

A satellite image of a large hurricane with a well-defined eye and spiral cloud bands, positioned over the Gulf of Mexico. The text is overlaid on the image.

2008 Florida Governor's Hurricane Conference

Tornadoes and Tropical Cyclones

Bart Hagemeyer

NOAA/NWS

Southern Region

Melbourne, Florida



10 DEADLIEST FLORIDA TORNADO OUTBREAKS

FEBRUARY 1998	42 DEAD	
FEBRUARY 2007	21 DEAD	
MARCH 1962	17 DEAD	
APRIL 1966	11 DEAD	
JUNE 1972	7 DEAD	HURRICANE AGNES
JANUARY 1936	7 DEAD	
SEPTEMBER 2004	6 DEAD	HURRICANE IVAN
SEPTEMBER 1882	6 DEAD	HURRICANE
APRIL 1925	5 DEAD	
OCTOBER 1992	4 DEAD	Un-Named Hybrid
MARCH 1939	4 DEAD	

Through 2007

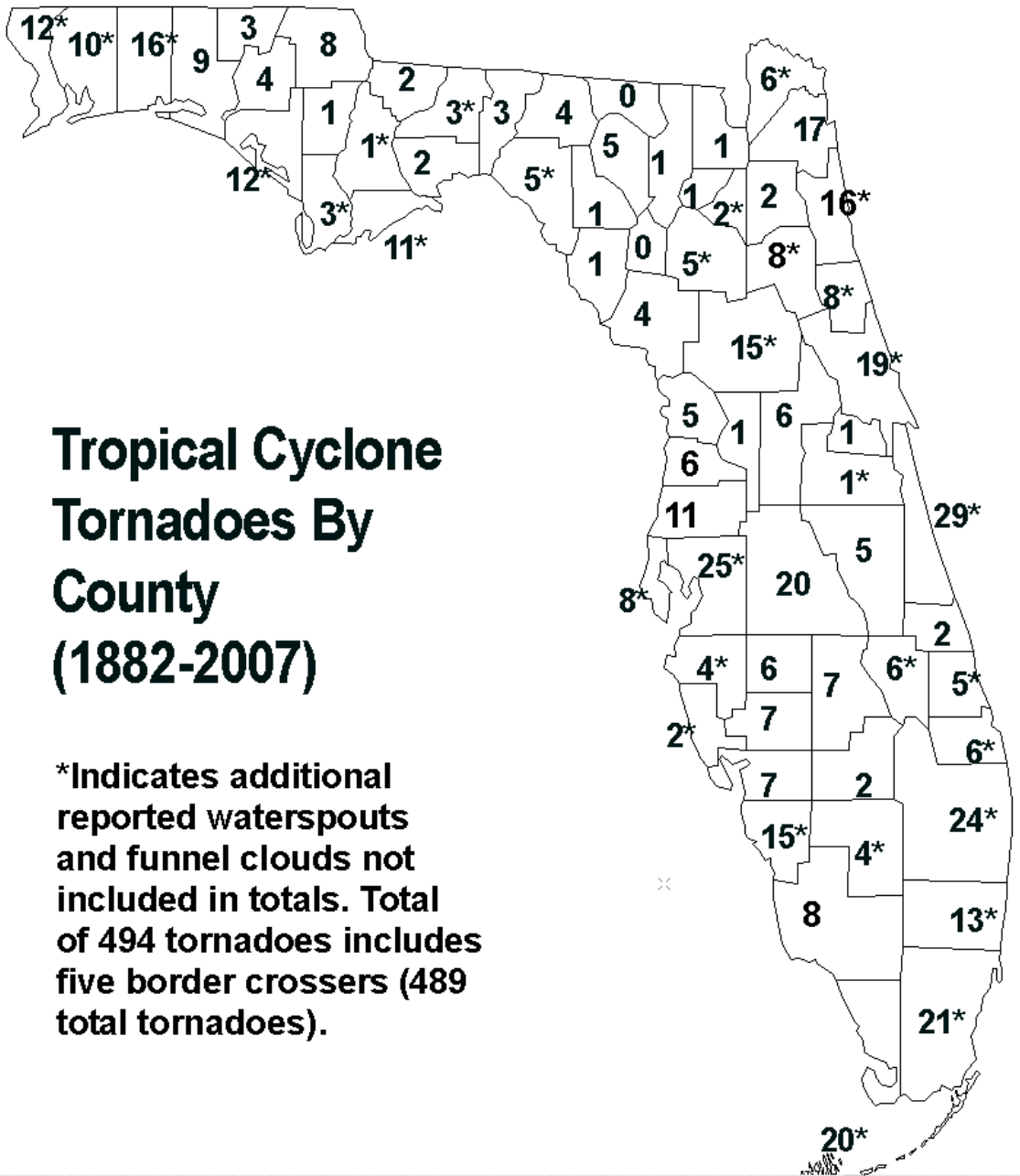
95 Cases in Recorded History (1882-2007)

Florida Tornadoes Associated With Tropical and Sub-Tropical Cyclones 1882-2007									
Case	Date	System Type	Tors		Max F#	Time (EST)	Death	Injury	Location/Storm Center Relative
1	9/9/82	Hurricane	5	+	2	eve-am 10th	6	17	NW-N Central/ rf
2	10/11/85	t. storm	1		2	2355	0	8	alachua/rr
3	9/10/1919	hurricane	1		2	112	0	6	dade/ rf
4	9/28/29	hurricane	4		2	aft-eve	0	16	SE/RF
5	10/4/33	hurricane	3		2	eve-am 5th	0	3	southeast/lf
6	9/20/37	t. storm	1		2	2100	0	0	st.johns/ rf
7	10/20/41	t. storm	2		2	afternoon	1	1	n central/ rf
8	10/18/44	hurricane	3		1	afternoon	0	0	w central/ rf

-	9/20/05	H. Rita	0	*	n/a	1125 EST	0	0	Palm Beach/RR
90	10/23 to 24/05	H. Wilma	10		2	AFT 23rd - AM24th	0	0	Keys - Central/RF-F
91	6/12 to 13/06	TS Alberto	7	*	0	AM 12th - AM 13th	0	0	Central - North/RF
92	8/24 to 25/ 06	TS Ernesto	2		0	AFT of 24 &25	0	0	EC and North/RF
93	6/1/07	TS Barry	2		1	late AM - PM	0	0	Keys & Dade/RF
94	9/20/07	Pre TD#10	2		1	Evening	0	0	NC/RF
95	12/16/07	Post-Olga	1		1	early AM	0	0	WC/RF
			489		1.34		33	729	
Case	Date	System Type	Tors		Max F#	Time (EST)	Death	Injury	Location/Storm Center Relative

2007 – 3 Weak Tropical Systems – 5 Tornadoes

Tornadoes Have Occurred In 65 of 67 Counties



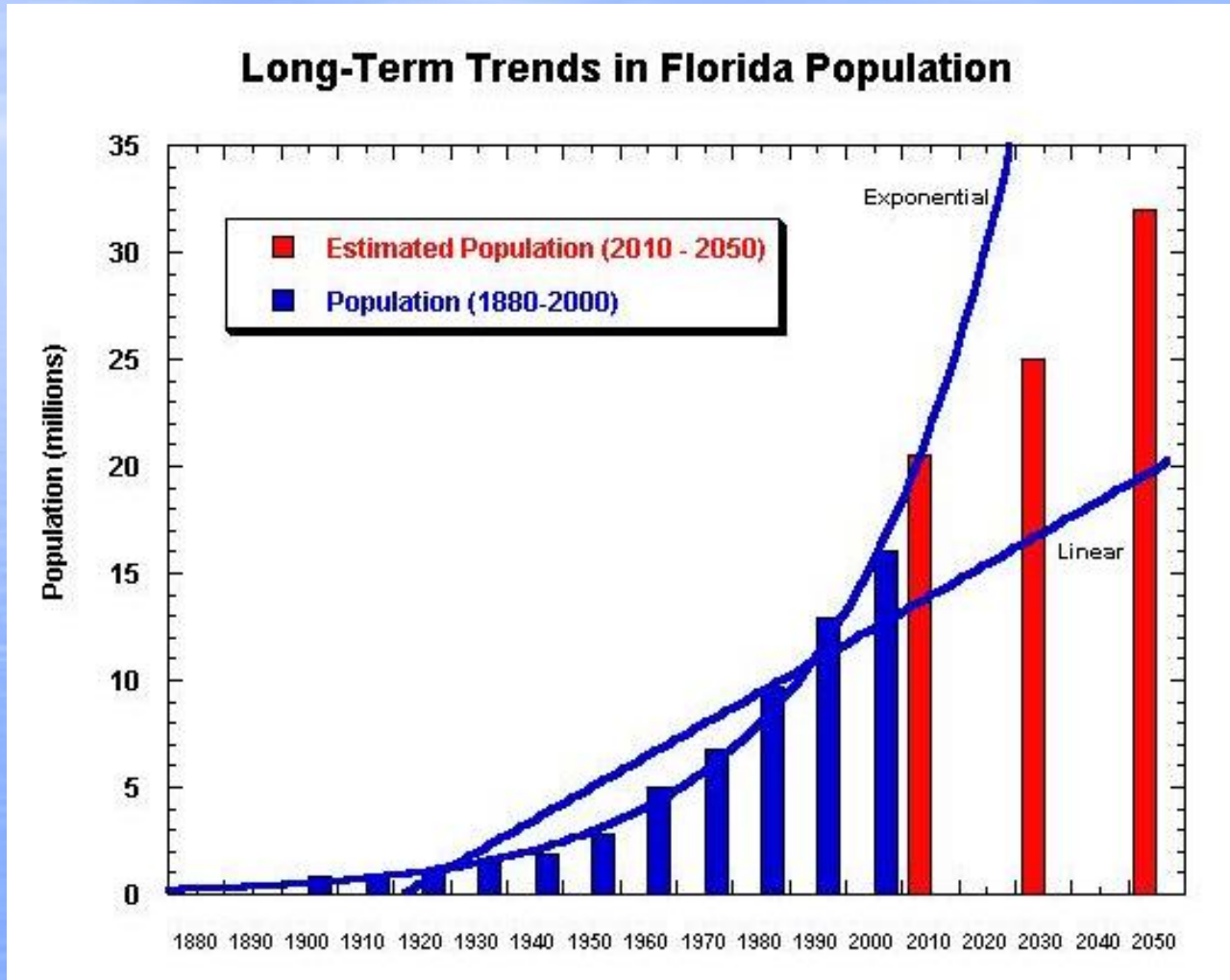
Tropical Cyclone Tornadoes By County (1882-2007)

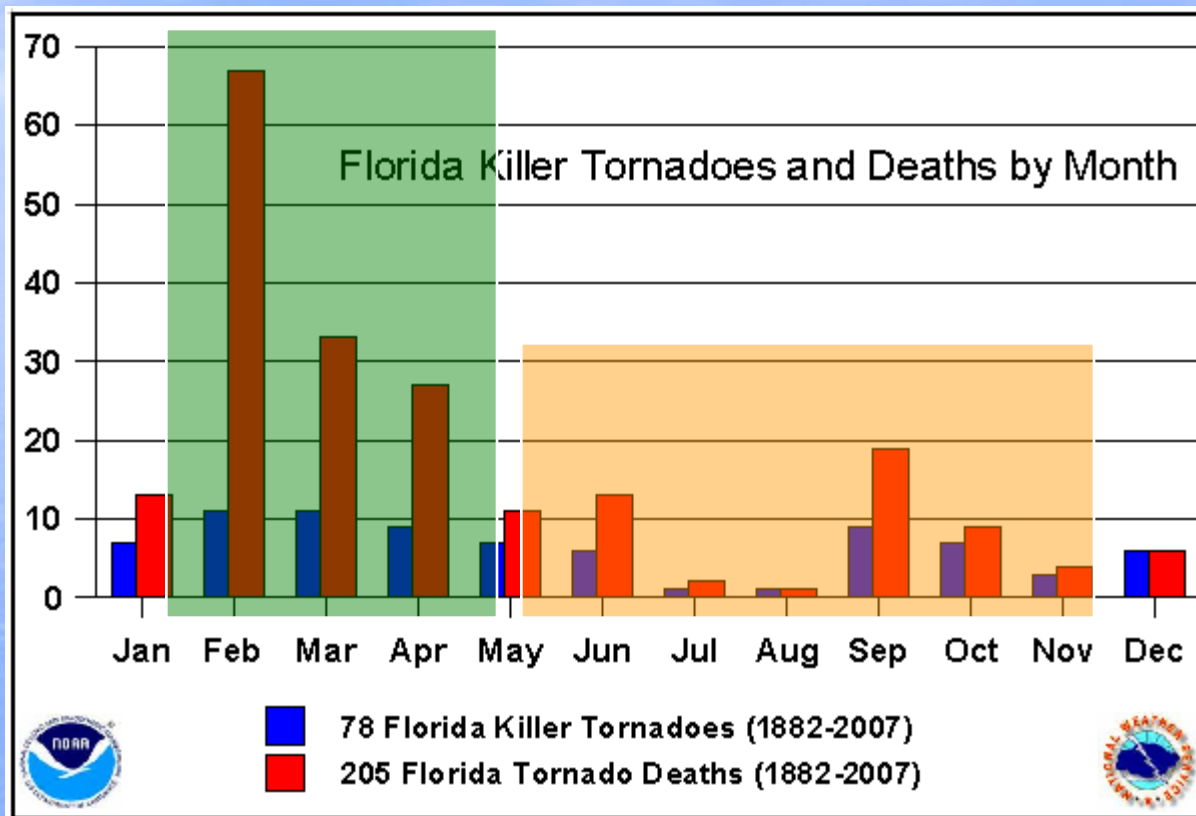
*Indicates additional reported waterspouts and funnel clouds not included in totals. Total of 494 tornadoes includes five border crossers (489 total tornadoes).

Top 10 Counties

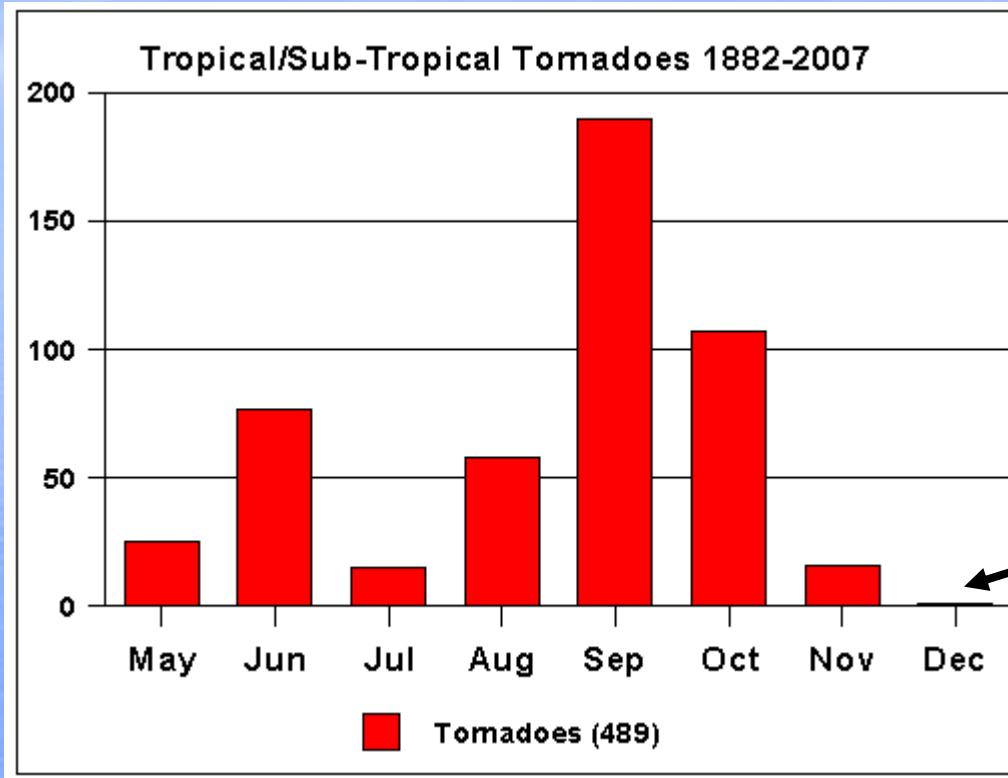
- Brevard (29)
- Hillsborough (25)
- Palm Beach (24)
- Dade (21)
- Polk (20)
- Monroe (20)
- Volusia (19)
- Duval (17)
- St. Johns (16)
- Okaloosa (16)

Increasing Population - Increasing Tropical Cyclone Activity - Greater Documentation - Greater Risk



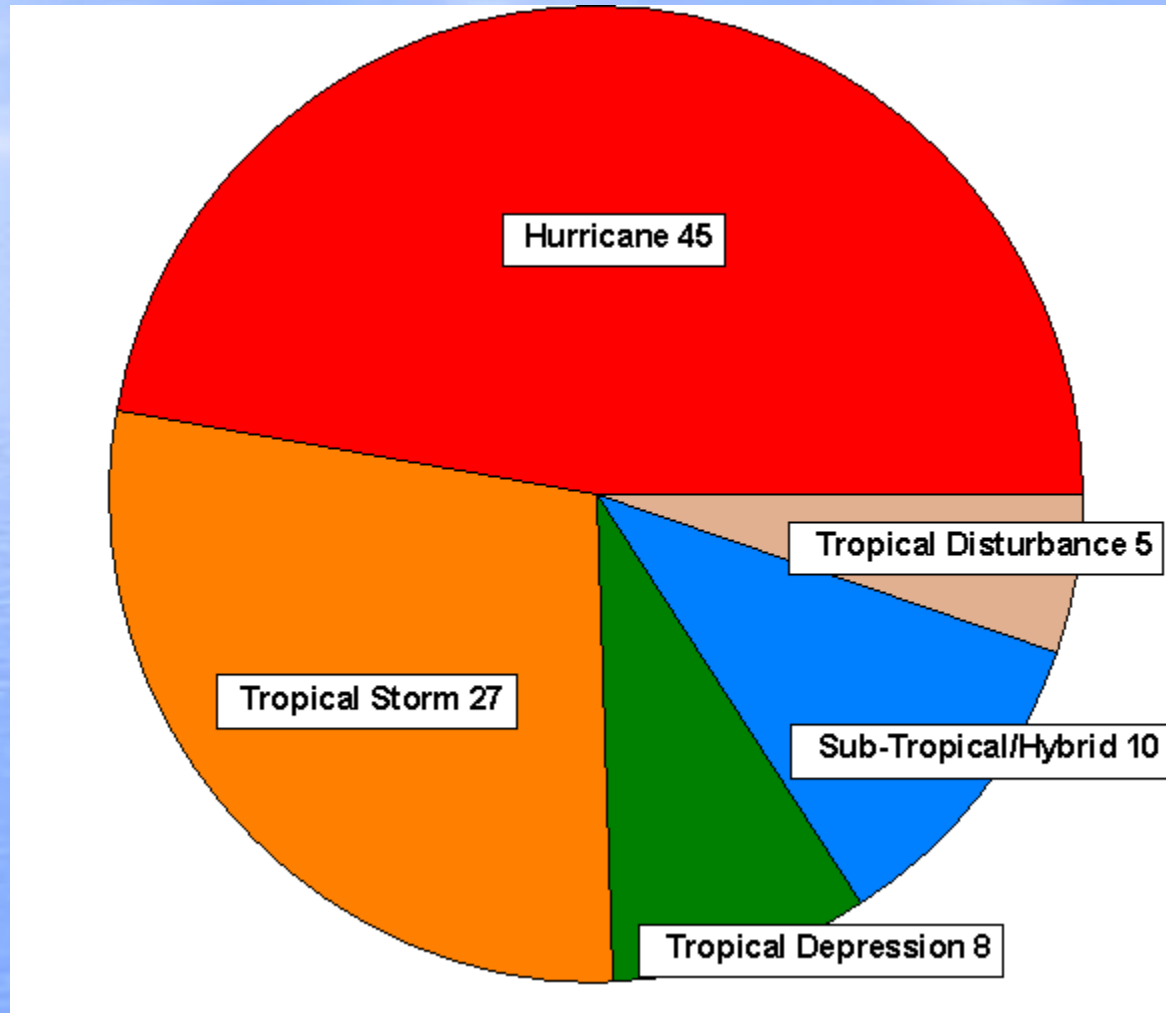


Tornadoes By Month



*First-ever
December Event
Remnants of Olga*

Types of Tornado-Producing Systems (1882-2007)



What are Hybrid or Subtropical Cyclones ?

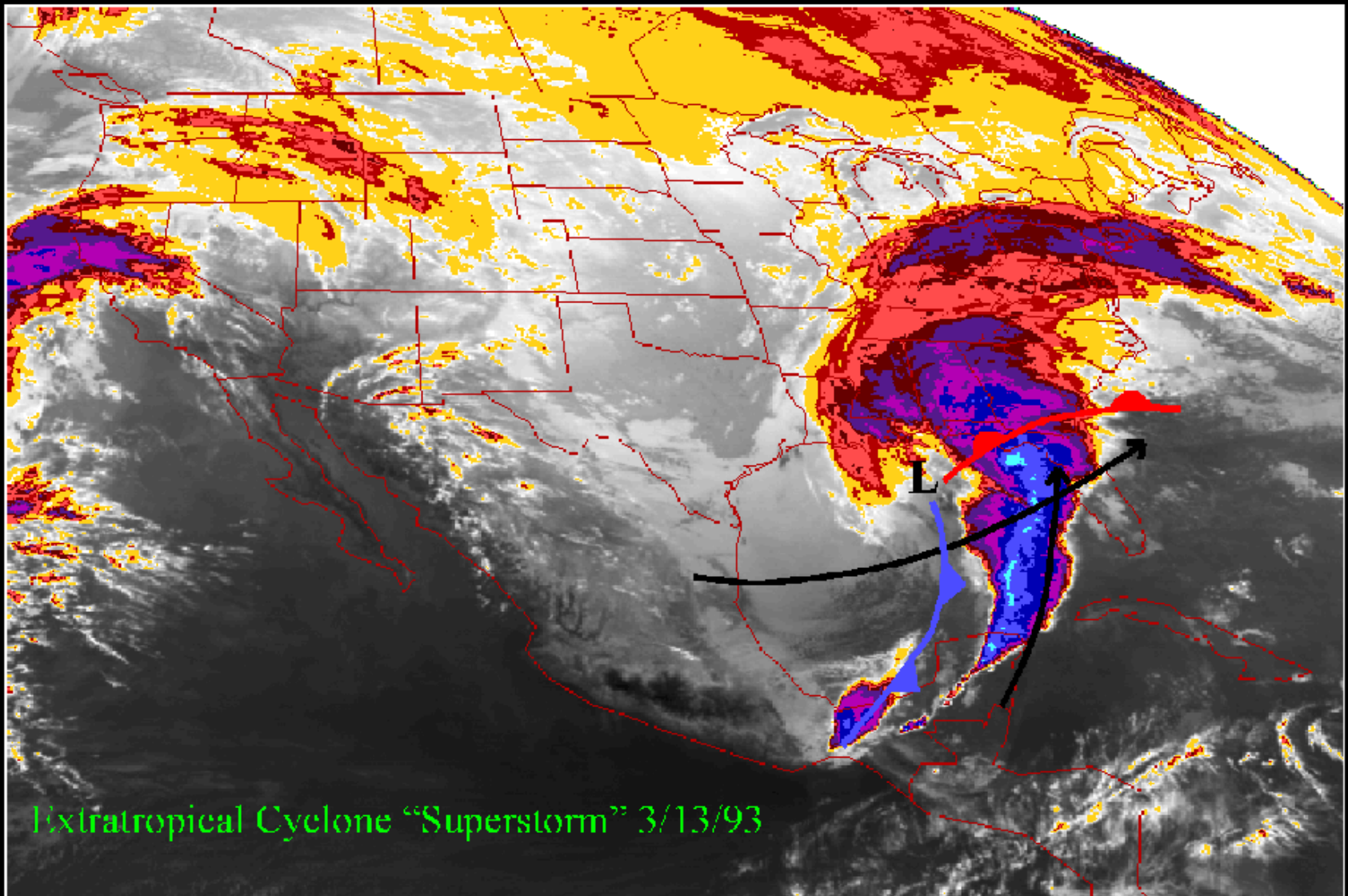
Low pressure systems that exhibit both tropical and extratropical characteristics

Typically tropical-like at the surface with non-tropical influences aloft - often highly sheared.

Most likely in May, June, October and November - the transition months between wet and dry seasons.

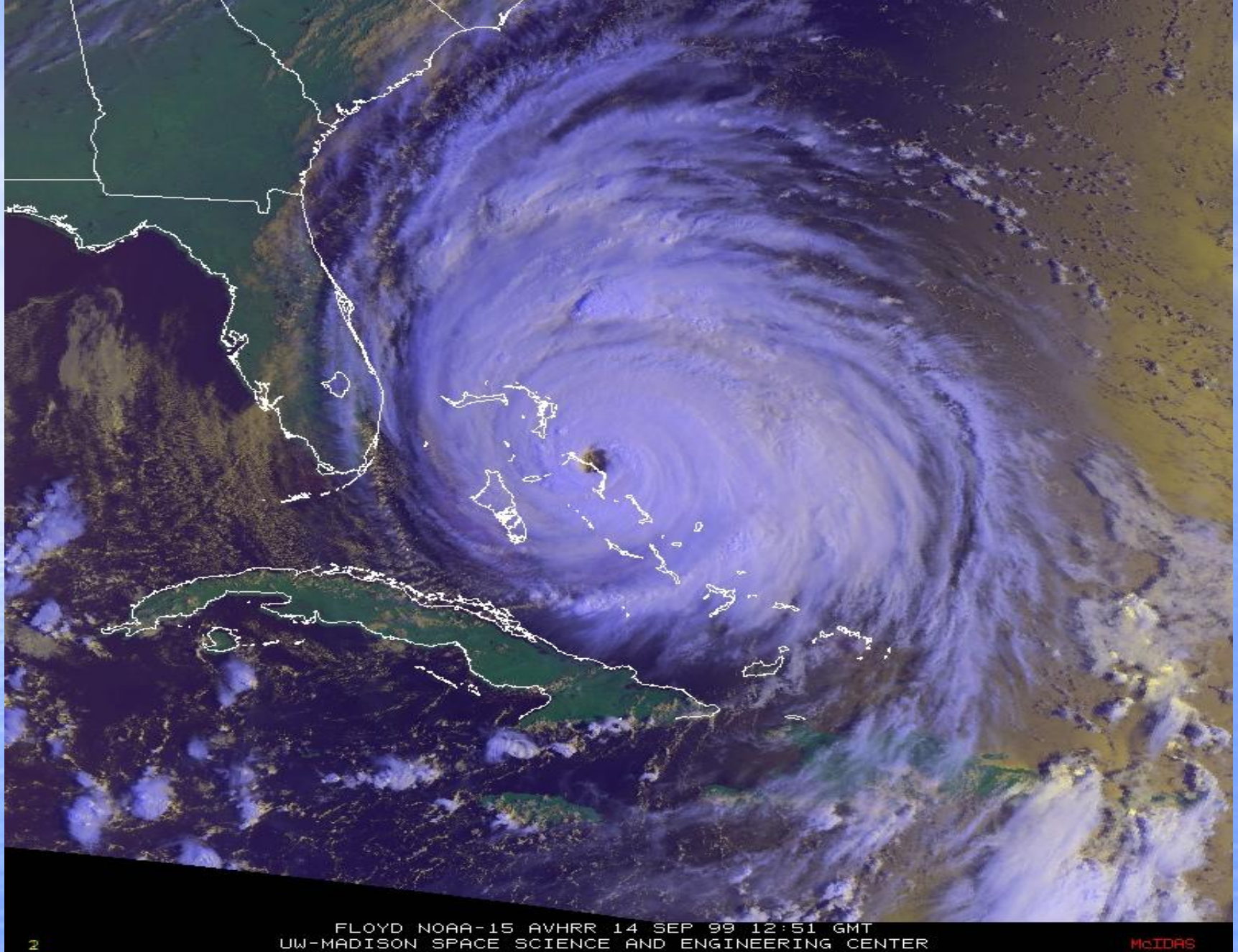
Hybrid Storms may not meet traditional criteria for naming - such as the October 1992 storm that struck Tampa Bay area.

Many “Named” tropical cyclones have considerable hybrid influences - not purely tropical. It is estimated that over half of the tornado cases had some hybrid characteristics.



ENHANCE: CHIZ

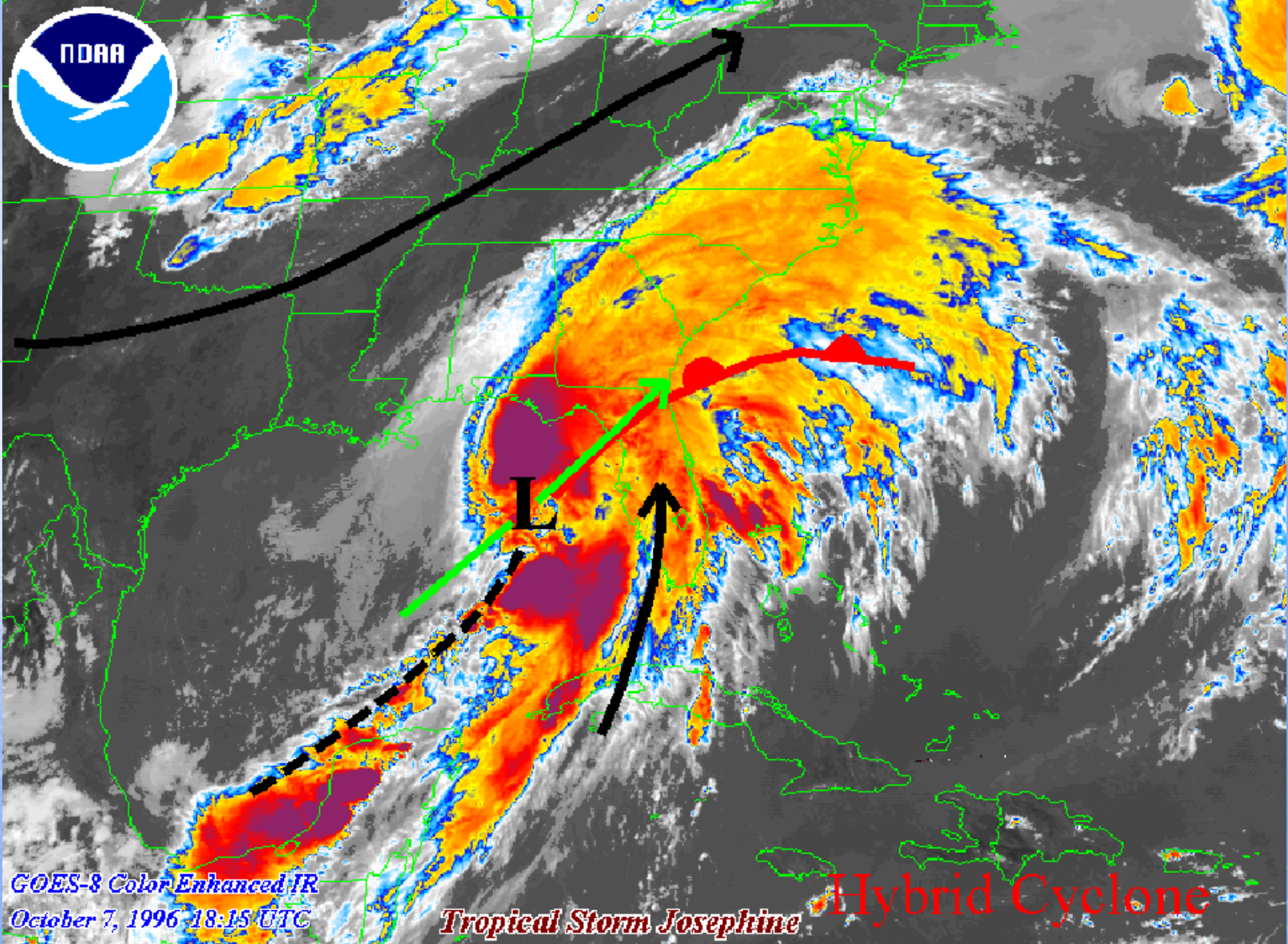
Extratropical Cyclone



FLOYD NOAA-15 AVHRR 14 SEP 99 12:51 GMT
UW-MADISON SPACE SCIENCE AND ENGINEERING CENTER

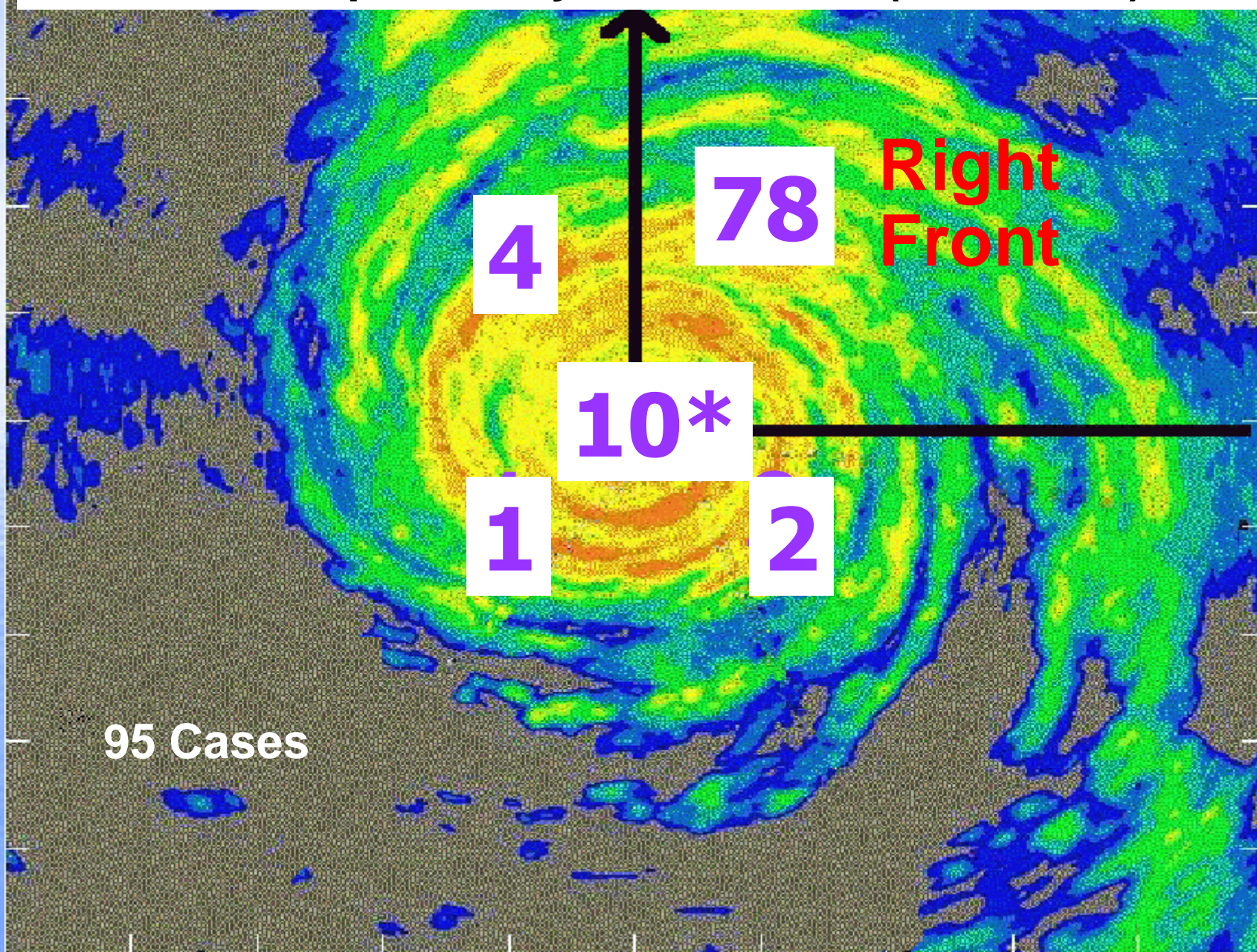
McIDAS

Tropical Cyclone



Subtropical or Hybrid Cyclone

Location of Tornadoes Relative to Cyclone Center With Respect to Cyclone Motion (1882-2006)



Tropical/Hybrid Cyclone Tornado Strength Characteristics

46% of cases produce F2 or greater tornadoes
(a much higher percentage compared to non-tropical/hybrid cyclones)

54% of cases produce weak tornadoes

66% of cases produce 4 or fewer tornadoes

TORNADO STRENGTH	OPERATIONAL EF SCALE		HURRICANE STRENGTH COMPARISON
Fujita or F-Scale	EF Number	3 Second Gust (mph)	Saffir-Simpson Scale
F0 40-72 MPH - slight damage	0	65-85	Tropical Storm
F1 73-112 MPH - moderate damage	1	86-110	CAT 1 (74-95 MPH) through CAT 2 (96-110 MPH)
F2 113-157 MPH - considerable damage	2	111-135	CAT 3 (111-130 MPH) through CAT 4 (131-155 MPH)
F3 158-206 MPH - severe damage	3	136-165	CAT 5 >155 MPH
F4 207-260 MPH - complete destruction	4	166-200	
F5 261 and greater - complete destruction	5	Over 200	

Typical EF0 Tornado Damage in Florida (New Smyrna Beach). Damage primarily to structures attached to houses such as screen rooms, car ports, awnings, and non-anchored outbuildings and structures.



Representative EF1 Tornado Damage in Florida (New Smyrna Beach). Severe roof damage, windows, and doors broken, trees down and cars flipped over, but integrity of structure generally remains.



Representative EF2 Tornado Damage in Florida (New Smyrna Beach). Typically roofs are gone or mostly gone with most walls remaining standing.



Representative EF3 Tornado Damage in Florida (New Smyrna Beach). Two-story frame house severely damaged with 2nd floor totally gone and first floor a total loss.



**Representative EF4 Tornado Damage in Florida
(Kissimmee). New concrete block/stucco house totally
destroyed much of home swept off the foundation.**

An EF5 would leave a bare concrete slab!

(There has never been an EF5 Tornado in Florida)



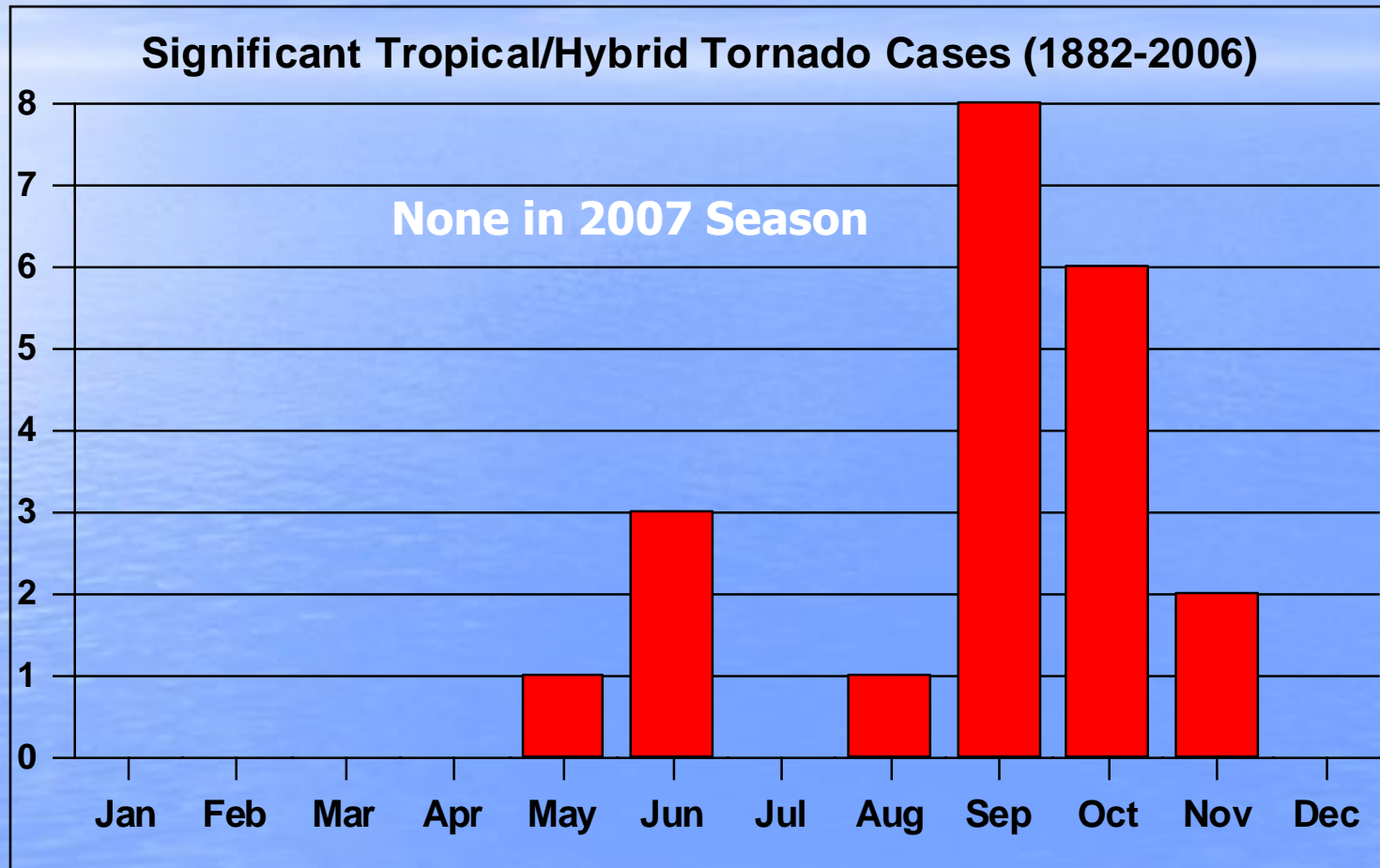
Focus on Significant Tornado Events

- **Any Tornado-Related Death**
- **Five or More Tornadoes in 24-Hour Period with At Least One Tornado of F2 or Greater Intensity**
- **Any F3 Tornado**

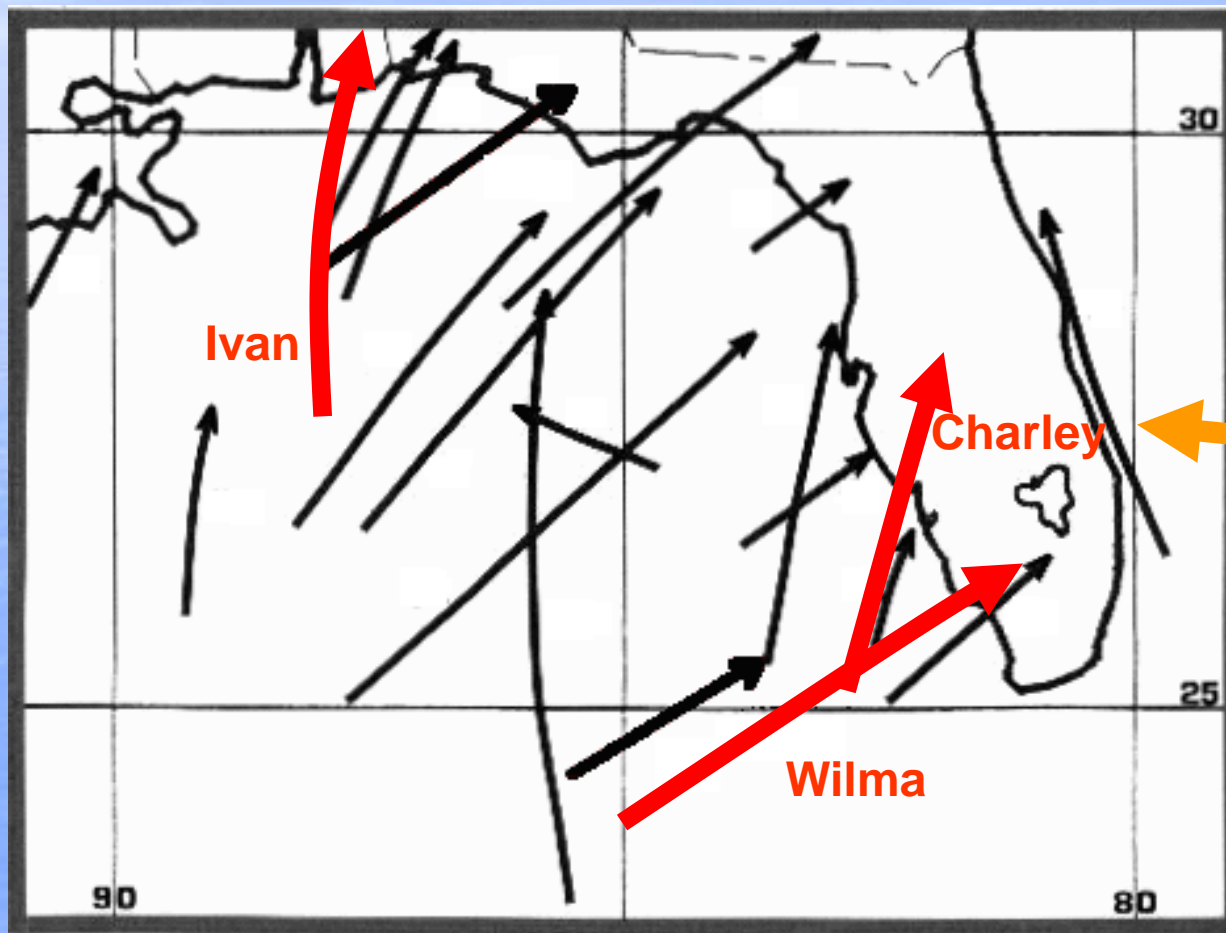
Twenty-One Cases Considered Significant

- **Eleven Hurricanes**
- **Six Tropical Storms**
- **Four Hybrid Cyclones**

Significant Cases Consist of Early Season and Peak to Late Season Cyclones



Track Segments of Significant Tropical/Hybrid Cases During Florida Tornado Production Phase 1882-2007



Frances and
Jeanne
Not
Significant
Tornado
Events

All Significant Tornado Cases Began Well Before Landfall

Historical Observations of the Nature of Significant Tropical and Hybrid Cyclone Tornado Events

21 Cases - Nearly Half have hybrid influences - Cyclone Central Pressure and Organization is a Poor Predictor of Tornado Potential

20 of 21 in Gulf of Mexico at Time of Tornadoes

20 of 21 Produced Tornadoes in Outer Rainbands in the Right-Front Quadrant with Respect to Storm Motion

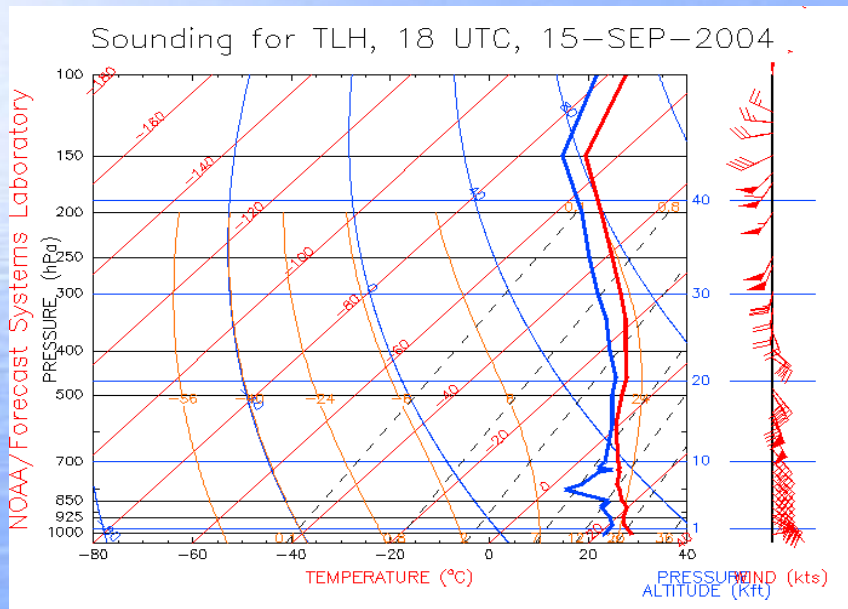
19 of 21 Moving Between 360 and 60 Degrees

19 of 21 Recurving or Moving Northeast - Upper Low NW of Florida

In All Cases Tornadoes Began Before landfall

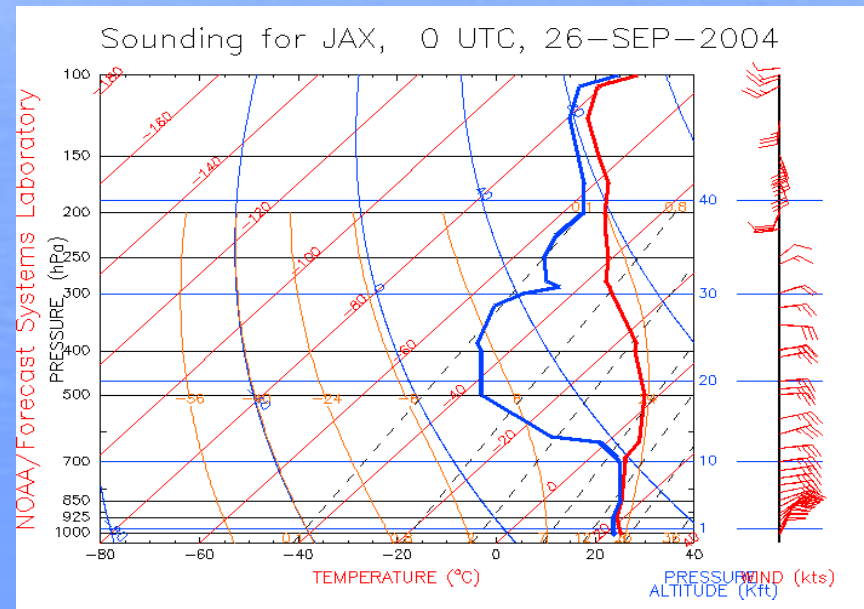
Differences in Gulf and Atlantic Pre-Storm Environment

Strong Shear



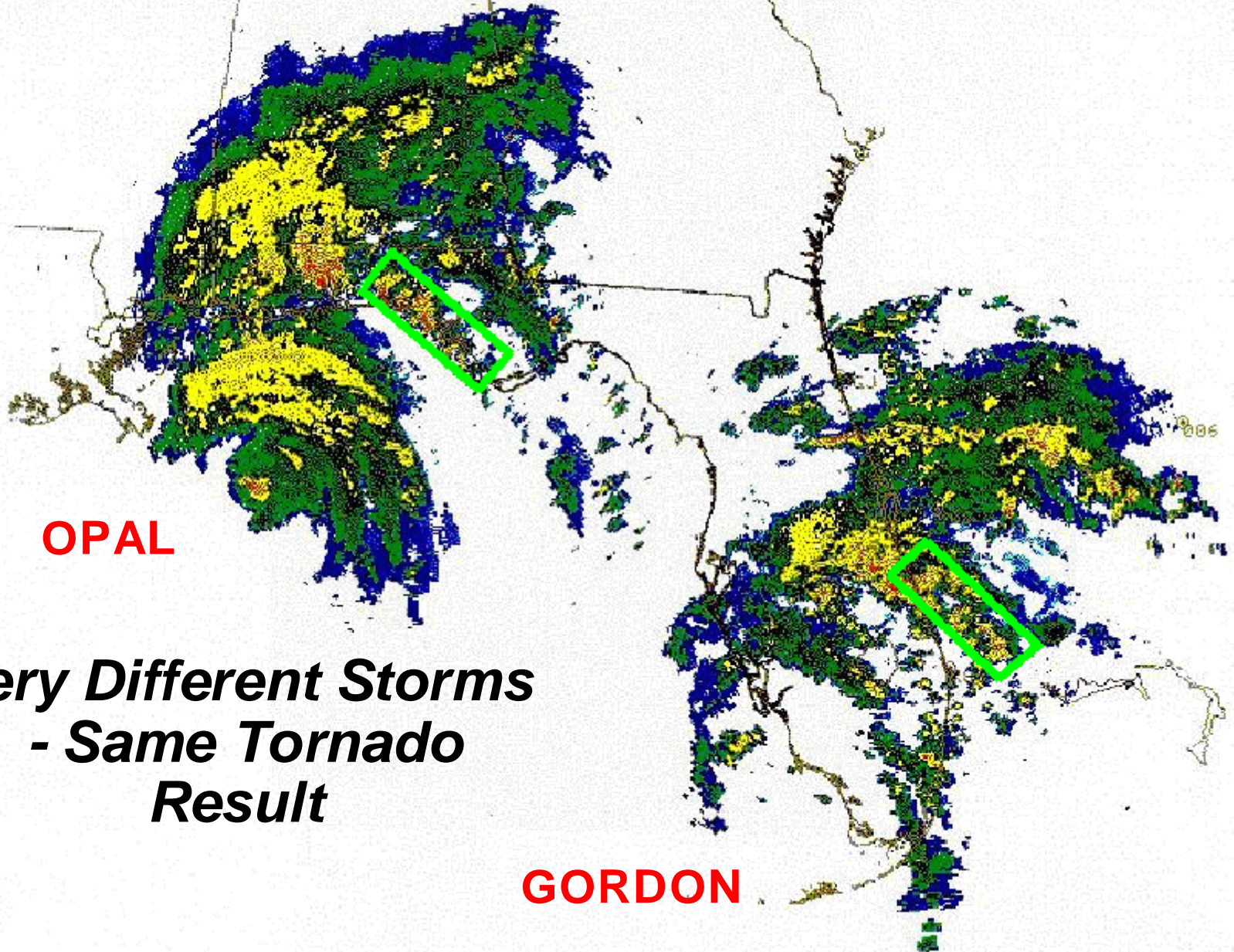
Ivan Pre-Landfall

Weak Shear



Jeanne Pre-Landfall

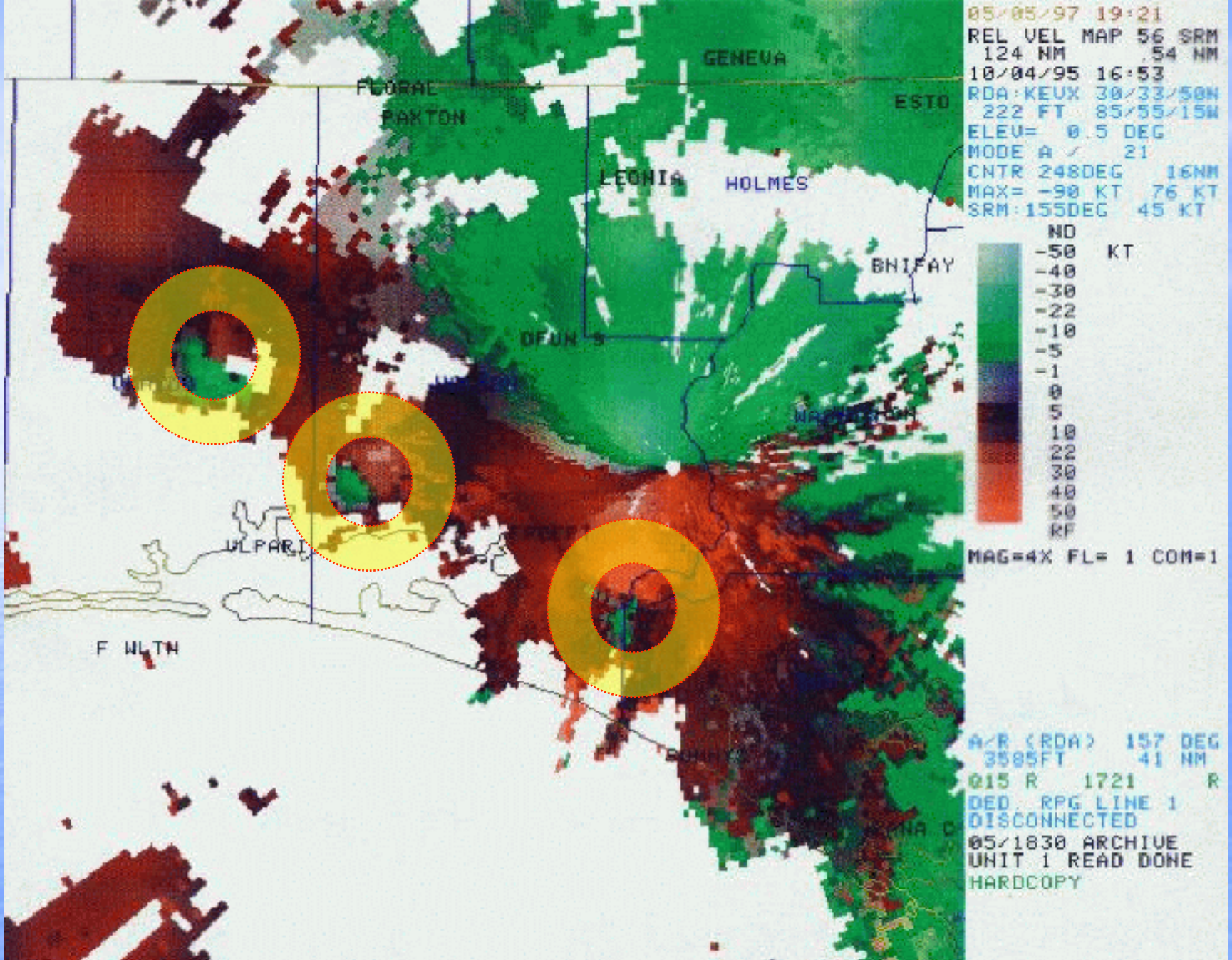
Significant Tornadoes - Focus on Outer Rainbands



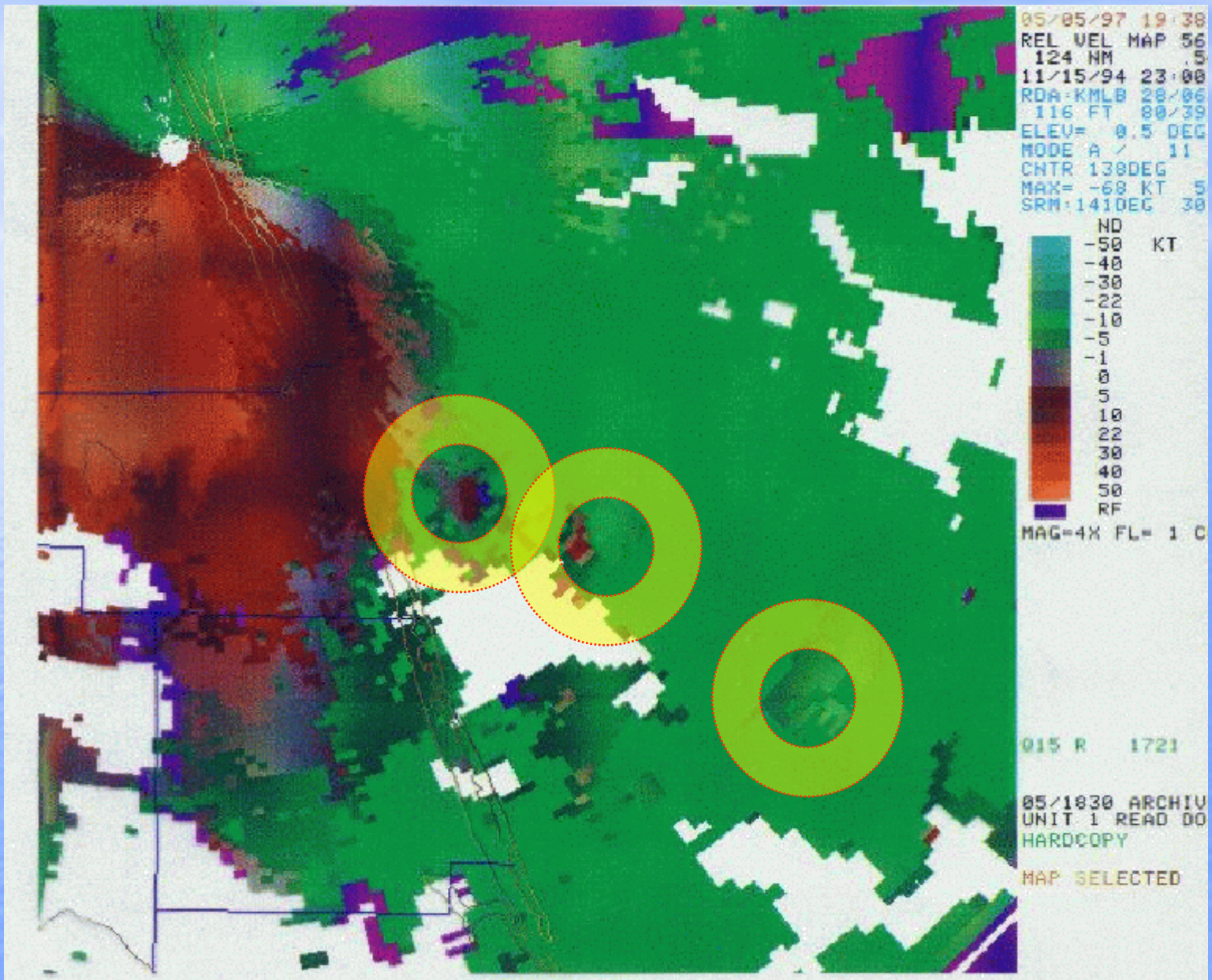
OPAL

***Very Different Storms
- Same Tornado
Result***

GORDON



Hurricane Opal 10/4/95 - F2 Tornado 1 Dead



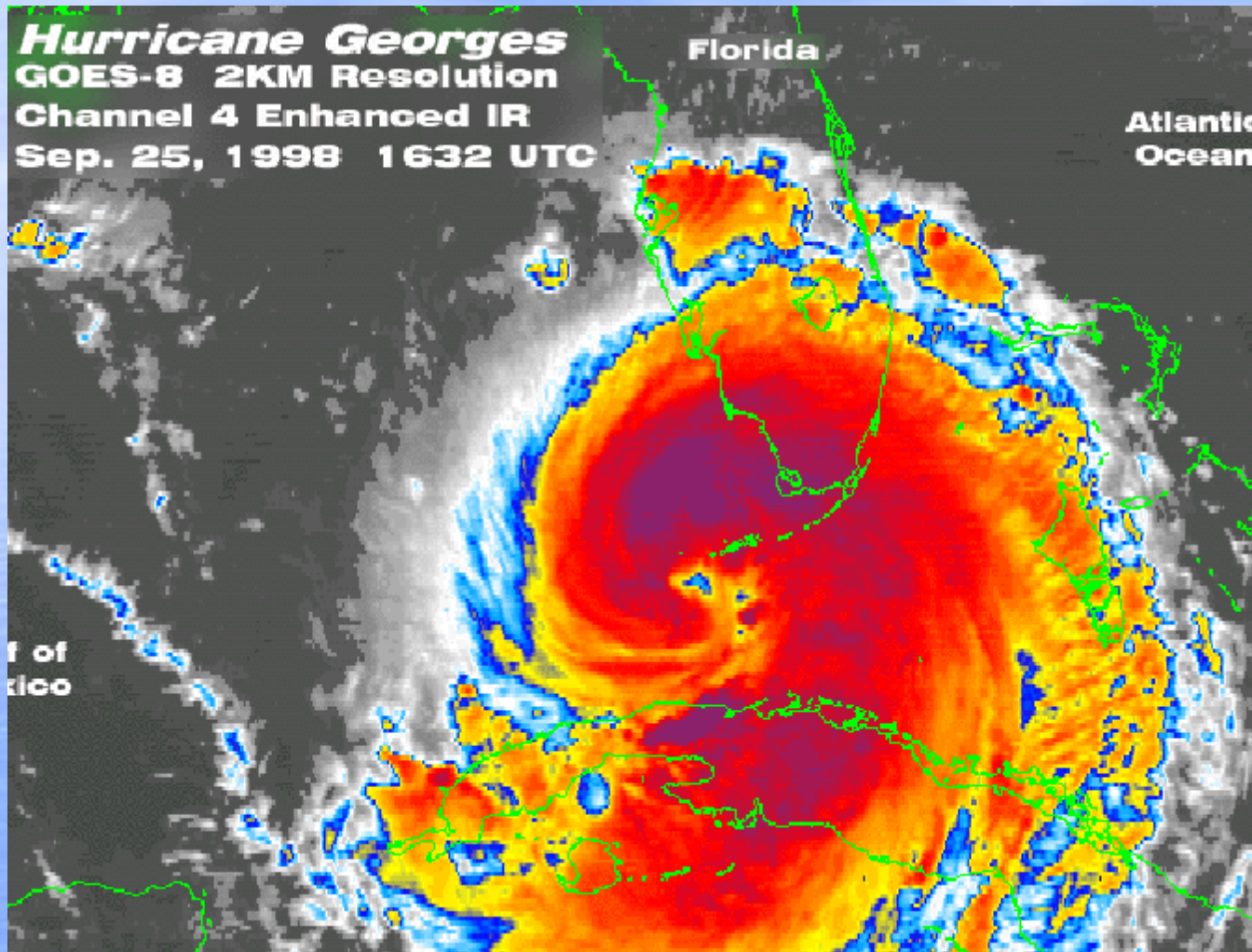
Tropical Storm Gordon 11/15/94 - F2 Tornado 1 Dead

Hurricane Georges
GOES-8 2KM Resolution
Channel 4 Enhanced IR
Sep. 25, 1998 1632 UTC

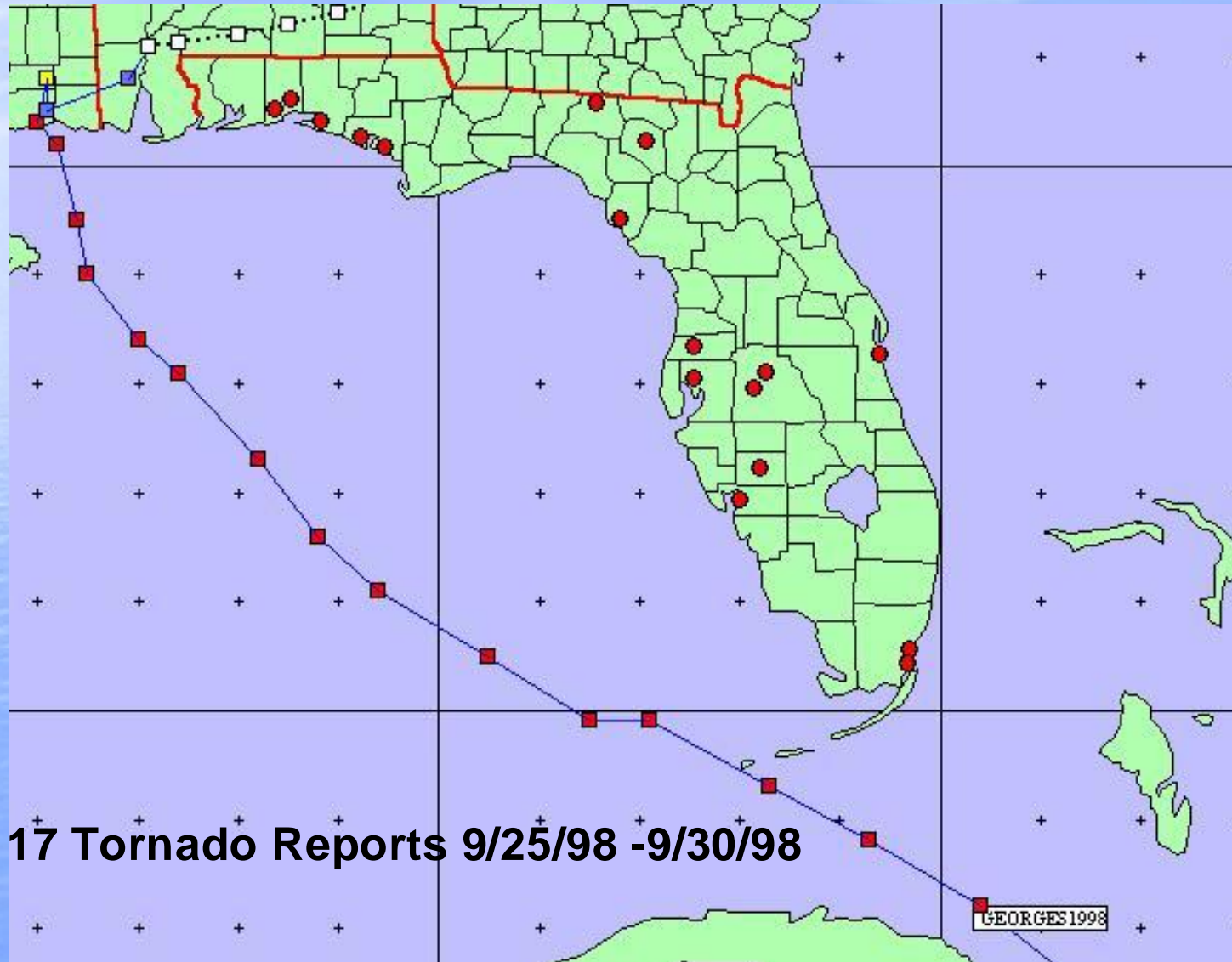
Florida

Atlantic
Ocean

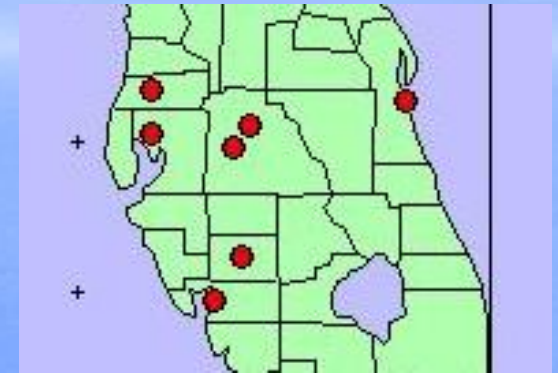
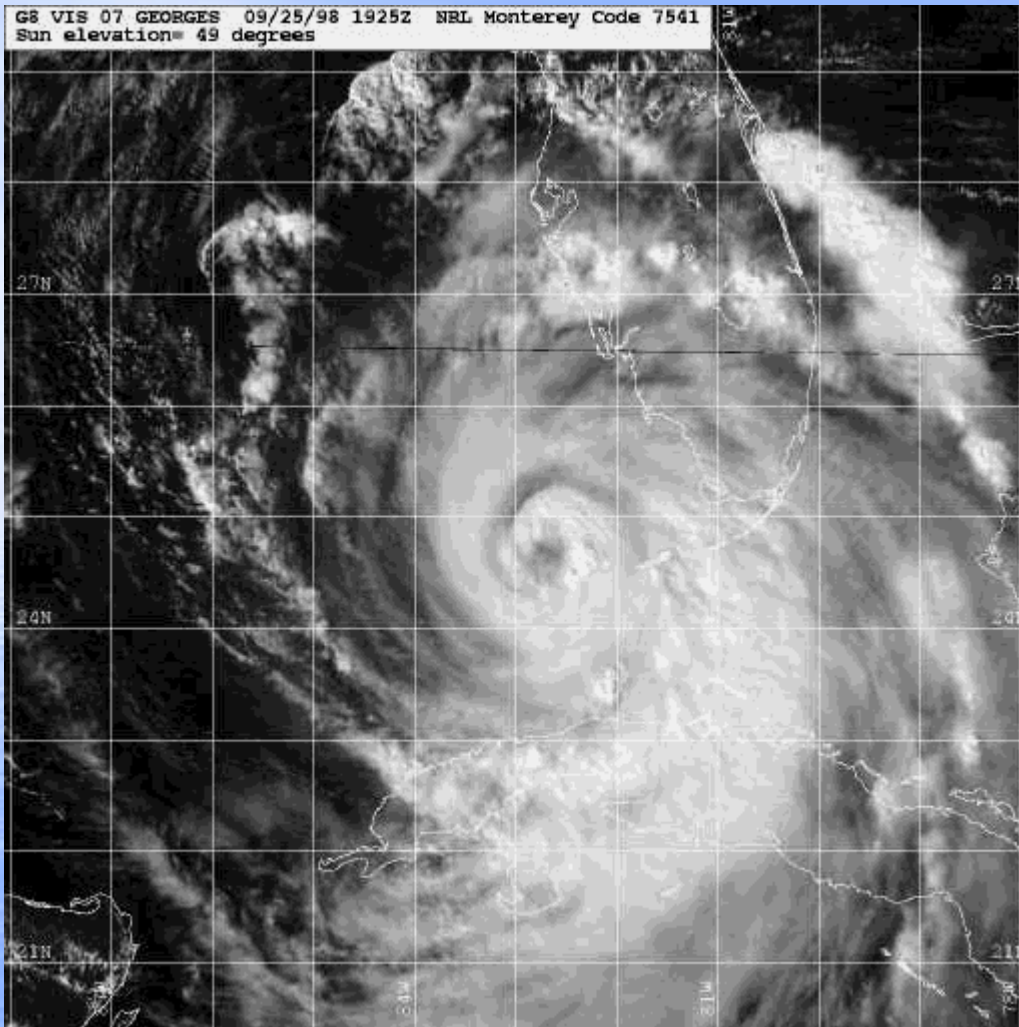
of
Mexico



Hurricane Georges - Most Extended Tornado Threat in Florida History



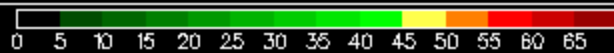
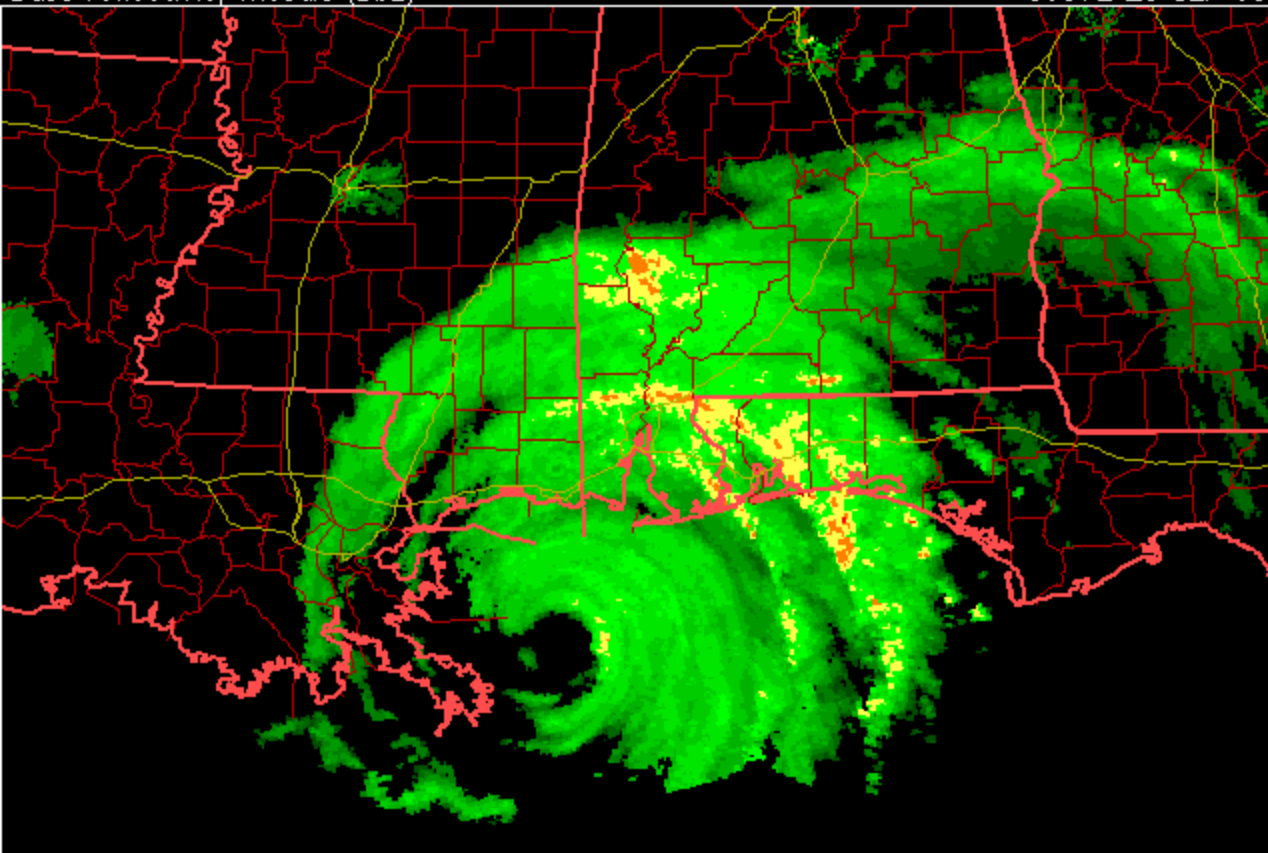
F0-F1 Tornado Outbreak 9/25/98



Tornado Watches in effect from 6 am 25th to 6 am 26th - 7 tornadoes occur in a few hours!

Base reflectivity mosaic (Dbz)

0357Z 26 SEP 98

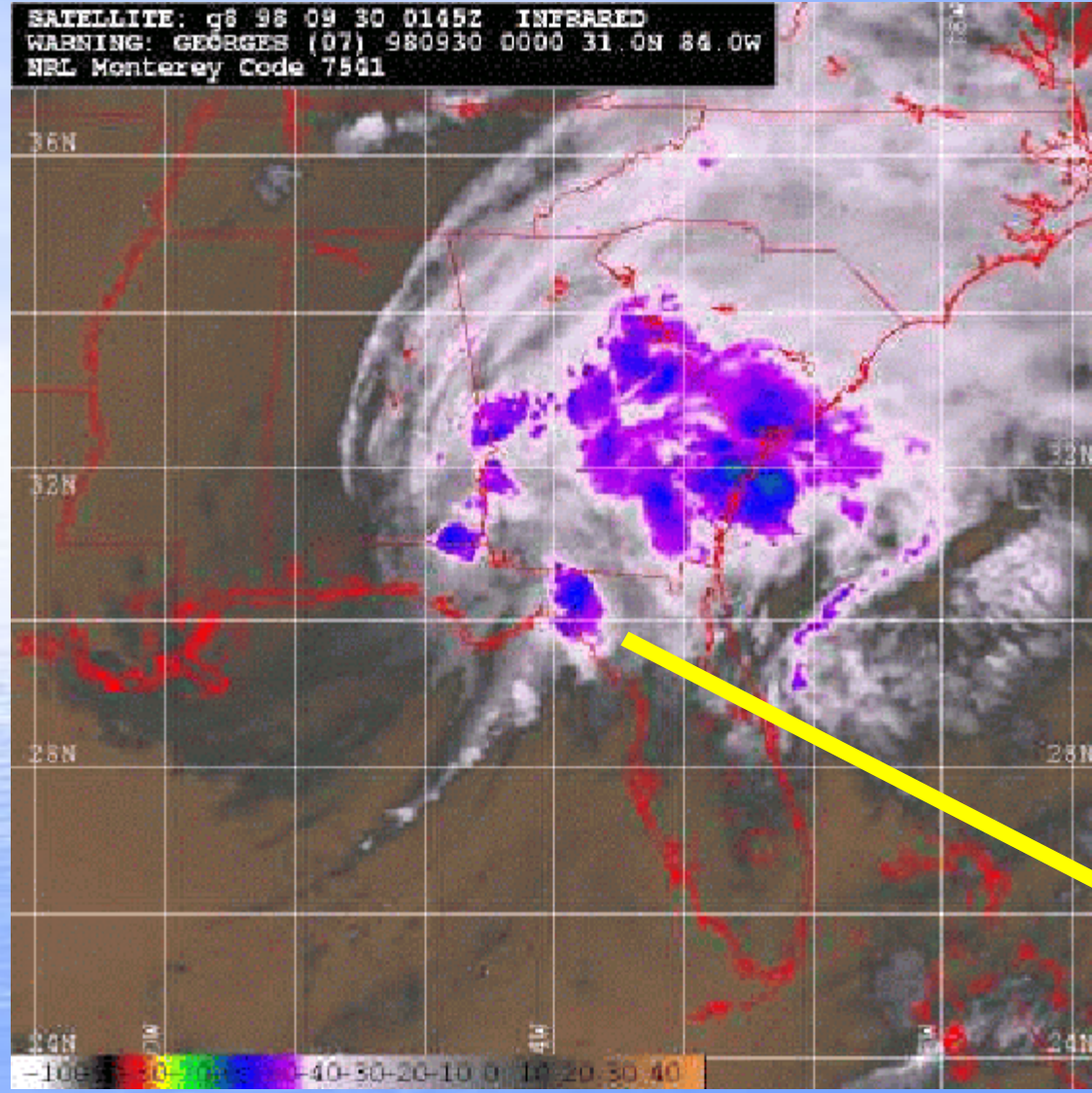


Md=pr Res=1.1 Mx=69



Weak Tornadoes reported in the Panhandle on the 27th and 28th as Georges slows and weakens

SATELLITE: 08 98 09 30 0145Z INFRARED
WARNING: GEORGES (07) 980930 0000 31.0N 84.0W
NRL Monterey Code 7561

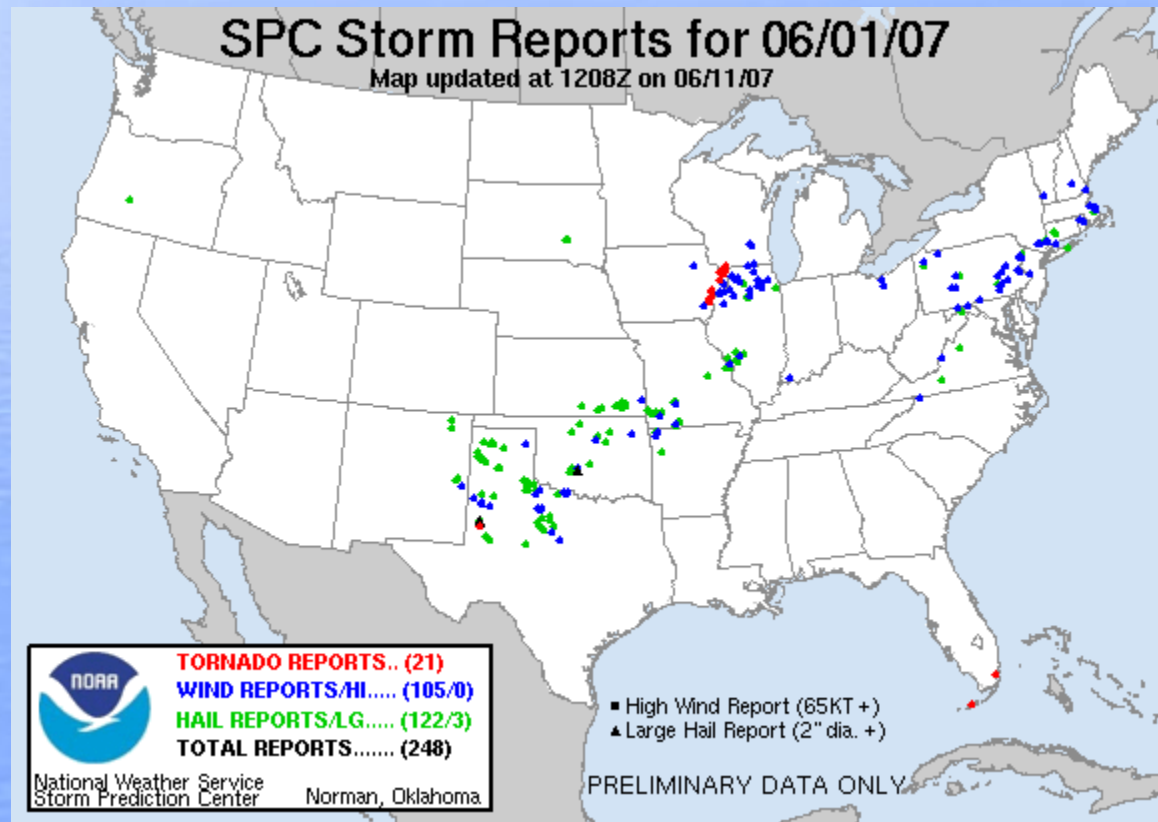


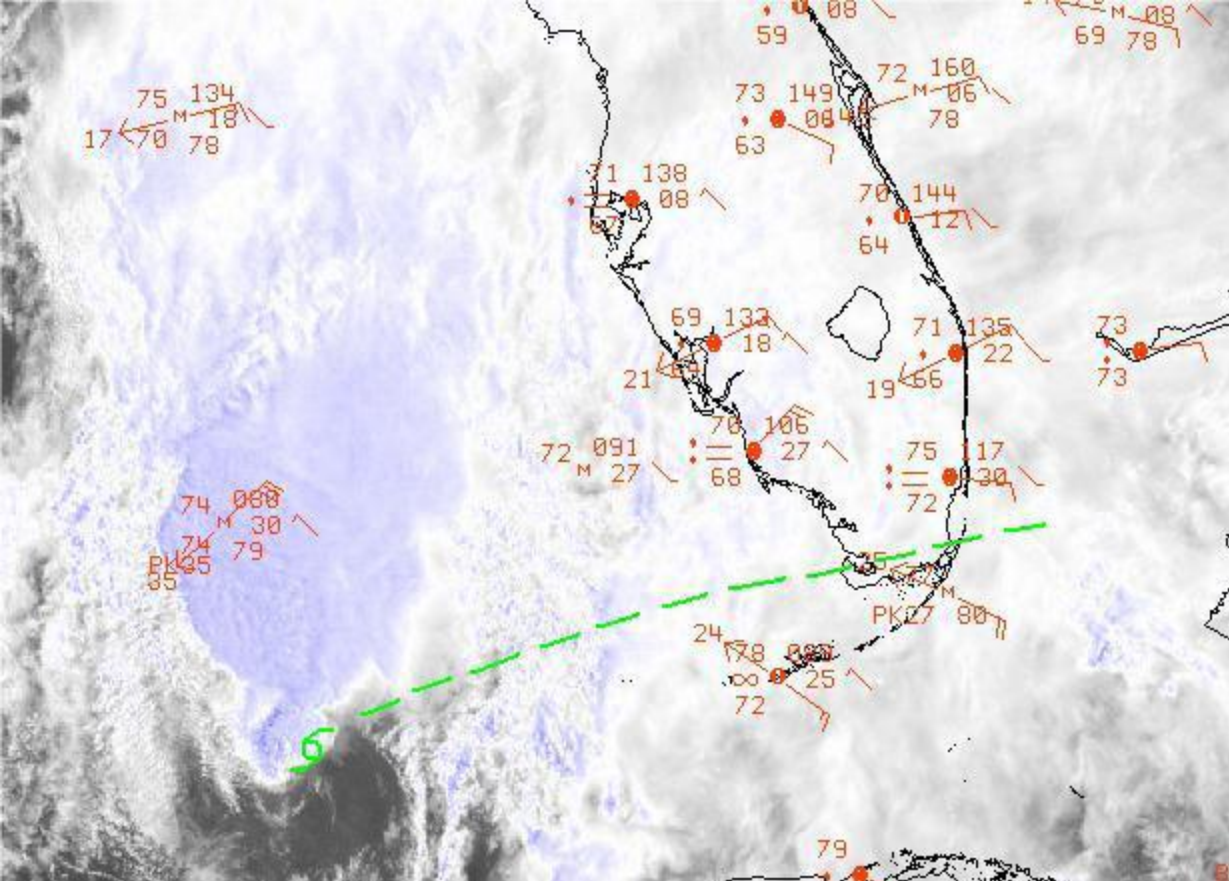
**Near Midnight on
9/29/98 - After
Dissipation and in the
presence of significant
shear “Georges”
Produced the Strongest
Tornado**



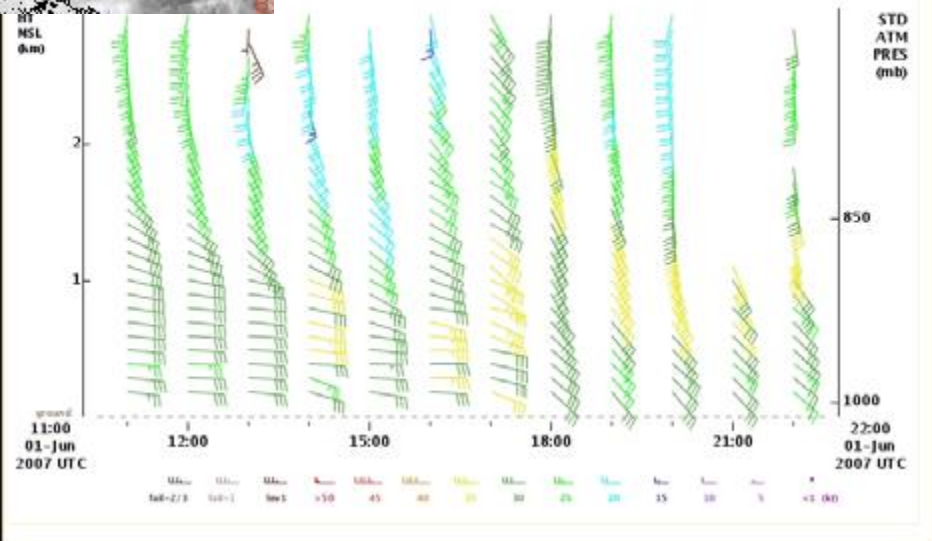
Review of 2007 Season

Tropical Storm Barry June 2007





JKFL Lat:24.7 Lon:-81.5 Elev:3m
 ation | Mode:106m | Res:60min | QC:LEVEL 1 OR BETTER
 NOAA ESRL PHYSICAL SCIENCES DIVISION



Courtesy Andy Devanas, SOO NWS Key West

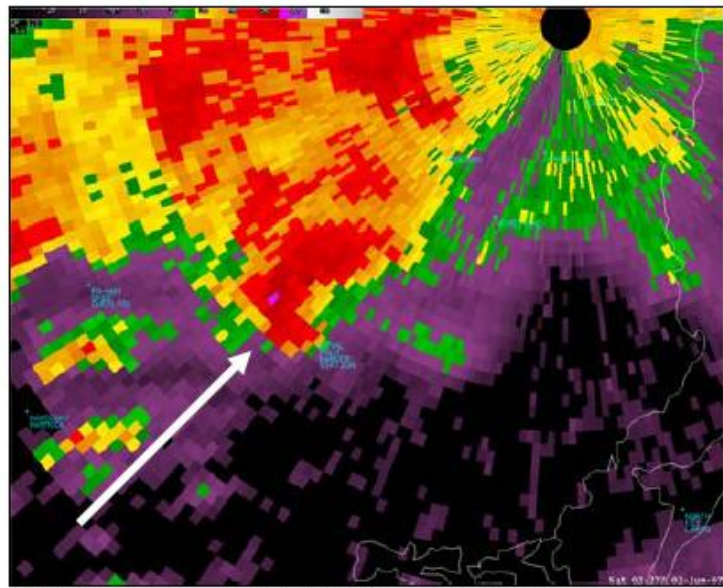


Fig. 8. KAMX 0.5-degree base reflectivity image at 0227 UTC 2 Jun 2007; Everglades mesocyclone denoted by white arrow.

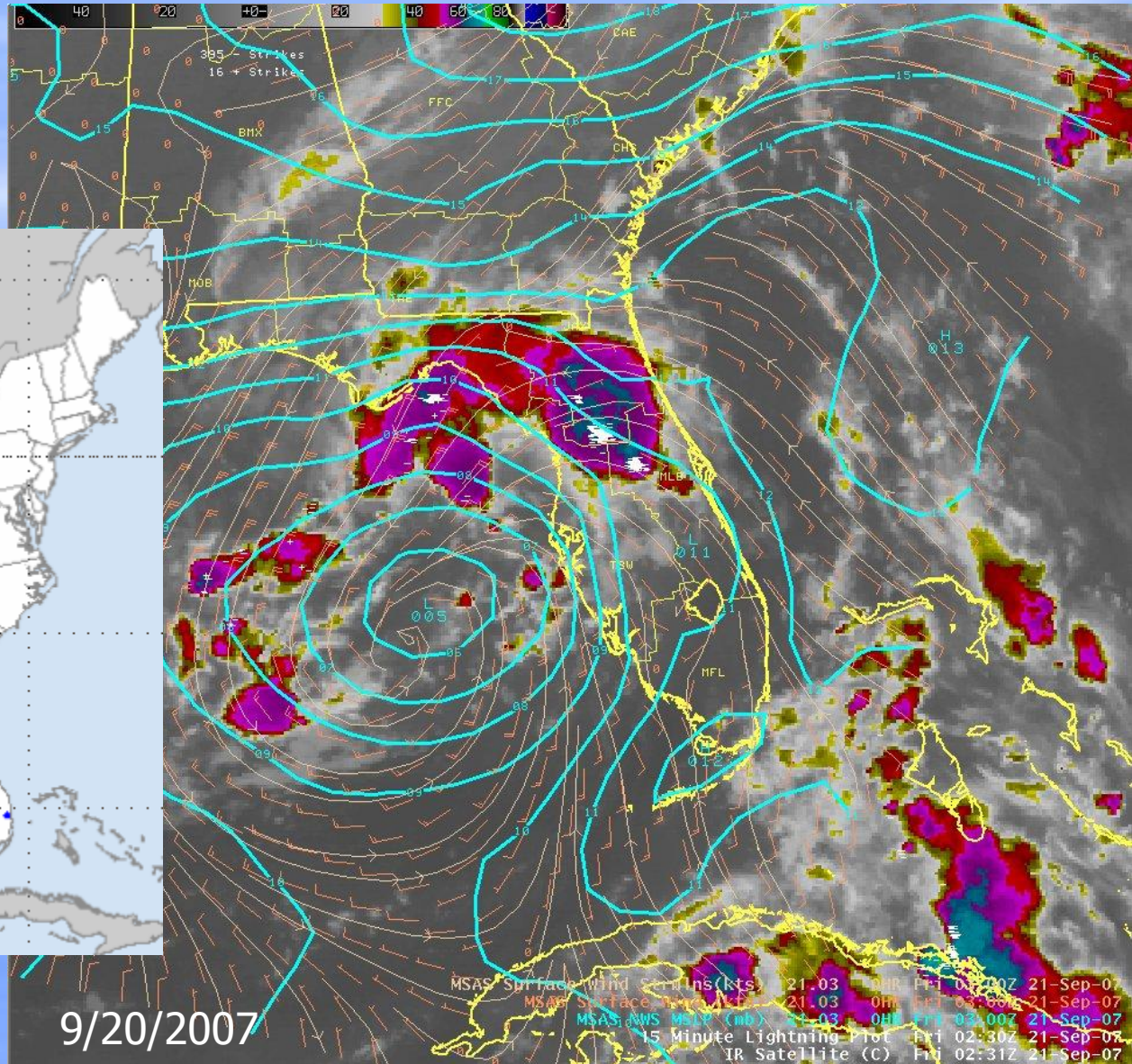
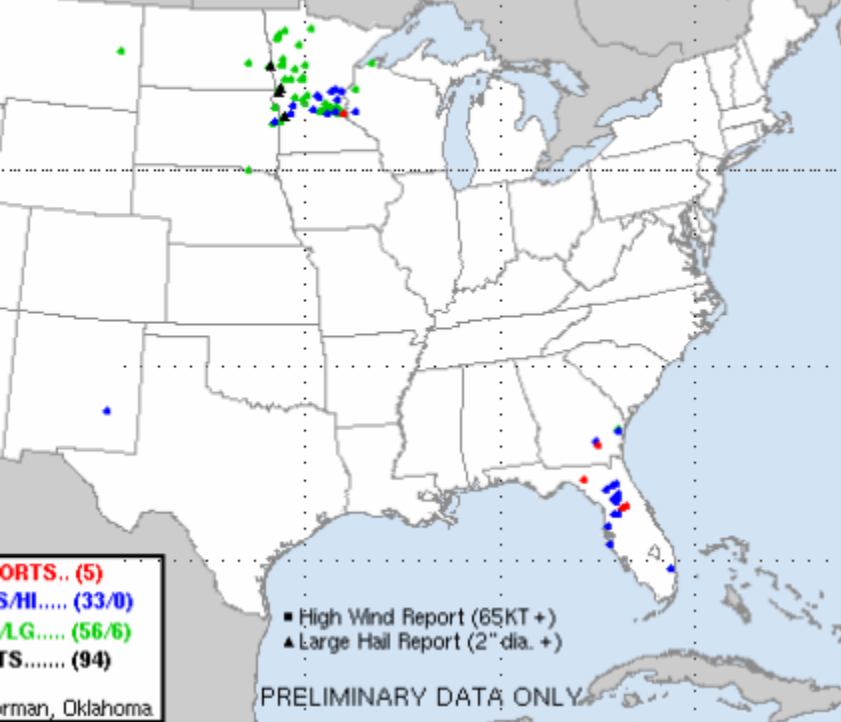


Fig. 9. KAMX 0.5-degree base reflectivity image at 0145 UTC 2 Jun 2007; Card Sound (Cutler Ridge) mesocyclone denoted by white (blue) arrow.

Pre – TD #10 September 2007

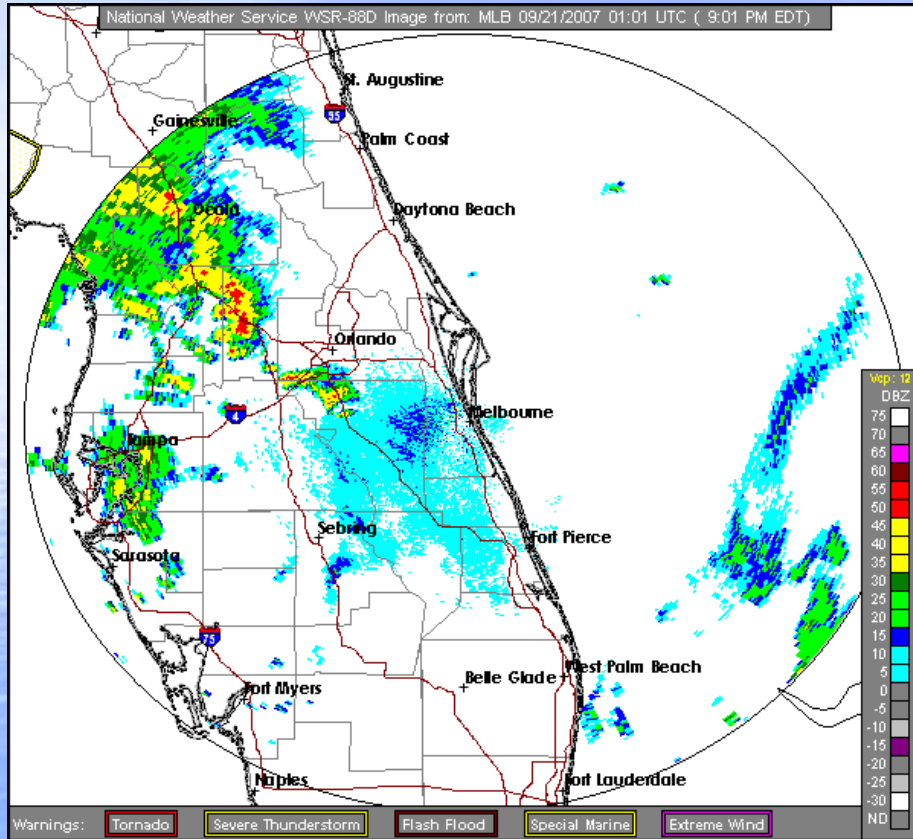
Storm Reports for 09/20/07

Map updated at 1208Z on 09/30/07

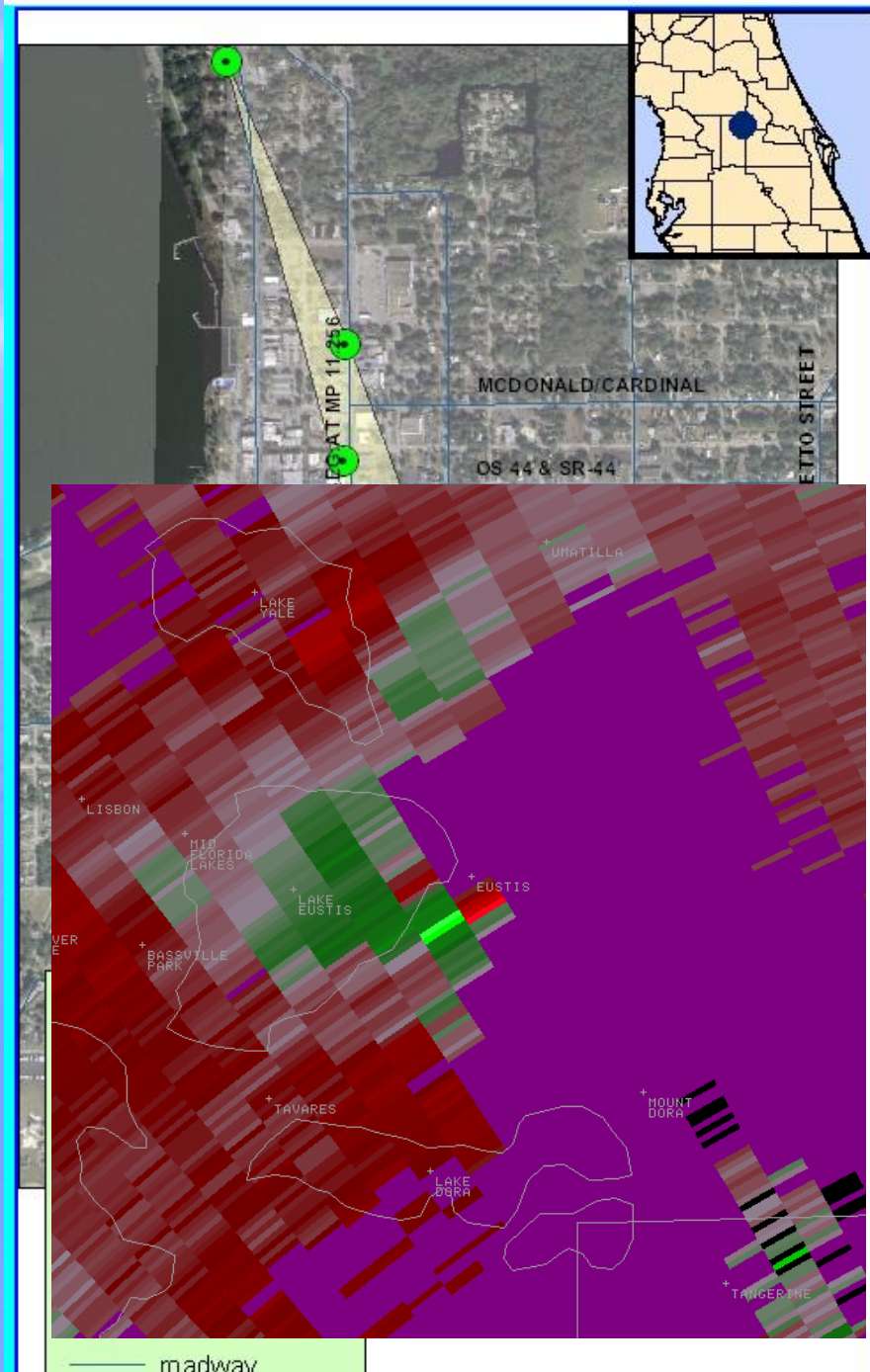


9/20/2007

EF 1 Tornado Damage at Eustis



9/20/2007



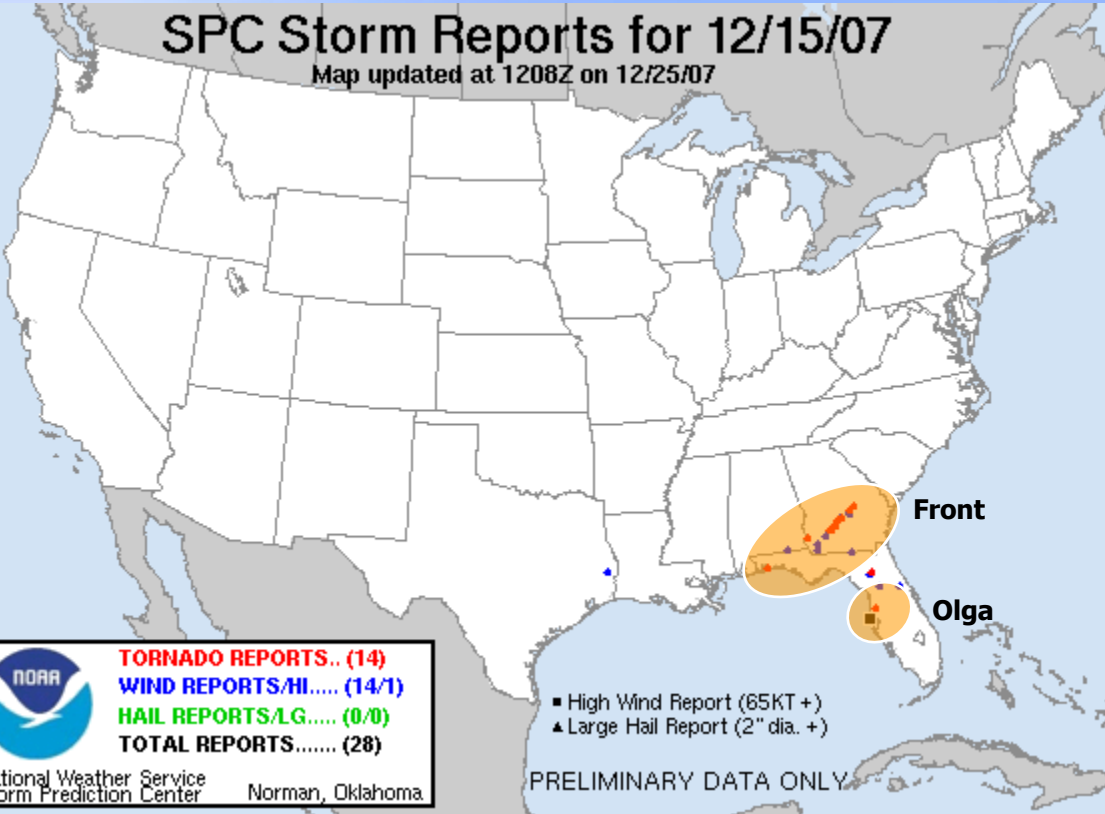
EF 1 Tornado Damage



Remnants of Tropical Storm Olga 16 December, 2007

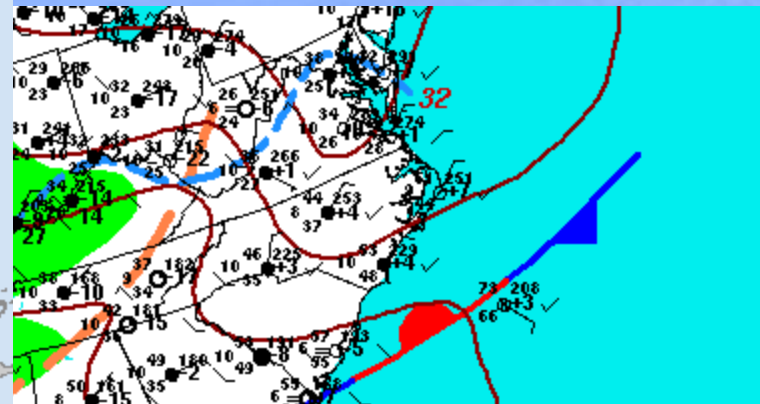
SPC Storm Reports for 12/15/07

Map updated at 1208Z on 12/25/07

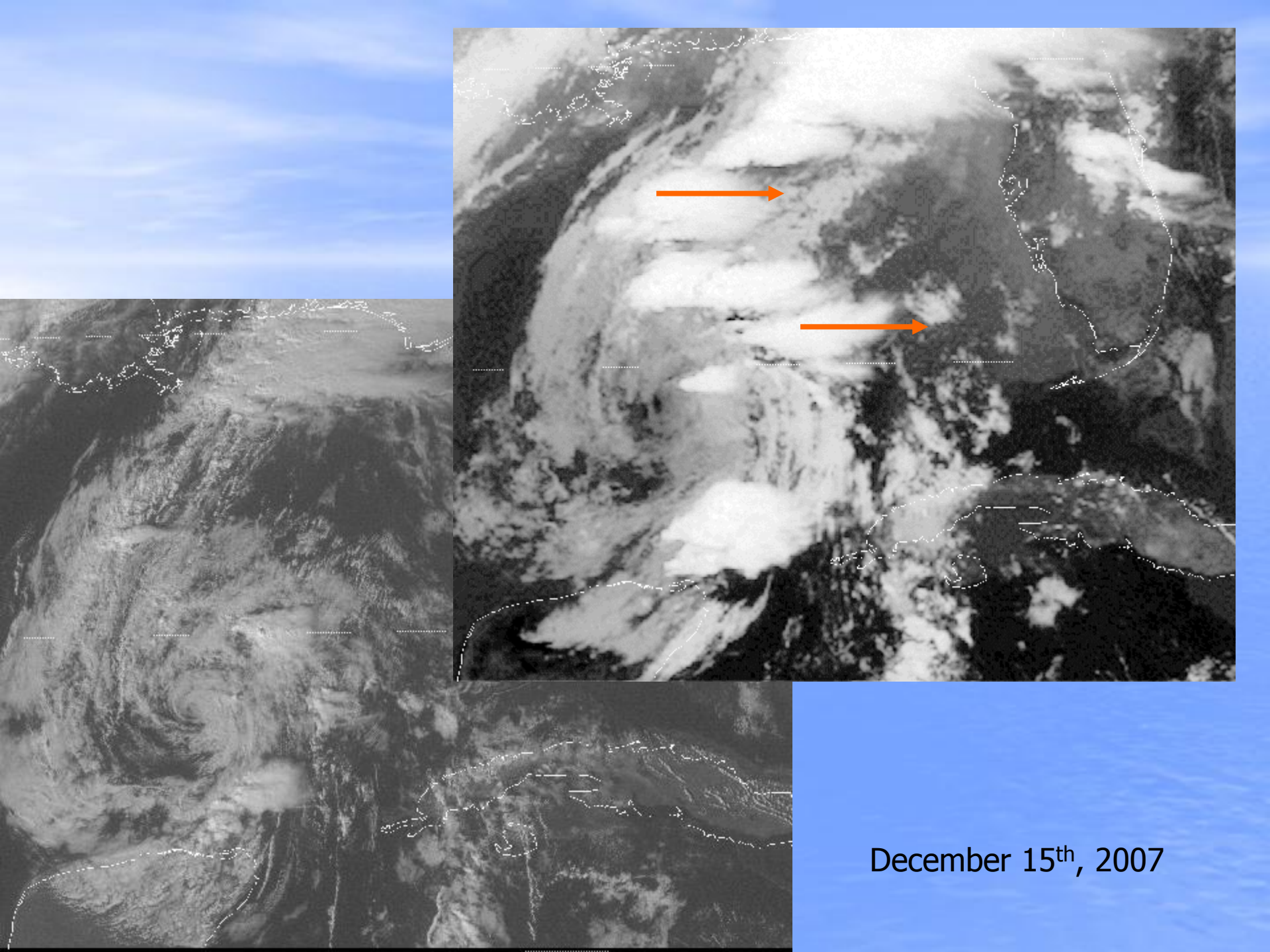


TORNADO REPORTS.. (14)
WIND REPORTS/HI..... (14/1)
HAIL REPORTS/LG..... (0/0)
TOTAL REPORTS..... (28)

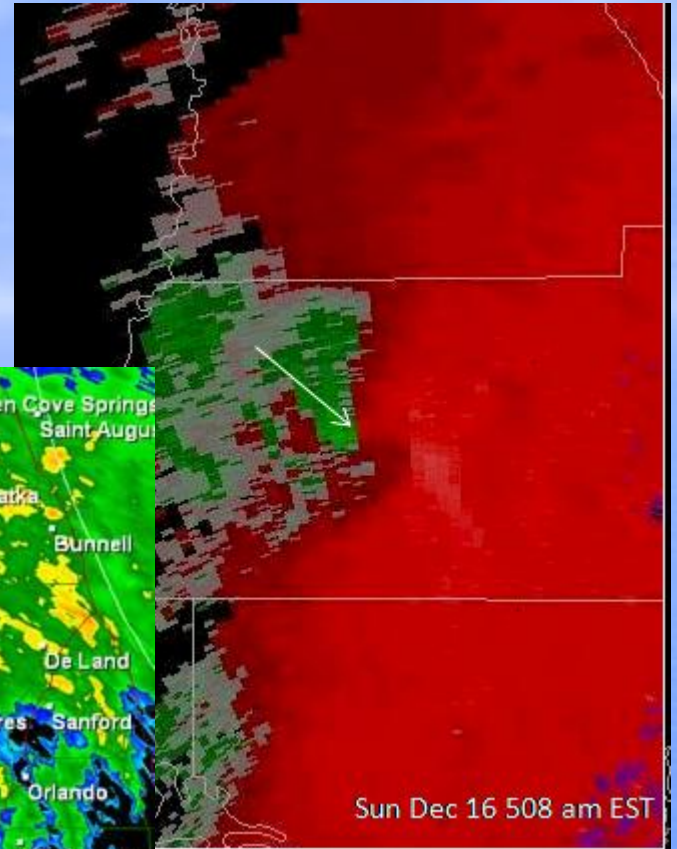
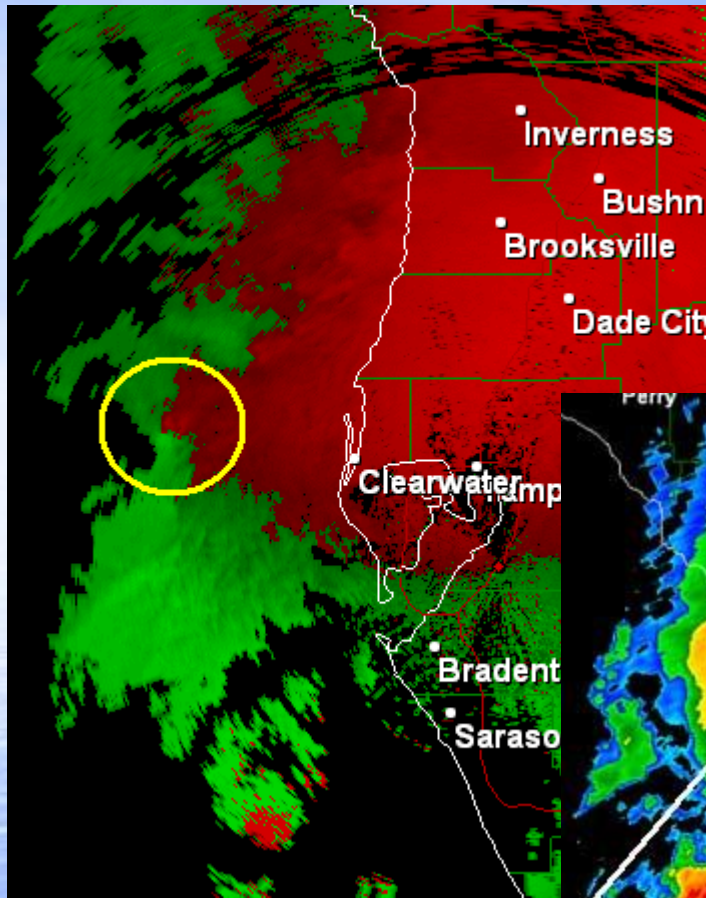
National Weather Service
 Storm Prediction Center
 Norman, Oklahoma



and Station Weather at 7:00 P.M. EST



December 15th, 2007



EF1 Tornado - Pasco County Jail near Land O' Lakes, Fl.
16 December, 2007



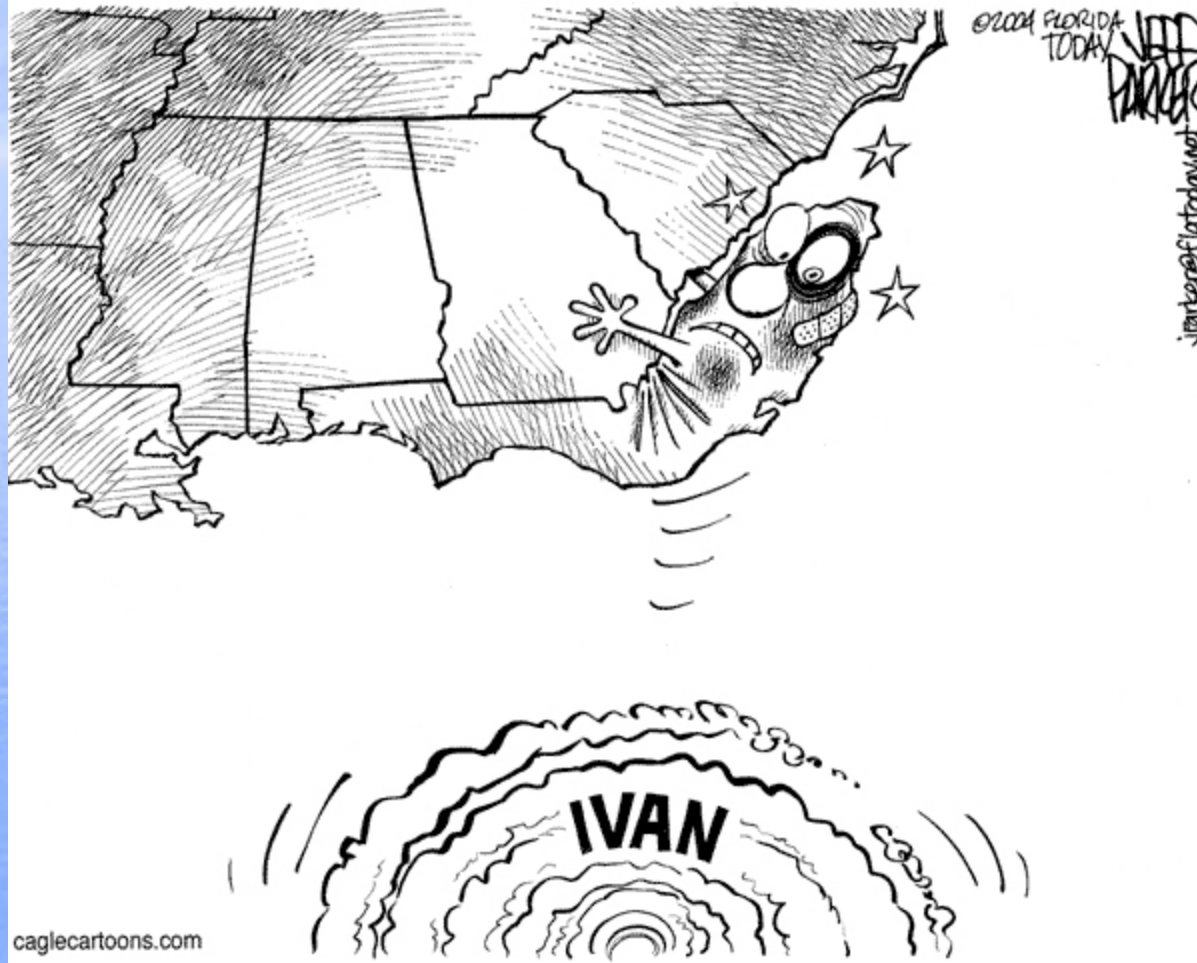
Figure 6 Images.



Courtesy NWS Tampa Bay

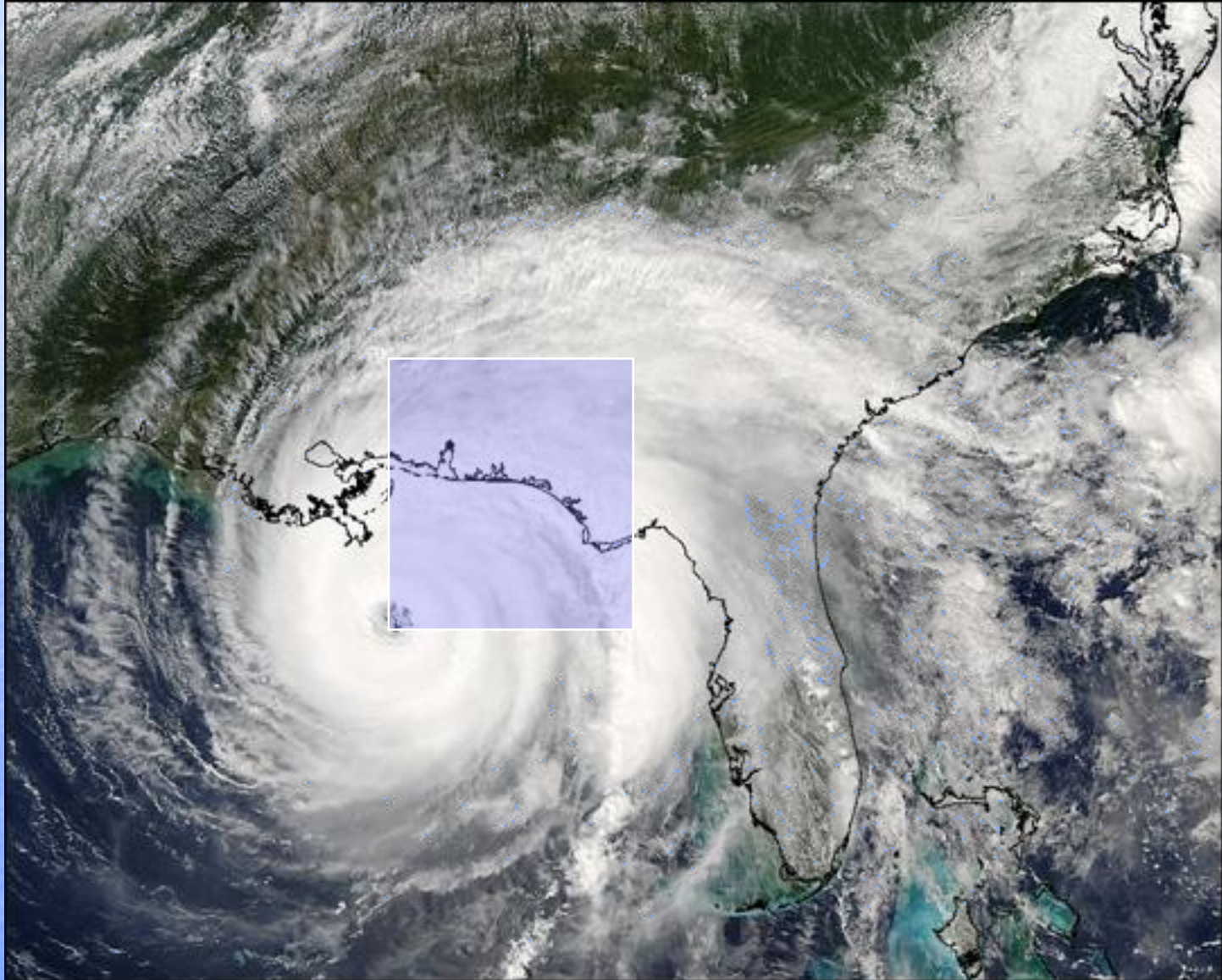
Figure 6. Site C damage (Jailhouse parking lot and rear field).

Record 2004 Hurricane Season

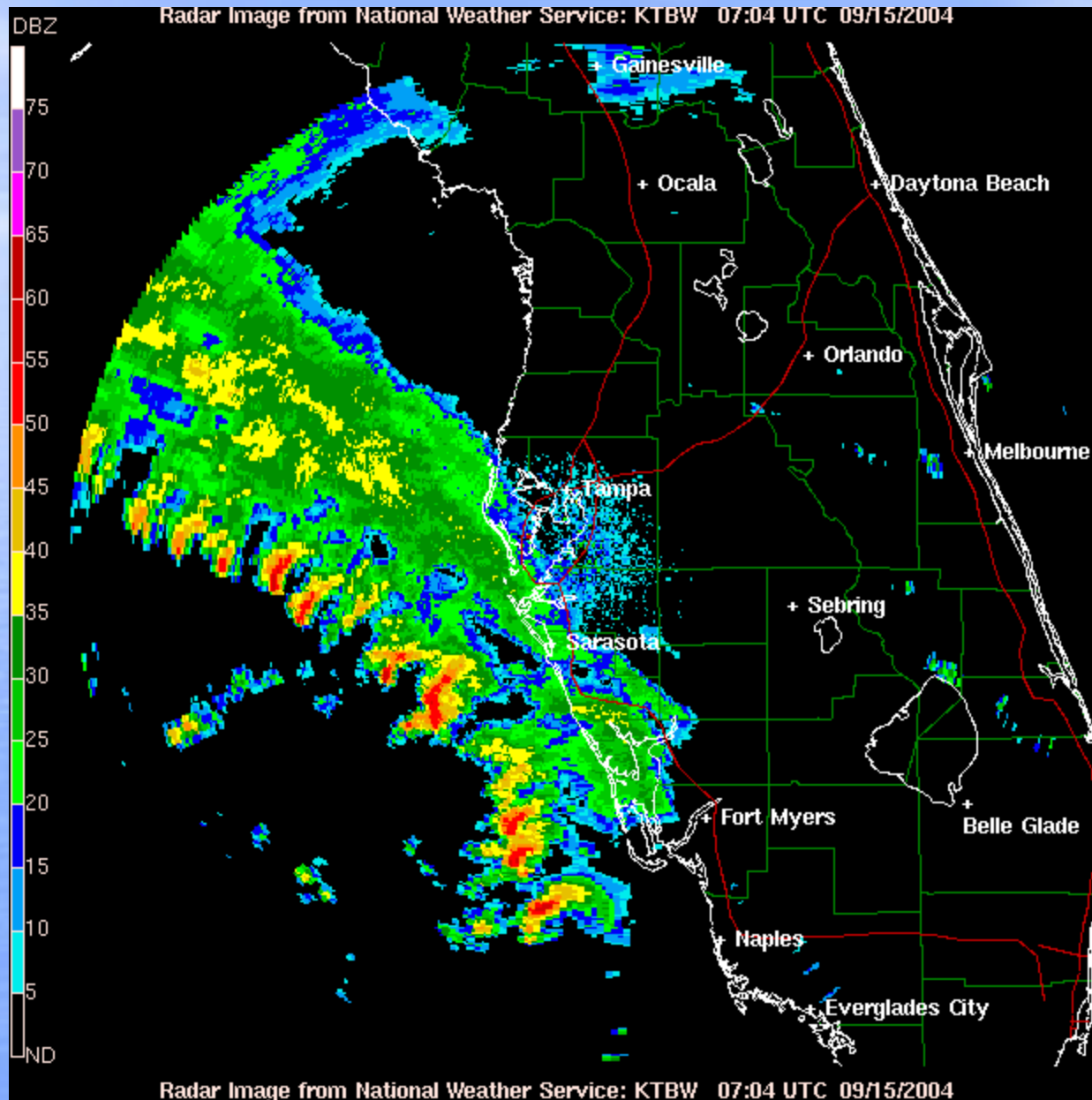


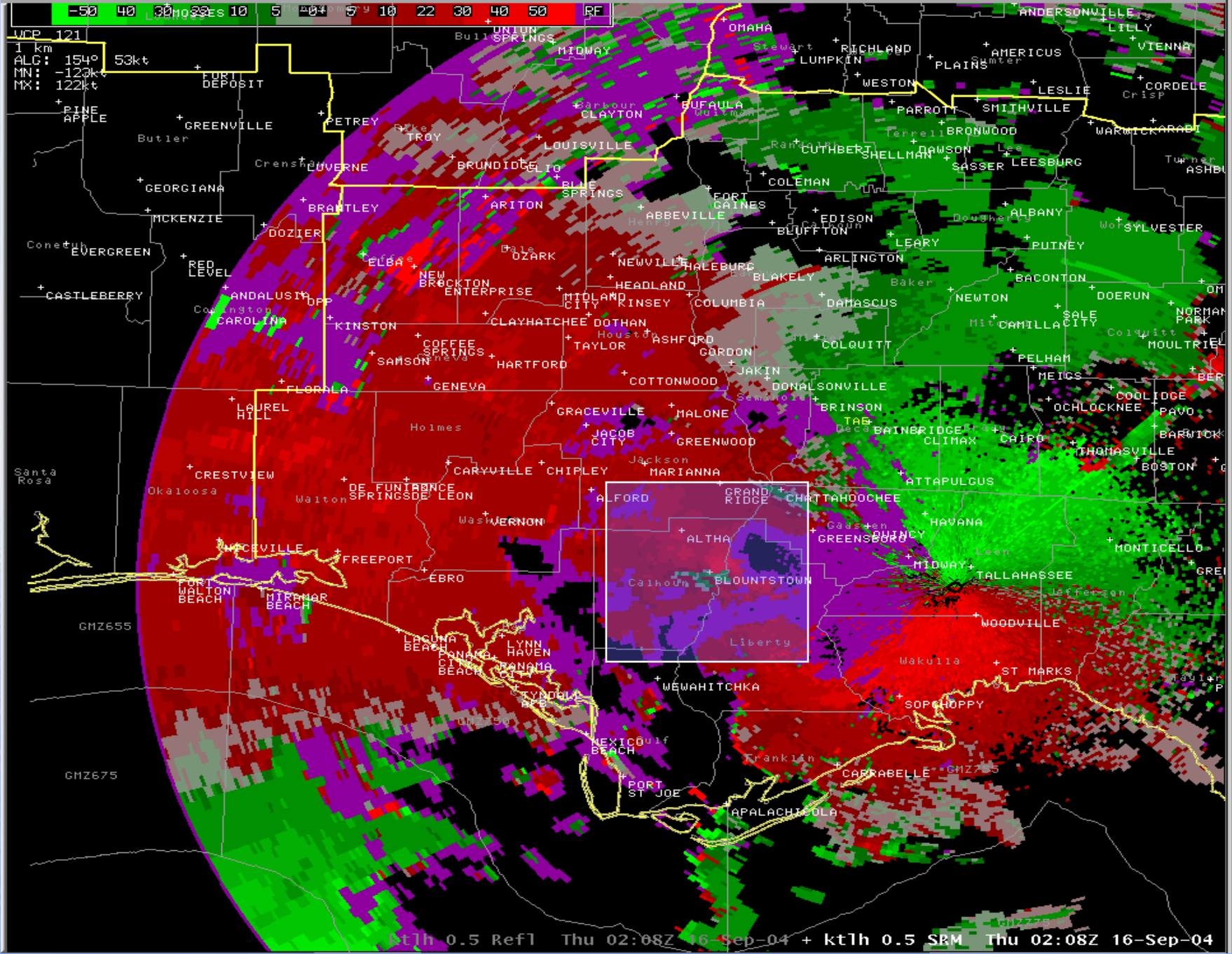
Hurricane Ivan

3 Killer Tornadoes - 2 F2 and 1 F1 – 6 Dead



Dominant Outer Rainband Missed Peninsula!



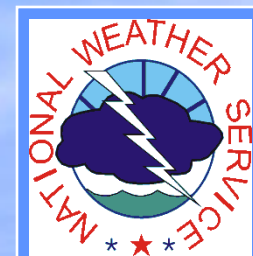


Four People Killed Near Blountstown (F2) 9/15/04 907PM



National Weather Service Forecast Office

Tallahassee, FL

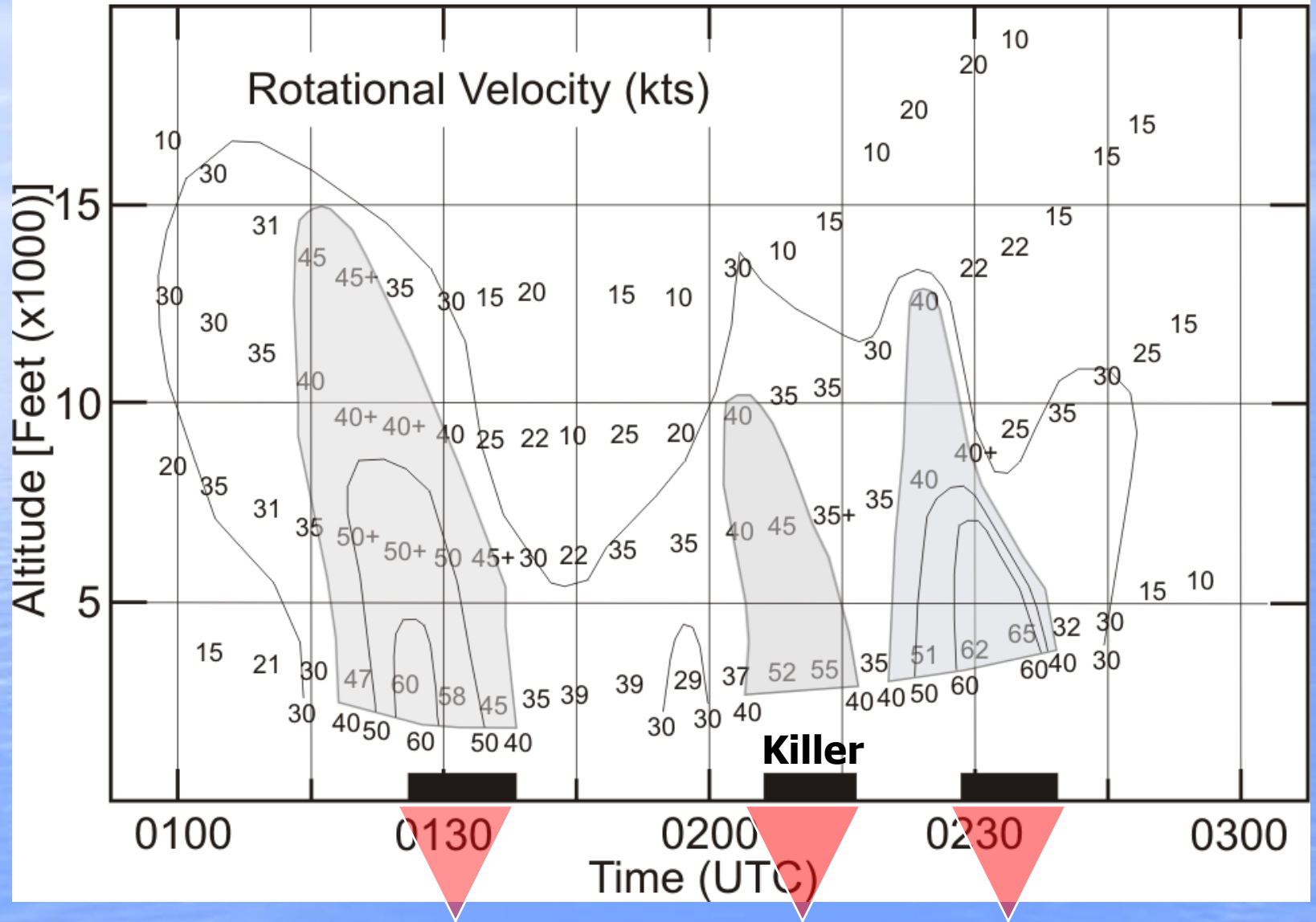


**"Tornado on the ground"
Live video!**

**Jason C. Kelley
WJHG-TV**

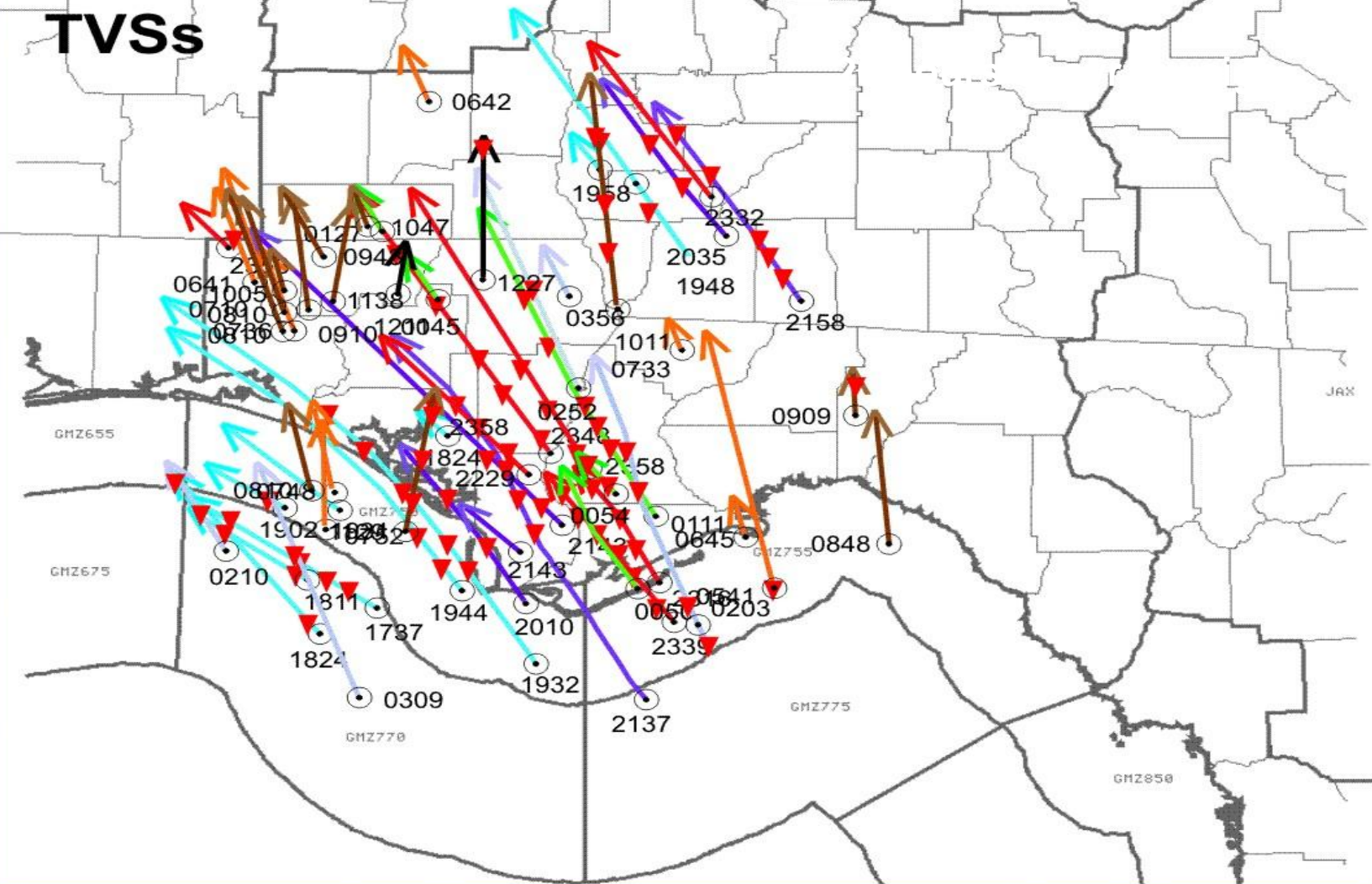


Hurricane Ivan - Blountstown/Marianna Tornado

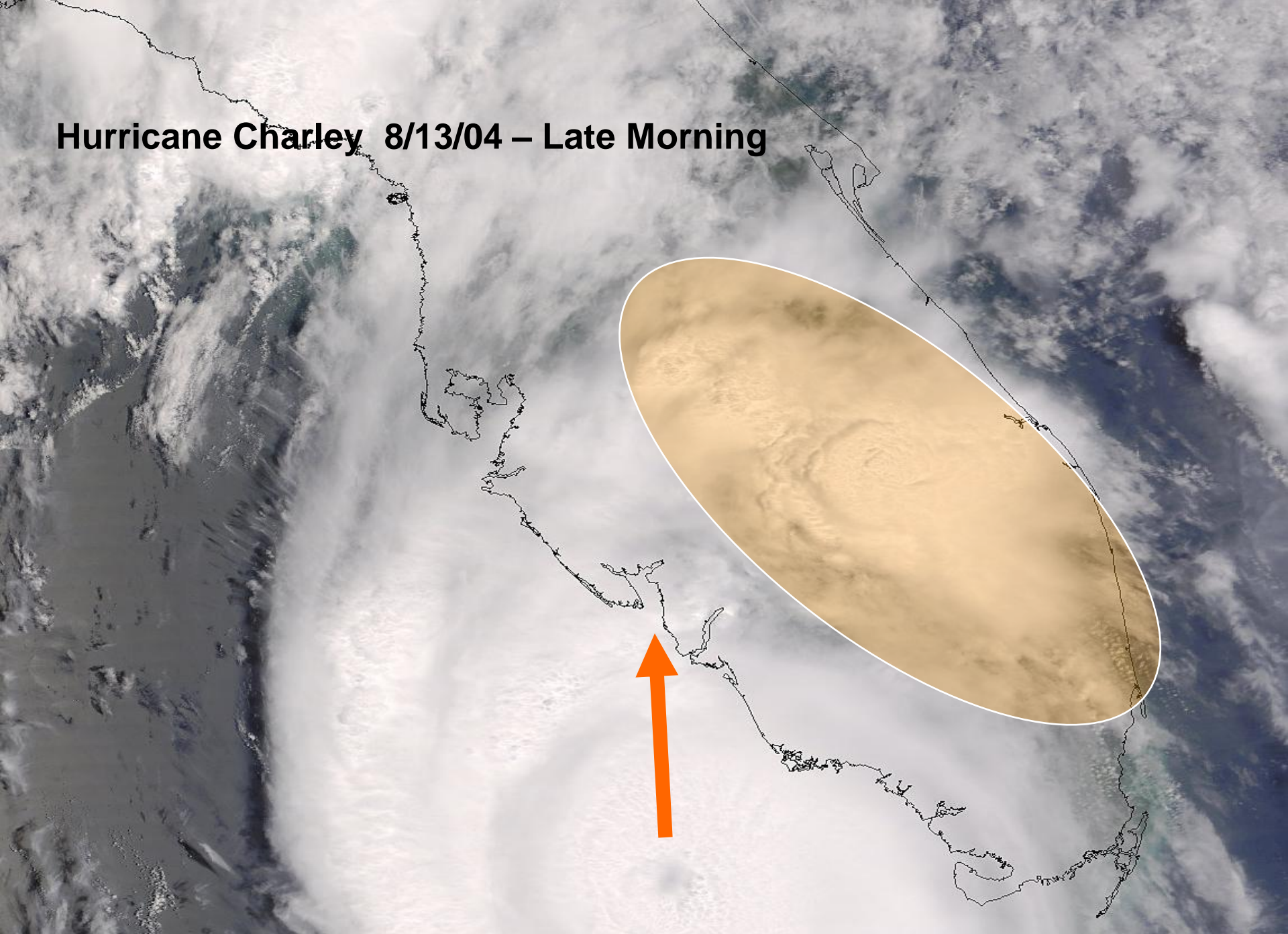


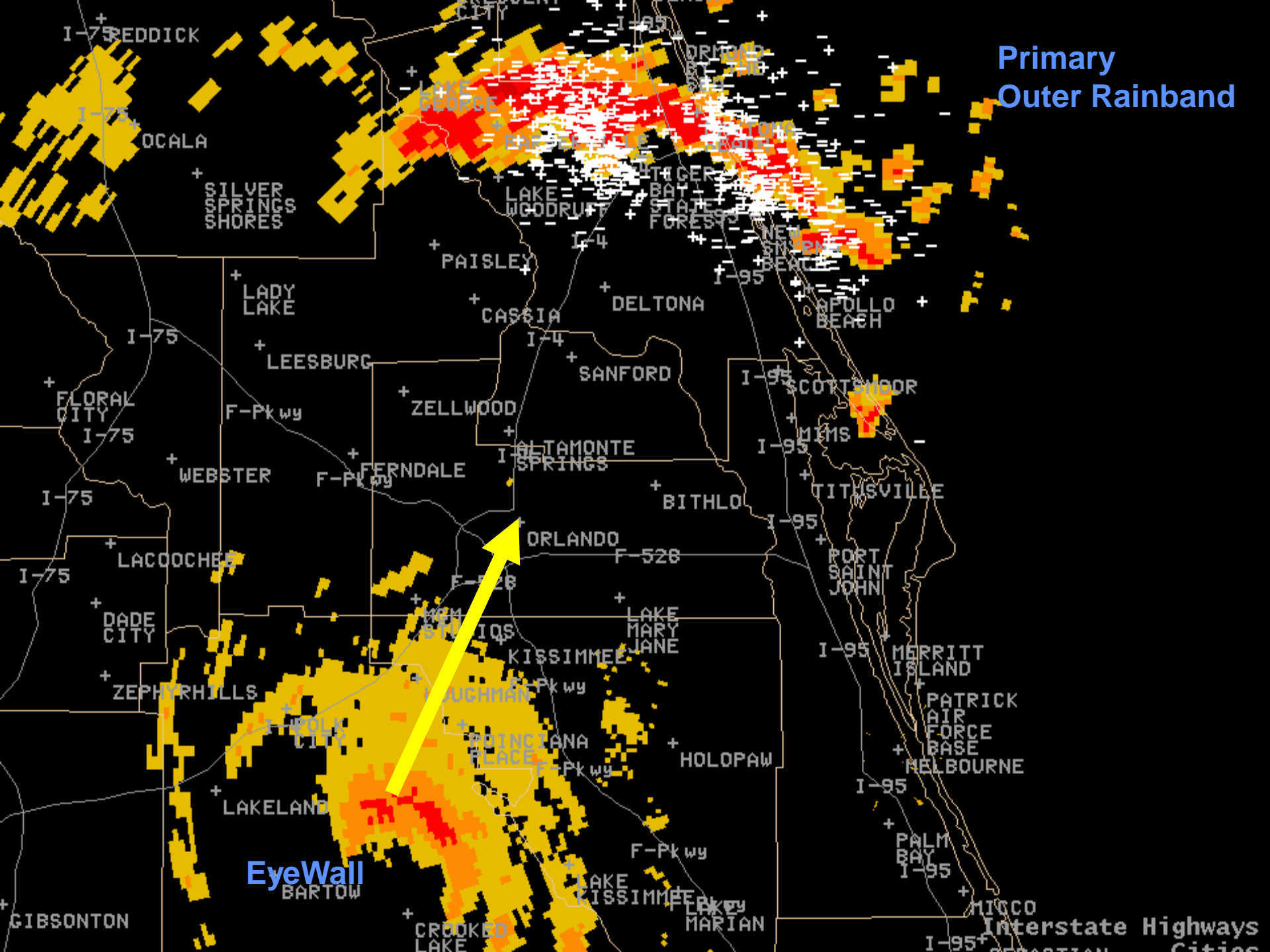
Irv Watson WFO TLH

**9/15 1800 UTC to
9/16/04 1400 UTC
MESOs
TVSs**



Hurricane Charley 8/13/04 – Late Morning





Primary
Outer Rainband

EyeWall
BARTOW

Interstate Highways
Cities

**BULLETIN - EAS ACTIVATION REQUESTED
TORNADO WARNING**

***AT 642 PM EDT...THE NATIONAL WEATHER SERVICE HAS ISSUED
A TORNADO WARNING FOR DESTRUCTIVE WINDS OVER 100 MPH
AND TORNADOES IN THE EYE WALL AND INNER RAIN BANDS OF
HURRICANE CHARLEY.**

*** THE LEADING EDGE OF HURRICANE CHARLEYS DESTRUCTIVE
WINDS IS EXPECTED TO MOVE INTO THE KISSIMMEE AND GREATER
ORLANDO AREA BY 715 PM.**

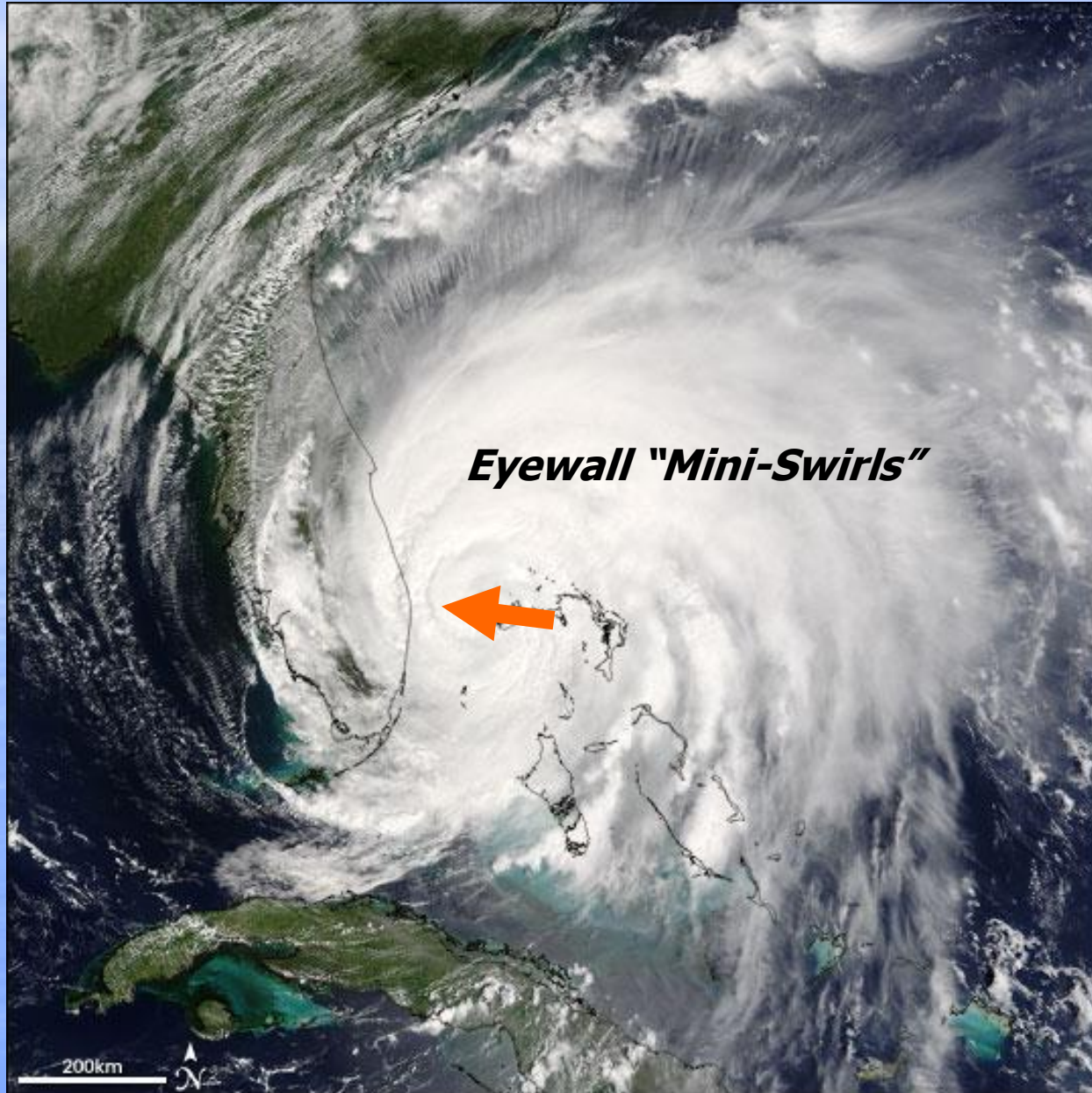
Starting in 2007 Season: **Extreme Wind Warning for
sustained 100 knot (115 mph) winds. Valid for up to two
hours.**

The Eyewall and innermost rainbands of landfalling hurricanes are extremely dangerous phenomena that produce very localized devastation!



Charley – Metro Orlando

Hurricane Jeanne 25 SEP 2004



Conceptual Model of Hurricane Eyewall “Mini-Swirls”

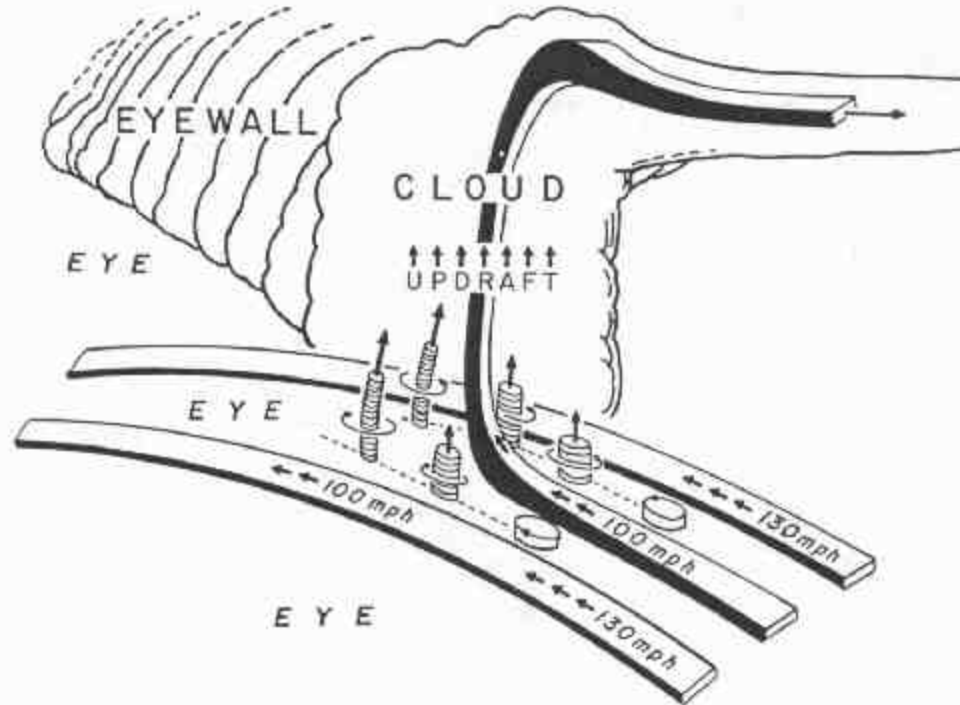


Figure 308. Mini-swirls in a hurricane

According to Professor Fujita, wind shear zones are set up within the eye wall, because different parts of the eyewall rotate at different speeds. The wind shear gives rise to areas of rotation along a vertical axis. If those areas of rotation coincide with an updraft, the mini-swirls spin up and move rapidly forward with the intensity of a strong to (possibly) violent tornado. Drawing courtesy of Professor Ted Fujita.

BULLETIN - EAS ACTIVATION REQUESTED

TORNADO WARNING

NATIONAL WEATHER SERVICE MELBOURNE FL

858 PM EDT SAT SEP 25 2004

THE NATIONAL WEATHER SERVICE IN MELBOURNE HAS ISSUED A

*** TORNADO WARNING FOR...**

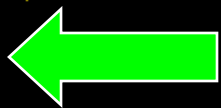
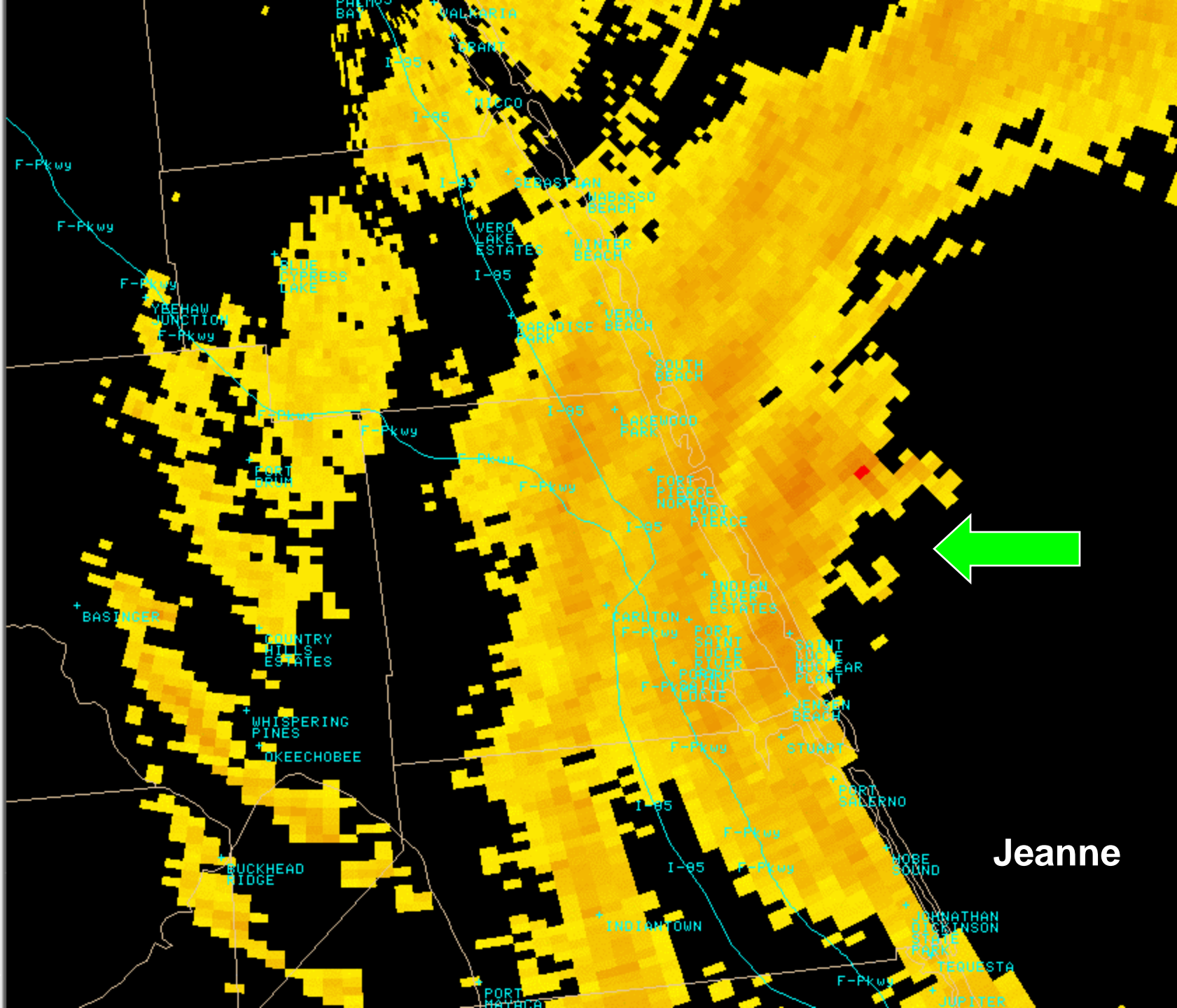
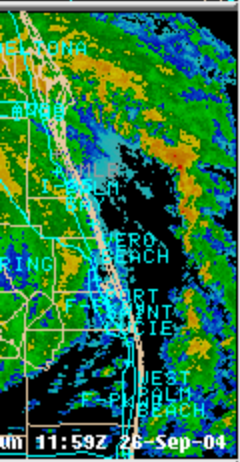
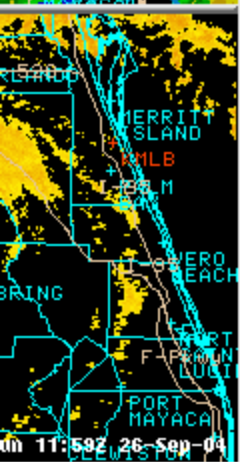
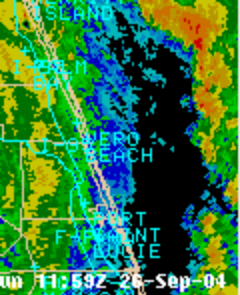
MARTIN COUNTY

ST. LUCIE COUNTY

IN EAST CENTRAL FLORIDA

*** UNTIL 1000 PM EDT**

*** AT 855 PM EDT...THE NATIONAL WEATHER SERVICE HAS ISSUED A TORNADO WARNING FOR MARTIN AND ST LUCIE COUNTIES MAINLY FOR THE **ONSET OF EXTREME HURRICANE WINDS AND EMBEDDED TORNADOES ASSOCIATED WITH THE INNER CORE OF HURRICANE JEANNE AS THE CENTER NEARS THE COAST. WINDS TO 100 MPH WITH GUSTS TO 120 MPH ARE EXPECTED...ALONG WITH TORNADOES.****



Jeanne





STOP

Survey results -Jeanne



One Lucky Row of Manufactured Homes – Near Barefoot Bay

Eyewall “Mini-swirls” or extreme wind swaths



And Some Not so Fortunate

- Damage gradient extreme, destruction localized – county scale.
- Historic severe weather events where they occur.
- Hurricane Warnings may have been out for 24 hours or more.

- Power may be out and information lacking just before the worst hits.
- Citizens need final warning – last chance to save lives ~ 1-2 Hours. Need EAS.
- Not talking about track – but impact!
- Extreme Wind Warning **EWW**

**Exercises:
Predict Tornado Locations and
Maximum Strength!**

Case #1

Where Will Tornadoes Strike within the Next 24-36 Hours?

HURREVAC 2000 for Windows 95/98/NT/2000/XP

File Advisory Map Move Overlay Display Mode Timing What-IFs Rain/River Traffic Utilities Help

OLD Advisory

11
MON 05 EDT

(09Z) - Initial Position
25.80 N 88.40 W
45kt (50mph)-Cat 0
FcstMove.15kt (17mph)



Change -



MAP -



Mode - Single Plot



What-IFs



Other..



Tropical Storm

5 AM EDT Monday

Current Location 25.8 N 88.4 W

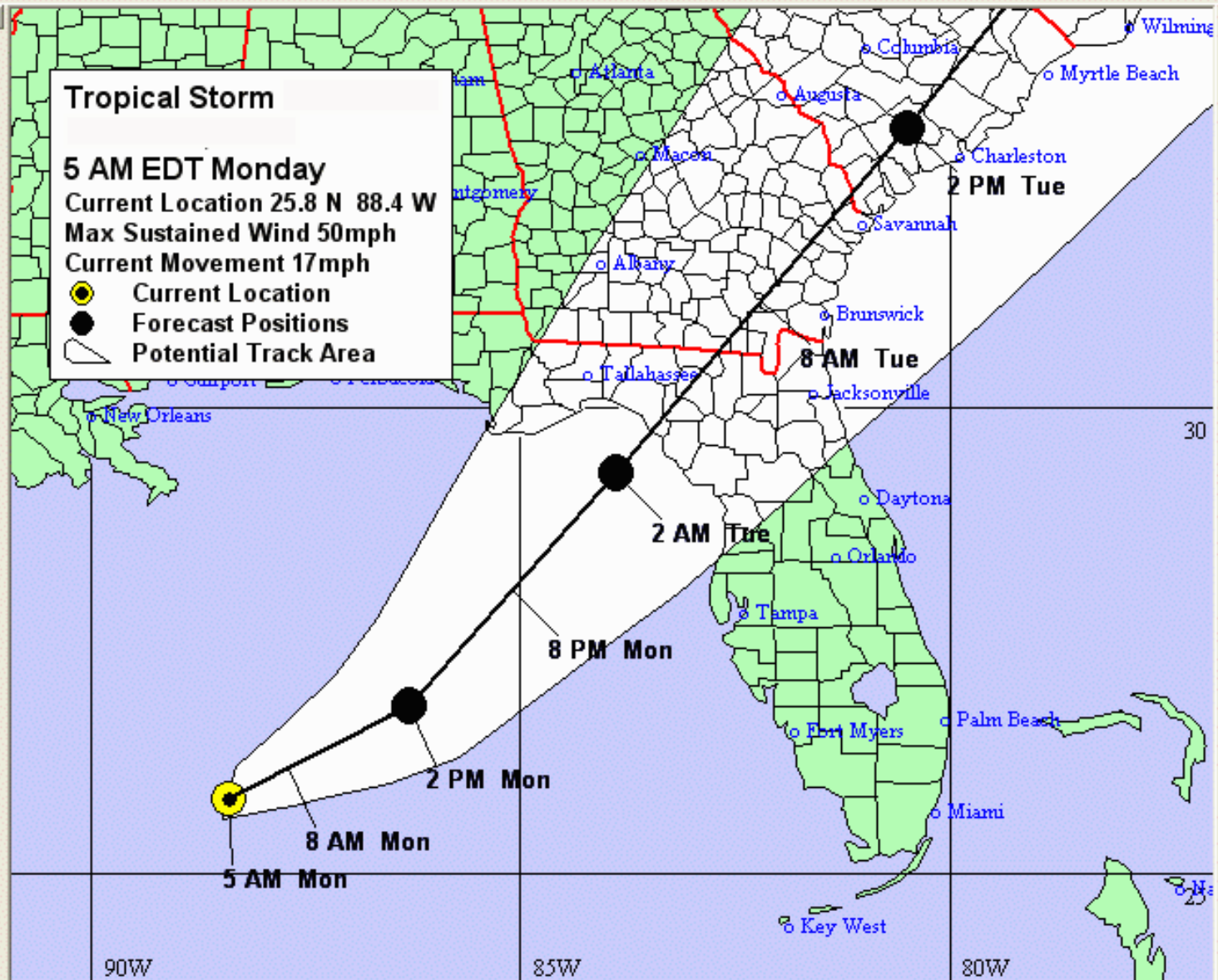
Max Sustained Wind 50mph

Current Movement 17mph

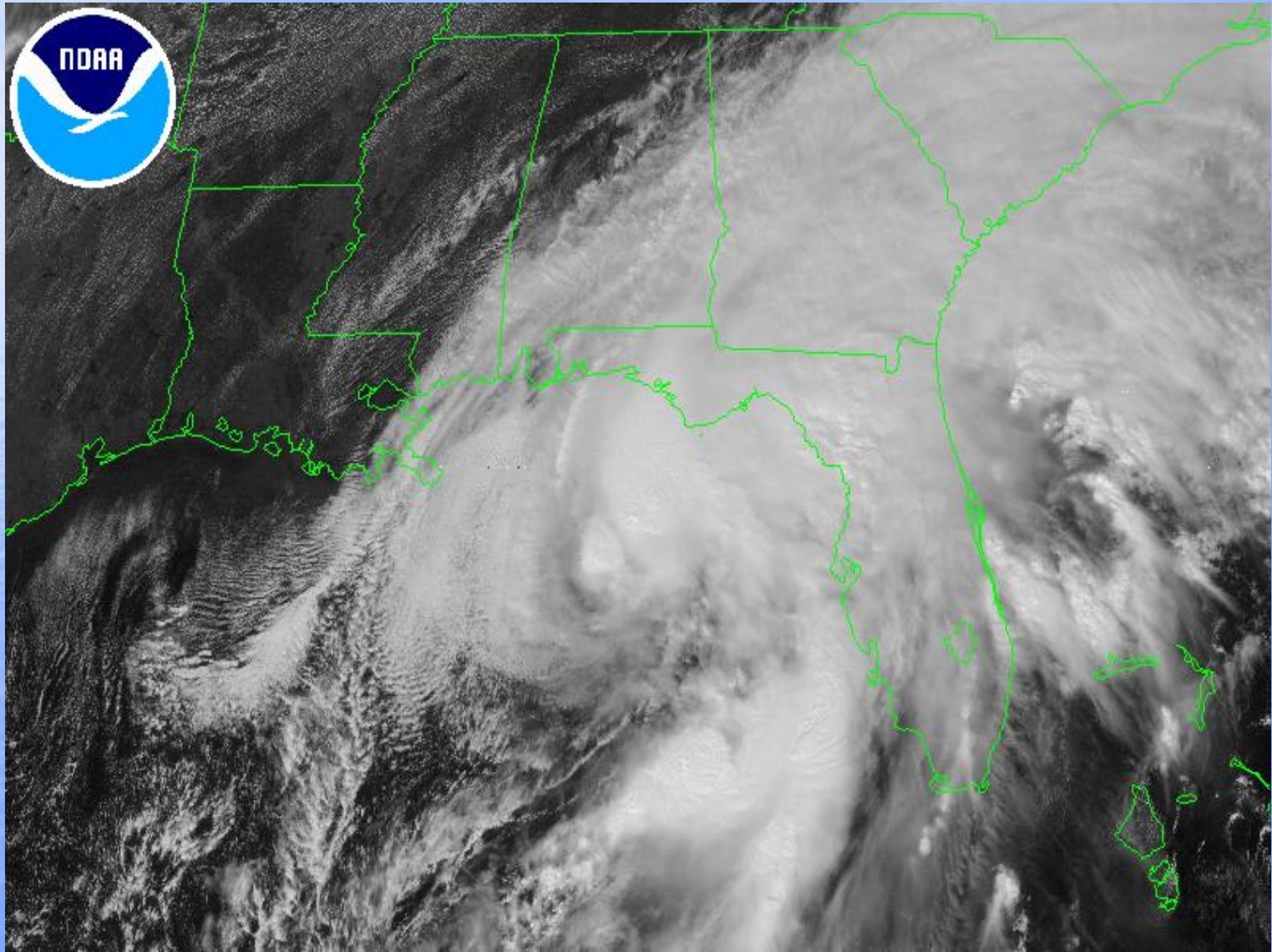
● Current Location

● Forecast Positions

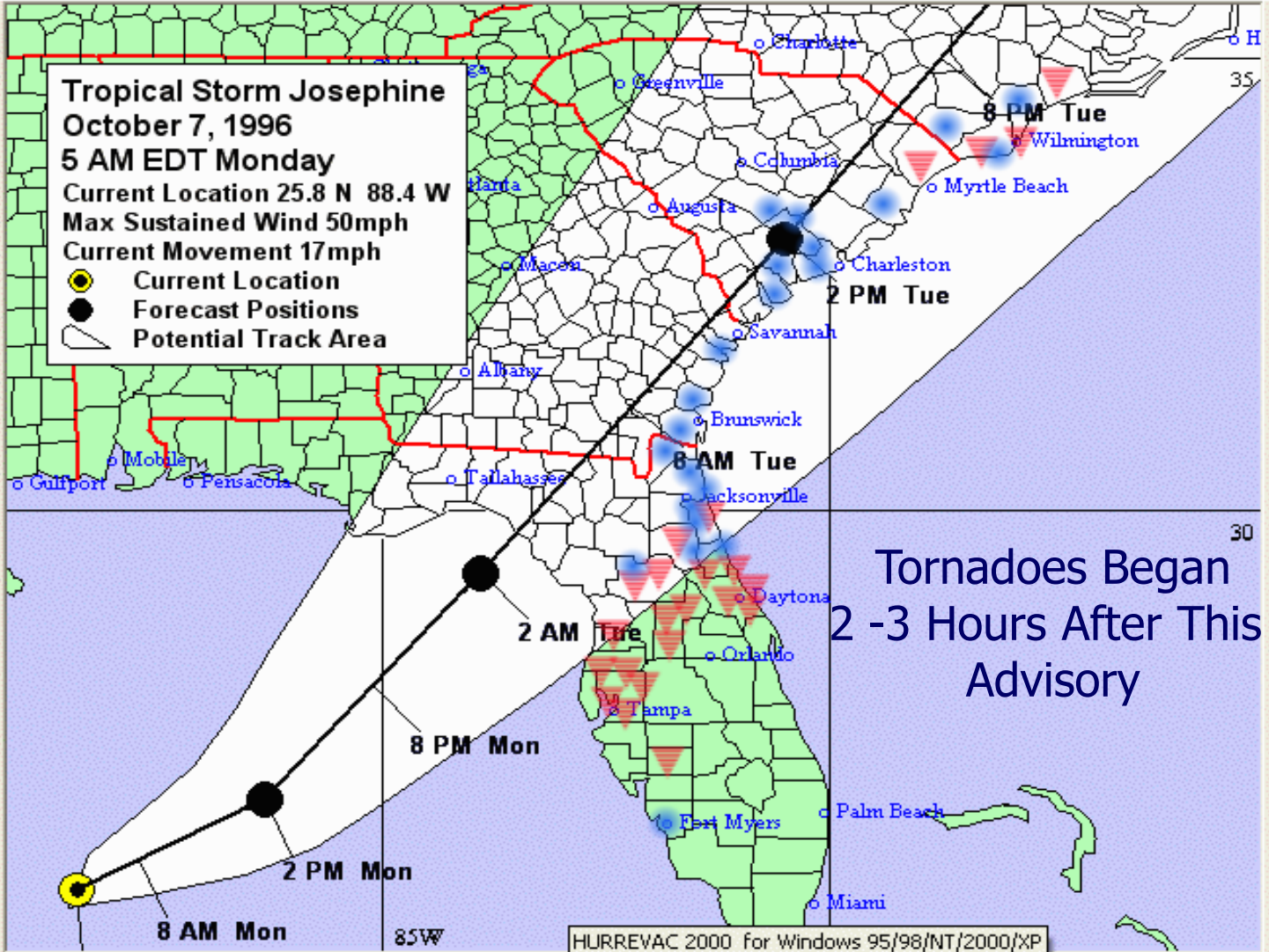
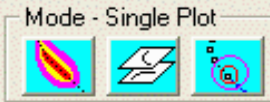
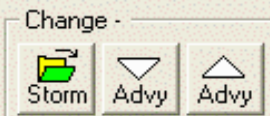
▭ Potential Track Area



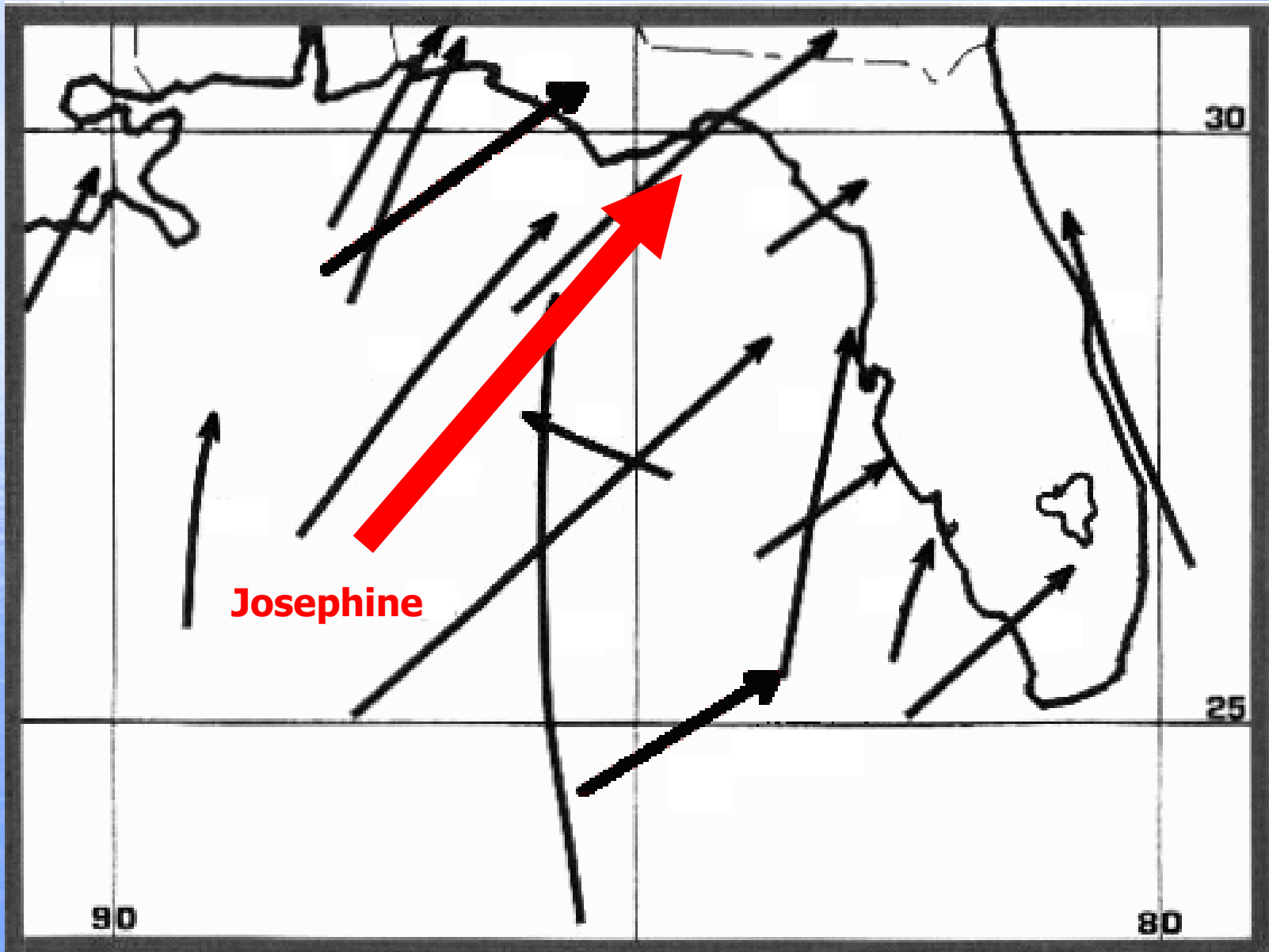
**Shade the Counties Where Tornadoes Will Strike
Within the Next 24-36 Hours and Estimate How Soon
After the Advisory They Will Begin?**



DLD Advisory
JOSEPHINE # 11
MON 10/07/96 05 EDT
 (09Z) - Initial Position
 25.80 N 88.40 W
 45kt (50mph)-Cat 0
 FcstMove.15kt (17mph)



Significant Tornado Outbreaks



Josephine rolls across Florida with rain, tornadoes

October 8, 1996
Web posted at: 8:15 a.m. EDT

ST. MARKS, Florida (CNN)-- Tropical storm Josephine, with 65



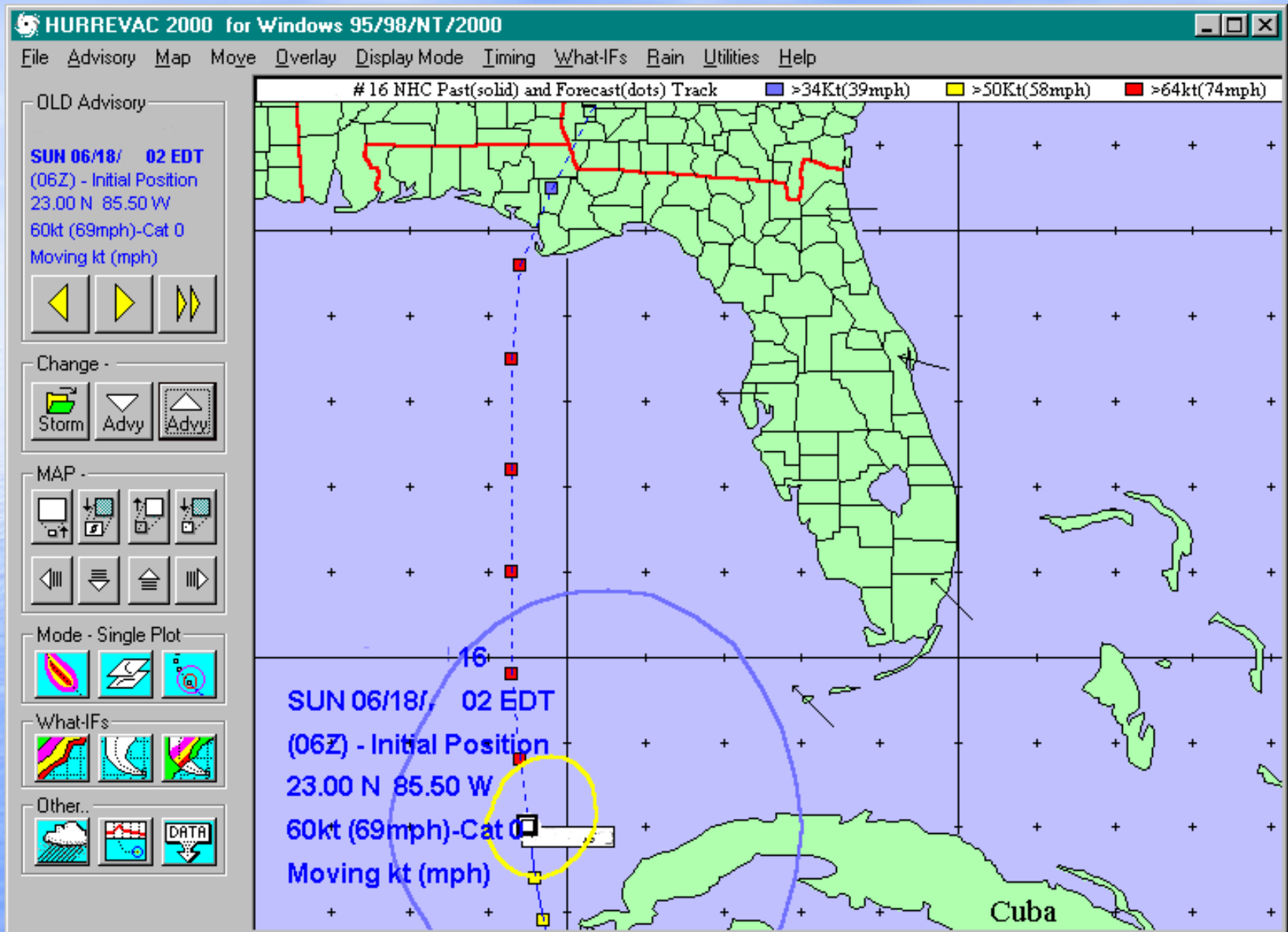
Edgewater, Florida

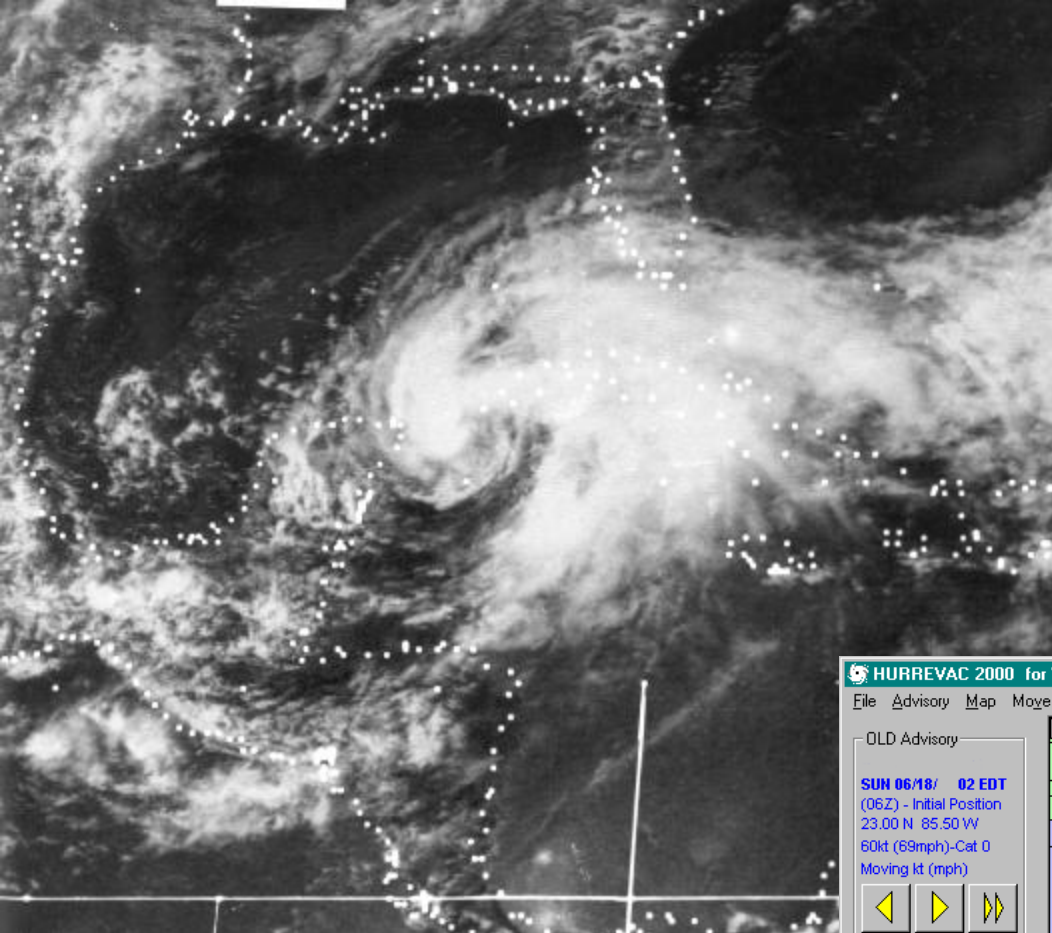
(Courtesy WCPX)



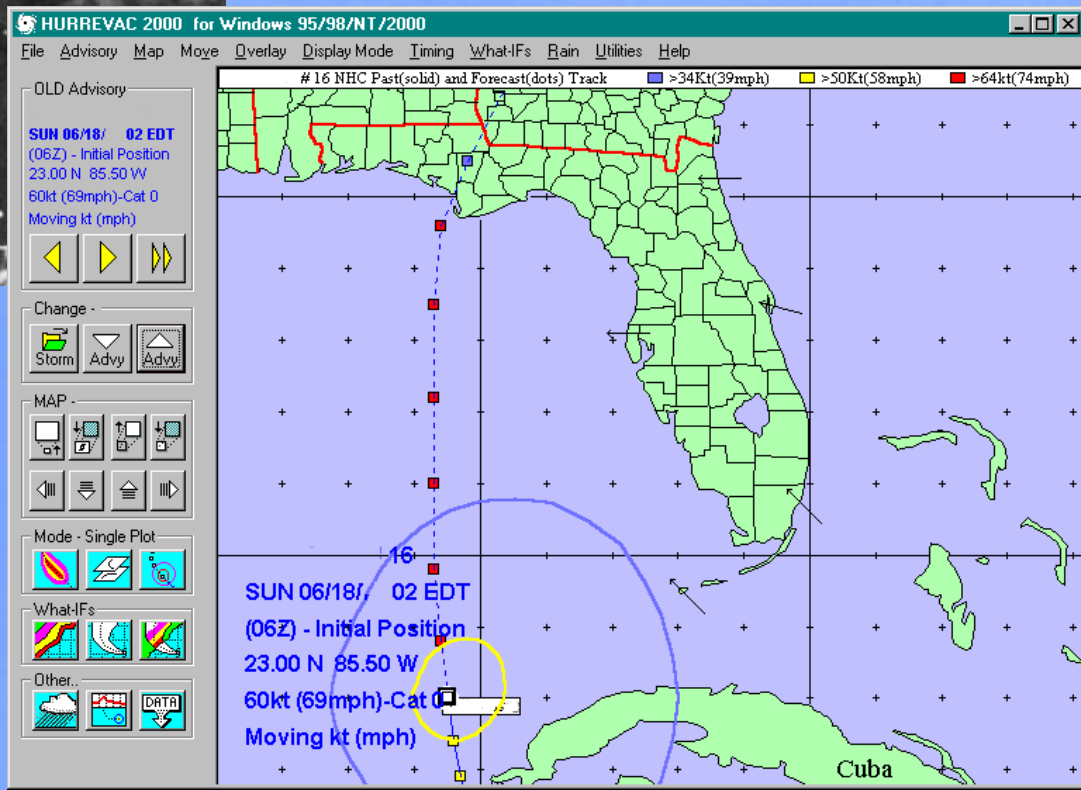
Case 2

Where Will Tornadoes Strike within the Next 24-36 Hours?

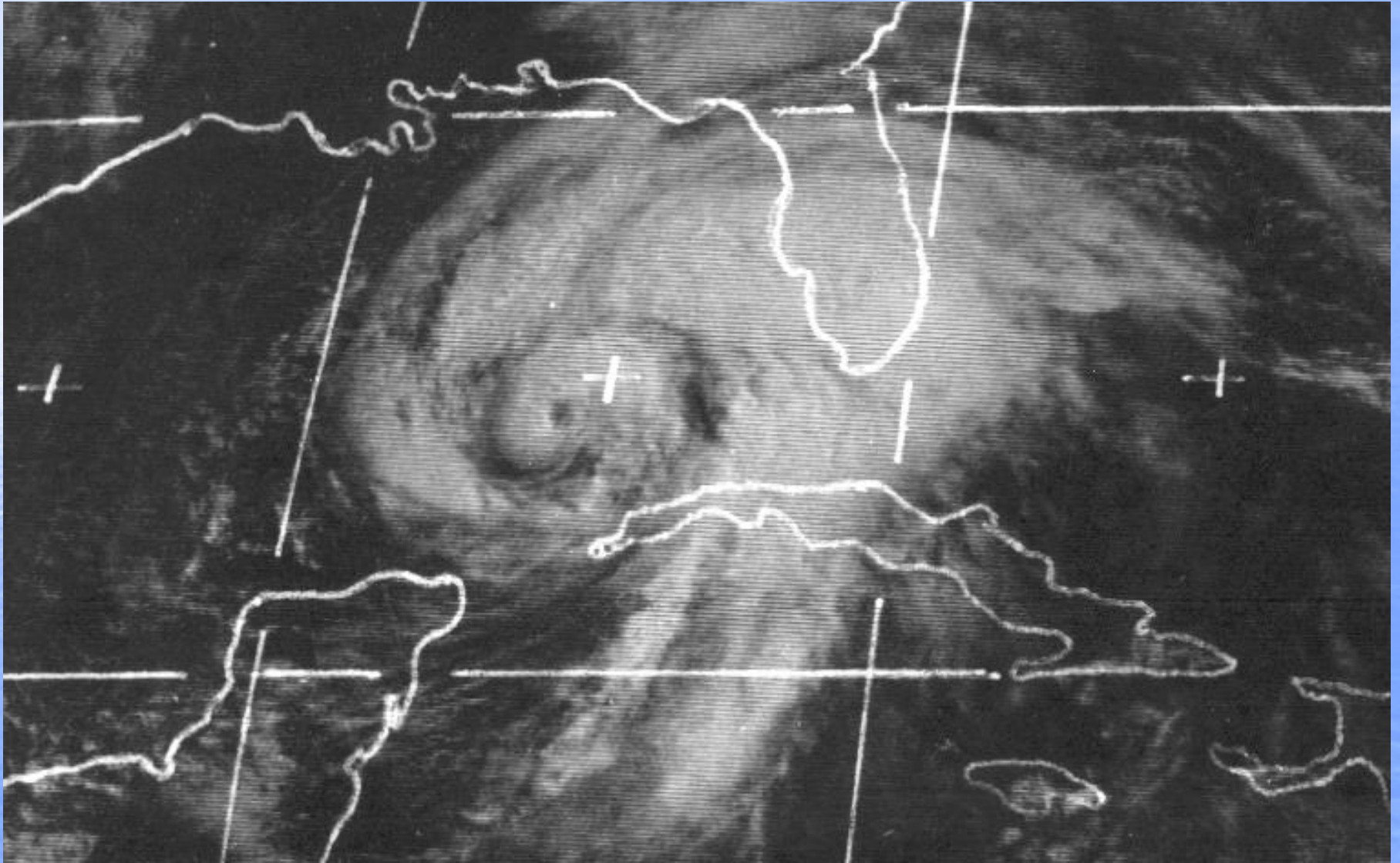




**Shade the Counties
Where Tornadoes Will
Strike Within the Next
24-36 Hours and Estimate
How Soon After the
Advisory They Will Begin?**



CLUE - Category 1 Hurricane – No Strengthening Forecasted



Tornado rips path across Key West

Photos by Wendy Tucker



Big Coppitt Key: sudden devastation, terror in darkness



Savage

Tornadoes Began 15 minutes after Advisory



Funnel Cloud Over Cape Coral

Damage in Cape Coral from Hurricane Agnes was caused primarily by tornados that dropped out of the cloud and rain shield spreading over the city from the sea. This photo shows one dark funnel cloud spinning over Cape Coral Sunday afternoon as it moved northward with a squall line. (BREEZE by Kirkpatrick)

TODAY

Florida's Space Age Newspaper

Published by The Gannett Company in Brevard County, Florida

Next Space Shot
An Orbiting Astronomical Observatory will go Aug. 10 on an Atlas-Centaur rocket.

TODAY's Weather
Cloudy, showers. High mid-80s, low mid-70s. Winds east-southeast 20-25 m.p.h. (Complete weather Page 2A)

10 Cents

ach Post



JUNE 10, 1972

11 PAGES - PRICE TEN CENTS

Eleven Hurt as Tornado Slams South Brevard

Photos on back page this

Brevard Hospital. Most in-

noise," said Paul Brown, 44,

trailer was demolished."

trailer was blown in on him.

DEP Cpl. Bill Mathews

Evacuation Urged in Low Area of Panhandle

Related stories, A2, C1

From Panhandle Press

Residents of a low-lying area along a strip of the Florida Panhandle were urged to evacuate yesterday as Hurricane Agnes churned toward them with winds up to 100 miles an hour and tornadoes that killed one person and injured at least 35.

As the season's first hurricane plodded north at about 12 m.p.h. from a position 275 miles south of Panama City, the National Hurricane Center recommended evacuation of the offshore islands and beach areas along a 110-mile strip of the panhandle.

"Evacuation routes in this area are low, and some escape routes may be cut off by rising waters three to six hours before the center reaches the coast early this afternoon," the center's advisory said.

Police in the agricultural town of La Belle, about 80 miles northwest of Miami, said one woman was killed and several persons were injured when a tornado tore into a nearby residential section.

Civil Defense officials in Port St. Joe said 700 to 800 residents of low-lying sections of the town were being evacuated. Many of them were preparing to spend the night in a high school, according to the local CD chief, Richard Lawrester. He added that persons would be evacuated today to Marianna if conditions became worse.

The hurricane center said Agnes was expected to cross the Panhandle near Apalachicola early this afternoon if she maintained her course and speed.

"Everybody around here is boarding up their houses, and the boats are all being pulled into safe harbor," said Nick Fortunus, an officer of the Apalachicola Police Department.

"We've been pretty busy helping people board up and carrying radios to places where we think communications might be knocked-out."

Civil Defense, firemen, sheriff's deputies, county service, everybody's been helping out," he said.

"It's lucky that not too many people here live in low-lying areas," Fortunus added. Apalachicola is a coastal town of about 3,500 persons.

Stateside Cuban fishing boats had anchored just off Cedar Key within U.S. territorial waters to seek safety as Agnes approached, the Florida Marine Patrol reported.

Patrolman W. H. Wilson said in Crystal River that the patrol was notifying the U.S. Coast Guard that the Cuban boats had been observed from Cedar Key docks. No other action was being taken, he said.

The National Hurricane Center in Miami issued a 10 p.m. warning to persons living in low-lying areas along a 110-mile section of the Florida Panhandle to evacuate.

Agnes was centered then near Latitude 28° 2 North, Longitude 82° 2 West.

A spokesman for the Brevard Hospital in Melbourne said 11 people were treated for injuries sustained from a tornado which touched down at a nearby trailer park about 8 p.m.



Picking Through the Rubble, 'It Sounded Like a Freight Train Was Coming,' Said One

Tornado Kills Woman Near La Belle

By DEAN JONES
and JAMES QUINN

LA BELLE (Special to Today) — A woman's apartment in Brevard County was slashed through track by a tornado west of here yesterday, killing a housewife and injuring six other persons.

Witnesses said the twister toppled oak trees, raised citrus groves and buried a go-kart track into a rubble

hoop. It tumbled down on both sides of the La Belle-Hawthorne River some 15 miles west of Melbourne.

It first landed on the south bank of the river. Mrs. Yvonne Messer, about 30, was killed and her husband, Marion, injured when the twister demolished their trailer.

Civil defense authorities said 10-20 trailers were damaged or destroyed.

Mr. and Mrs. Emile LeClair, neighbors of the Messers in a nearby trailer, were at home at the time the twister struck.

"It sounded like a freight train was coming," said Mrs. LeClair.

Her husband, who went outside said he stood in amazement as the tornado dropped out of the sky, clipped the tips

of a dozen pine and oak trees and then "exploded" into the Messers' trailer.

"When it hit there was a flash and an explosion," LeClair said. "I ran over to the spot but there was nothing left. He (Messer) was standing over his wife when I got there. Buddy was just saying 'Please help me, please God help me.'"

Turn to LA BELLE, A7

Turn to HURRICANE, A2



FOR PEOPLE
IN TROUBLE
WE CARE INC.
FURNISHING PERSONAL SERVICE
301-2121 21 STORES

Orlando Sentinel

FINAL
Late Baseball

'Tis a Privilege to Live in Central Florida

Vol. 88—No. 37 52 Pages

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Orlando, Florida, Tuesday, June 20, 1972

ESTABLISHED 1877

10 Cents

150 Homes Suffer Heavy Damage In Agnes Spinoff

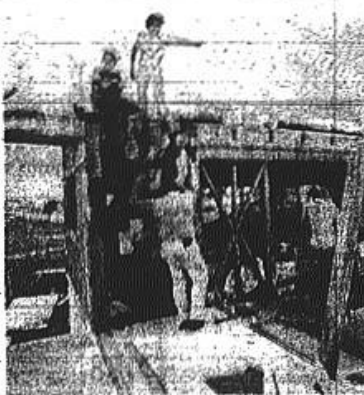
3 Tornadoes Leave \$12 Million Trail

BULLETIN

Alloto, Aides Acquitted
TACOMA, Wash. (AP)—A federal judge ordered acquittal Monday of San Francisco Mayor Joseph Alloto and two former Washington officials on charges that they conspired to bribe public officials.



SEARCH CONDUCTED FOR SALVAGEABLE



APPLAGATE FAMILY SEARCHES RUINS: Home hit at 515

Agnes Slows After Hitting Panhandle

APALACHICOLA (AP)—Hurricane Agnes smacked the Florida Panhandle with 80-mile-an-hour winds, heavy rains and raging seas Monday, but its fury started to subside as it churned inland.

At least 12 persons were left dead in the wake of the 1972 hurricane's season's first storm. Forecasters said more deadly tornadoes or flash floods were possible.

THE NATIONAL Hurricane Center in Miami downgraded Agnes to a tropical storm Monday evening when its winds dropped below hurricane strength. Highest sustained winds were reported at 55 m.p.h. as the storm spent its energy in the Panhandle's piney woods.

But forecasters said Agnes threatened to spawn more tornadoes in the east as it moved north-northeast at 15 m.p.h.

Storm tides flooded streets in coastal towns along a 50-mile strip from Apalachicola to St. Marks in a popular fishing and tourist area.

FIVE DEATHS, and injuries to more than 100 persons in Florida, were attributed to tornadoes spawned by Agnes as she churned northward in the Gulf of Mexico. The storm earlier caused seven deaths by drowning in Cuba.

Coastal residents crowded into schools, armories and other sanctuaries prepared by civil defense and Red Cross workers.

RAGING WINDS from Agnes raked cornfields miles inland, and

24 Injured By Twisters

The Palm Beach Post



Pyle Kennedy, Publisher

Partly cloudy with mainly afternoon showers and thunderstorms. Rain probability 40 per cent. High 88. Low 74-78.

Details, A1

VOL. LXIV, NO. 92

WEST PALM BEACH, FLORIDA, TUESDAY MORNING, JUNE 20, 1972

36 PAGES—PRICE, TEN CENTS

Deadly Agnes Hits Panhandle, Fades Okeechobee Twister Kills 4; 44 Hurt

More Pictures, Stories, A1-5; Editorial, A10



Turn to PANHANDLE, A4

APALACHICOLA — Hurricane Agnes hurled deadly tornadoes into inland Florida yesterday, before smacking into the Florida Panhandle at midday with high tides and howling winds but its fury started to subside as it churned inland.

At least 12 persons were left dead — seven in Cuba, one in LaBelle and four in Okeechobee City — in the wake of the first hurricane of the 1972 season.

Forecasters said more tornadoes and flash floods were possible and much of the rest of the Deep South was placed under warnings as Agnes lost its hurricane status and was down graded to tropical storm at dusk when it was centered near Cape San Blas.

Damage was reported heavy at Apalachicola on the Gulf Coast and Cedar Key, west of Gainesville. Carabelle, a fishing village east of Apalachicola, was cut off by flood tides. One man was reported missing there, washed from his car by water raging across a highway.

Tides flooded streets along the coast in a 50-mile strip from Apalachicola to St. Marks in the popular fishing and tourist area.

Coastal residents crowded into schools, armories and other sanctuaries prepared by Civil Defense and Red Cross workers. They were urged to wait out the stalled storm, but most residents who had sought refuge returned to their homes as the winds subsided.

By PAT CULLEN and DEAN JONES

PHOTO BY AP/WIDE WORLD

OKEECHOBEE — Four persons were killed and 44 others were injured, 25 seriously, when a tornado smashed through three mobile home parks near here yesterday.

"About 100 trailers were destroyed and at least another 100 were damaged," said Okeechobee County Sheriff's Chief Deputy Cliff Lightsey.

Three deaths occurred at Treasure Island, a mobile home park just off Taylor Creek. Seventy mobile homes, many of them in the \$15,000 price range, were destroyed.

"We had just gone to bed," said Mrs. Robert Harris of Treasure Island. "Then we heard it — that horrible sound. My husband and I made a dash for the kids. But we never made it."

"We were running through the trailer, but then the next thing I remember, I was in the canal," said the woman, who suffered serious leg and rib injuries.

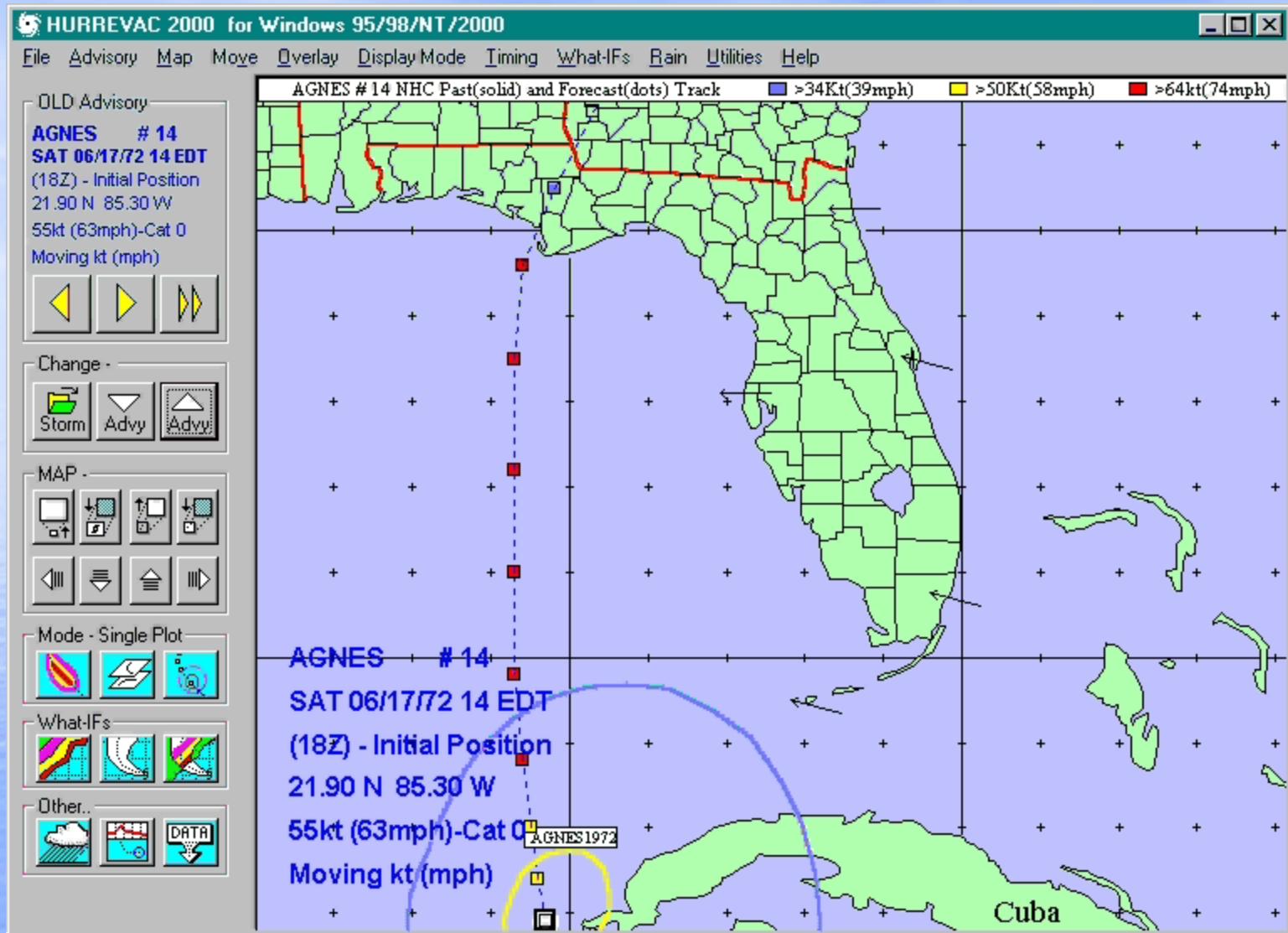
"I just knew I was going to drown, but I grabbed something. Maybe it was the edge of the trailer. Anyway, I held on very tight."

"Bob, he's my husband, he wound up in a boat. Don't ask me how . . . but he was thrown right into a boat."

Turn to TWISTER, A5



Hurricane Agnes June 1972



Deadliest Tropical Cyclone Tornado Outbreak in Florida History...28 Tornadoes in 26 hours... (2 F3, 9F2, 11 F1, 6 F0), including several tornado families and 7 reports of severe thunderstorms 2 tornadoes killed 7 and 10 tornadoes injured 140...

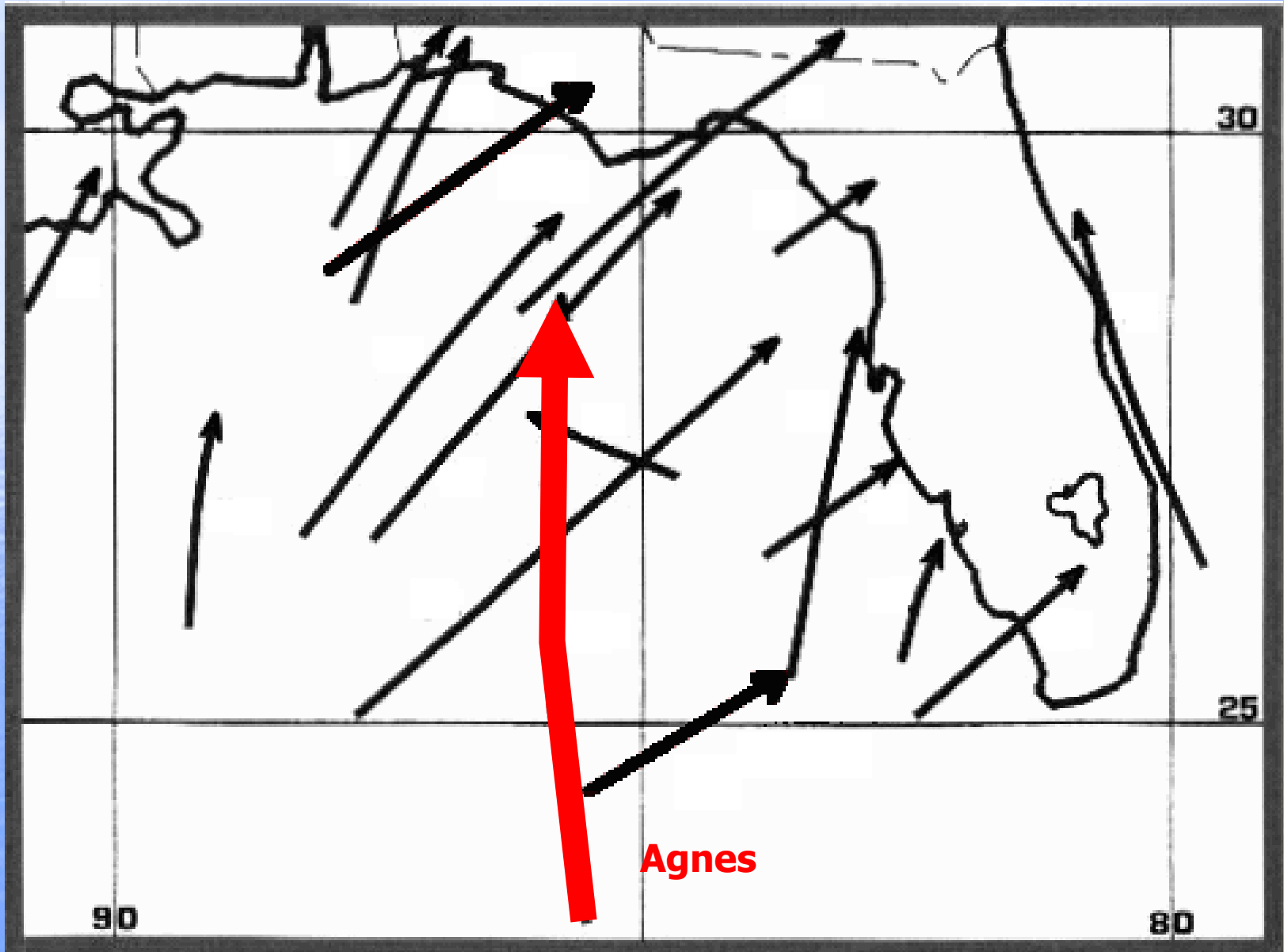
Agnes produced the most tornadoes, the most F2 and greater tornadoes, and the most death and injury producing tornadoes (10) of any outbreak in Florida history.

Agnes is the 5th deadliest tornado outbreak in Florida history.

Agnes is the largest and deadliest TC tornado outbreak in Florida history and, in fact, the third deadliest in U.S. history since 1900, eclipsed only by Hilda in October 1964 (22 dead) and Carla in September 1961 (13 dead) - both post-landfall outbreaks from Gulf of Mexico TC's.

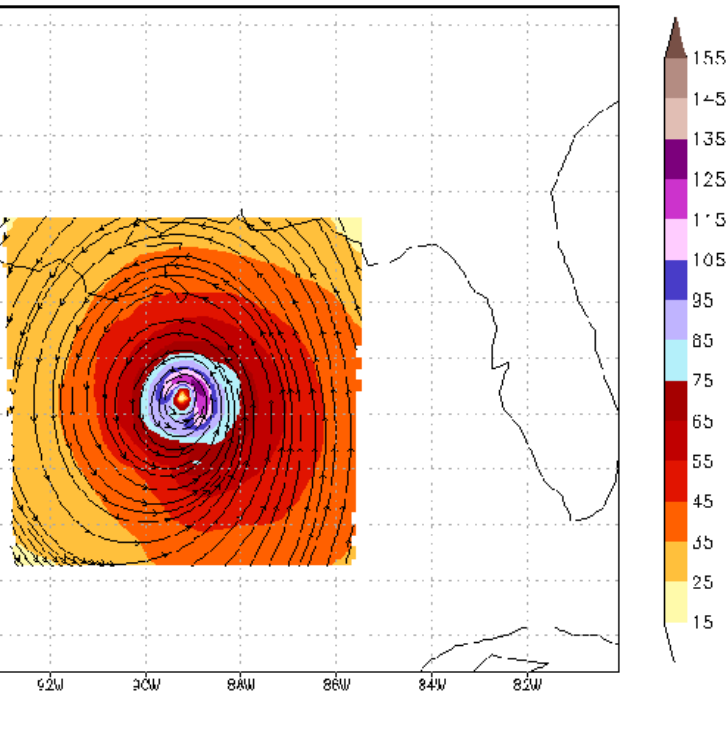
Agnes stands alone as the deadliest pre-landfall TC tornado outbreak in the recorded history of the U.S.

Significant Tornado Outbreaks



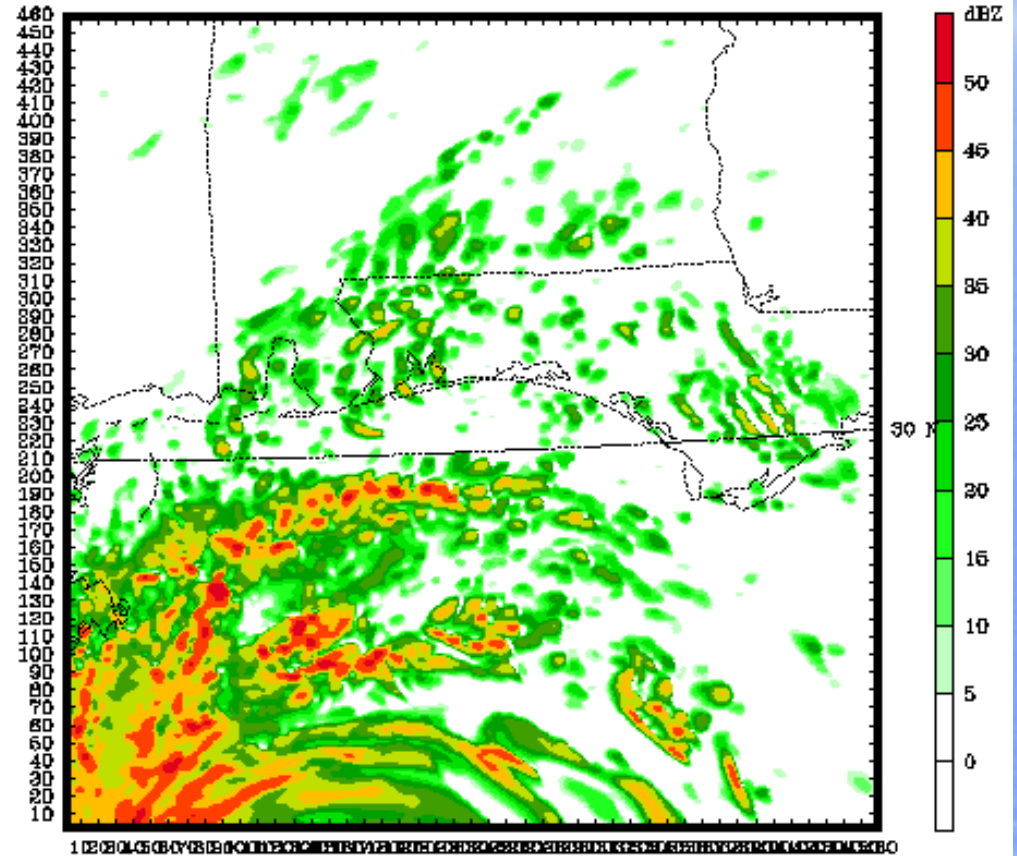
The Future Mesoscale Modeling

Forecast, Katrina Initial Time:2005082512
Wind Speed in knots



Dataset: r39a RIP: reflect
Fcast: 79.90
Reflectivity

Init: 0000 UTC Mon 02 Oct 95
Valid: 0754 UTC Thu 05 Oct 95 (0254 CDT Thu 05 Oct 95)
at sigma = 0.999



Model Info: V3.4.0 No Cumulus Blockrdr Retainer 1 1 km, 35 levels, 2 sec

Hurricane Opal (10/95) MM5 Radar Reflectivity Simulation

Concluding Thoughts

We Now Know a Lot About Tornadoes and Tropical Cyclones...but Major Issues Remain.

There is no reason to believe that in the future, a TC tornado outbreak could not kill more people than the February 1998 Extratropical Outbreak (42).

Remembering Agnes and Ivan is useful as a planning metric – The outer rainband tornado archetype – to help realize what is possible.

Forecast ability has improved significantly: Tornado Watches are put up for most tropical cyclones. Tornado Warnings must be taken seriously, but potential for false alarms can be high in some cases. In other cases tornadoes can spin up rapidly with little warning.

The ability to separate the typical TC tornado from the truly dangerous outbreaks is not nearly so advanced. High resolution models and continued research provide our best chance for improvement.

Extended threat period with lengthy periods of inactivity followed by brief periods of strong tornadoes – hard to keep guard up that long - desensitizing risk is high.

Evacuation and Sheltering - Evacuate mobile homes in threat area? -This could be 200 miles from landfall and 24 to 36 hours before landfall?

**Safe Rooms in homes built for hurricanes will perform well for about 99% of Florida Tornadoes.
Shelters in mobile home parks would be beneficial.**

Shelters probably don't exist in most cases. But there are recent success stories:

Gulfstream Harbor Mobile Home Park – Orange Co.

**FWIN (Florida Warning & Information Network) Grant
700 Weather Radios for all residents**

**Community Club House – Engineering Study - Hardened -
Impact Screens**

Questions?

bart.hagemeyer@noaa.gov



