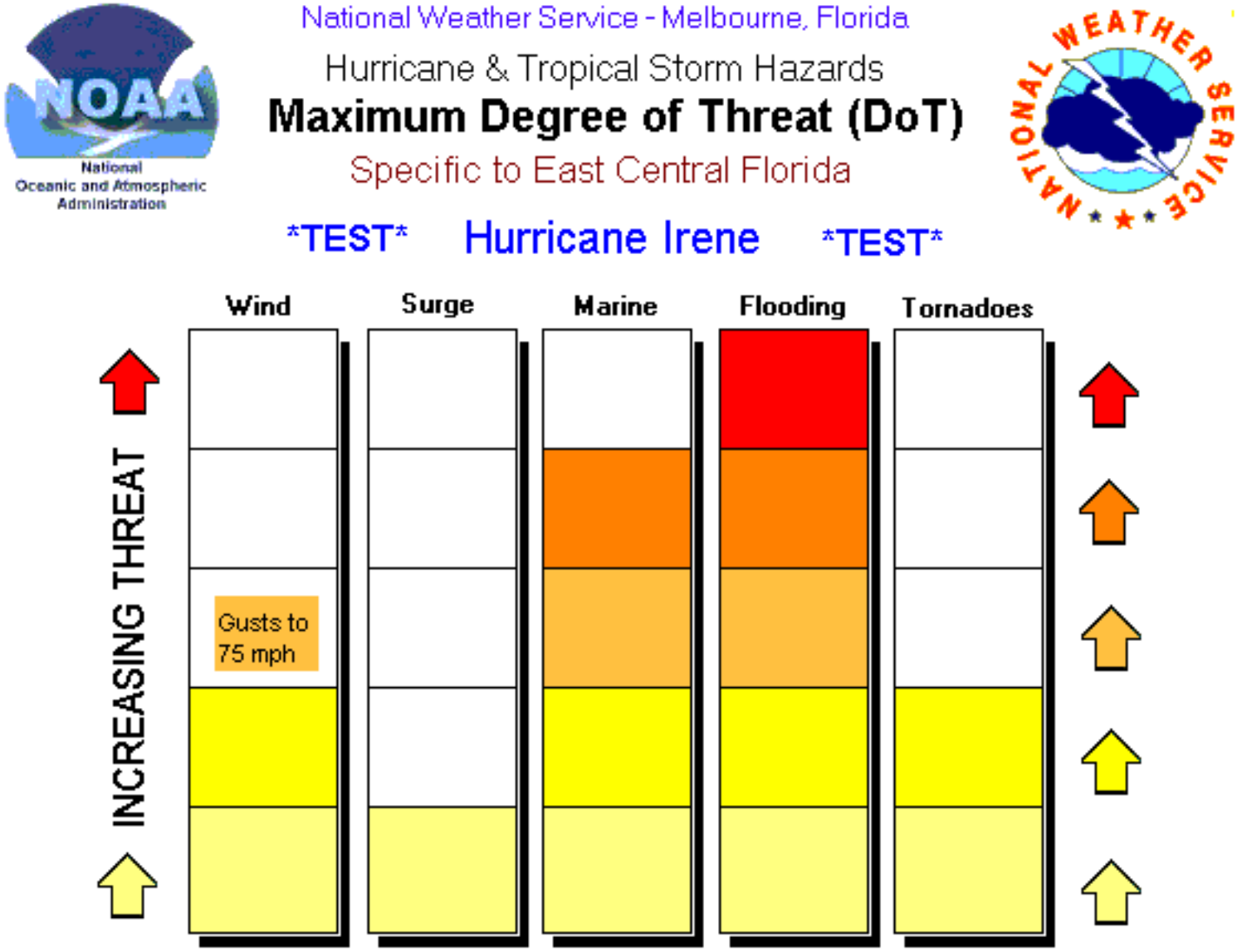


Figure 4. Uniquely, individual hazards can be compared against one another to reveal the greater threats as the tropical cyclone impacts any given area that is under a Hurricane/Tropical Storm Watch/Warning. Importantly, the depiction is geographically-centered and not storm-centered.

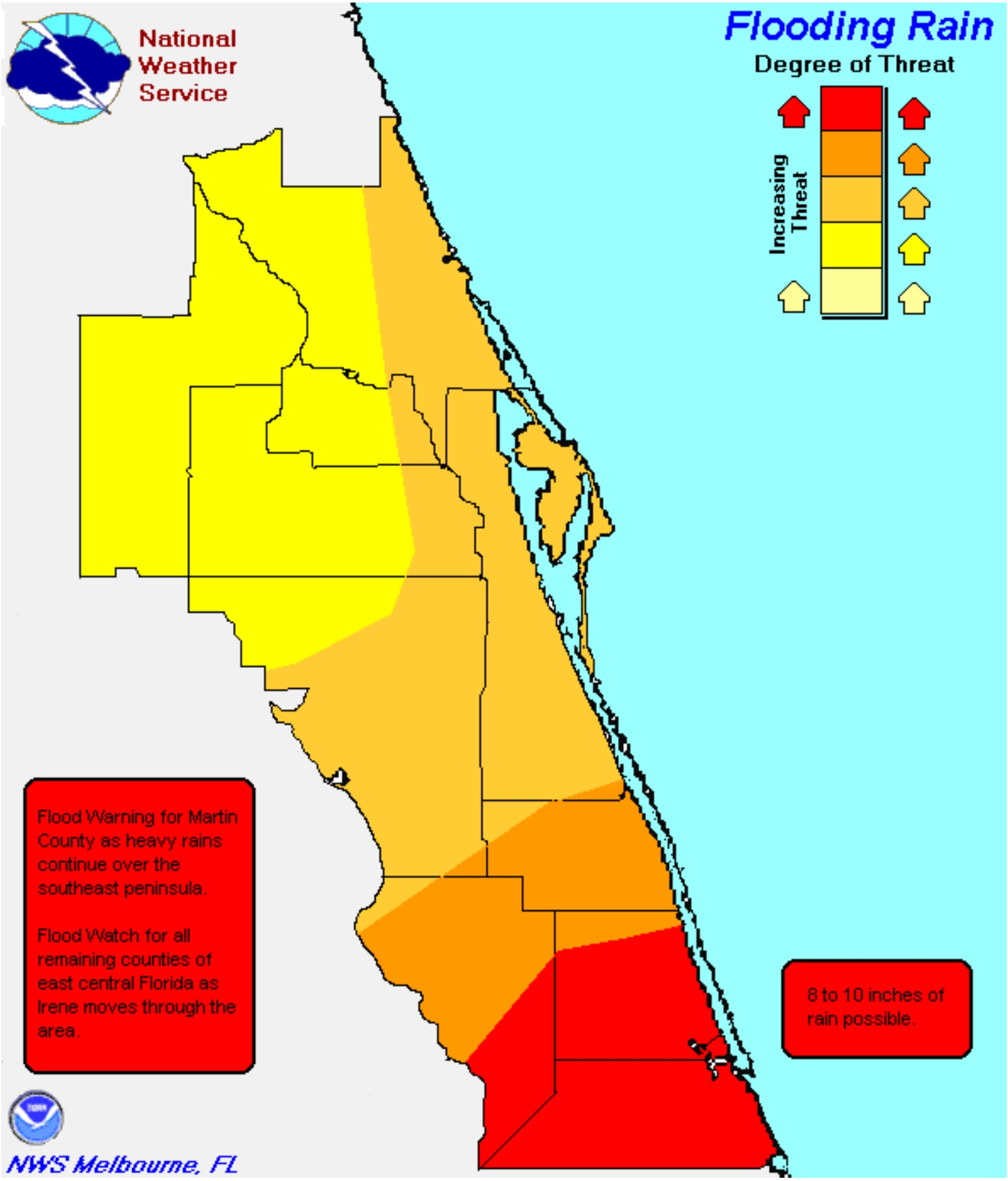


Figure 5. Prototype graphics were created using actual forecast information from the Hurricane Irene

(1999) event. Here is the depiction of flood threat where the greatest flood threat was determined to be
over the southeast section of the forecast area and decreasing north and west.