

Tornado Threats & Impacts with Hurricane Milton

Including Lessons-Learned



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Tornado Threats & Impacts with Hurricane Milton

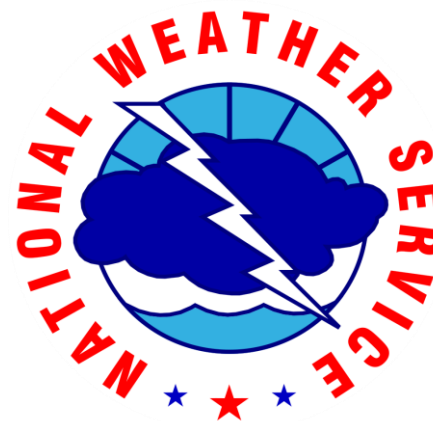
Including Lessons-Learned

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A Quick Background of **Tropical Cyclone Tornadoes**



EF0 Tornado
Hurricane Ian (2022)
Brevard County, FL

Courtesy: Gabe Taylor (FIT)



Damaging Winds & Higher Gusts

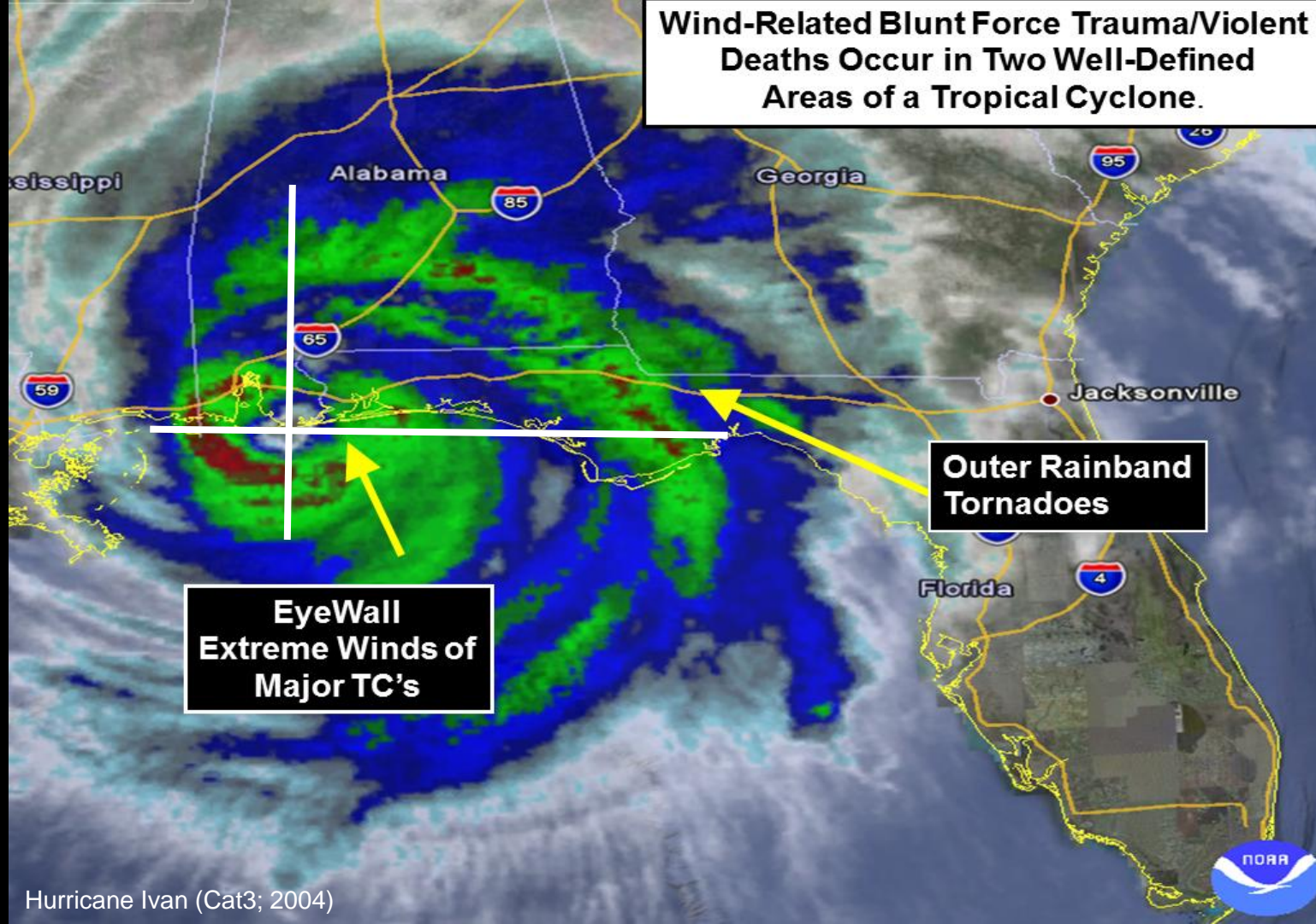


Tornadoes & Tornadic Waterspouts

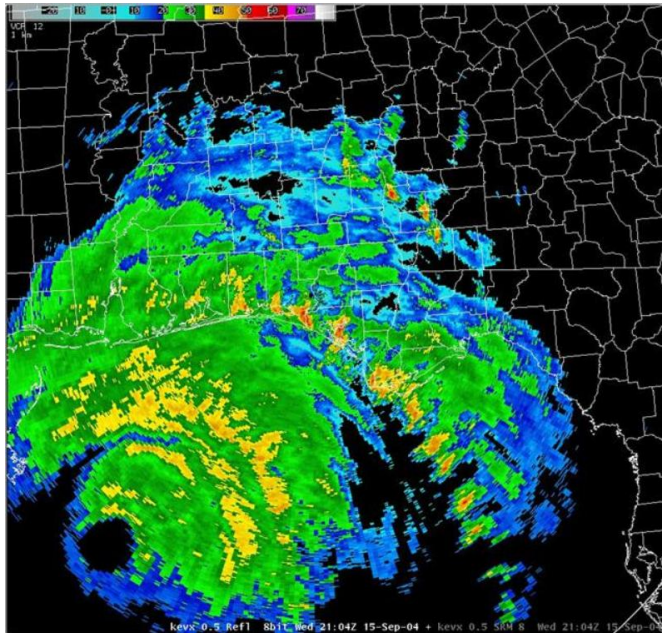
CONSIDERATION:

To most decision-makers, local assessments of the WIND hazard are thought to already contain the collective of wind concerns.

Wind-Related Blunt Force Trauma/Violent Deaths Occur in Two Well-Defined Areas of a Tropical Cyclone.



Hurricane Ivan (Cat3; 2004)



Tornado Outbreak !!!

Hurricane Ivan (2004)

Typically, counties/parishes or cities do not have a tornado contingency within their hurricane emergency plans.

CONCEPTUAL MODELS:

- Tornadoes that occur ***ahead of*** the main wind event.
- Tornadoes that occur ***amidst*** the main wind event.
- Tornadoes that occur ***after*** the main wind event.
- Tornadoes that occur ***in places away from*** the main wind event (in location and/or time); tornadoes are a primary hazard.
- Tornadoes that occur ***post-landfall*** over inland locations; tornadoes are a primary hazard.

TC Tornadoes

Often occur in outer rainbands

- Typically the right front quadrant

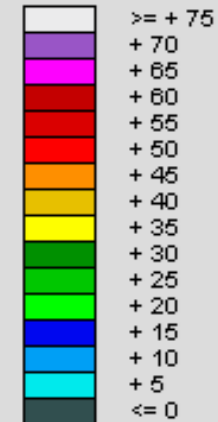
Often occur in families

- But can be isolated in occurrence

Often weaker, narrower, and brief

- But can be stronger, wider, and have longer tracks

Legend: (Category) dBZ

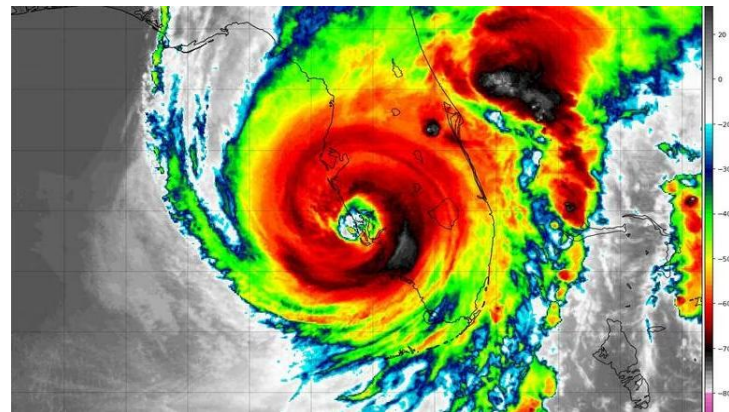
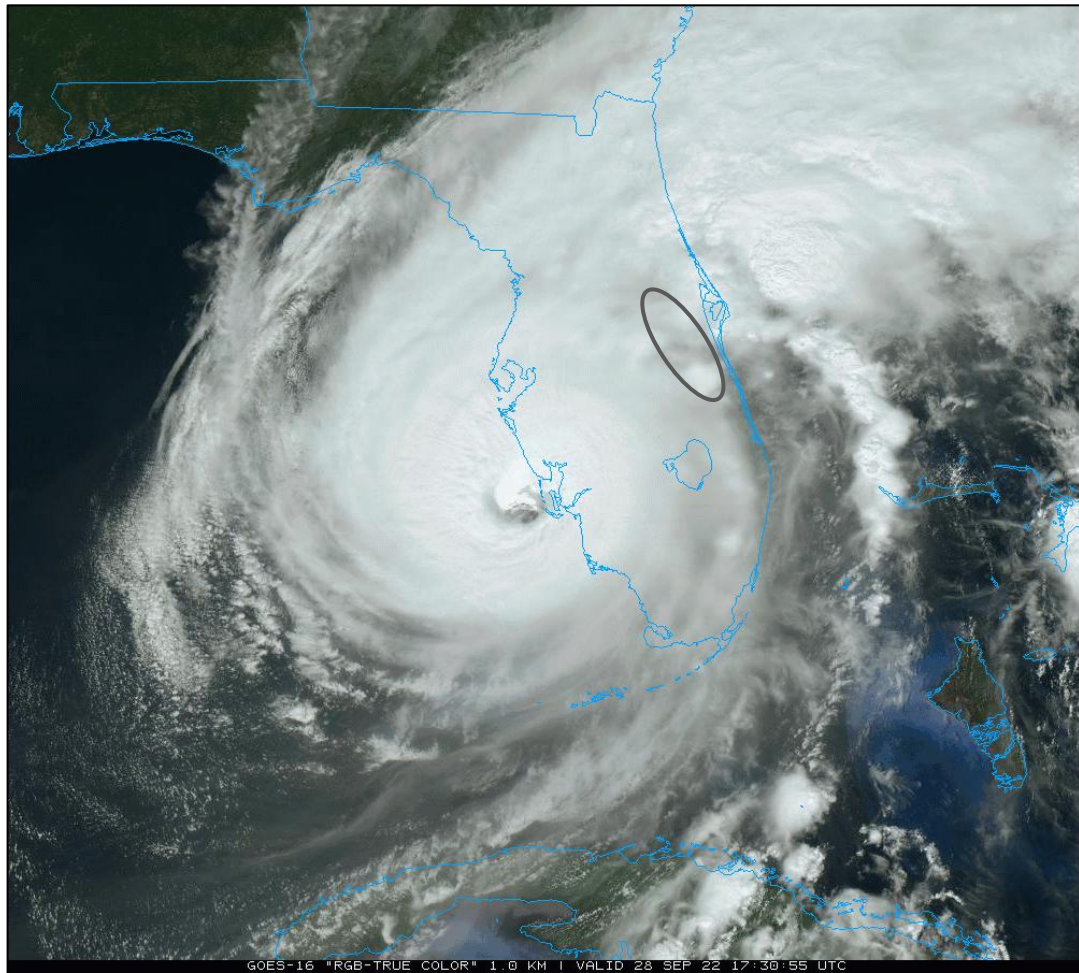


Hurricane Opal (Cat3; 1995)



Hurricane Ian

28 SEP 2022

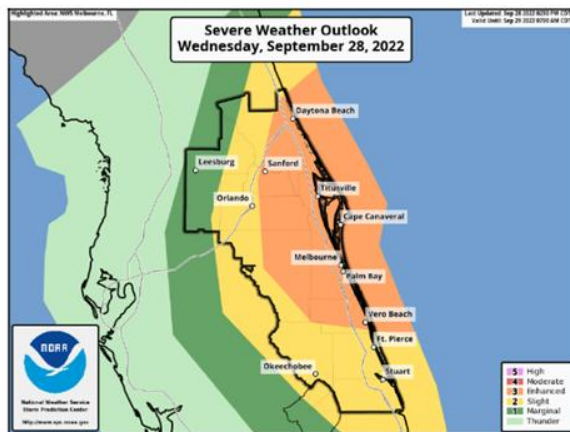




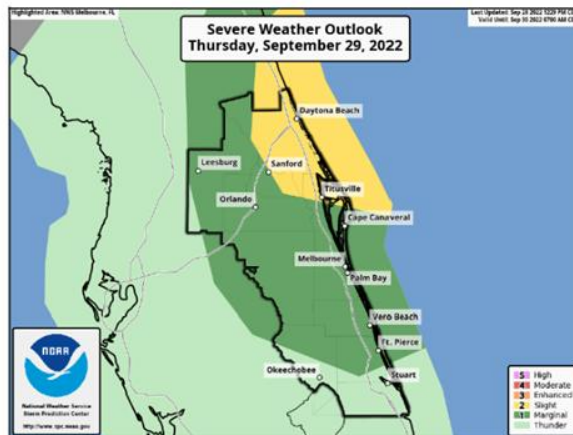
Severe Weather Outlook

Hurricane Ian

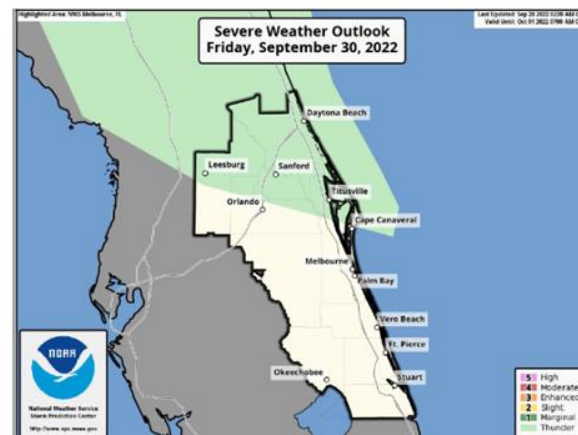
Day 1: Today and Tonight



Day 2: Thursday & Thursday Night



Day 3: Friday & Friday Night



East Central Florida:

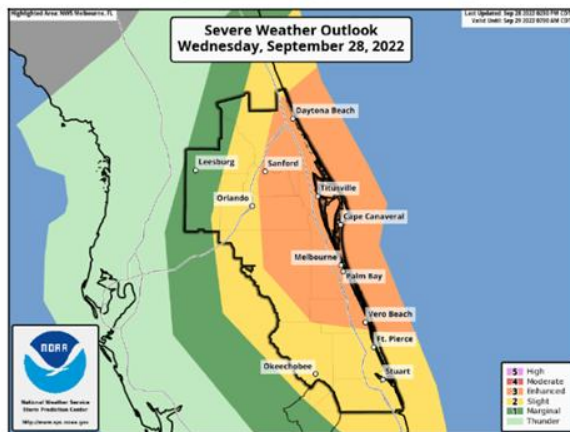
- As Ian continues to approach, strengthening wind profiles will increase the threat for tornadoes within outer rain bands. A Tornado Watch is in effect for much of East Central Florida through 5 PM, and will likely be extended beyond.



Severe Weather Outlook

Hurricane Ian

Day 1: Today and Tonight



Storm Prediction Center

Understanding Severe Thunderstorm Risk Categories

THUNDERSTORMS (no label)	1 - MARGINAL (MRGL)	2 - SLIGHT (SLGT)	3 - ENHANCED (ENH)	4 - MODERATE (MDT)	5 - HIGH (HIGH)
No severe* thunderstorms expected	Isolated severe thunderstorms possible	Scattered severe storms possible	Numerous severe storms possible	Widespread severe storms likely	Widespread severe storms expected
Lightning/flooding threats exist with all thunderstorms	Limited in duration and/or coverage and/or intensity	Short-lived and/or not widespread, isolated intense storms possible	More persistent and/or widespread, a few intense	Long-lived, widespread and intense	Long-lived, very widespread and particularly intense

Within 25 miles of a location

East Central Florida:

- As Ian continues to approach, strengthening wind profiles will increase the threat for tornadoes within outer rain bands. A Tornado Watch is in effect for much of East Central Florida through 5 PM, and will likely be extended beyond.



Hazards Assessment

Hurricane Ian

Tornado Threat



To accommodate different time & space scales.

Time to Hunker-Down

Threat Level - Potential for several tornadoes

Potential Impacts Include:

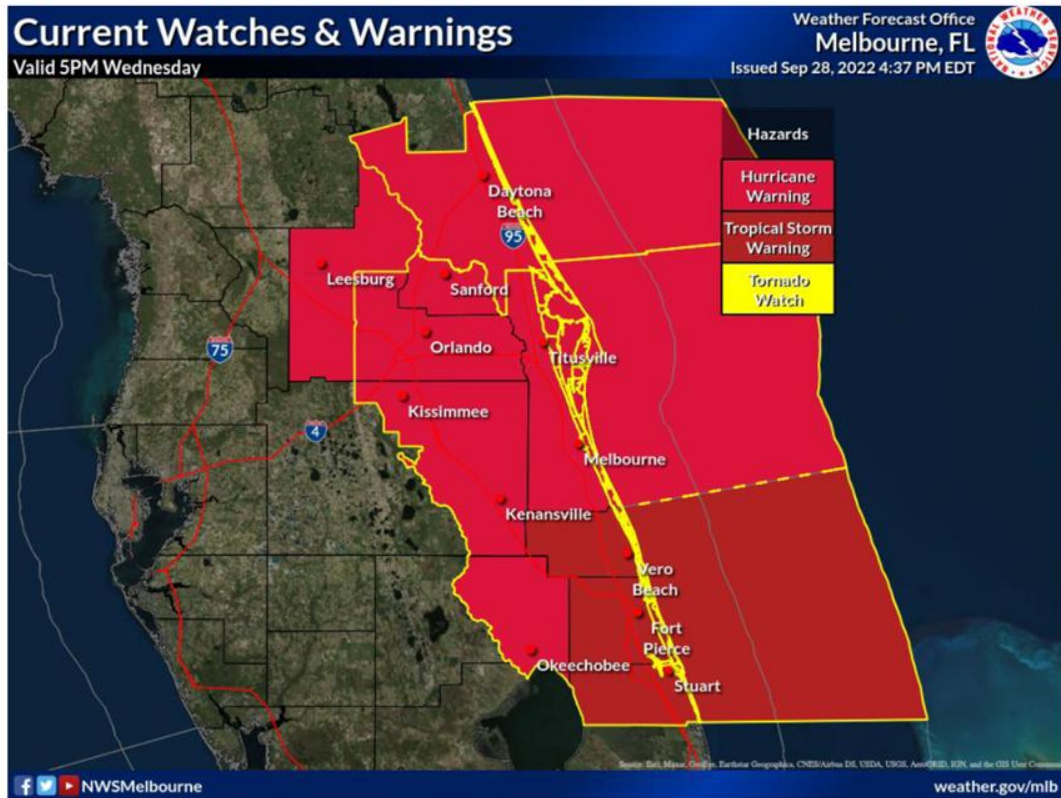
- * Several places may experience tornado damage with a few spots of considerable damage, power loss, and communications failures.
- * Locations could realize roofs torn off frame houses, mobile homes demolished, boxcars overturned, large trees snapped or uprooted, vehicles tumbled, and small boats tossed about. Dangerous projectiles can add to the toll.

- Tornadoes with tropical cyclones are typically short-lived and occur in families. They bring an increased threat to life, along with narrow swaths of enhanced wind damage.



Watches & Warnings

Hurricane Ian



Graphic for ECFL only; Watches/Warnings cover larger areas

Hurricane Warnings

- Volusia, Lake, Brevard, Seminole, Orange, Osceola, and Okeechobee counties

Tropical Storm Warnings

- Indian River, St. Lucie, and Martin counties and adjacent coastal waters

Tornado Watch

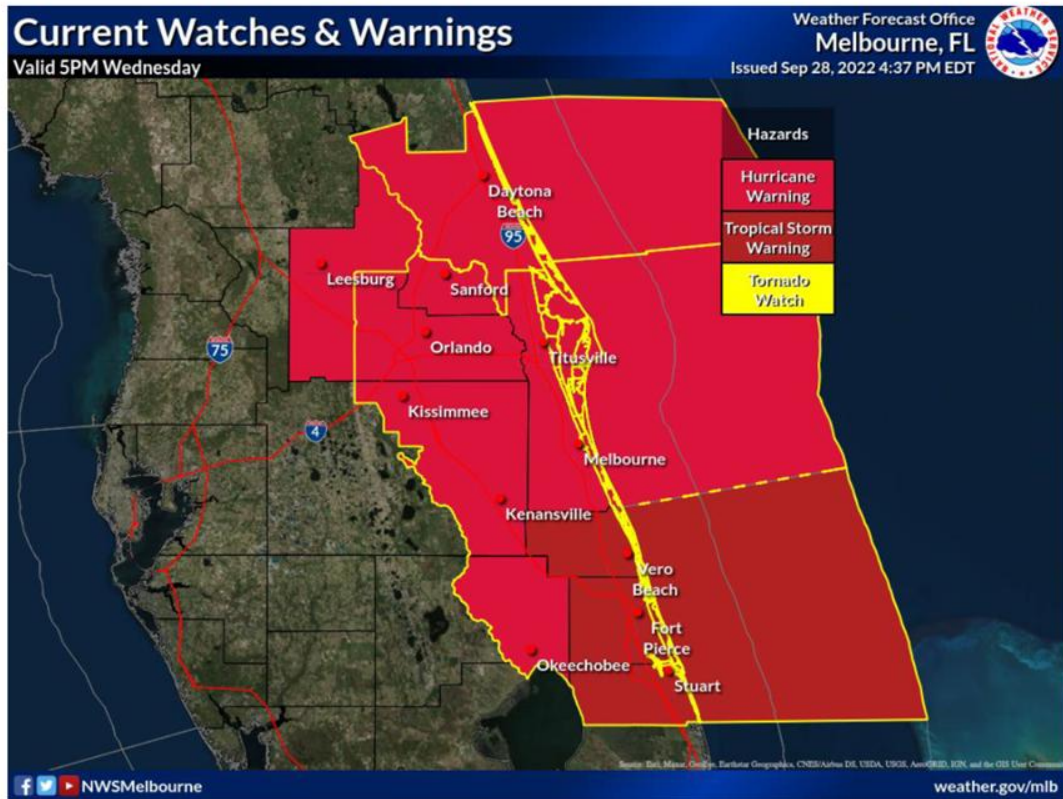
- All counties except Lake County through 1:00 a.m.





Watches & Warnings

Hurricane Ian



Graphic for ECFL only; Watches/Warnings cover larger areas

Hurricane Warnings

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Tropical Storm Warnings

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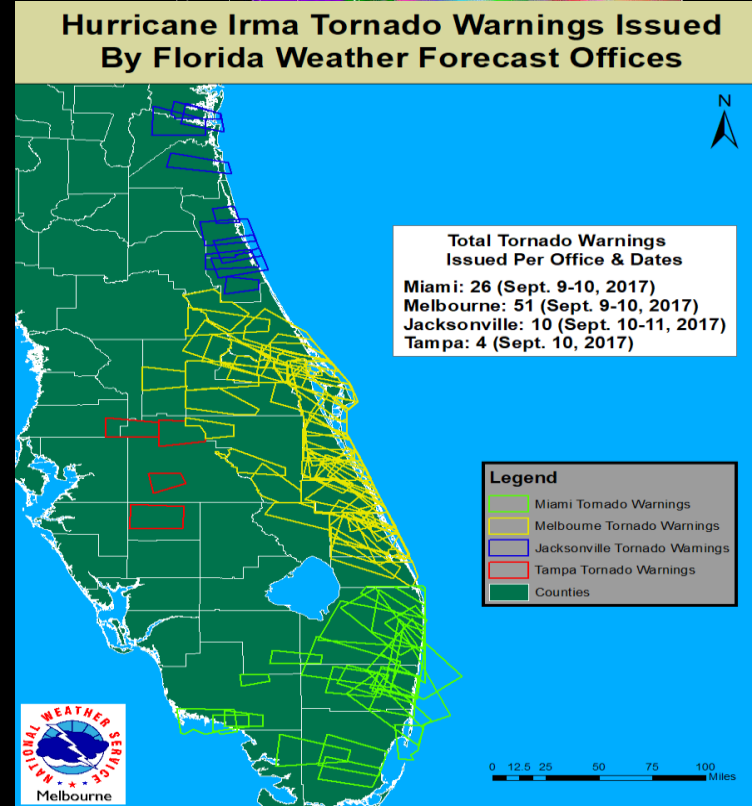
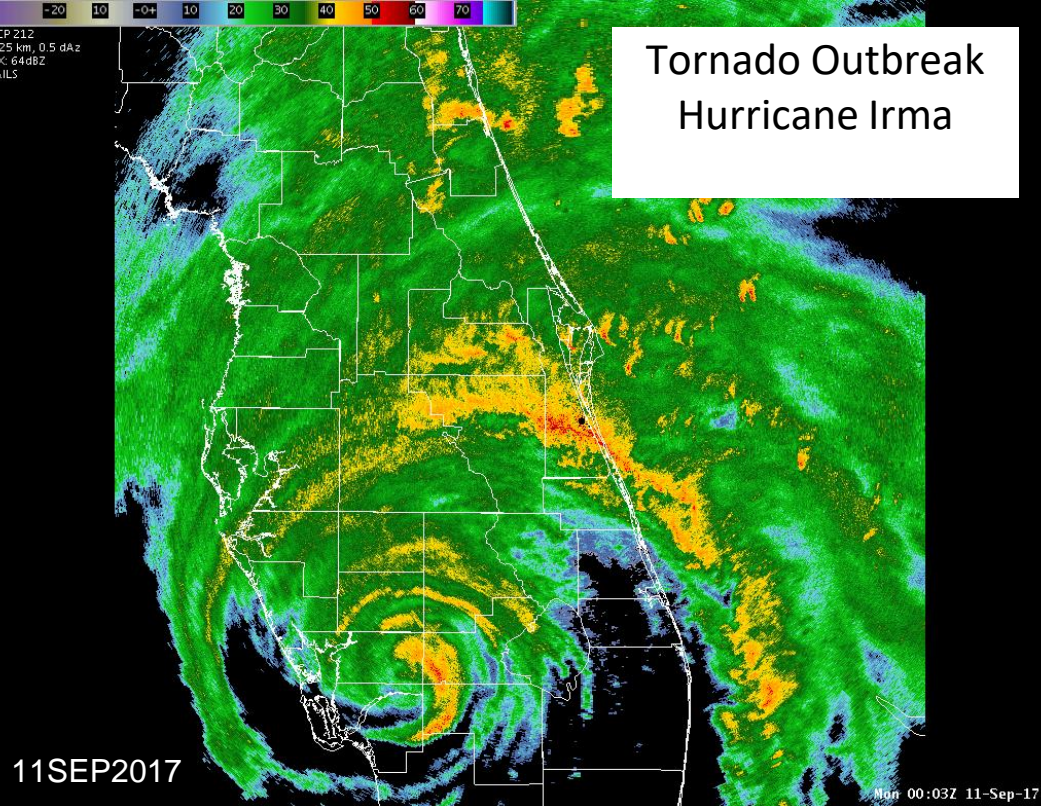
Flood Watch

- All East Central Florida counties

Tornado Watch

- All counties except Lake County through 1:00 a.m.





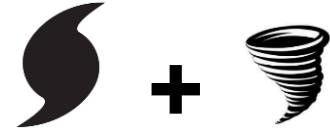
EM Focus Groups:

EM REQUEST: If hurricane warnings are in effect, related tornado warnings should only be issued when the immediate threat to life exceeds that currently posed by the background wind itself. {hmm ...}

Tornado Warnings: Situational Safety Instruction

*Where are the people?
What are they doing?
What must they do right now?*

- During Preparedness & Evacuations
- When Hunkered-Down
- During Initial Response & Recovery



According to the
**Phase of the
Hurricane Event**



Tornadoes While Preparing For Tropical Systems

Have Multiple Ways To Receive Warnings!



WEATHER FORECAST OFFICE

Melbourne Florida

When A Tornado Warning Is Issued During Preparations...



Stop what you are doing



Find safe shelter. Remember, mobile homes are not safe options to shelter from a tornado

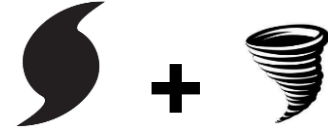


Move indoors immediately



Have multiple ways to receive warnings while outside or away from home!

weather.gov/safety/tornado



Be sure to

COORDINATE
Public Safety Messages

Situational Infographics
for Web Pages &
Social Media



Tornadoes During Evacuations

Find Safe Shelter



WEATHER FORECAST OFFICE

Melbourne Florida

When A Tornado Warning Is Issued During An Evacuation...



Pull to the side of the road and turn your emergency flashers ON

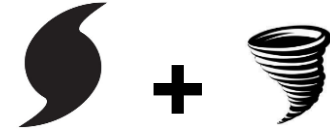


Get to a safe building. Sheds, storage facilities, & overpasses are not safe



As a last resort, get down in your car & cover your head, or abandon your car & seek shelter in a low-lying area

weather.gov/safety/tornado



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Situational Infographics
for Web Pages &
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Tornadoes During Tropical Events

You're Already Sheltering. Now what?



WEATHER FORECAST OFFICE

Melbourne Florida

**When A Tornado Warning Is
Issued For Your Area...**



Move quickly to the safest place inside your shelter



Consider setting up supplies like flashlights, pillows, and pet leashes beforehand

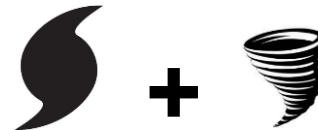


Protect your head and neck



Have multiple ways to receive warnings, even if you lose power!

weather.gov/safety/tornado



Be sure to

COORDINATE
Public Safety Messages

Situational Infographics
for Web Pages &
Social Media



Tornadoes During Recovery Efforts

Have Ways To Receive Warnings Without Power!



WEATHER FORECAST OFFICE

— Melbourne Florida —

*Tornadoes Can Occur Even After The
Main Effects Of A Tropical System*

**When A Tornado Warning Is
Issued During Cleanup Efforts...**



Stop what you are doing

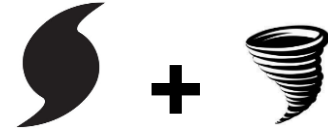


Move indoors immediately. Consider
whether your shelter remains safe after
the storm



Continue to have multiple ways to
receive warnings, even without power
or cell phone service

weather.gov/safety/tornado



Be sure to

COORDINATE
Public Safety Messages

Situational Infographics
for Web Pages &
Social Media



Fact Sheet:

Tropical Cyclone Tornadoes



Near Merritt Island, FL with Hurricane Irma (2017)

Tropical Cyclone (TC) Tornadoes ... are those tornadoes associated with hurricanes and tropical storms. The occurrence of tornadoes during a tropical emergency can interrupt evacuation and preparedness activities before the storm, increase the overall wind danger during the storm, and/or cause emergency response efforts to become more difficult after the storm.

Such tornadoes are typically located away from the TC's center and often within its outer rainbands in the storm's right front quadrant. They can even occur in places that are well-away from the point of landfall, or well-inland as a tropical system weakens after landfall. Importantly, public awareness of a significant TC tornado threat may be lower than traditional tornado situations, making safety messaging more challenging related to the other tropical hazards in play.

Considered least among all tropical hazards, TC tornadoes can still wreak havoc and become deadly. Compared to other tornadoes, TC tornadoes are generally smaller with shorter and more narrow damage paths. Most are weaker, but some can become intense (i.e. EF2 or greater on the tornado intensity scale). It is not uncommon for an outbreak of tornadoes to occur in Florida as rainbands traverse through an area (i.e. tornadoes in families).



When tornadoes threaten during a tropical event ...

- Stay informed, having two ways to receive weather alerts. Listen for Tornado Watches and Warnings.
- Identify the safest place suitable for ready cover. This is often an interior room on the lowest floor away from windows.
- If a Tornado Warning is issued, move quickly to the identified safe place.
- Protect your head and body making good use of pillows, cushions, helmets, pads, etc.

Some TC Tornado Events in FL:

Milton (2024)	Opal (1995)
Irma (2017)	Gordon (1994)
Ivan (2004)	David (1979)
Josephine (1996)	Agnes (1972)



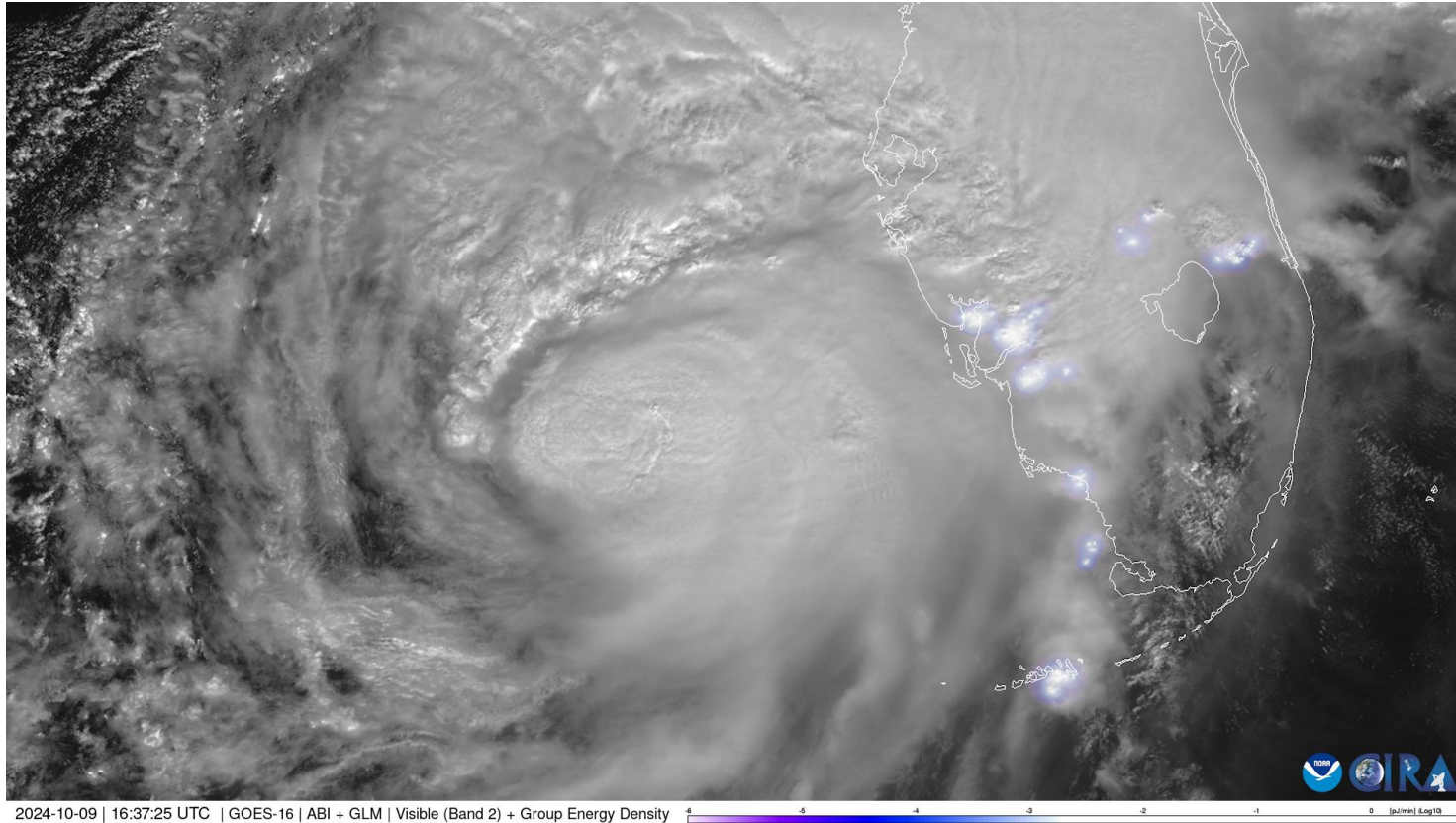
National Weather Service
Melbourne, FL
www.weather.gov/mlb/

Media Fact Sheets

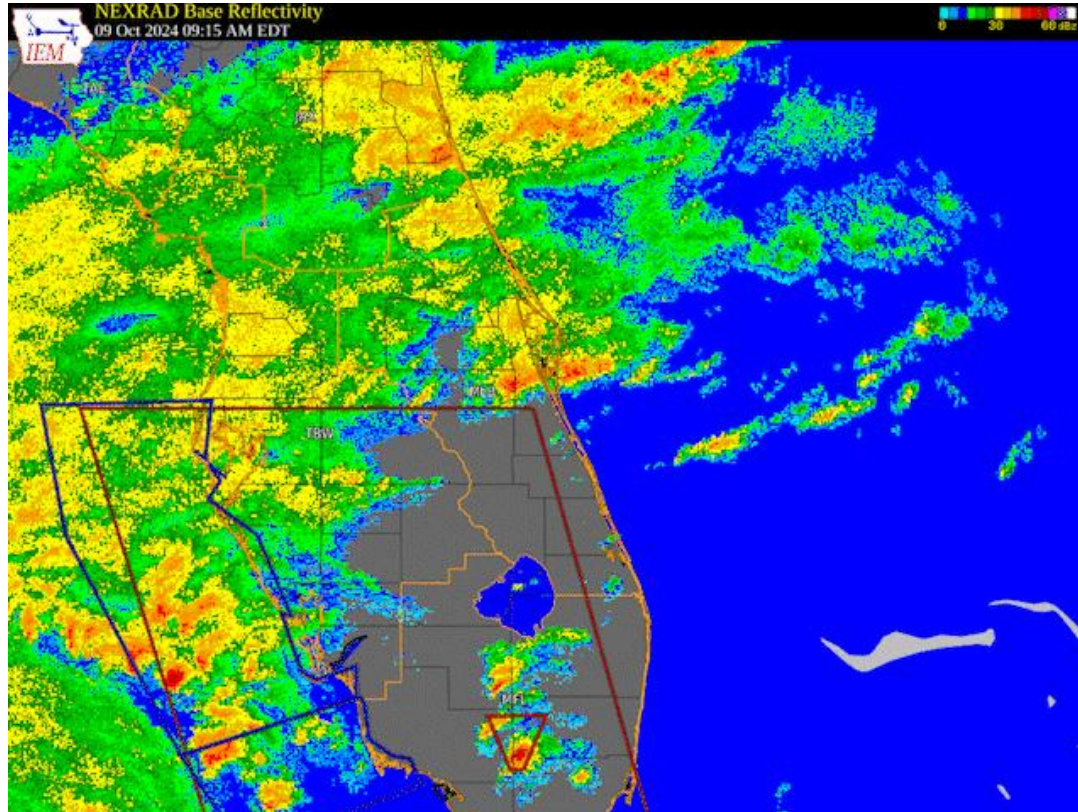
Pre-made hand-outs;
ready to give to reporters



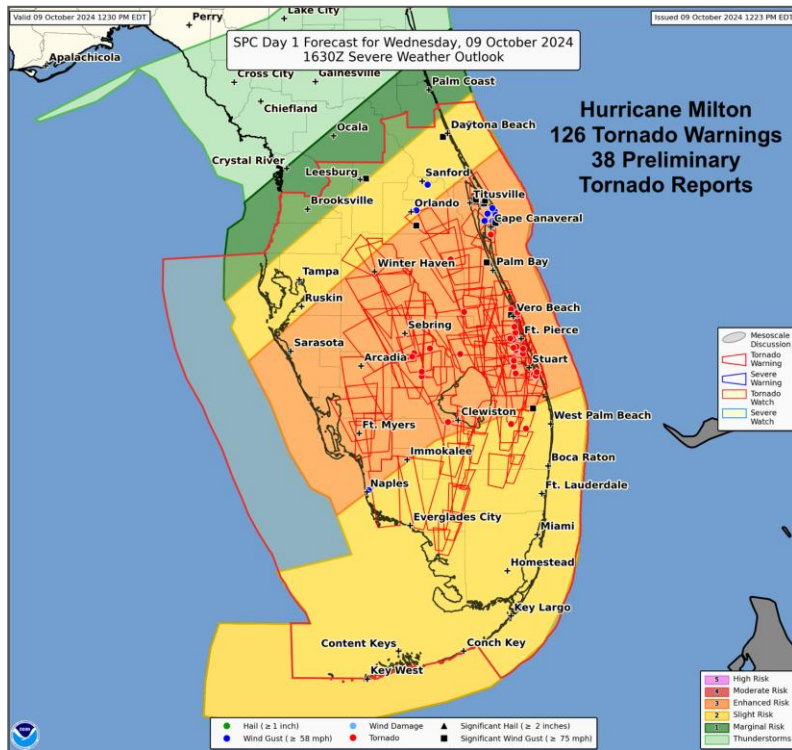
A Review: Hurricane Milton Tornadoes



A Review: Hurricane Milton Tornadoes



A Review: Hurricane Milton Tornadoes



Tornado Warnings

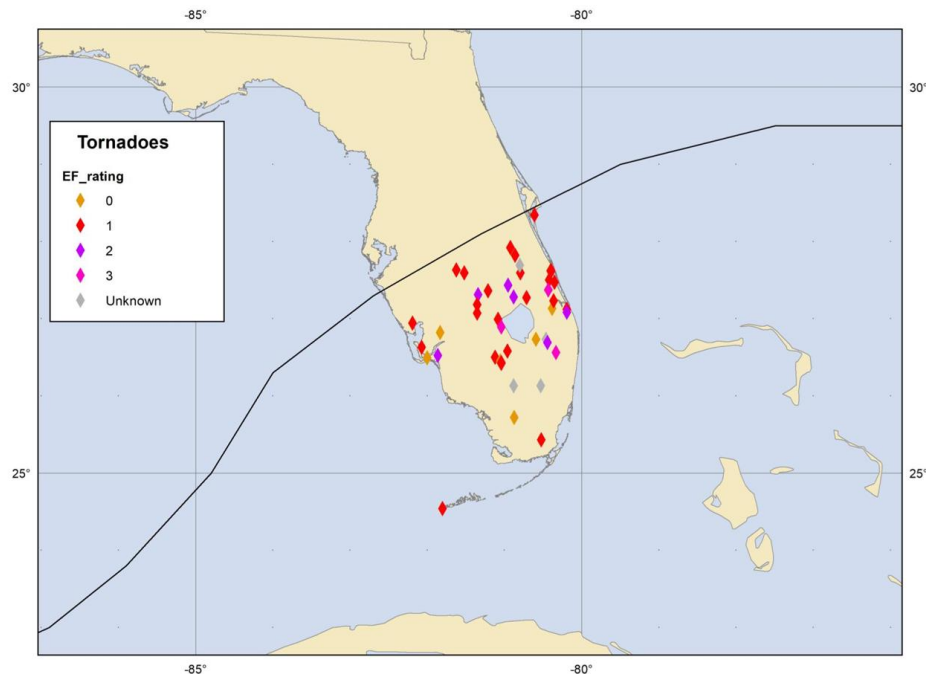
- NWS offices issued **126** tornado warnings, mostly within a 14-hour period
- The second largest number for a single state on a single day
 - 134 in Alabama on April 27, 2011

A Review: Hurricane Milton Tornadoes



Confirmed Tornadoes

- NWS confirmed 45 tornadoes over central and south Florida
 - 6 EF-2s
 - 3 EF-3s
- 6 fatalities



A Review: Hurricane Milton Tornadoes



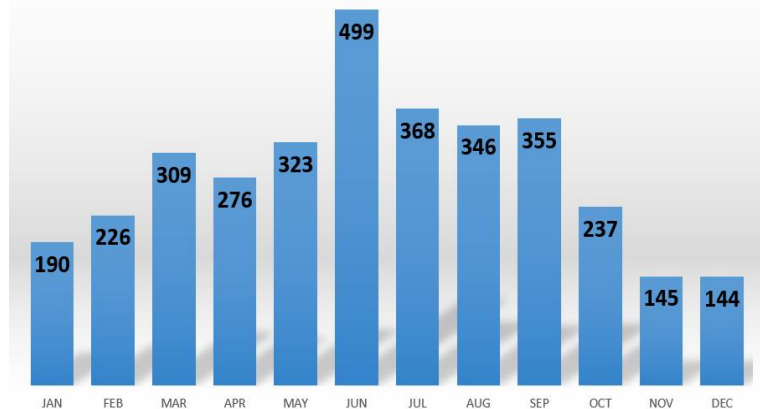
St. Lucie County
October 9, 2024 - Hurricane Milton
1 EF-3 (155 mph)
6 Fatalities



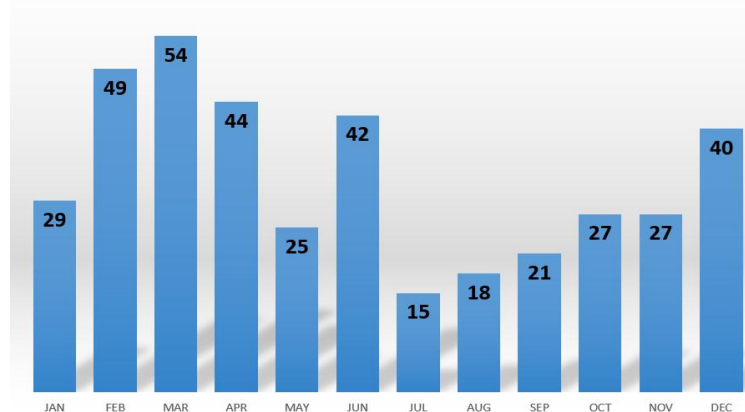
Understanding Tornadoes in Florida



All Tornadoes in Florida by Month
1950-2019



Strong Tornadoes (EF2+) in Florida by Month
1950-2019



- ❑ *Damage and loss of life potential grows exponentially as wind increases.*
- ❑ *94% of all Florida tornado fatalities associated with EF2+ or greater winds.*

Surveying the Damage



St. Lucie County EOC



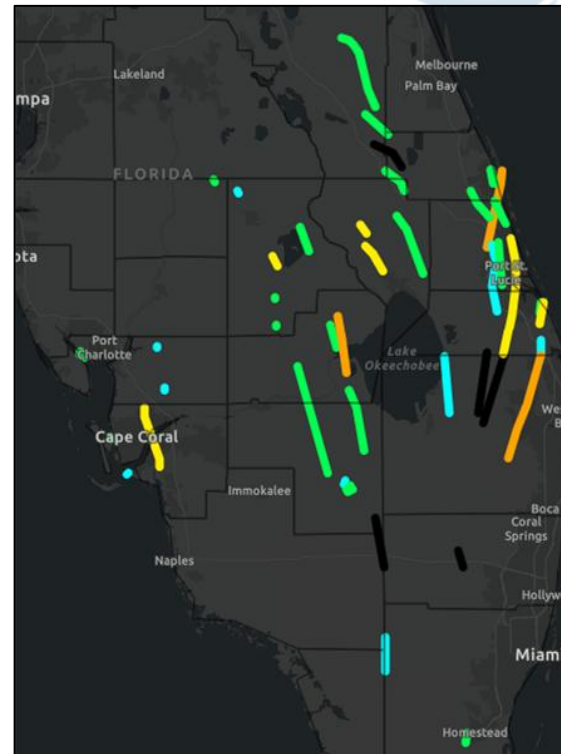
Okeechobee County EOC



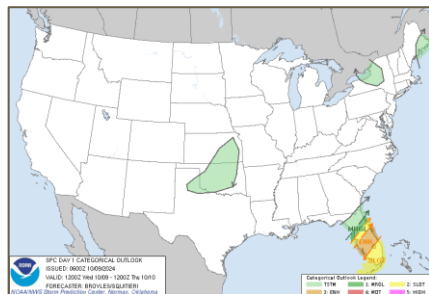
Cocoa Beach, FL



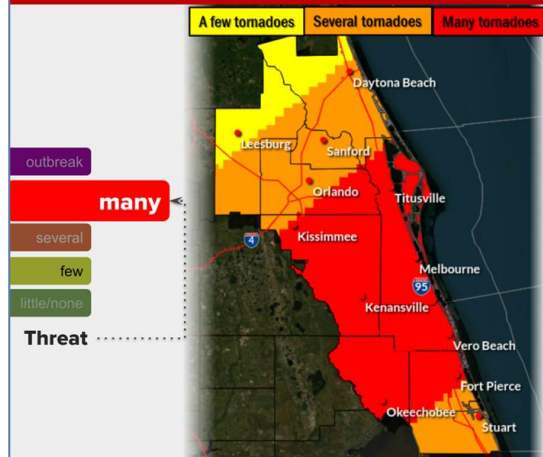
Fort Pierce, FL



Leveraging Informed Design Graphics



Tornado Threat



Several to many tornadoes can hinder emergency plans during tropical events.

Many places may experience...

- Tornado damage, with isolated immense destruction
- Power & communications failures

Examples of potential damage:

- Roof and wall failures of sturdy buildings. Some buildings may be leveled.
- Mobile homes obliterated
- Large trees snapped or twisted
- Vehicles & small boats tossed or destroyed

More Details: [weather.gov/mlb/hti](https://www.weather.gov/mlb/hti)



WEATHER FORECAST OFFICE

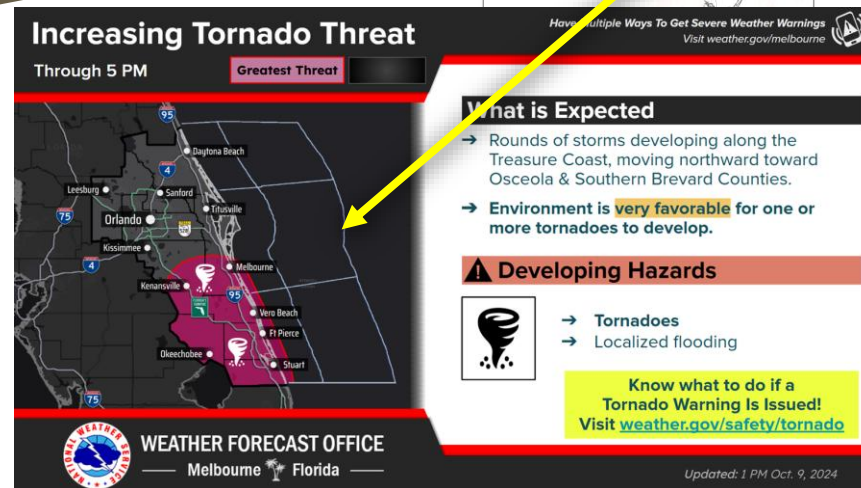
Melbourne Florida

Updated: October 9, 2024

Where We Are Headed...

Our Future, Driven By New Technology & More Frequent Communication

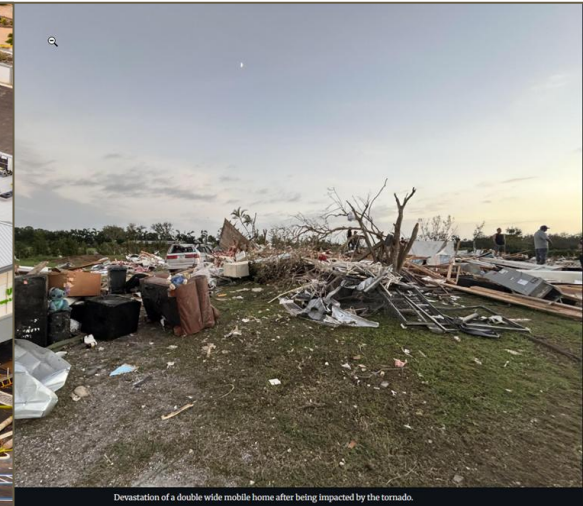
- **More High-Res Models.** Cutting-edge systems like Warn-On-Forecast rapidly integrate surface, radar, and satellite data for the most up-to-date forecasts.
- **Storm-Specific Hazard Predictions.** Using machine learning, we're delivering probabilistic forecasts for individual thunderstorms.
- **Bridging the Gap: Watch to Warning!** High-res data + forecaster expertise = faster, more targeted risk assessments for the public, partners, and media—*before* warnings are issued.



Wellington / Palm Beach Gardens EF-3 Tornado



- Maximum Wind: 140 mph
- 7 injuries



Lakeport (Glades County) EF-3 Tornado



- Maximum Wind: 140 mph
- 3 injuries



Utilizing Real-Time Data Sources



Several tornadoes were captured “live”
via FLDOT highway cameras

Severe Weather Statement

National Weather Service Miami FL
950 AM EDT Wed Oct 9 2024

FLC011-021-051-099-091400-
/O.CON.KMFL.TO.W.0047.00000T000Z-241009T1400Z/
Collier FL-Hendry FL-Broward FL-Palm Beach FL-
950 AM EDT Wed Oct 9 2024

...A TORNADO WARNING REMAINS IN EFFECT UNTIL 1000 AM EDT FOR EASTERN
COLLIER...SOUTHEASTERN HENDRY...NORTHERN BROWARD AND SOUTHWESTERN
PALM BEACH COUNTIES...

At 949 AM EDT, a confirmed tornado was located over Miccosukee Indian
Reservation, or 33 miles south of Montura, moving north at 25 mph.

HAZARD...Damaging tornado.

SOURCE...Video confirmed tornado.

IMPACT...Flying debris will be dangerous to those caught without
shelter. Mobile homes will be damaged or destroyed. Damage
to roofs, windows, and vehicles will occur. Tree damage is
likely.

Locations impacted include...

Miccosukee Indian Reservation, Big Cypress Seminole Reservation, and
Rotenberger Wildlife Refuge.

PRECAUTIONARY/PREPAREDNESS ACTIONS...

To repeat, a tornado is on the ground. TAKE COVER NOW! Move to an
interior room on the lowest floor of a sturdy building. Avoid
windows. If you are outdoors, in a mobile home, or in a vehicle, move
to the closest substantial shelter and protect yourself from flying
debris.



Utilizing Real-Time Data Sources



Other videos received via social media and storm spotters & chasers

BULLETIN - EAS ACTIVATION REQUESTED

Tornado Warning

National Weather Service Miami FL

448 PM EDT Wed Oct 9 2024

The National Weather Service in Miami has issued a

* Tornado Warning for...
Northeastern Palm Beach County in southeastern Florida...

* Until 515 PM EDT.

* At 447 PM EDT, a reported large and extremely dangerous tornado was located near Wellington, moving north at 40 mph.

This is a PARTICULARLY DANGEROUS SITUATION. TAKE COVER NOW!

HAZARD...Damaging tornado.

SOURCE...Weather spotters reported tornado.

IMPACT...You are in a life-threatening situation. Flying debris may be deadly to those caught without shelter. Mobile homes will be destroyed. Considerable damage to homes, businesses, and vehicles is likely and complete destruction is possible.

* Locations impacted include...
Wellington, Palm Beach Gardens, Royal Palm Beach, The Acreage, Loxahatchee Groves, and Loxahatchee NWR.



Wireless Emergency Alerts (WEA)

A joint effort between government & wireless industry that broadcasts emergency alerts to mobile devices.

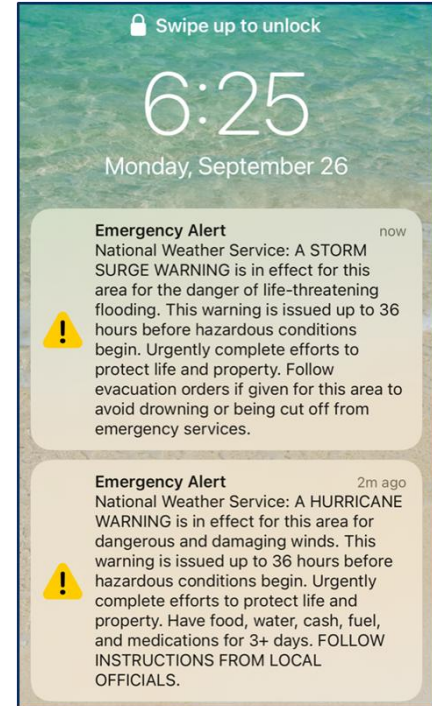
NWS activated WEA for tropical warnings:

- Hurricane Warnings
- Extreme Wind Warnings
- Storm Surge Warnings

Also activated for:

- Tornado Warnings
- Flash Flood Warnings

Geotargeted & not subject to network congestion!



Wireless Emergency Alerts (WEA)

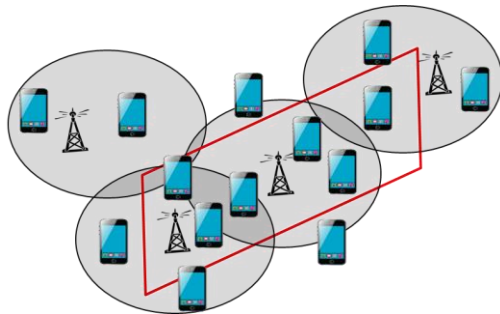
Geotargeting



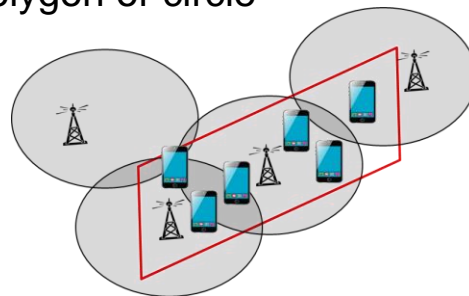
WEA is a cell broadcast from cell antennas in and around the alert area

Phones outside alert area present WEA

when legacy phone, phone unable to determine its location, or alert area only defined by geocodes



Only phones inside alert area present WEA if phone is WEA 3.0 capable, phone knows it's location, and alert area defined by polygon or circle



Note: Wireless carriers attempt to render WEA if phone travels into the alert area

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