Standardizing hurricane size descriptors for broadcast to the public

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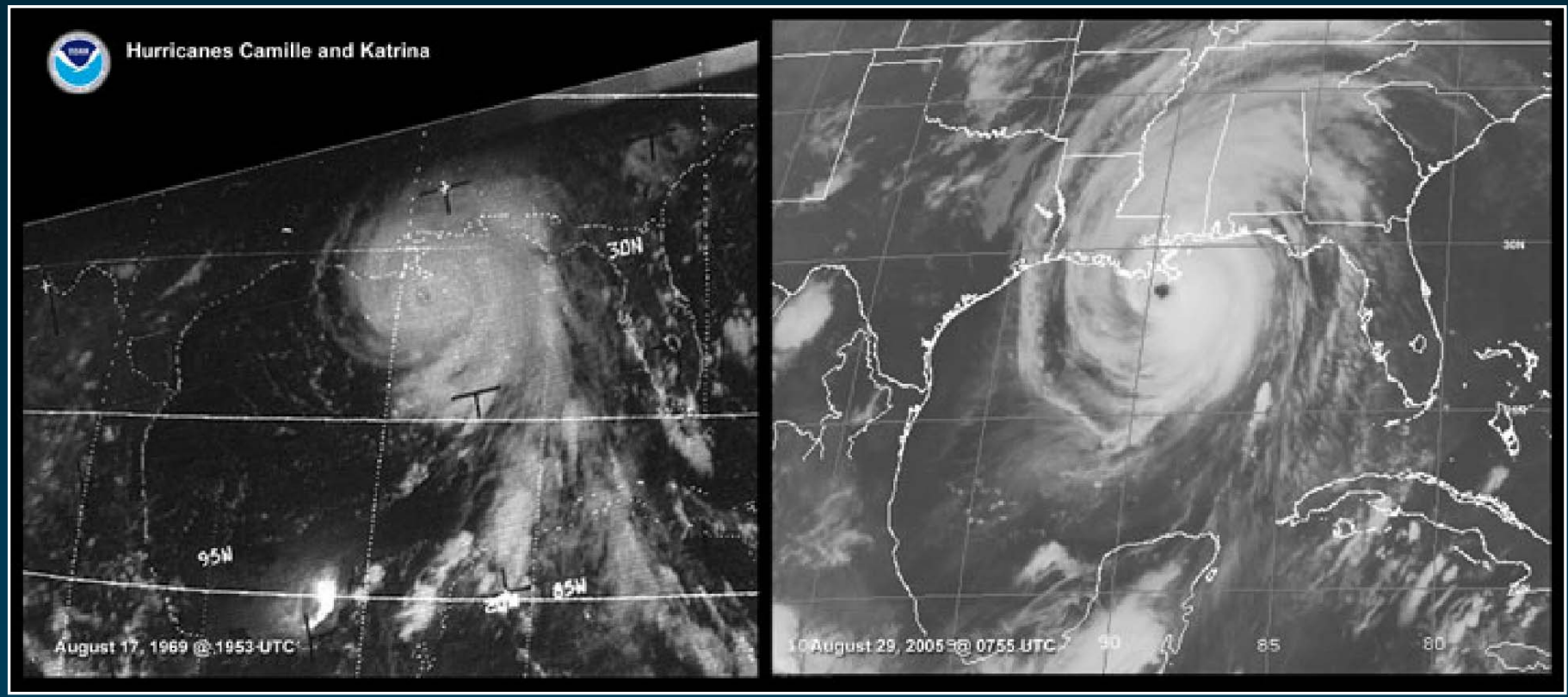
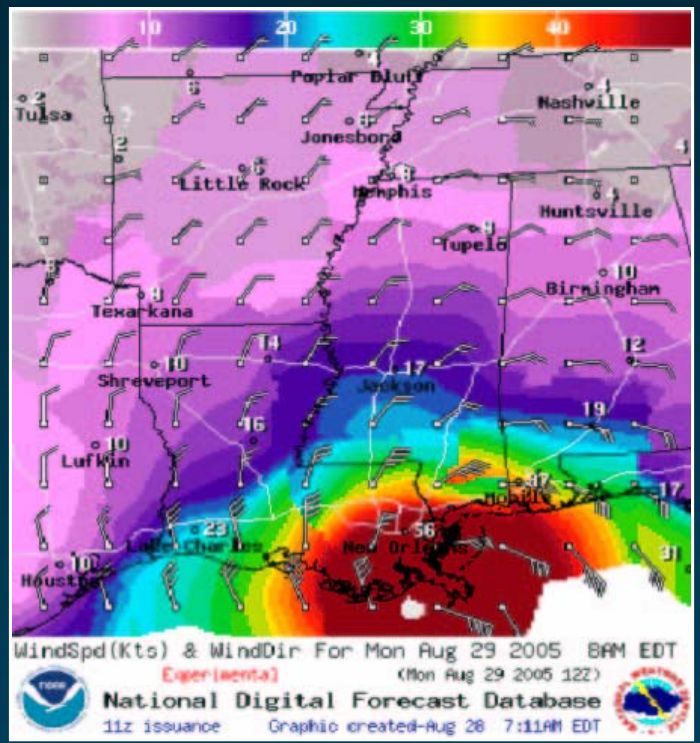
AMS 40th Conference on Broadcast Meteorology
August 22-24, 2012, Boston, MA, Operational Forecasting



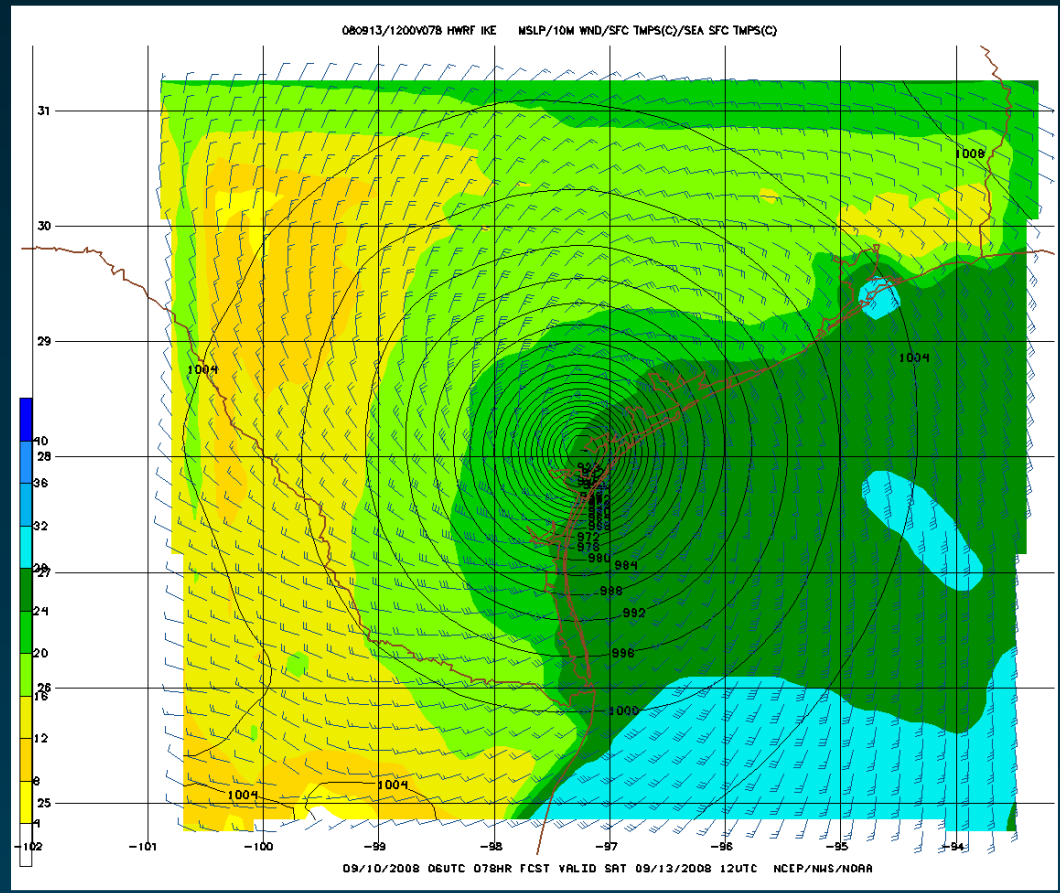
Significance of hurricane size to the general public

- **Contribution to surge heights**
- **Spatial extent of destruction**
- **Relative timing anomalies**
- **Duration of storm effects**

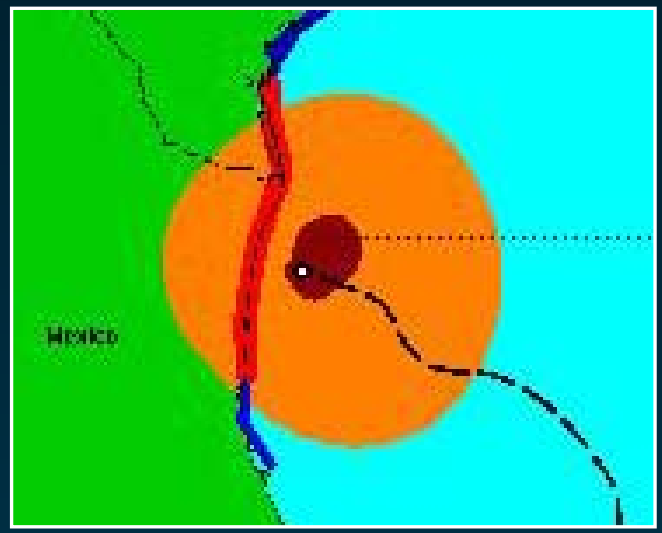
2005 Hurricane Katrina



2008 Hurricane Ike



Standardizing storm size descriptors in the Atlantic basin



"Even though it's hundreds of miles away, Alex is a big storm... On the one hand, Alex is not a large hurricane as hurricanes go. On the other hand, you do not want to be where it's making landfall tonight. And what may be the most damaging aspect of this storm is just its sheer width, its size, and its reach."

- National broadcast network news program, 6/30/10

Major Complications

- Global size vs. Atlantic size
- Multiple units of measurement
- Storm asymmetry/quadrants
- Radius vs. diameter
- Multiple wind radii thresholds
- Conflation with intensity
- Large forecast errors

HURRICANE ALEX ADVISORY NUMBER 21
NWS TPC/NATIONAL HURRICANE CENTER MIAMI FL
AL012010
400 PM CDT WED JUN 30 2010

...ALEX HEADING TOWARD NORTHEAST MEXICO WITH 90 MPH WINDS...

ALEX IS A LARGE TROPICAL CYCLONE AND HURRICANE FORCE WINDS EXTEND OUTWARD UP TO 70 MILES...110 KM...FROM THE CENTER...AND TROPICAL STORM FORCE WINDS EXTEND OUTWARD UP TO 205 MILES...335 KM PRIMARILY TO THE NORTHEAST OF THE CENTER....

Atlantic hurricanes in the global size classification

TC size:
Radius of gale force (34-kt) winds, OR
Radius of outermost closed isobar (ROCI)

Global Tropical Cyclone Size Chart

ROCI (° lat)	ROCI (nm)	SIZE CLASSIFICATION
< 2°	< 120	Very small/midget
2 - 3°	120 - 180	Small
3 - 6°	180 - 360	Medium/average
6 - 8°	360 - 480	Large
> 8°	> 480	Very large

Atlantic hurricanes by global and local standards

Atlantic hurricanes are on the order of 40 percent smaller than Pacific typhoons. Average size (ROCI) in the Atlantic basin: 3° latitude.

STORM	ROCI (nm)	ROCI (° lat.)	GLOBAL SIZE CLASSIFICATION
2010 Igor	410	7	Large
2005 Katrina	350	6	Medium/average (high side)
2010 Alex	275	5	Medium/average
2008 Ike	325	5	Medium/average
2003 Isabel	300	5	Medium/average
1999 Floyd	300	5	Medium/average

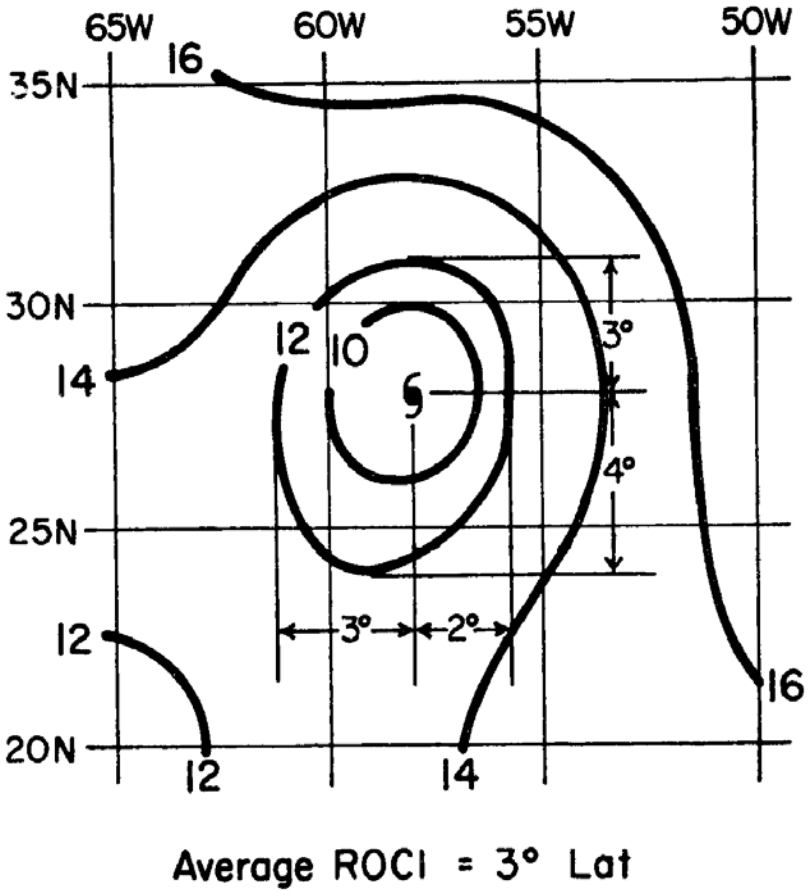
Merrill (1982) on TC size in the Atlantic (left) and Northwest Pacific (right)

SIZE		
Small	ROCI = 1–2 deg. lat.	ROCI = 1–3 deg. lat.
Medium	ROCI = 3 deg. lat.	ROCI = 4–5 deg. lat.
Large	ROCI > 3 deg. lat.	ROCI > 5 deg. lat.

ROCI = Radius of Outer Closed Isobar

Research and operational forecasting contexts

Research Contexts (radius of outermost closed isobar)



Merrill (1982)

Operational Forecasting Contexts (radius of tropical storm-force winds)

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64 KT.......110NE  90SE  55SW  75NW.
50 KT.......160NE 160SE  80SW 100NW.
34 KT.......240NE 200SE 150SW 170NW.
12 FT SEAS..425NE 425SE 270SW 150NW.
WINDS AND SEAS VARY GREATLY IN EACH
QUADRANT.  RADII IN NAUTICAL
MILES ARE THE LARGEST RADII EXPECTED
ANYWHERE IN THAT QUADRANT.
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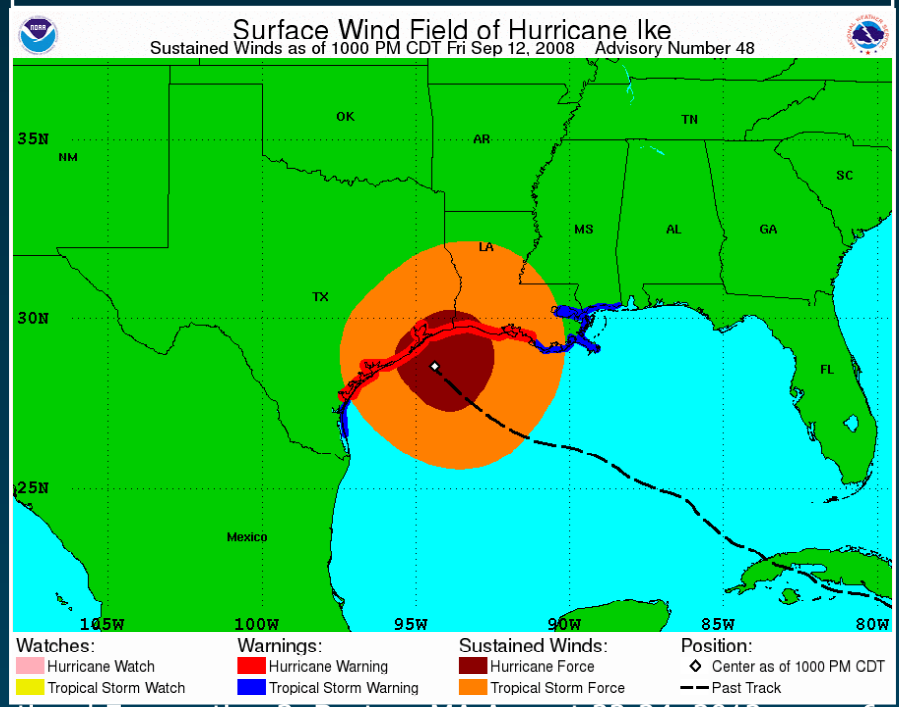


STORM	DESCRIPTION	DESCRIPTION SOURCE	34-KT WINDS (OUTERMOST, NM)	DATA SOURCE
2007 Gabrielle	"very small"	Forecast Disc 8	40	Forecast Adv 8
2007 Humberto	"small"	TC Report	50	Ext Best Track
2007 Lorenzo	"very small"	Forecast Disc 11	60	Forecast Adv 11
1999 Bret	"small"	Forecast Disc 7	90	Forecast Adv 7
2004 Charley	"small"	TC Report	100	Ext Best Track
2007 Felix	"relatively small"	Forecast Disc 16	100	Forecast Adv 16
2008 Cristobal	"small"	NASA	110	Forecast Adv 11
1992 Andrew	"relatively small"	TC Report	120	Ext Best Track
1969 Camille	"small"	Preliminary Report	125	HRD H-Wind
2001 Iris	"small"	TC Report	125	Ext Best Track
1999 Dennis	"larger than average"	TC Report	140	Ext Best Track
1998 Earl	"fairly large"	Forecast Disc 6	150	Forecast Adv 6
2004 Frances	"large"	Forecast Disc 35	160	Forecast Adv 35
2008 Gustav	"large"	Public Adv 27	175	Forecast Adv 27
2005 Rita	"large"	TC Report	180	Ext Best Track
2007 Dean	"large"	Forecast Disc 25	180	Forecast Adv 25
1995 Opal	"large"	Forecast Disc 20	200	Forecast Adv 20
1998 Bonnie	"large"	Public Adv 28	200	Forecast Adv 28
2005 Katrina	"very large"	Public Adv 25/26	200	Fcst Adv 25/26
2004 Ivan	"large"	Public Adv 52	225	Forecast Adv 52
2005 Wilma	"large"	Public Adv 37	225	Forecast Adv 37
2009 Bill	"large"	Public Adv 21	225	Forecast Adv 21
2008 Ike	"unusually large"	Forecast Disc 46	240	Forecast Adv 46
1996 Fran	"large"	TC Report	250	Ext Best Track
1999 Floyd	"large"	Forecast Disc 30	250	Forecast Adv 30
1961 Carla	"large"	HPC	300	Preliminary Report
2003 Isabel	"large"	TC Report	300	Ext Best Track
2010 Igor	"particularly large"	Public Adv 40	300	Forecast Adv 40

Small Medium Large Very Large

STORM	34-KT WINDS (OUTERMOST, NM)	NHC DESCRIPTION	ROCI (NM)	ATL SIZE /ROCI DEG LAT (ROUNDED)
2001 Iris	125	"small"	100	small 2°
2004 Charley	100	"small"	100	small 2°
2007 Lorenzo	60	"very small"	100	small 2°
1999 Bret	90	"small"	120	small 2°
2007 Gabrielle	40	"very small"	120	small 2°
2007 Humberto	50	"small"	120	small 2°
1992 Andrew	120	"relatively small"	125	small 2°
1969 Camille	125	"small"	140	small 2°
2008 Cristobal	110	"small"	140	small 2°
2007 Felix	100	"relatively small"	150	medium 3°
1999 Dennis	140	"larger than average"	175	medium 3°
1998 Earl	150	"fairly large"	200	medium 3°
2004 Frances	160	"large"	200	medium 3°
2004 Ivan	225	"large"	200	medium 3°
2007 Dean	180	"large"	200	medium 3°
2009 Bill	225	"large"	240	large 4°
1998 Bonnie	200	"large"	250	large 4°
2008 Gustav	175	"large"	275	large 5°
2005 Rita	180	"large"	300	large 5°
2005 Wilma	225	"large"	300	large 5°
2005 Katrina	200	"very large"	350	large 6°
2005 Opal	200	"large"	360	large 6°
1996 Fran	250	"large"	250	large 4°
1999 Floyd	250	"large"	300	large 5°
2008 Ike	240	"unusually large"	300	large 5°
1961 Carla	300	"large"	n/d	large > 4°
2003 Isabel	300	"large"	300	large 5°
2010 Igor	300	"particularly large"	400	large 7°

Small Medium Large Very Large

Examples of small, medium, large, and very large hurricanes by Atlantic basin standards

50	75	100	125	150	175	200	225	250	275	300	325
SMALL			MEDIUM			LARGE			VERY LARGE		

Size descriptor	34-kt wind radius (OUTERMOST, NM)	Examples
SMALL	≤ 125	Camille, Andrew, Charley, Felix
MEDIUM	126 - 174	Emily, Dolly, Fay, Tomas
LARGE	175 - 225	Ivan, Katrina, Rita, Dean
VERY LARGE	> 225	Carla, Isabel, Ike, Igor

"Growth" as a Size Descriptor (Merrill 1982)

Growth: *"An expansion of the tropical cyclone circulation."*

Size descriptor
Antonym: contraction

Intensification: *"A decrease in MSLP or an increase in maximum winds."*

Intensity descriptor
Antonym: deintensification

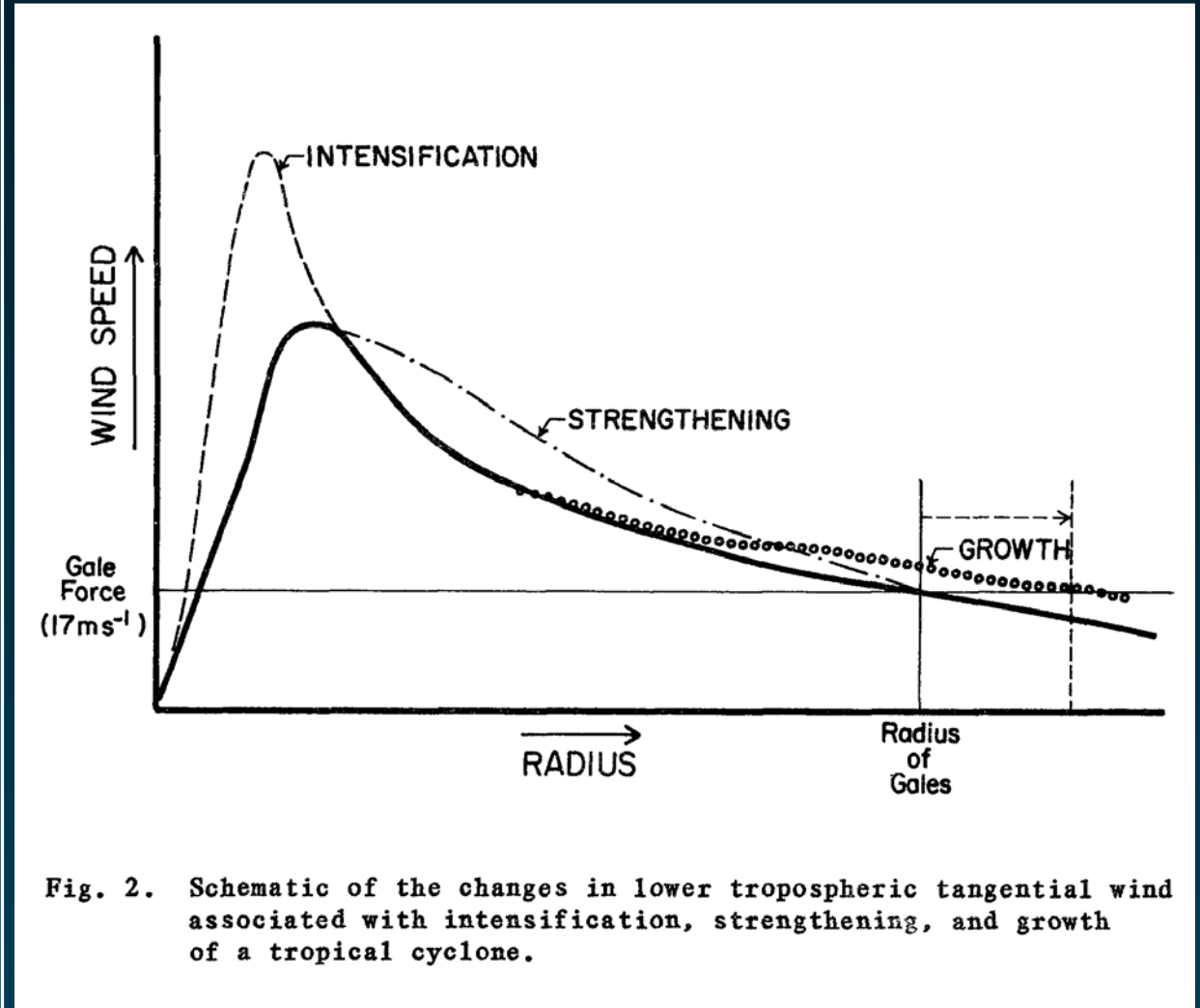


Fig. 2. Schematic of the changes in lower tropospheric tangential wind associated with intensification, strengthening, and growth of a tropical cyclone.

Recent broadcast reports using the term "growth"

Example #1: "They're counting on the shear to limit the growth of this thing [Tropical Storm Don], and they're bringing it in as a tropical storm."

Example #2: "This thing [2011 Irene] is looking to be growing into a major hurricane."

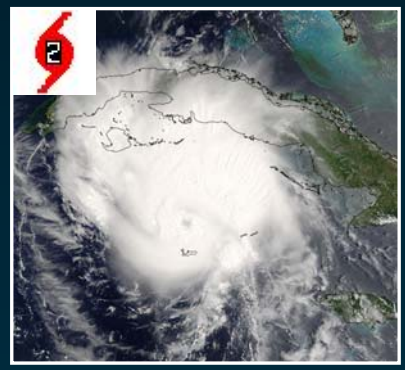
Example #3: "The hurricane [2011 Irene] has already hit Puerto Rico as a Category-1 storm, and it's expected to grow to a Category-3..."

- Reports from major national television news networks during the 2011 hurricane season.

Which hurricane is growing?

2004 Charley
8/11 - 8/13:
Intensifying and contracting

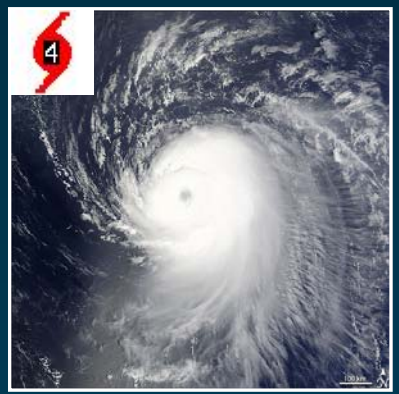
08/11/04 1815 UTC
Max winds: 65 kt (Cat-1)
Central pressure: 993
34-kt radii: 90 75 0 75
ROCI: 100 nm



08/12/04 1555 UTC
Max winds: 90 kt (Cat-2)
Central pressure: 980
34-kt radii: 90 90 40 90
ROCI: 100 nm

08/13/04 1635 UTC
Max winds: 125 kt (Cat-4)
Central pressure: 947
34-kt radii: 40 75 75 50
ROCI: 100 nm

2008 Ike
9/4 - 9/12:
Deintensifying and expanding



9/4/08 1440 UTC
Max winds: 115 kt (Cat-4)
Central pressure: 940
34-kt radii: 105 95 90 85
ROCI: 180 nm

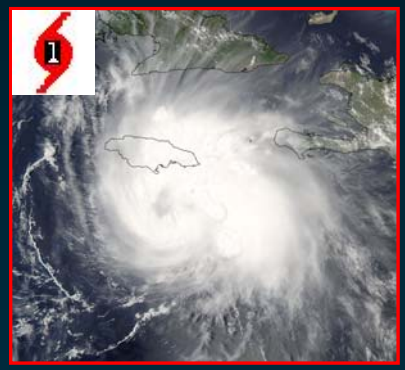
9/7/08 1630 UTC
Max winds: 105 kt (Cat-3)
Central pressure: 946
34-kt radii: 145 125 100 125
ROCI: 200 nm

9/12/08 1605 UTC
Max winds: 95 kt (Cat-2)
Central pressure: 954
34-kt radii: 240 210 150 180
ROCI: 300 nm

Which hurricane is growing?

2004 Charley

8/11 - 8/13: Intensifying and contracting



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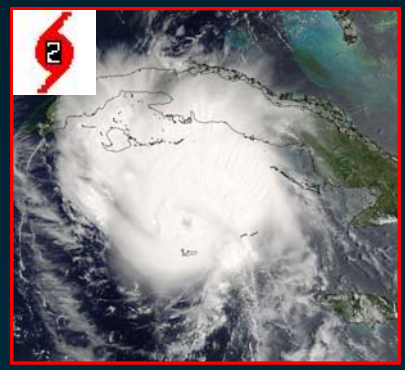

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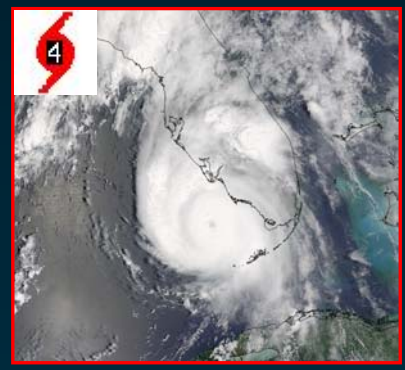

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34-kt radii: 40 75 75 50
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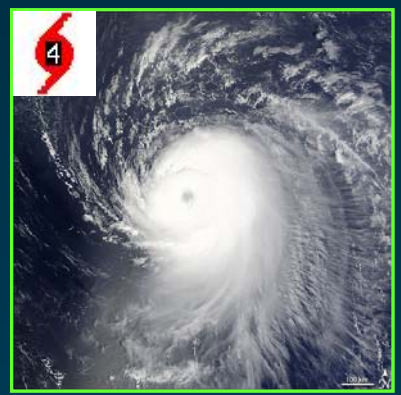
2008 Ike

9/4 - 9/12: Deintensifying and expanding



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Central pressure: 946
34-kt radii: 145 125 100 125
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9/12/08 1605 UTC
Max winds: 95 kt (Cat-2)
Central pressure: 954
34-kt radii: 240 210 150 180
ROCI: 300 nm

Standardizing the "growth" size descriptor

"They're counting on the shear to limit the [intensification] of this thing [Tropical Storm Don], and they're bringing it in as a tropical storm."

Example #2: "This thing [2011 Irene] is looking to be [intensifying] into a major hurricane."

Example #3: "The hurricane [2011 Irene] has already hit Puerto Rico as a Category-1 storm, and it's expected to [intensify] to a Category-3...."

- Reports from major national television news networks during the 2011 hurricane season.

Hurricane Ike, Galveston, TX, September 12, 2008

9/12/08 1605 UTC: Max winds: 95 kt (Cat-2), Central pressure: 954 mb
34-kt radii: 240 210 150 180, ROCI: 300 nm; landfall 9/13/08 0700 UTC