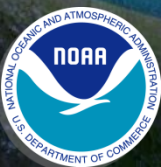


National Hurricane Center Forecast “Requirements”

Christopher Landsea
Science and Operations Officer
National Hurricane Center

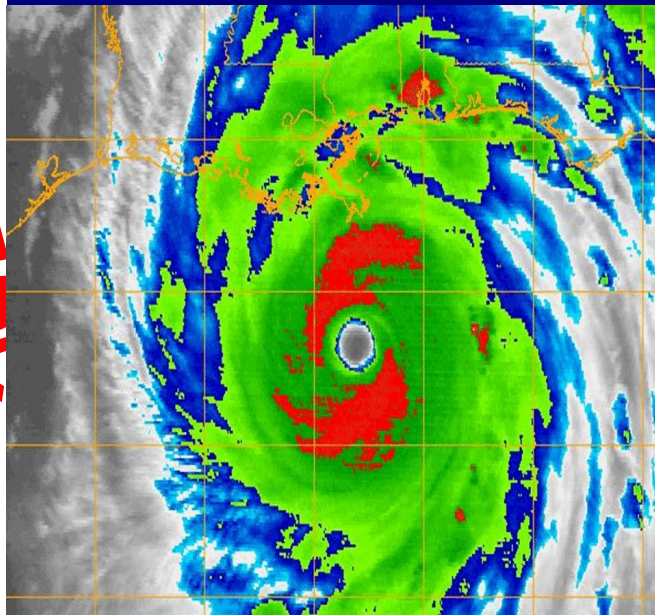
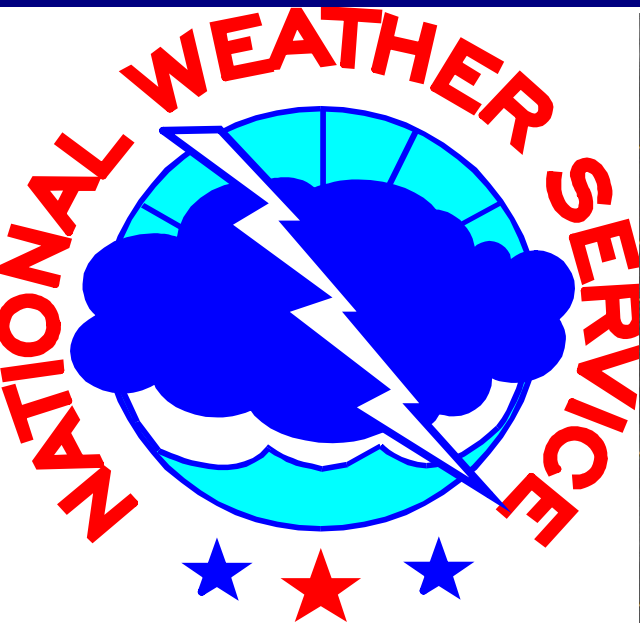
HURRICANE
EVACUATION
ROUTE

10 November, 2011



National Hurricane Center Forecast “Requirements”

- What are our current NHC products?
- What kinds of model output do these require?
- How might the NHC products and model output needed change in the HFIP decade?

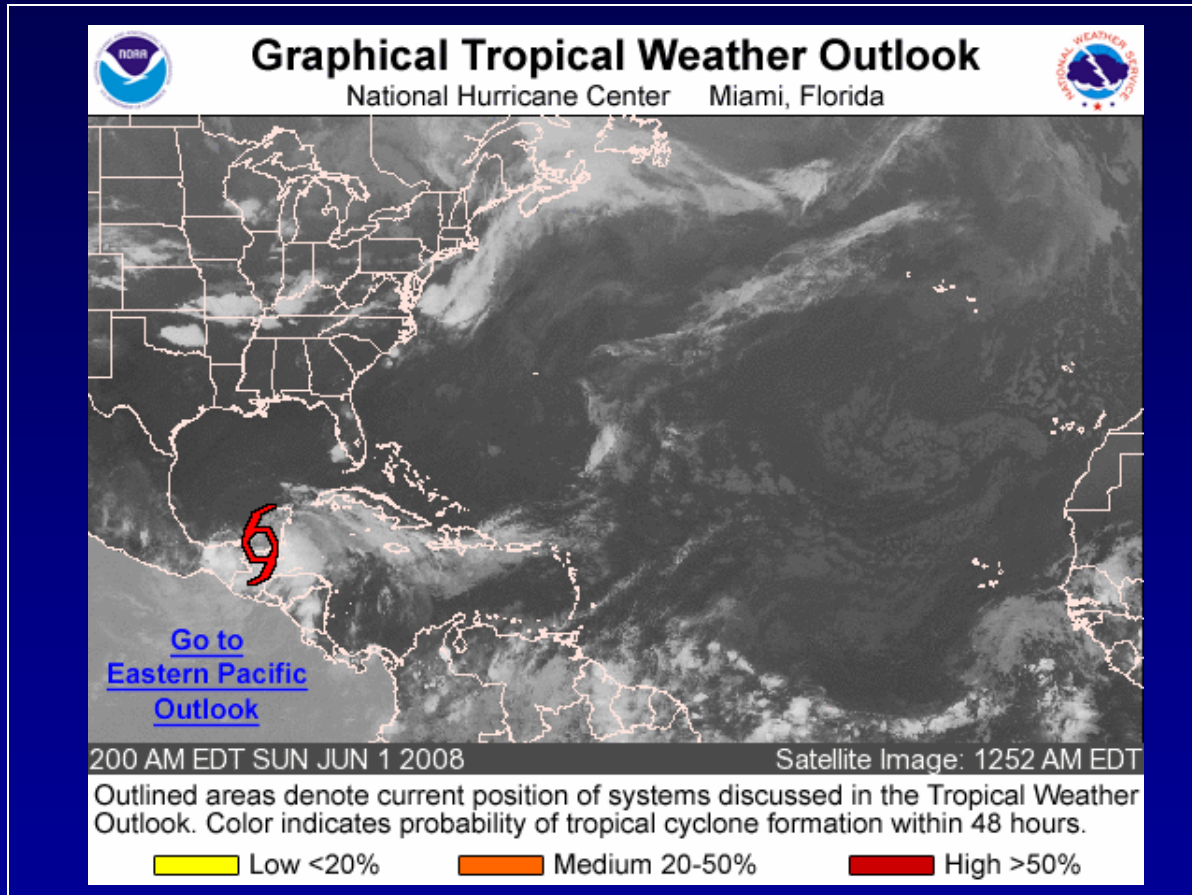




Graphical Tropical Weather Outlook



- *became operational in 2009*
- *provides exact chance for formation*



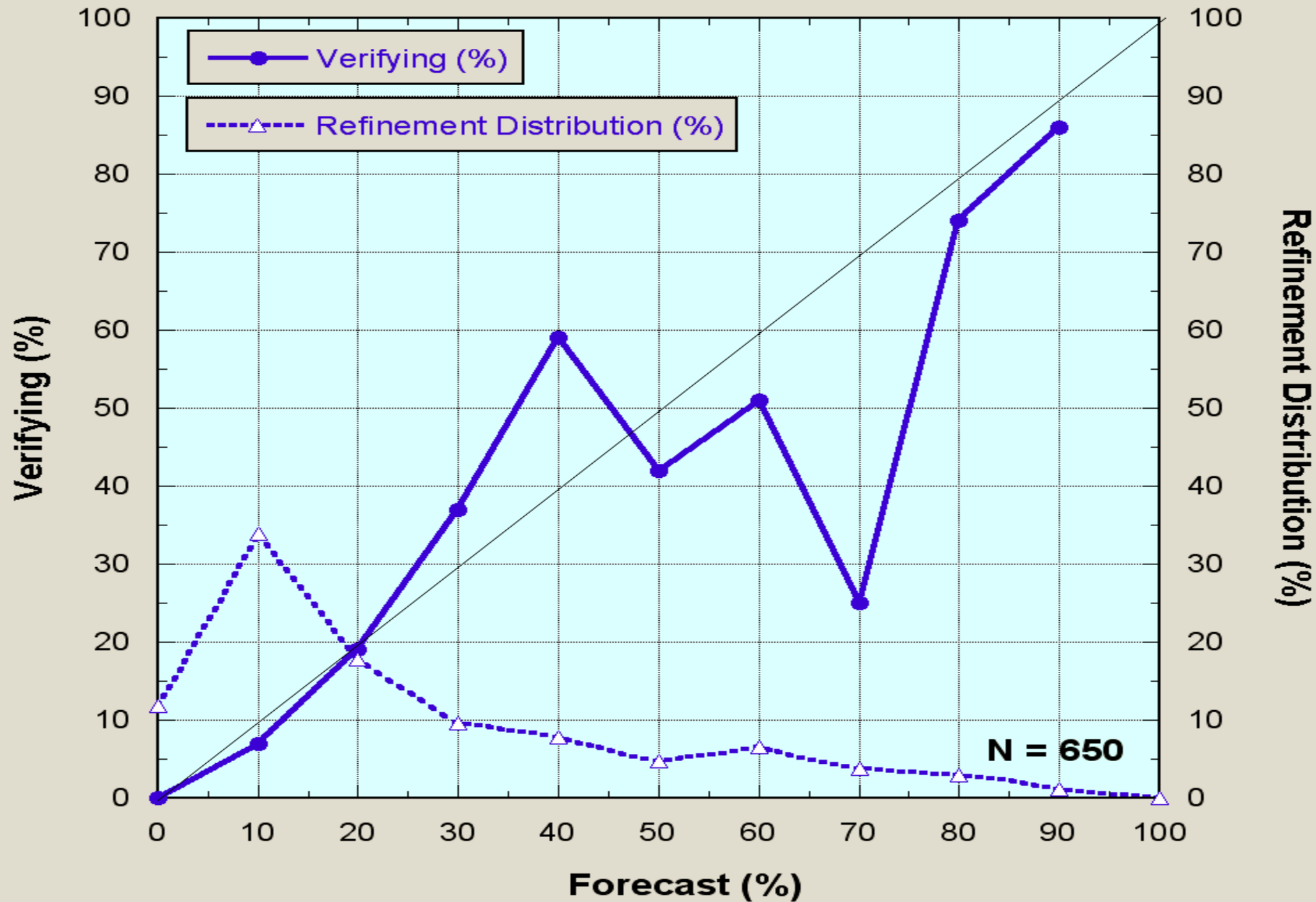
Shows on satellite pictures the current locations of areas of disturbed weather and provides categorical estimates of development potential over the next 48 hours.



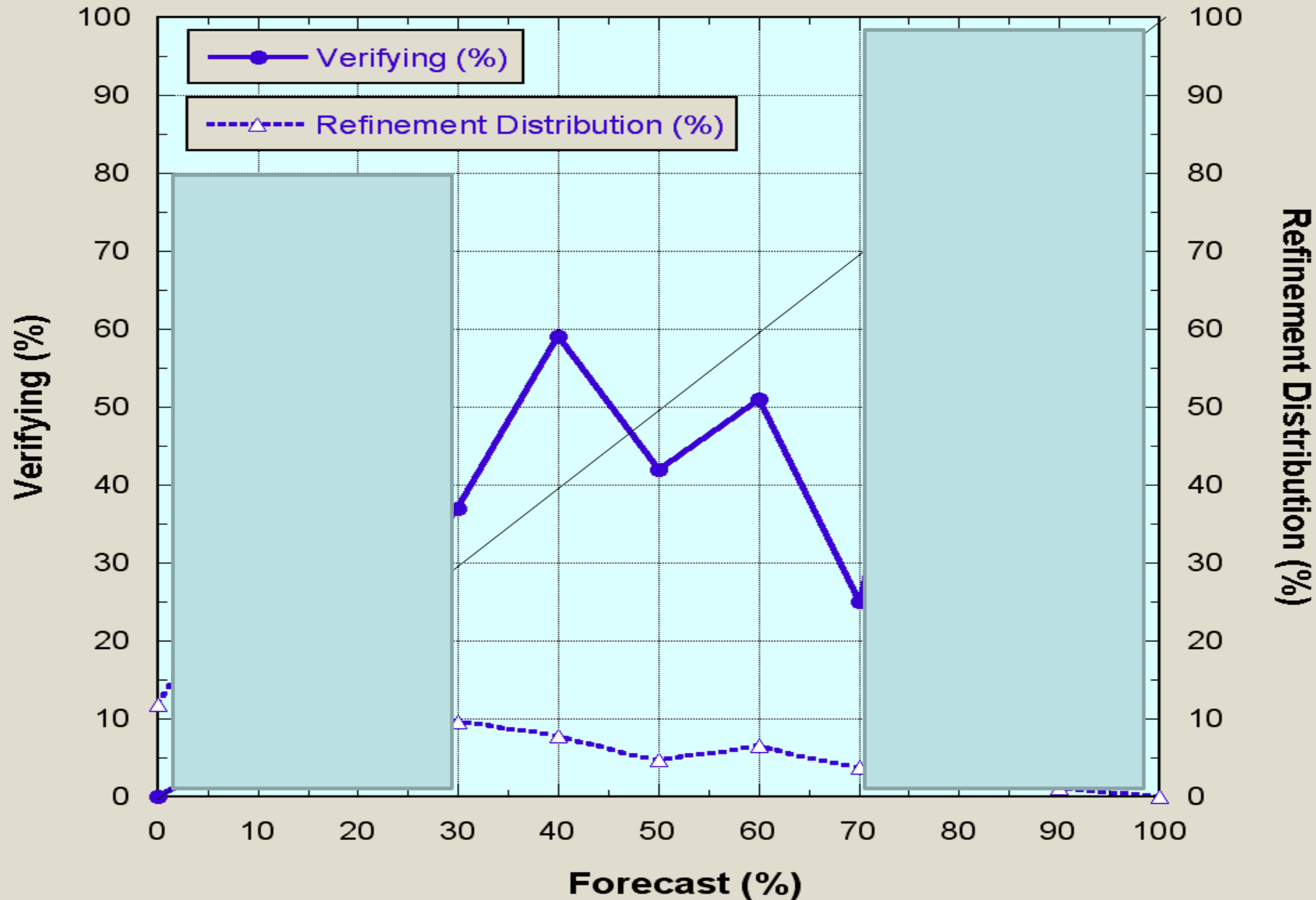
TC Genesis Probabilities

- Operational 48 h “Tropical Weather Outlook”
 - Evaluation of synoptic environment (convective structure, vorticity, SSTs, vertical shear, moisture, etc.)
 - Global multi-model genesis predictions

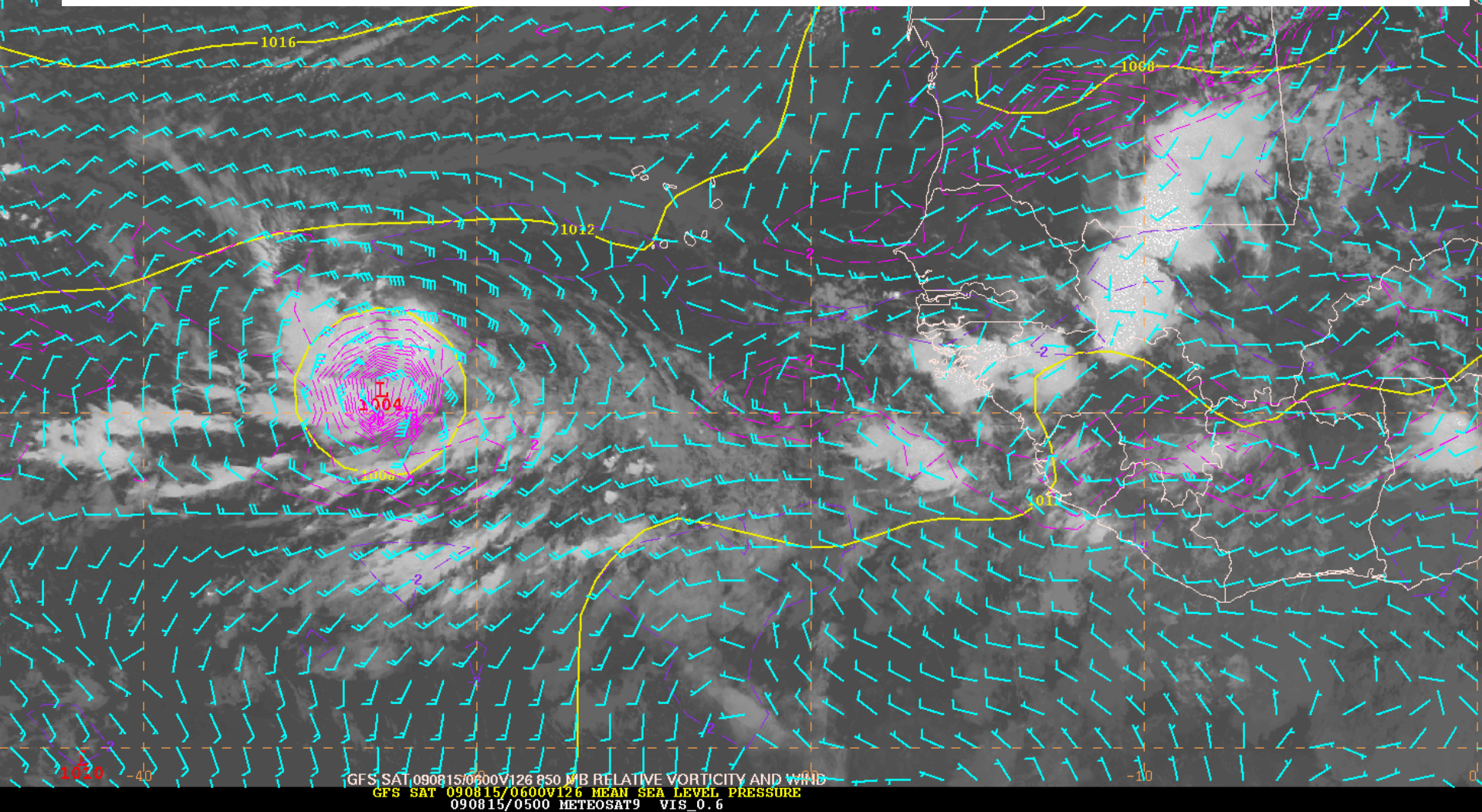
2010 OFCL 48-h Genesis Forecasts Atlantic Basin



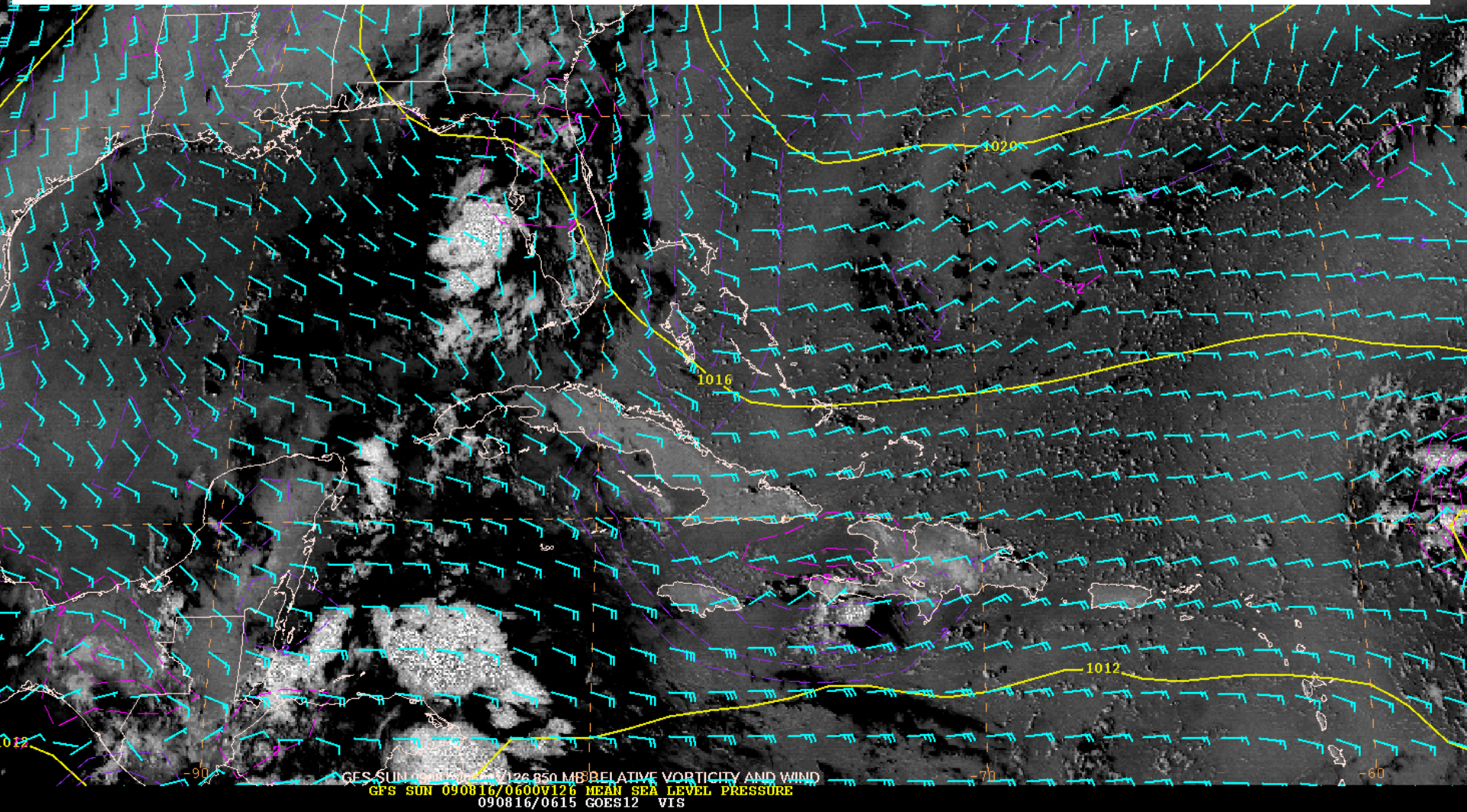
2010 OFCL 48-h Genesis Forecasts Atlantic Basin



Genesis of Bill was well predicted by the GFS (another case of good GFS forecasts of eastern tropical Atlantic genesis). This is a series of model forecasts of sea level pressure and 850 mb winds/vorticity, starting from 126 hours out, all verifying at the time of genesis (0600 UTC 8/15/09).



Claudette's formation was not well anticipated by the GFS or by the NHC forecasters (another case of models underforecasting Gulf genesis). This is a series of model forecasts of sea level pressure and 850 mb winds/vorticity, starting from 126 hours out, all verifying at the time of genesis (0600 UTC 8/16/09).



Potential Additional NHC TC Genesis Probabilities

- 3-5 day genesis outlook
 - Almost exclusively on global multi-model output

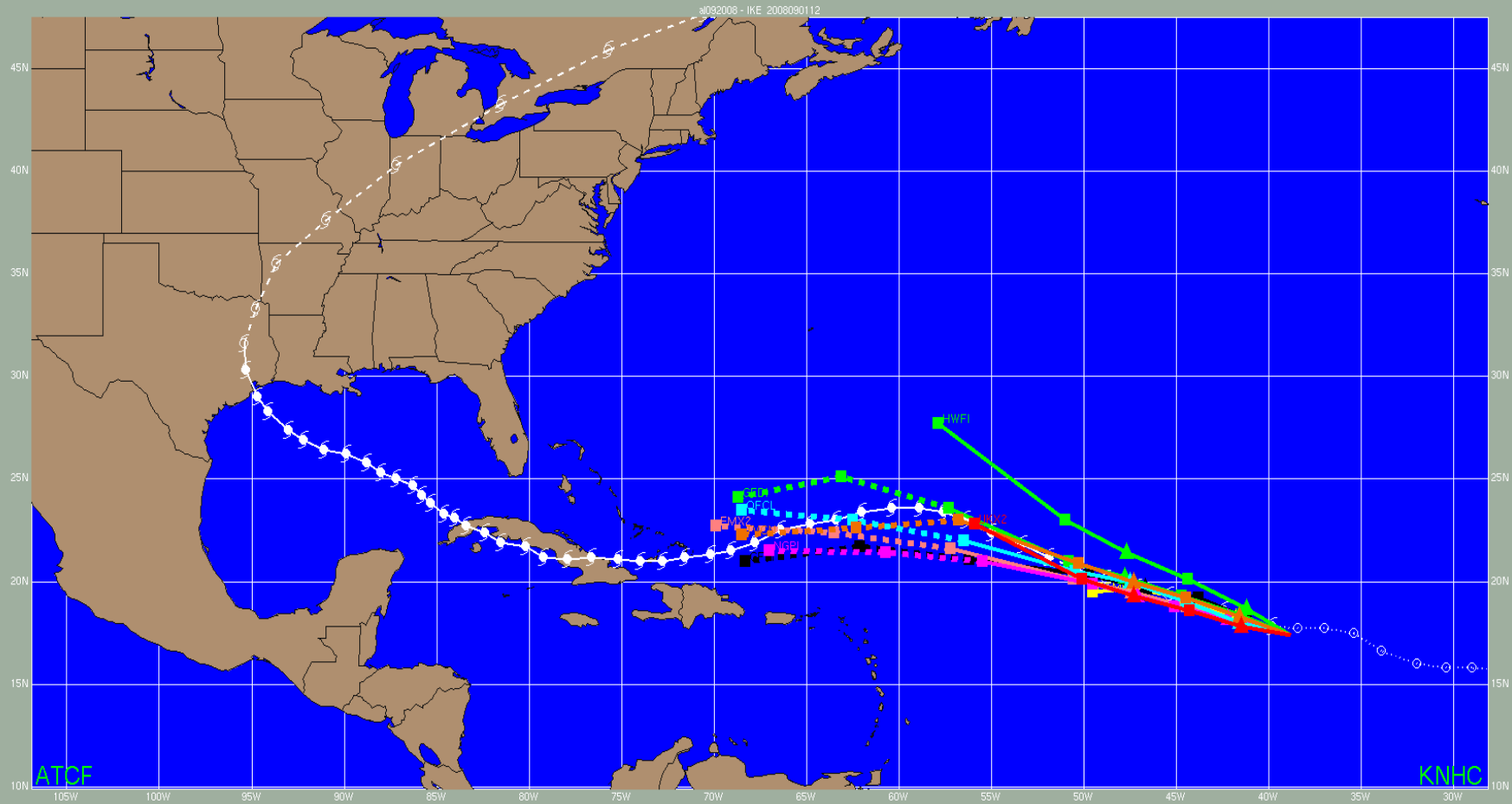
Current NHC Tropical Cyclone Forecast Parameters

Forecast Hour (Day)	Position and Intensity	12 ft seas radii	34 kt wind radii	50 kt wind radii	64 kt wind radii	Wind Speed Probs
3 (adv time)						
12						
24 (1)						
36						
48 (2)						
72 (3)						
96 (4)						
120 (5)						

Additional Future Possible NHC Tropical Cyclone Forecast Parameters

Forecast Hour (Day)	Position and Intensity	12 ft seas radii	34 kt wind radii	50 kt wind radii	64 kt wind radii	Wind Speed Probs
3 (adv time)						
12						
24 (1)						
36						
48 (2)						
60						
72 (3)						
96 (4)						
120 (5)						
144 (6)						
168 (7)						

Hurricane Ike Track models

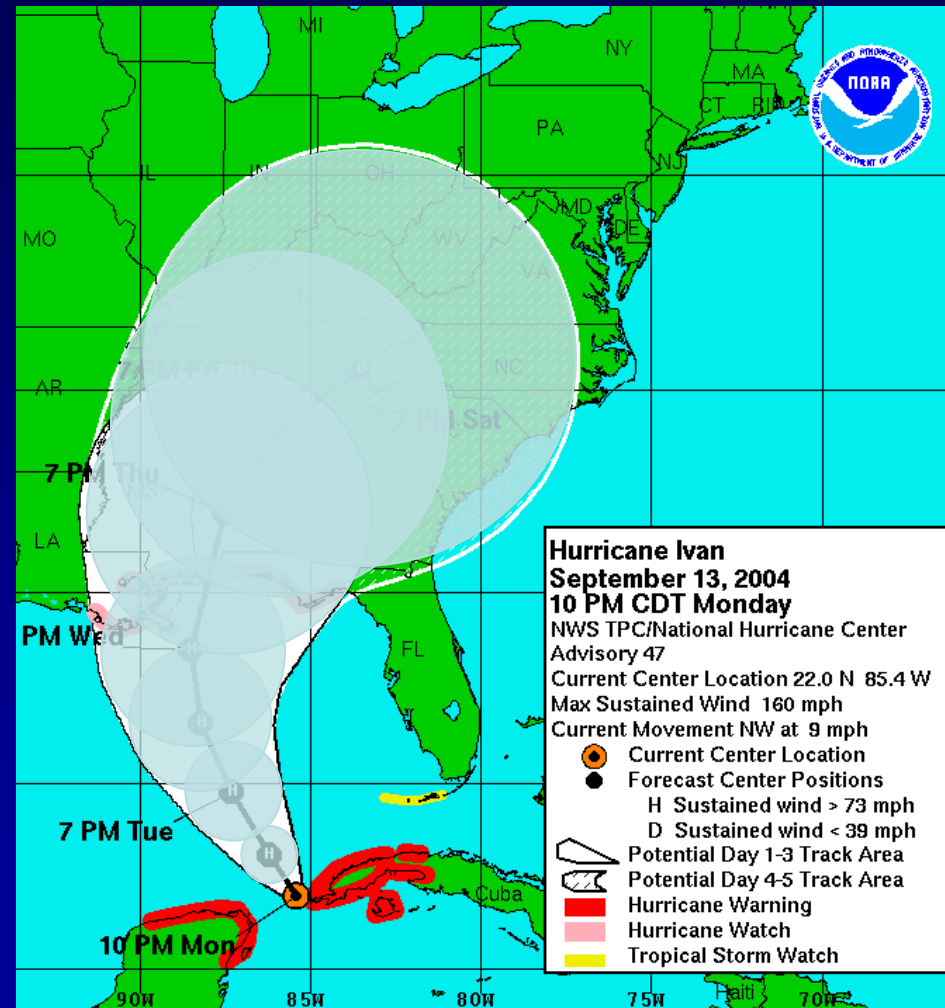


NHC Forecast Cone

Represents the probable track of the center of the tropical cyclone.

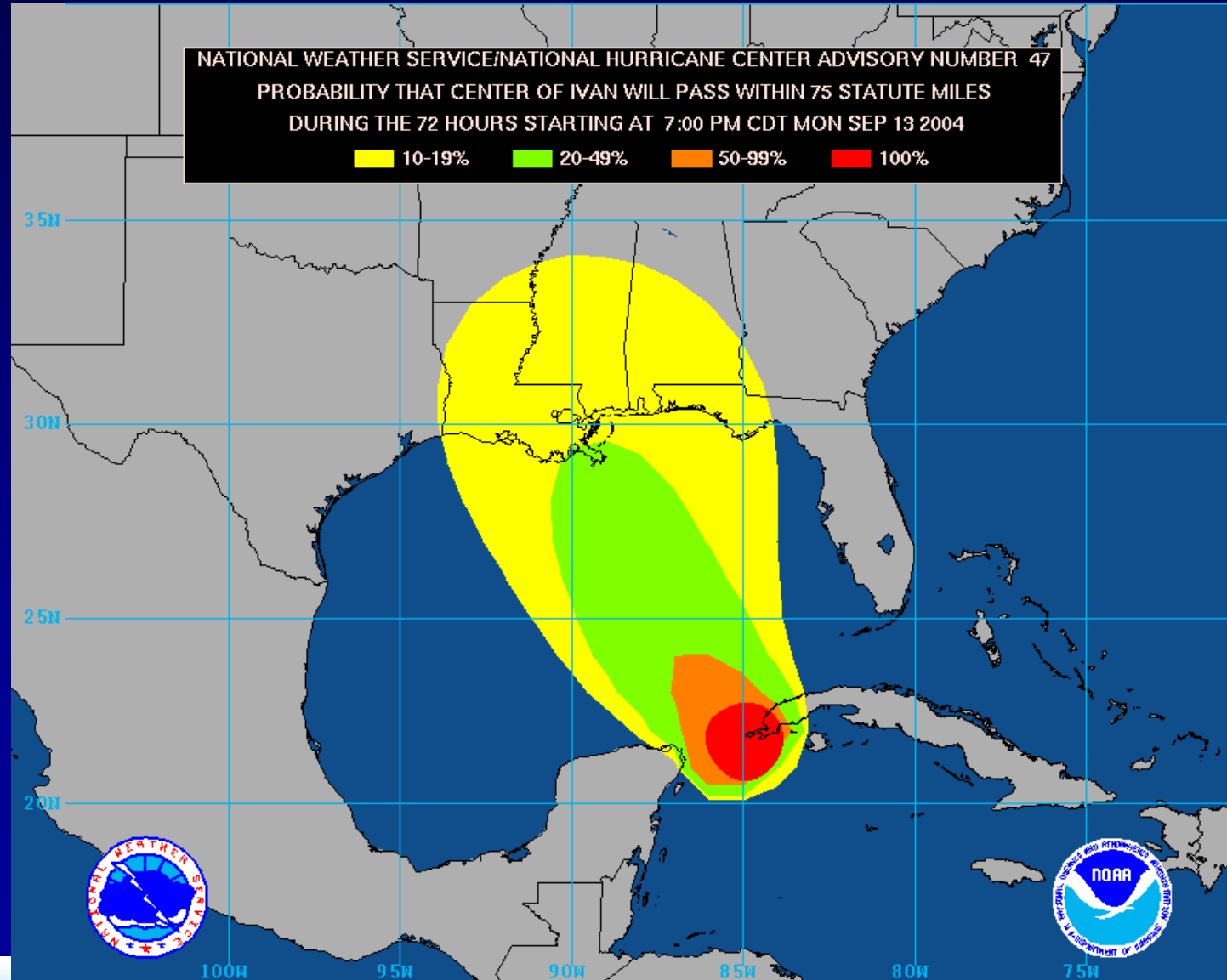
Formed by connecting circles centered on each forecast point (at 12, 24, 36 h, etc.)

Size of the circles determined so that, say, the actual storm position at 48 h will be within the 48-h circle 67% of the time.



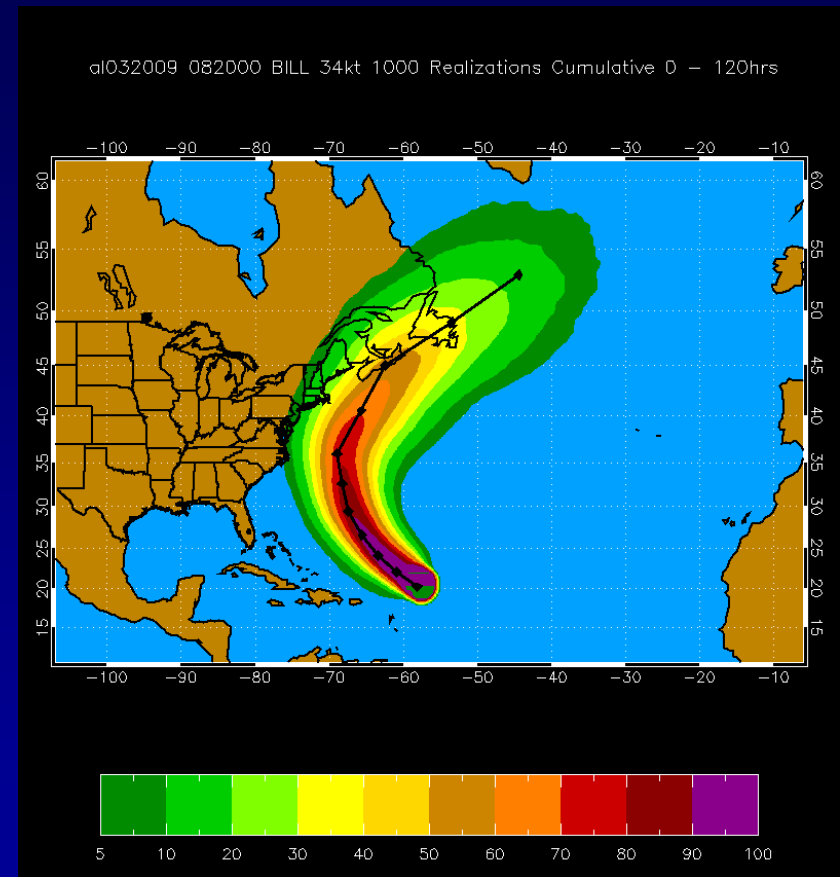
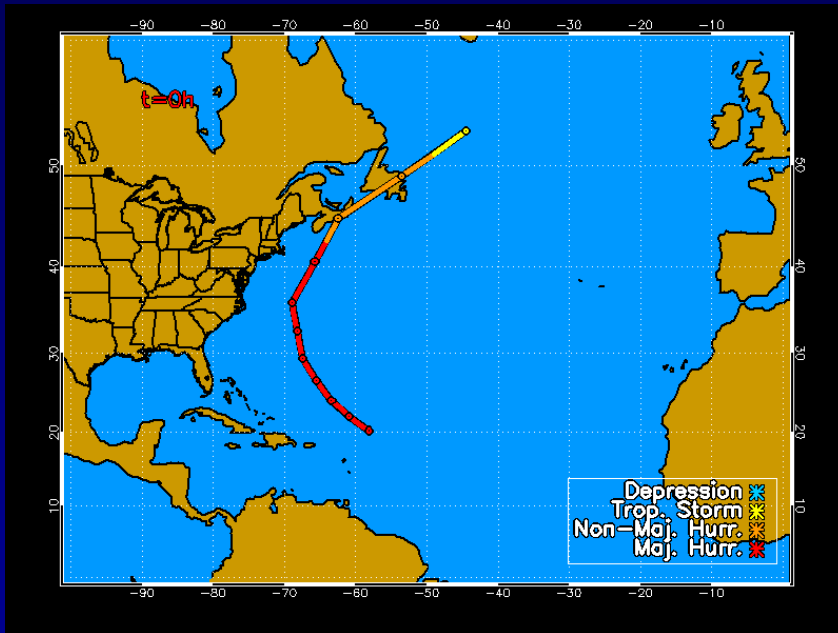
Previous NHC Products Used to Convey Uncertainty

Strike Probability Graphic



Wind Speed Probabilities

Ex: Hurricane Bill 20 Aug 2009 00 UTC



1000 Track Realizations



Wind Speed Probabilities

ZCZC MIAPWSAT4 ALL
 TTA000 KNHC DDHMM
 HURRICANE WILMA PROBABILITIES NUMBER 20
 NWS TPC/NATIONAL HURRICANE CENTER MIAMI FL
 0900Z THU OCT 20 2005

...THIS IS AN EXPERIMENTAL PRODUCT FOR 2005...

AT 0900Z THE CENTER OF HURRICANE
 WILMA WAS LOCATED NEAR LATITUDE 18.3 NORTH...
 LONGITUDE 85.0 WEST WITH
 MAXIMUM SUSTAINED WINDS NEAR 130 KTS...150 MPH...240 KM/HR.

CHANCES OF EXPERIENCING WIND SPEEDS OF AT LEAST
 ...34 KT (39 MPH... 63 KPH)...
 ...50 KT (58 MPH... 93 KPH)...
 ...64 KT (74 MPH...119 KPH)...

FOR LOCATIONS AND TIME PERIODS DURING THE NEXT 5 DAYS

PROBABILITIES FOR LOCATIONS ARE GIVEN AS IP(CP) WHERE
 IP IS THE PROBABILITY OF THE EVENT BEGINNING DURING
 AN INDIVIDUAL TIME PERIOD (INDIVIDUAL PROBABILITY)
 (CP) IS THE PROBABILITY OF THE EVENT OCCURRING BETWEEN
 06Z THU AND THE FORECAST HOUR (CUMULATIVE PROBABILITY)

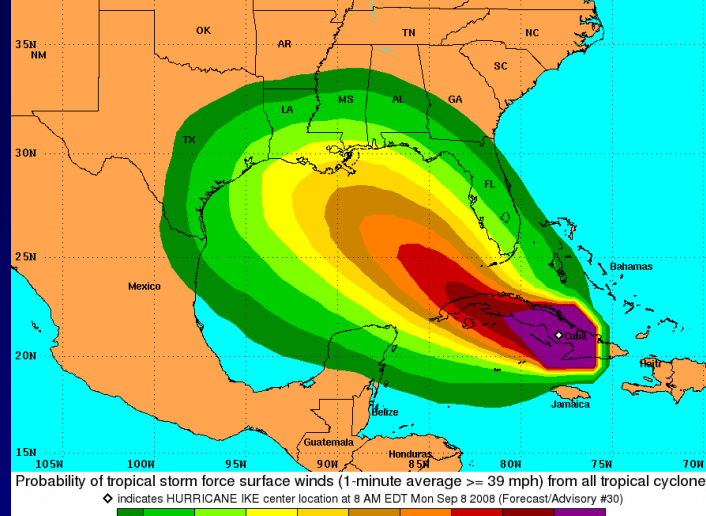
PROBABILITIES ARE GIVEN IN PERCENT
 X INDICATES PROBABILITIES LESS THAN 10%
 LOCATIONS SHOWN WHEN THEIR TOTAL
 PROBABILITY IS AT LEAST 2.5 PERCENT
 Z INDICATES UNIVERSAL COORDINATED

Shows the chance of a particular event occurring at a specific location

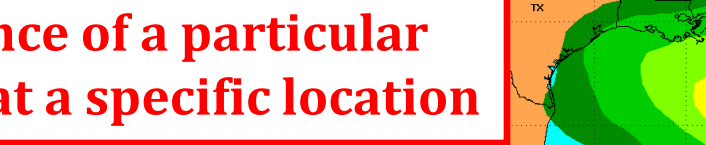
--- WIND SPEED PROBABILITIES FOR SELECTED LOCATIONS ---

TIME PERIODS	FORECAST HOUR	FROM 06Z THU		FROM 18Z THU		FROM 06Z FRI		FROM 18Z FRI		FROM 06Z SAT		FROM 18Z SAT		FROM 06Z SUN		FROM 18Z SUN		FROM 06Z MON		FROM 18Z MON	
		(12)	(24)	(36)	(48)	(72)	(96)	(120)													
MIAMI FL	KT	34	X	X (X)	X (X)	2 (2)	16 (18)	23 (41)	5 (46)												
MIAMI FL		50	X	X (X)	X (X)	X (X)	6 (6)	11 (17)	3 (20)												
MIAMI FL		64	X	X (X)	X (X)	X (X)	2 (2)	5 (7)	1 (8)												
KEY WEST FL		34	X	X (X)	2 (2)	7 (9)	26 (35)	18 (53)	3 (56)												
KEY WEST FL		50	X	X (X)	X (X)	1 (1)	14 (15)	11 (26)	1 (27)												
KEY WEST FL		64	X	X (X)	X (X)	X (X)	8 (8)	5 (13)	1 (14)												
MARCO ISLAND		34	X	X (X)	X (X)	5 (5)	20 (25)	23 (48)	4 (52)												
MARCO ISLAND		50	X	X (X)	X (X)	1 (1)	10 (11)	12 (23)	2 (25)												
MARCO ISLAND		64	X	X (X)	X (X)	X (X)	5 (5)	6 (11)	X (11)												

Tropical Storm Force Wind Speed Probabilities
 For the 120 hours (5 days) from 8 AM EDT Mon Sep 8 to 8 AM EDT Sat Sep 13

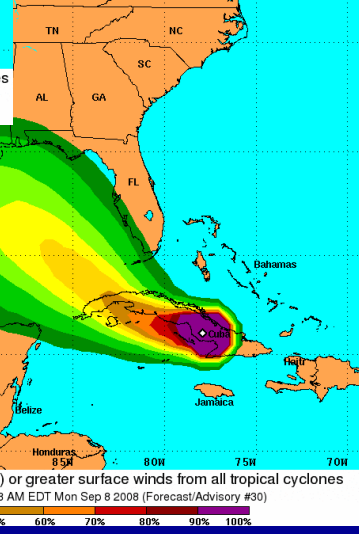


Probability of tropical storm force surface winds (1-minute average \geq 39 mph) from all tropical cyclones
 ♦ indicates HURRICANE IKE center location at 8 AM EDT Mon Sep 8 2005 (Forecast/Advisory #30)

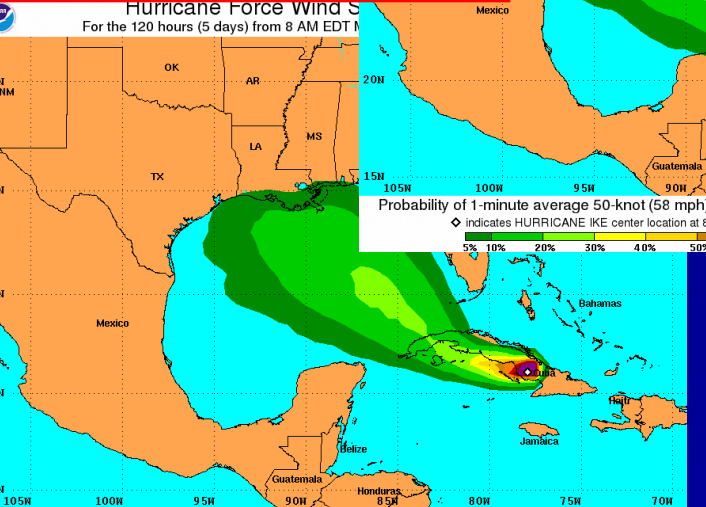


Probability of hurricane force surface winds (1-minute average \geq 74 mph) from all tropical cyclones
 ♦ indicates HURRICANE IKE center location at 8 AM EDT Mon Sep 8 2005 (Forecast/Advisory #30)

Wind Speed Probabilities
 For the 120 hours (5 days) from 8 AM EDT Mon Sep 8 to 8 AM EDT Sat Sep 13

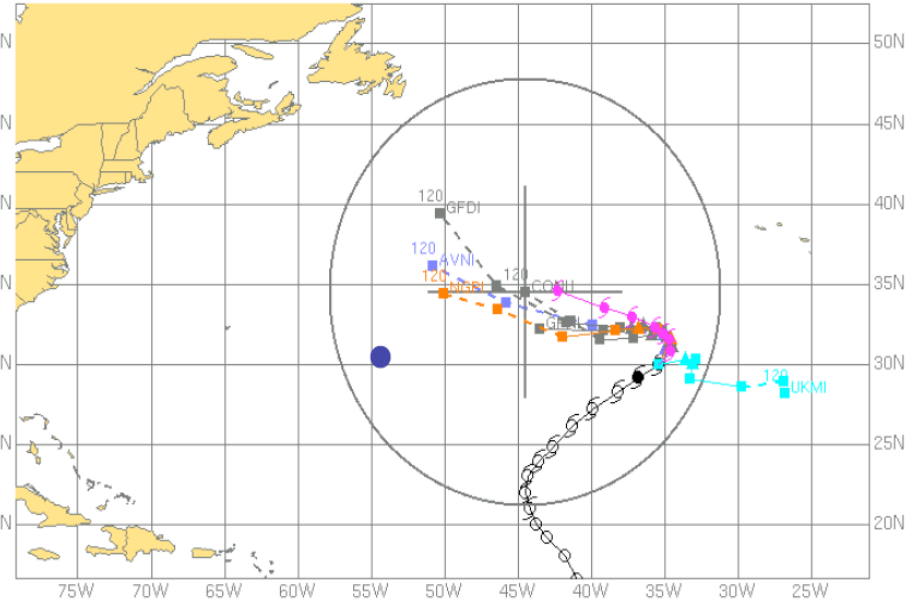
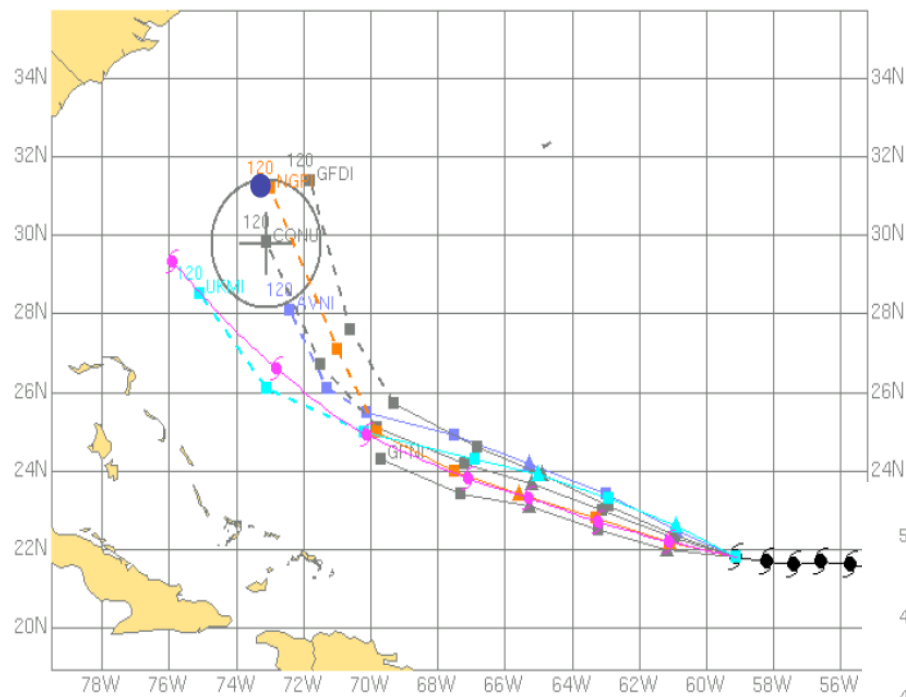


Probability of 1-minute average 50-knot (58 mph) or greater surface winds from all tropical cyclones
 ♦ indicates HURRICANE IKE center location at 8 AM EDT Mon Sep 8 2005 (Forecast/Advisory #30)



Probability of hurricane force surface winds (1-minute average \geq 74 mph) from all tropical cyclones
 ♦ indicates HURRICANE IKE center location at 8 AM EDT Mon Sep 8 2005 (Forecast/Advisory #30)

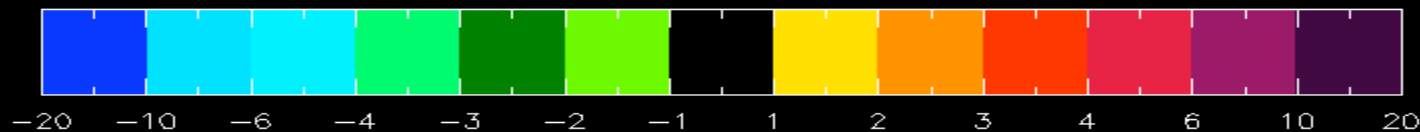
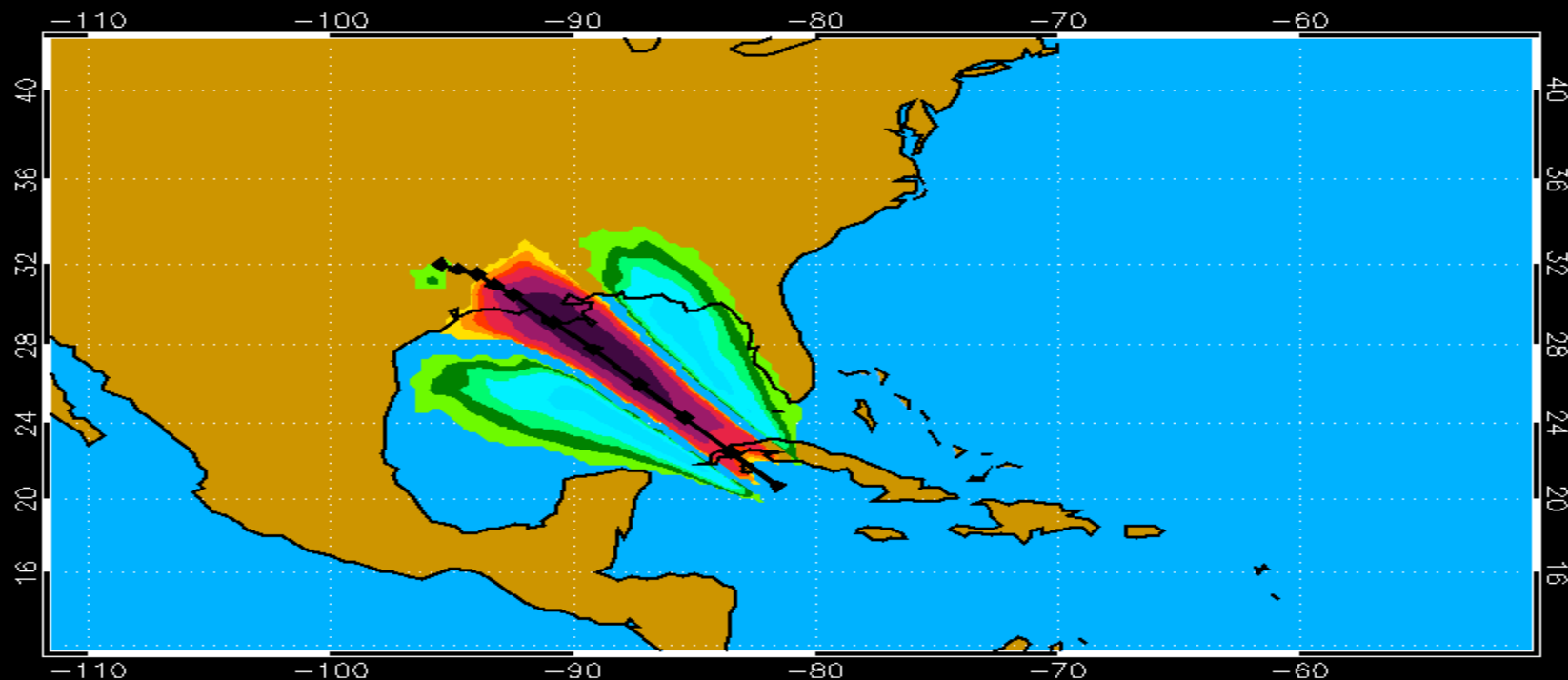
GPCE (Goerss Predicted Consensus Error) Circles



Quantifying tropical cyclone track forecast uncertainty and improving extended-range tropical cyclone track forecasts using an ensemble of dynamical models - Goerss (NRL)

Adjusted Wind Speed Probabilities – Based upon Spread of Multi-model Track Guidance

AL072008 083D12 GUSTAV 50kt 1000 Realizations Cumulative 0 – 120hrs



Intensity Probability Table



Intensity (Maximum Wind Speed) Probability Table
 Tropical Storm Igor Advisory Number 1
 11:00 AM AST Sep 8 2010



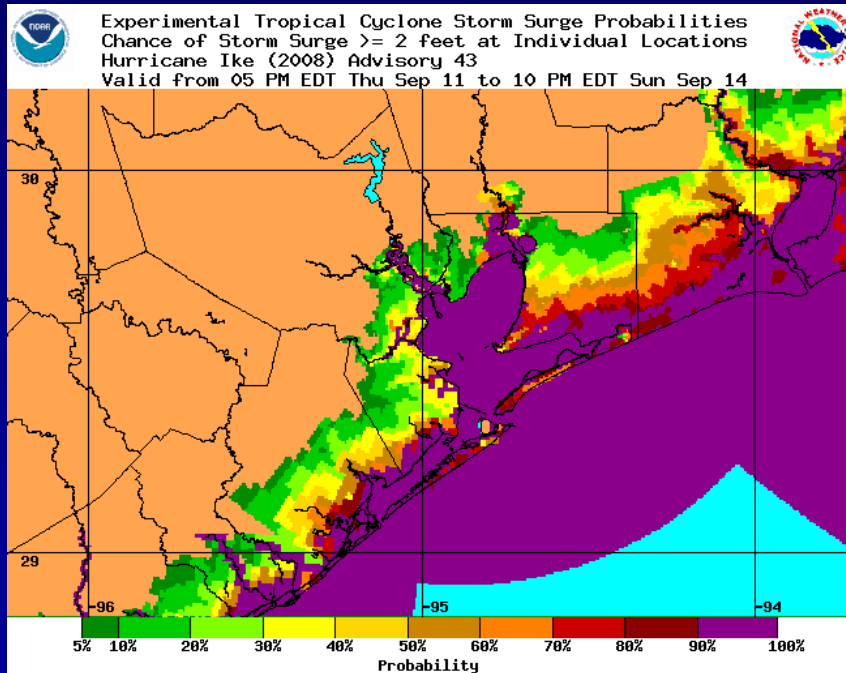
Wind Range (mph)	Forecast Time						
	12 hour for 8 PM Wed	24 hour for 8 AM Thu	36 hour for 8 PM Thu	48 hour for 8 AM Fri	72 hour for 8 AM Sat	96 hour for 8 AM Sun	120 hour for 8 AM Mon
Dissipated	1%	1%	2%	1%	2%	1%	1%
Tropical Depression (<39)	12%	13%	11%	10%	6%	3%	3%
Tropical Storm (39-73)	85%	76%	69%	57%	43%	31%	28%
Hurricane (all categories)	2%	9%	18%	31%	49%	65%	68%
-- Category 1 (74-95)	2%	8%	15%	24%	32%	37%	34%
-- Category 2 (96-110)	<1%	1%	2%	5%	11%	17%	17%
-- Category 3 (111-130)	1%	1%	1%	2%	5%	9%	14%
-- Category 4 (131-155)	<1%	<1%	<1%	<1%	1%	2%	3%
-- Category 5 (>155)	<1%	<1%	<1%	<1%	<1%	<1%	<1%
Forecast Maximum Wind	45 mph	50 mph	60 mph	65 mph	75 mph	85 mph	100 mph



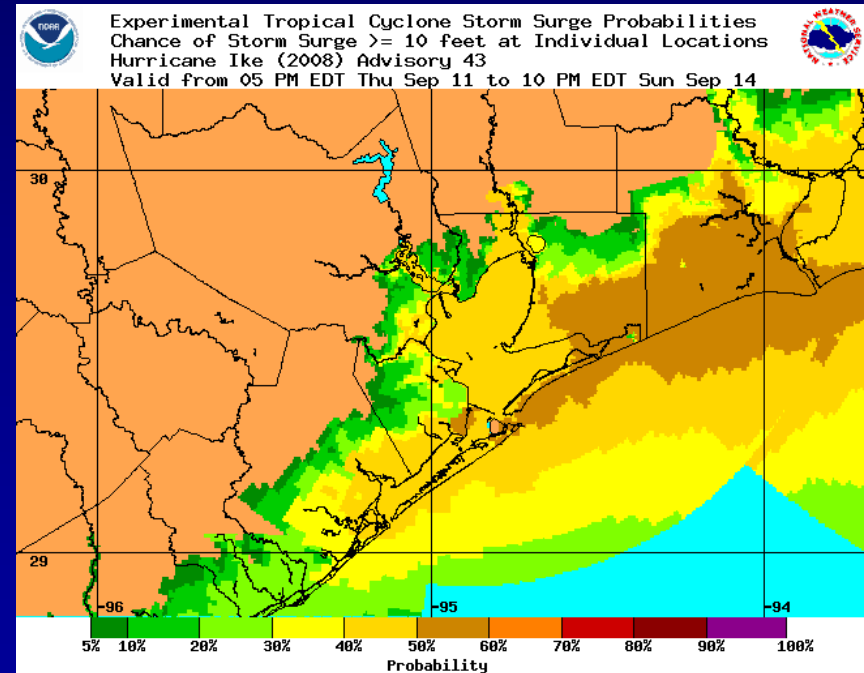
Storm Surge Probability

- *became operational in 2009*
- *available in 1-ft increments from 2 to 25 ft*
- *run when a Hurricane Watch or Warning is in effect*

Chance of surge > 2 ft



Chance of surge > 10 ft



2011 NHC Operational Deterministic Products

- Track (5 days)
- Intensity (5 days)
- 34/50 kt Wind Radii (3 days)
- 64 kt Wind Radii (36 hr)
- High Seas (5 days)

Probabilistic Products

- Genesis (0-48 h)
- Forecast Track Cone (upon historic track errors)
- Wind Speed Probabilities (upon historic intensity errors, but multi-model track spread)
- Intensity Probabilities (upon historic intensity errors)
- Storm Surge Probabilities (upon historic intensity errors, but multi-model track spread)

Possible Enhanced NHC Operational Deterministic Products (by 2018)

- Track (**7 days**)
- Intensity (**7 days**)
- 34/50 kt Wind Radii (**5 days**)
- 64 kt Wind Radii (**3 days**)
- High Seas (**7 days**)
- ***Provisional*** Track/Intensity/Size/Seas Forecast (**7 days**)

Probabilistic Products

- Genesis (**0-120 h**)
- Forecast Track Cone (**upon multi-model track spread**)
- Wind Speed Probabilities (multi-model track and **intensity spread**)
- Intensity Probabilities (**multi-model intensity spread**)
- Storm Surge Probabilities (multi-model track and **intensity spread**)

National Hurricane Center Forecast “Requirements”

Christopher Landsea
Science and Operations Officer
National Hurricane Center

HURRICANE
EVACUATION
ROUTE

10 November, 2011

