

Genesis forecasting at NHC

Chris Landsea

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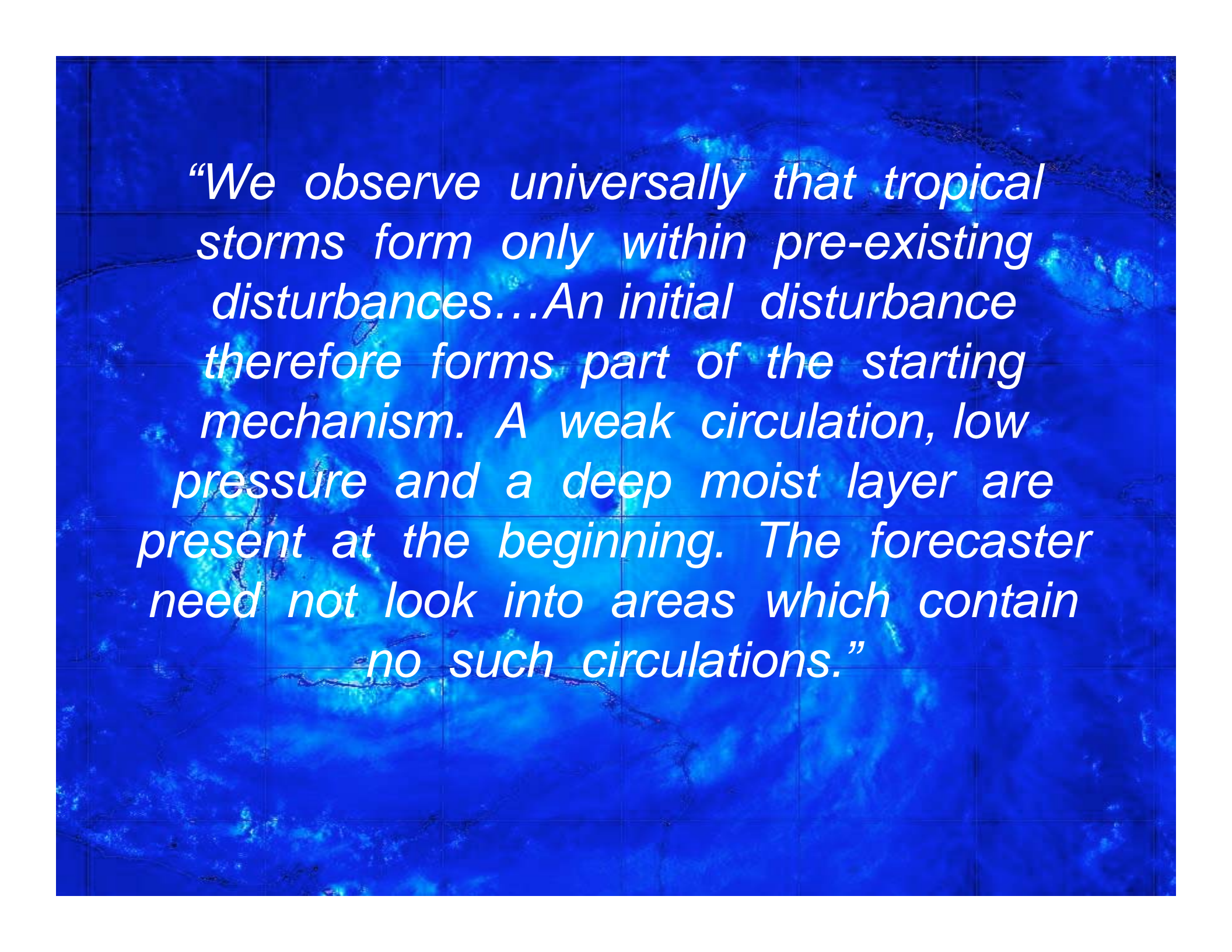
Science and Operations Officer

National Hurricane Center


HURRICANE
EVACUATION
ROUTE

12 November 2009





“We observe universally that tropical storms form only within pre-existing disturbances...An initial disturbance therefore forms part of the starting mechanism. A weak circulation, low pressure and a deep moist layer are present at the beginning. The forecaster need not look into areas which contain no such circulations.”

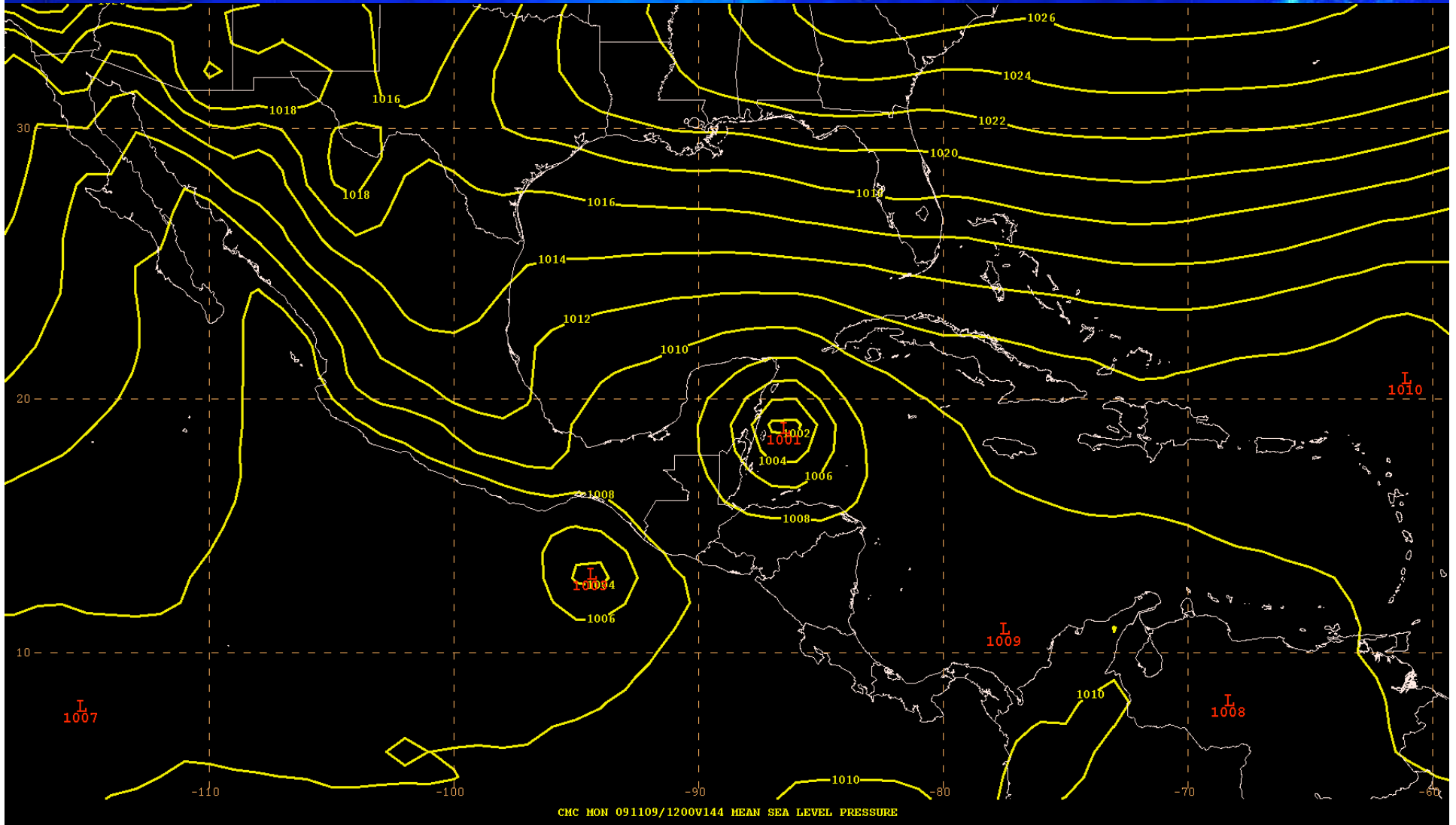


“We observe universally that tropical storms form only within pre-existing disturbances...An initial disturbance therefore forms part of the starting mechanism. A weak circulation, low pressure and a deep moist layer are present at the beginning. The forecaster need not look into areas which contain no such circulations.”

Herbert Riehl (1954)

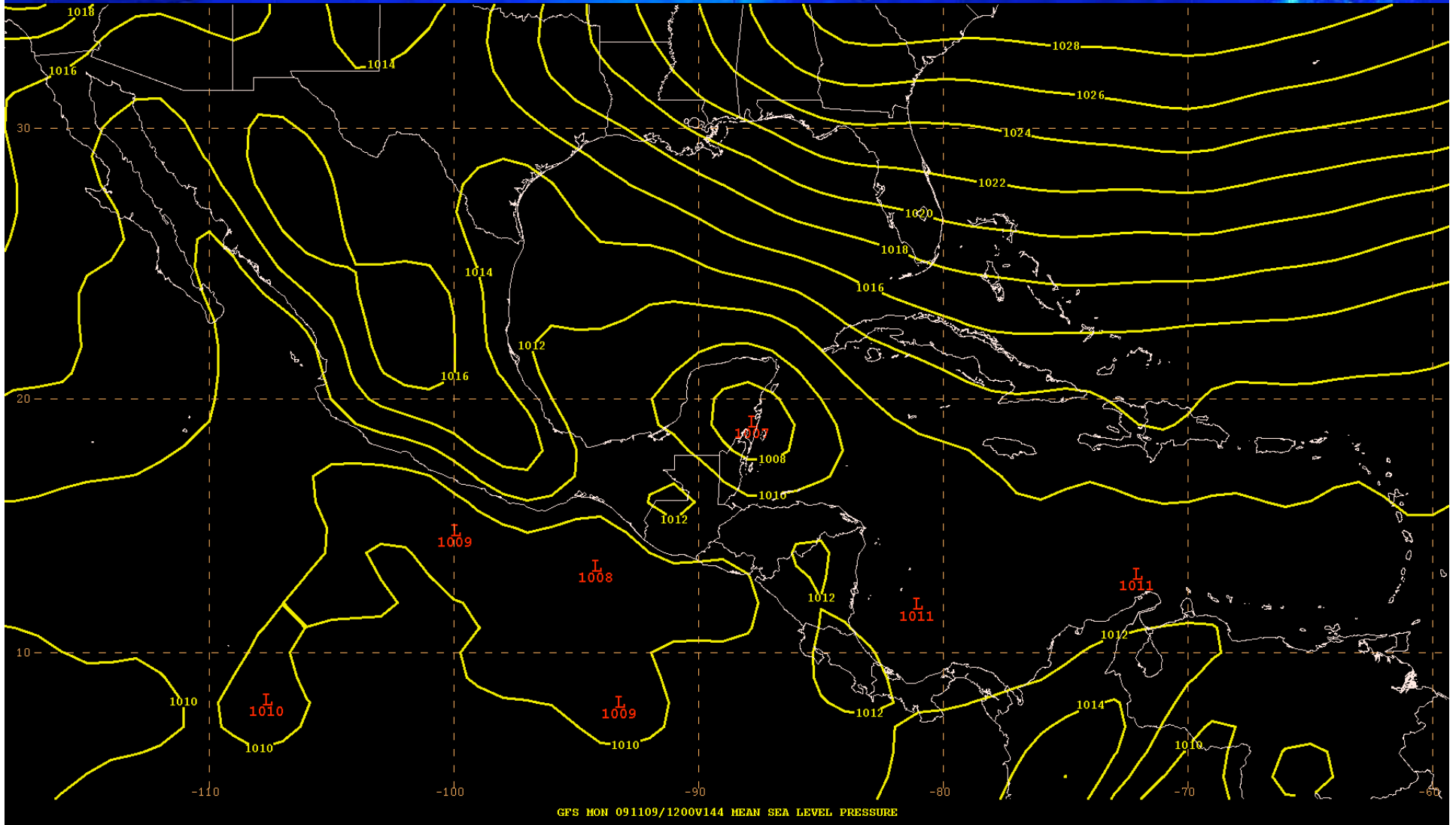
6 Day Forecast for Monday, November 9th –

CMC



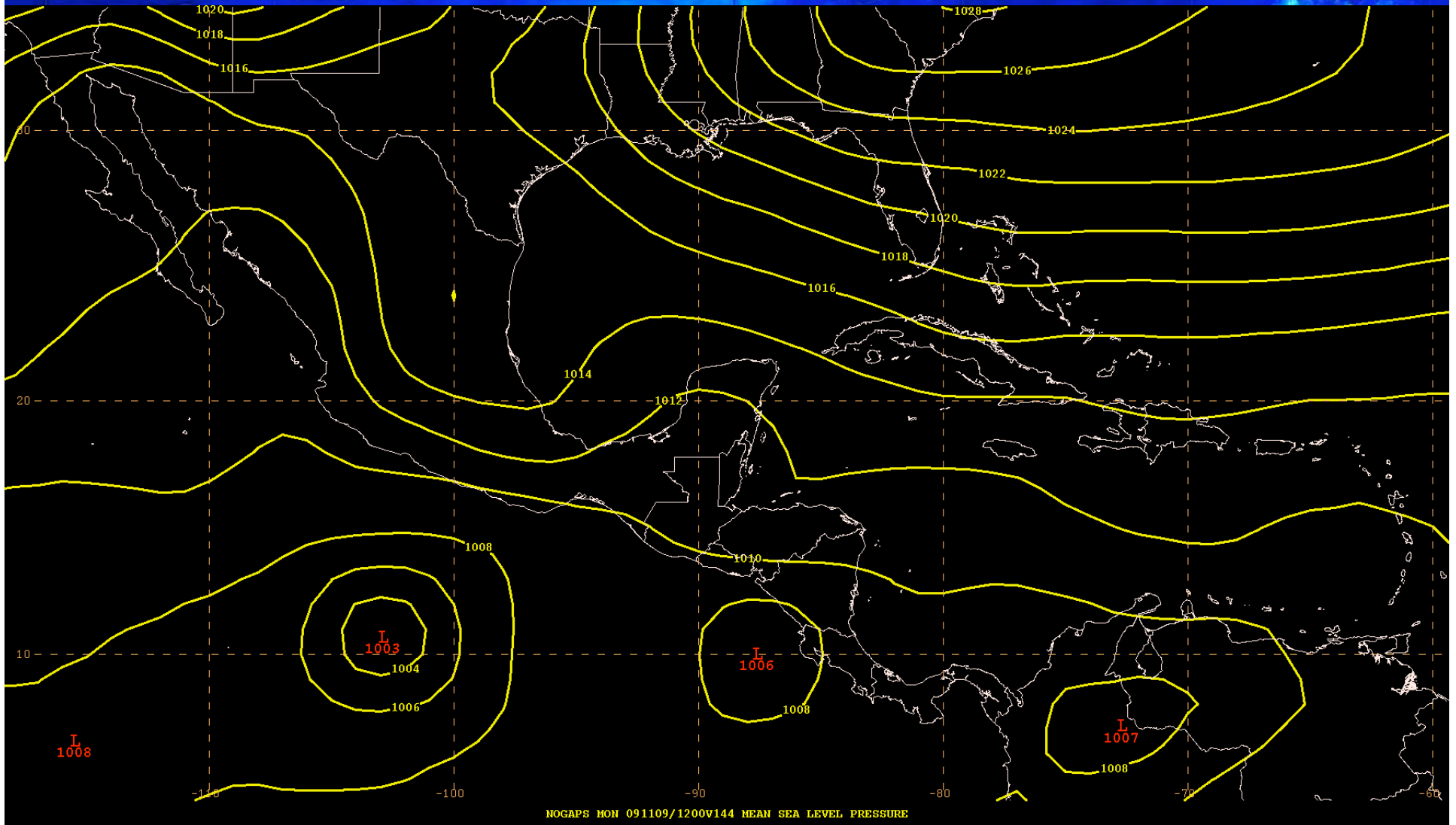
6 Day Forecast for Monday, November 9th –

GFS



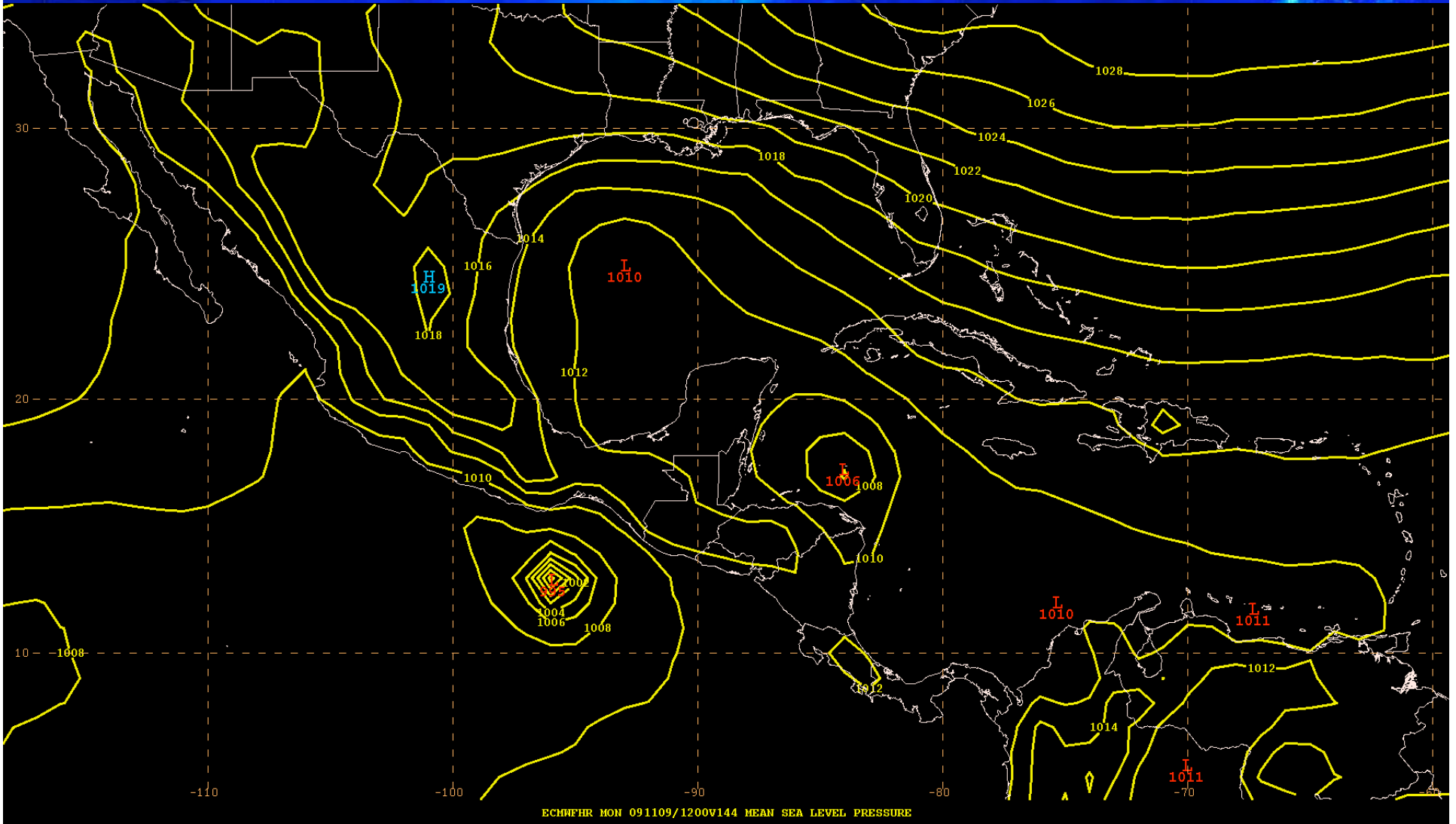
6 Day Forecast for Monday, November 9th –

NOGAPS



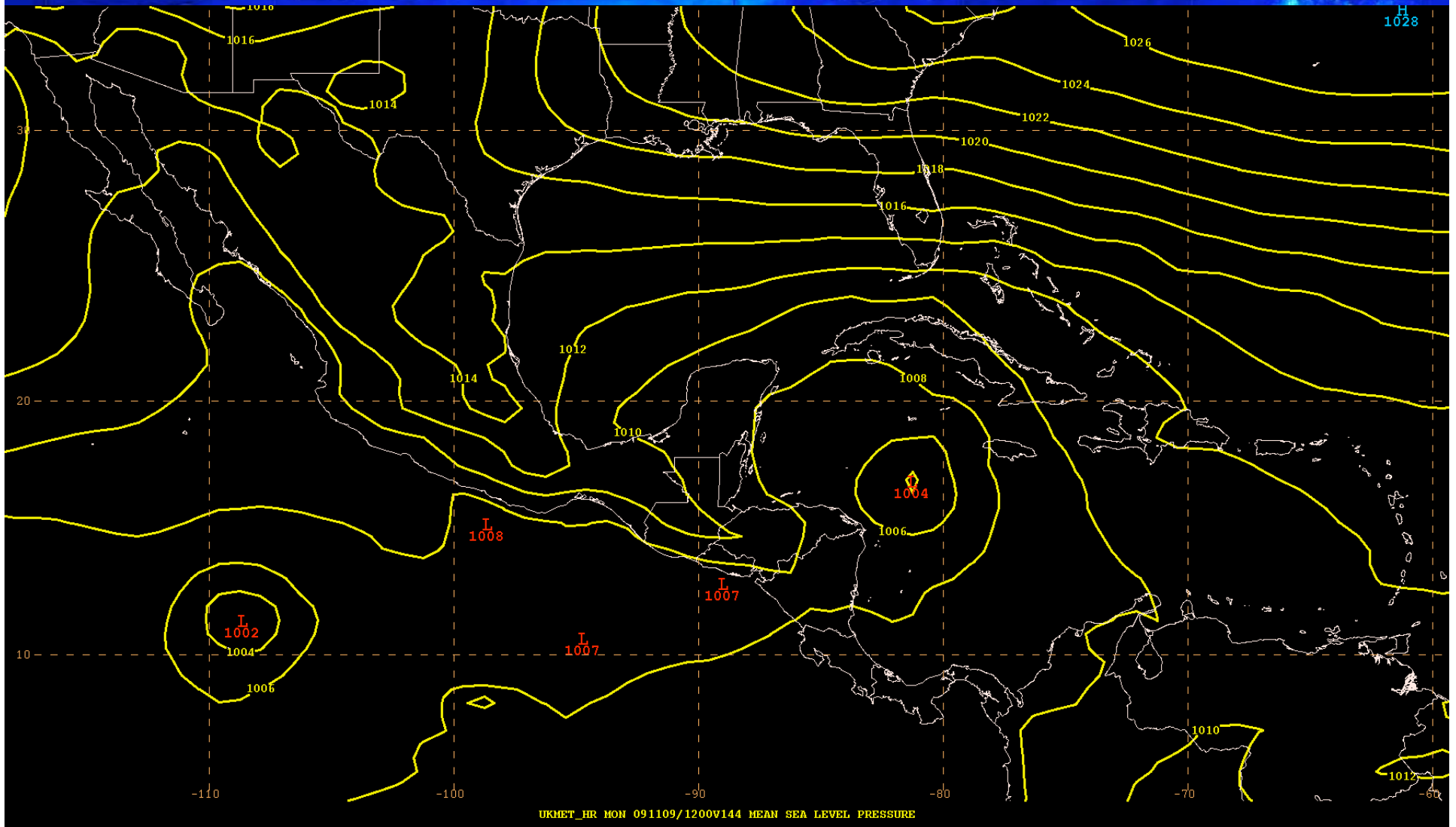
6 Day Forecast for Monday, November 9th –

ECMWF

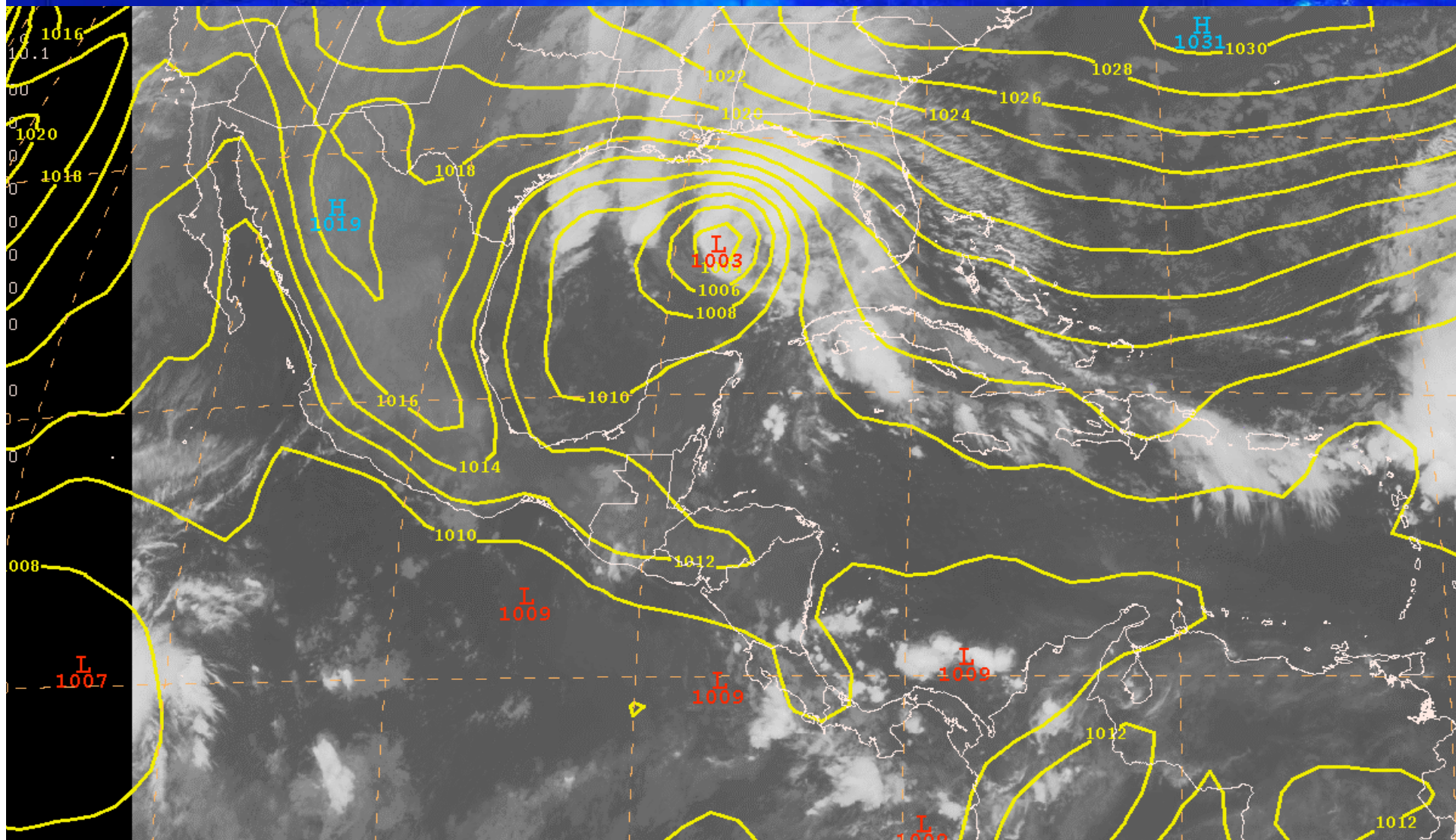


6 Day Forecast for Monday, November 9th –

UKMET



Analysis for 12Z Monday, November 9th

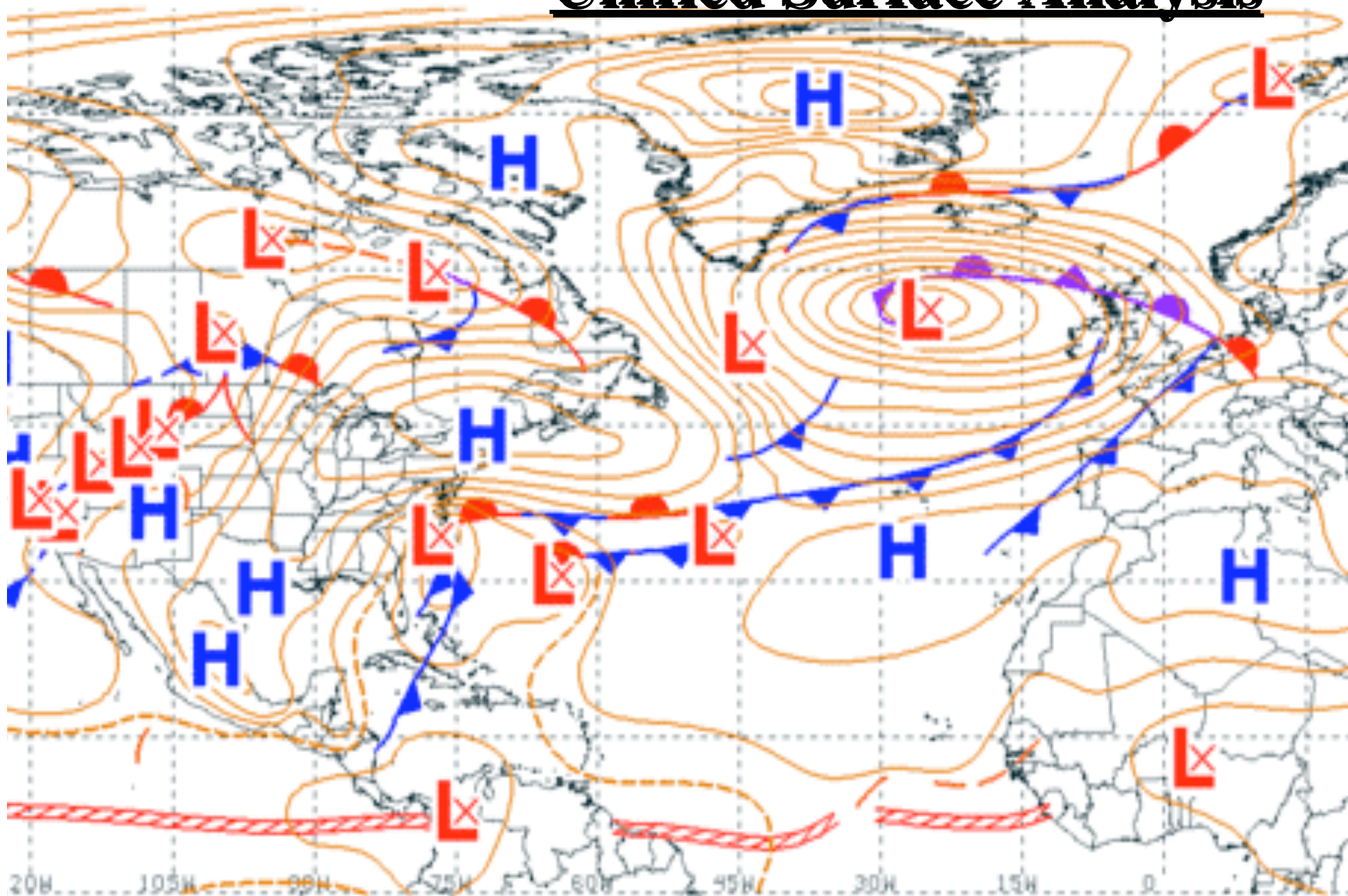




Tropical Cyclogenesis –
Definition used operationally
(NHOP 2009)

Tropical Cyclone. A 1) warm-core, 2) non-frontal 3) synoptic-scale cyclone, 4) originating over tropical or subtropical waters, with 5) organized deep convection and 6) a closed surface wind circulation about 7) a well-defined center.

Unified Surface Analysis



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AXNT20 KNHC 041035

TW DAT

Tropical Weather Discussion

TROPICAL WEATHER DISCUSSION

NWS TPC/NATIONAL HURRICANE CENTER MIAMI FL

805 AM EDT FRI SEP 04 2009

TROPICAL WEATHER DISCUSSION FOR NORTH AMERICA...CENTRAL AMERICA...GULF OF MEXICO...CARIBBEAN SEA...NORTHERN SECTIONS OF SOUTH AMERICA...AND ATLANTIC OCEAN TO THE AFRICAN COAST FROM THE EQUATOR TO 32N. THE FOLLOWING INFORMATION IS BASED ON SATELLITE IMAGERY...METEOROLOGICAL ANALYSIS...WEATHER OBSERVATIONS...AND RADAR.

BASED ON 0600 UTC SURFACE ANALYSIS AND SATELLITE IMAGERY THROUGH 0945 UTC.

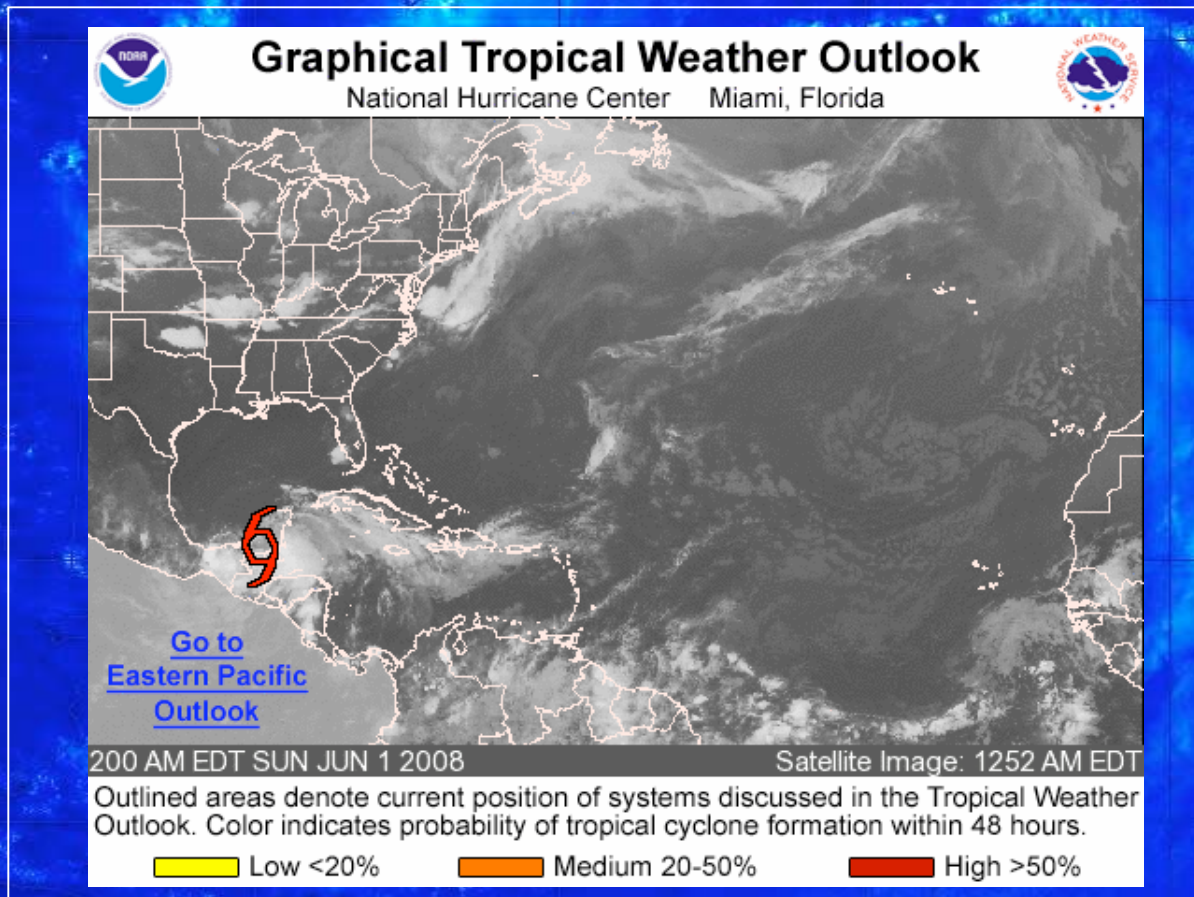
...TROPICAL WAVES...

TROPICAL WAVE IS FROM 18N22W THROUGH A 1010 MB LOW NEAR 14.5N22W

TO 9N20W MOVING NW NEAR 15 KT. WAVE REMAINS EMBEDDED WITHIN A

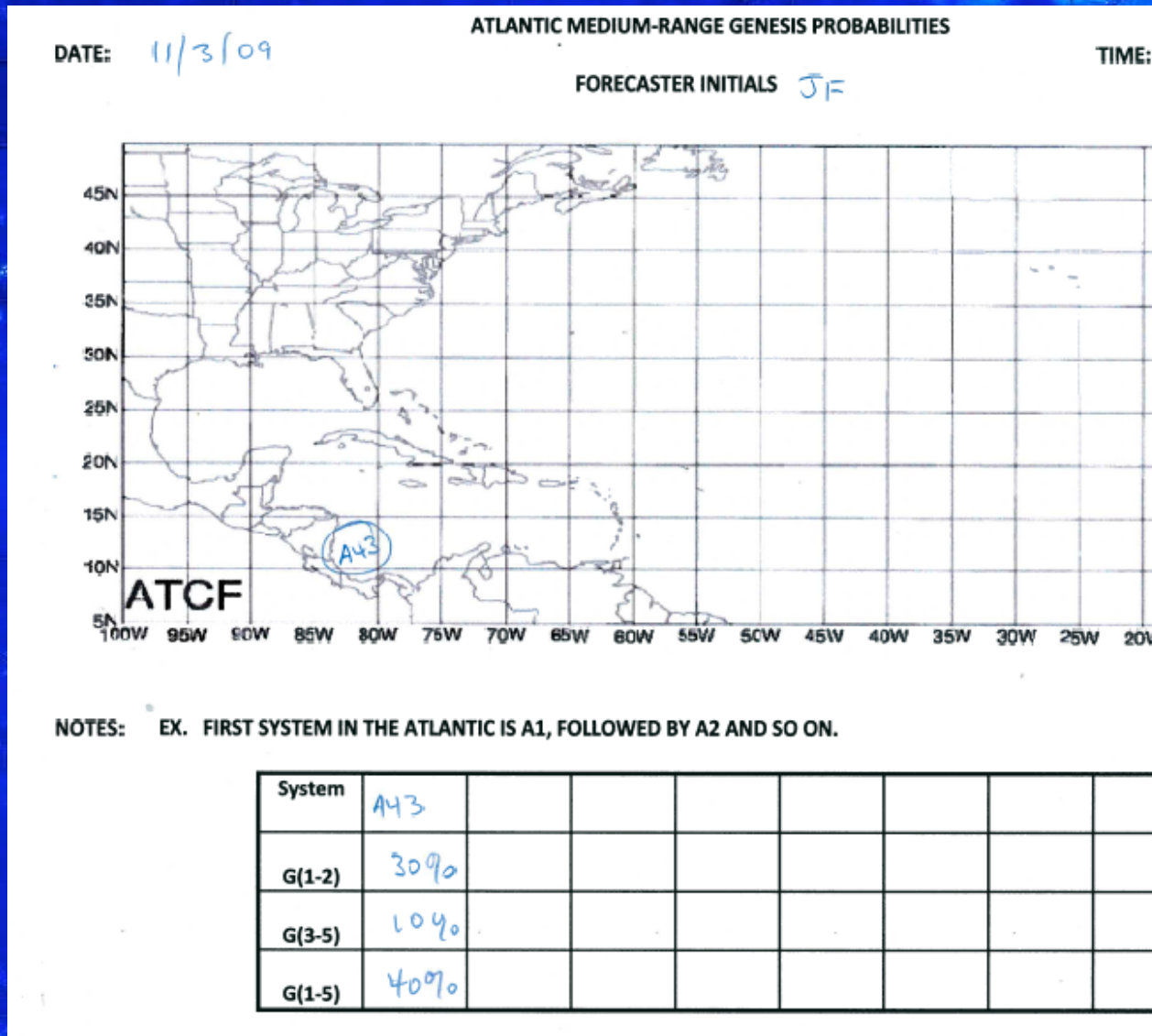
Graphical Tropical Weather Outlook

- *experimental in 2008, operational in 2009*
- *first quantitative genesis product ever issued*
- *forecast issued in 10% increments, but only “low” “medium”, and “high” provided to public*



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

Experimental (In-House) 5 Day Genesis Forecasts



Begun in 2009. To continue (in-house) in 2010.

Assessed twice daily (noon and midnight)

Like TWO, probabilities are assigned to individual disturbances

Tools utilized for genesis prediction in the 48 hr Tropical Weather Outlook:

- Amount and organization of deep convection and change over time (Dvorak classifications)
- Evaluation of synoptic environment (SSTs, deep tropospheric shear, moist instability, low level vorticity)
- To help determine baroclinicity and low-mid trop warm core, the FSU Cyclone Phase Space diagrams are utilized
- Global model solutions (GFS [4 times daily], UKMet [2], NOGAPS [4], CMC [4], and ECMWF [2])

Tools utilized for genesis prediction in the experimental 5 day outlook:

- **Global model solutions (GFS [4 times daily], UKMet [2], NOGAPS [4], CMC [4], and ECMWF [2])**

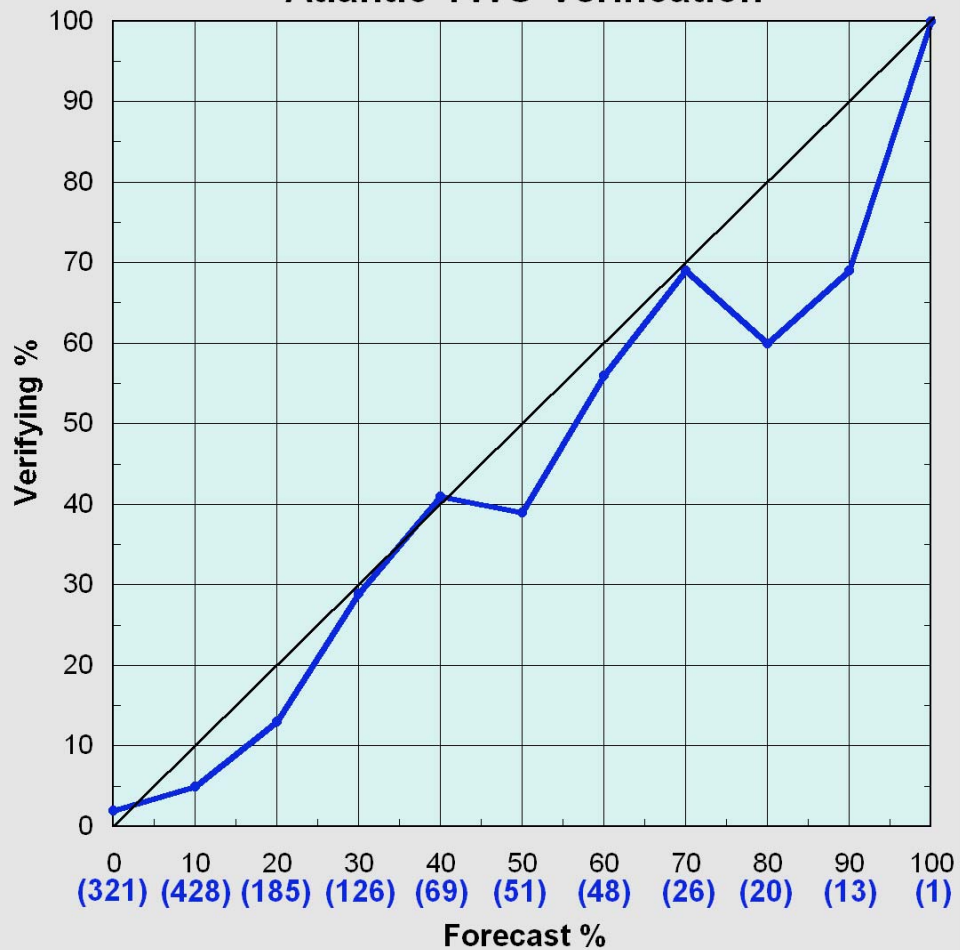
2008 Atlantic Genesis Forecasts 48 h Prior to TC Formation

Approximate Hours Prior to Genesis

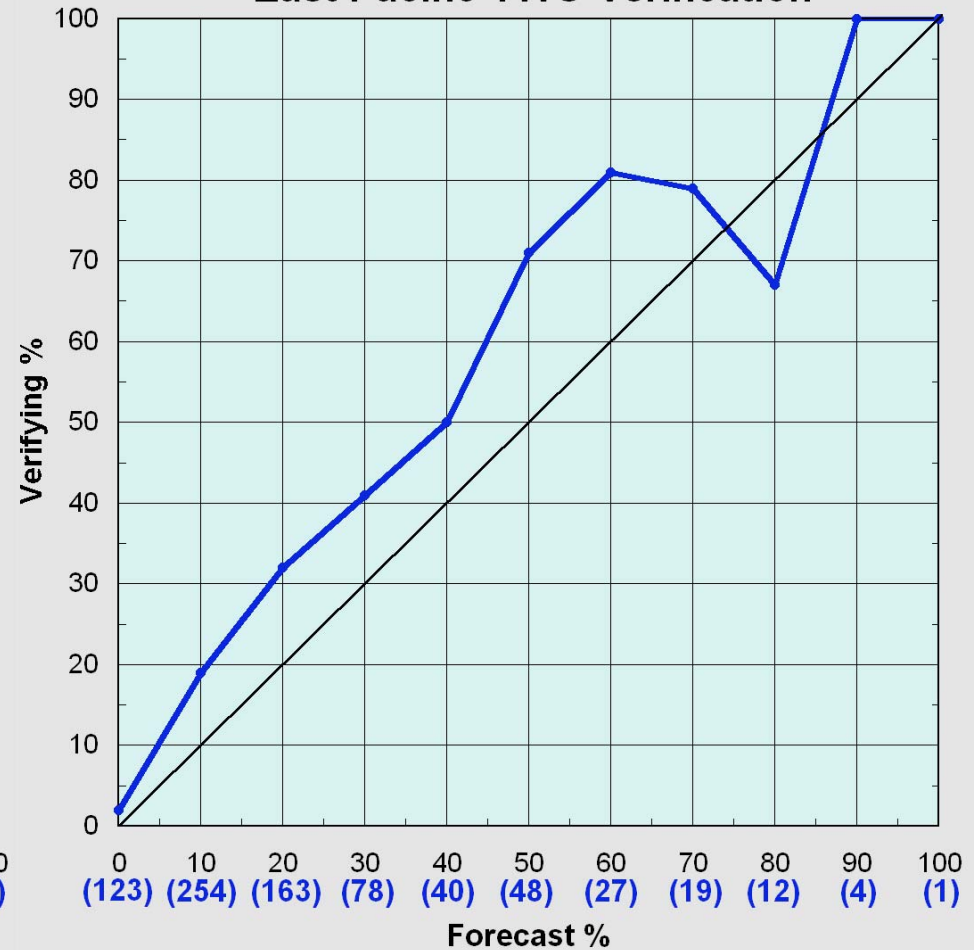
	-48	-42	-36	-30	-24	-18	-12	-6
Arthur								
Bertha	10	10	10	20	50	50	40	50
Cristobal	10	10	10	20	30	30	40	90
Dolly	80	70	70	90	70	70	80	80
Edouard						30	40	50
Fay	30	20	40	70	70	80	80	80
Gustav	30	30	30	30	30	40	40	50
Hanna	30	30	40	40	40	30	30	40
Ike	60	60	60	50	50	60	60	60
Josephine						30	50	70
Kyle	50	50	60	70	70	70	60	40
Laura			10	10	20	40	50	60
Marco	0	0	0	0	0	10	10	10
Nana	10	20	40	40	40	40	50	50
Omar	0	0	10	20	20	20	50	60
Sixteen					50	60	60	60
Paloma	30	30	30	30	40	50	50	60
Average 2008	28.3	27.5	31.5	37.7	41.4	44.4	49.4	56.9

2007-08 Genesis Forecast Verification

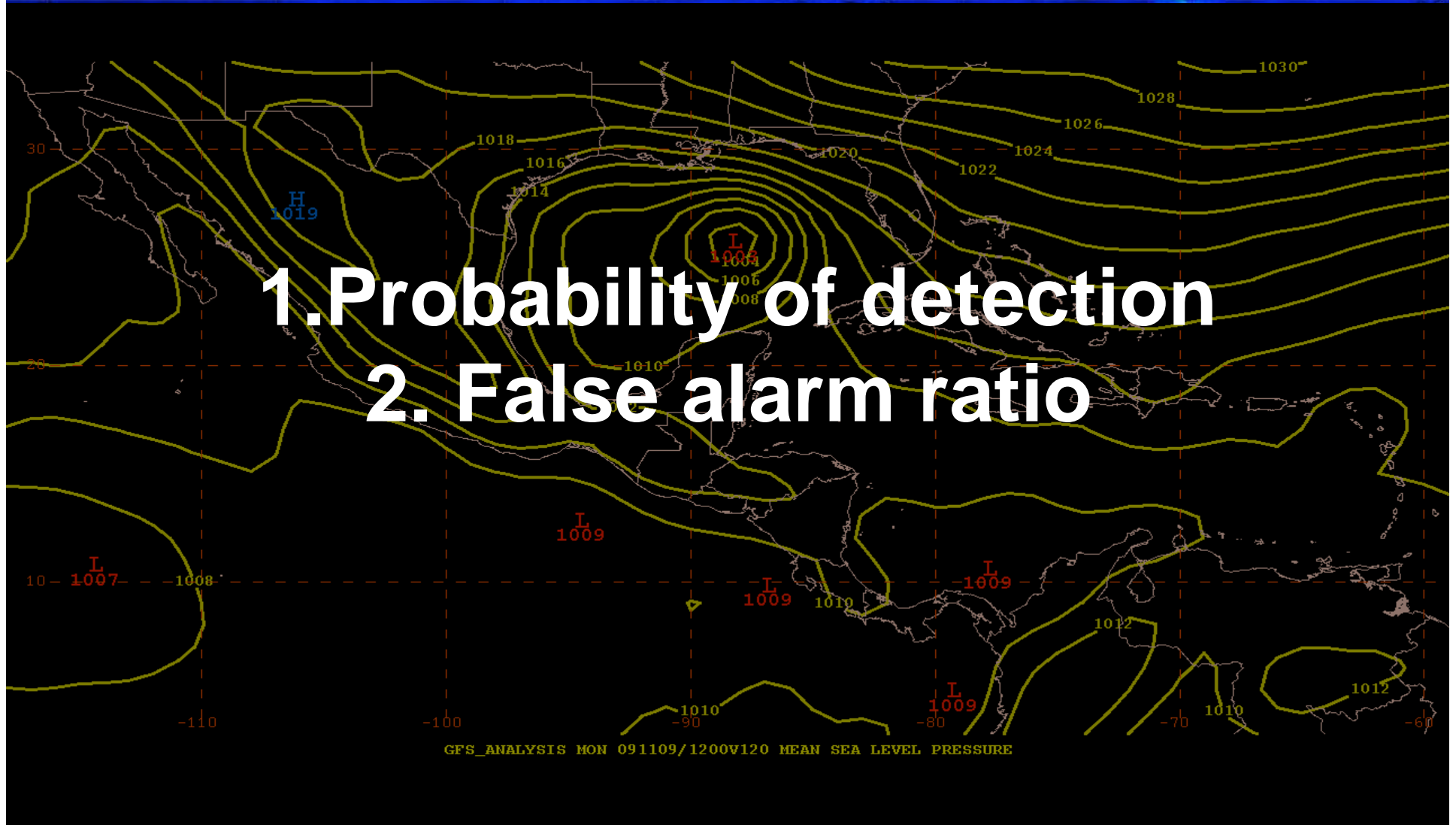
2007-08 Combined
Atlantic TWO Verification



2007-08 Combined
East Pacific TWO Verification



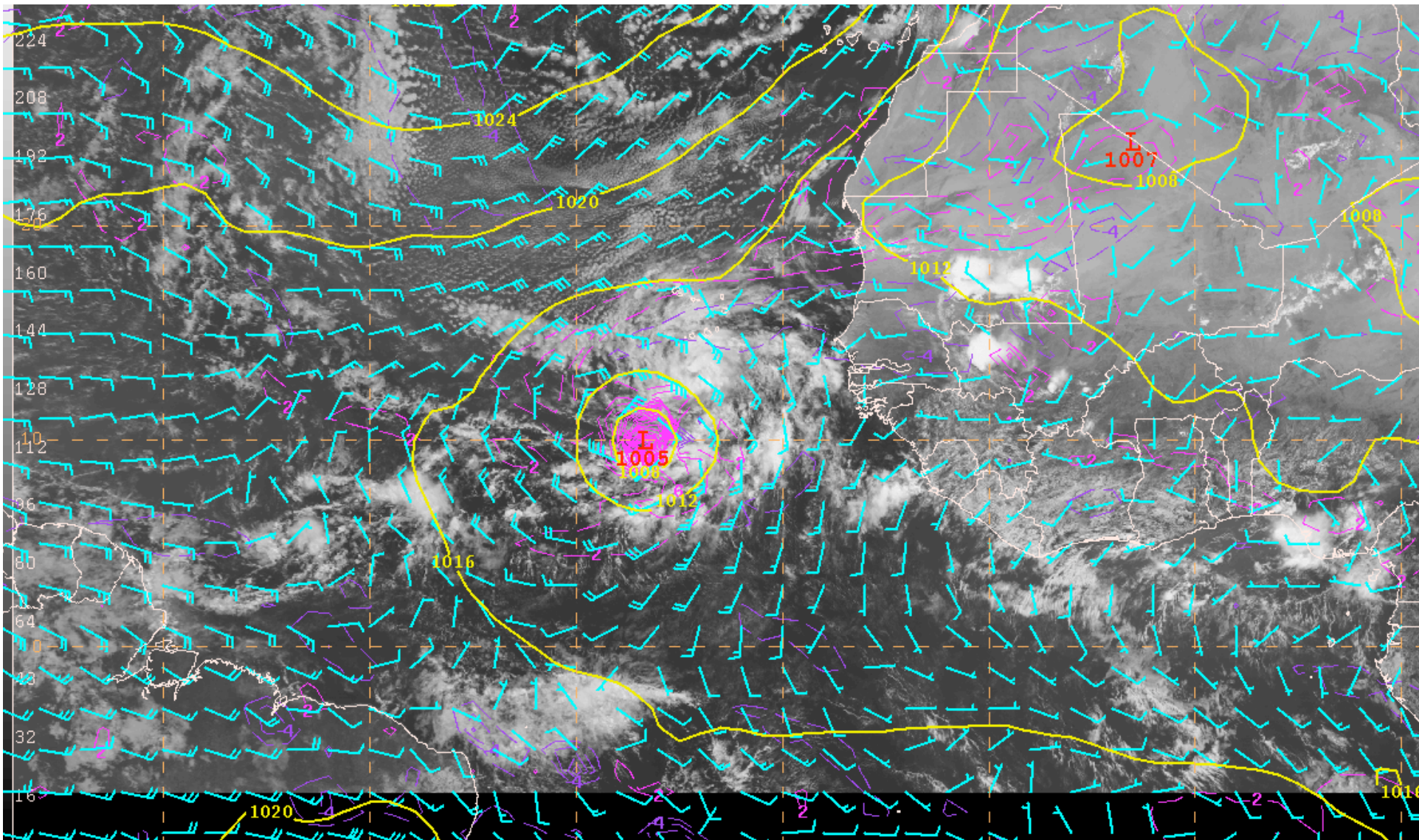
How accurate are model genesis forecasts?



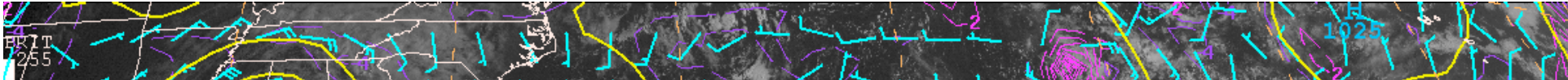
Thanks to Bob Hart (FSU), Dan Brown, and Dave Roberts



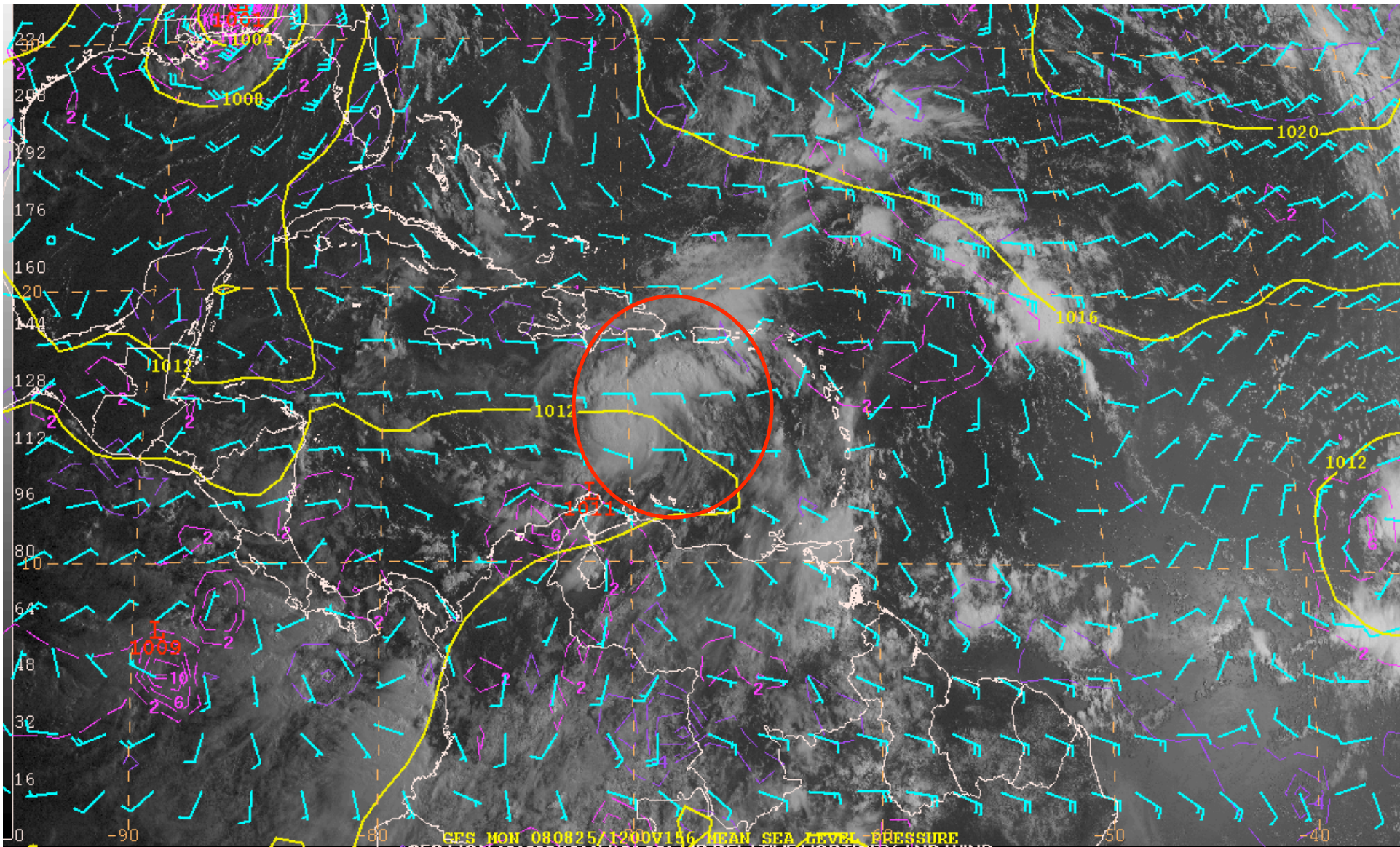
SERIES OF GFS FORECASTS VERIFYING NEAR OF GENESIS OF BERTHA



GFS THU 080703/1200V180 MEAN SEA LEVEL PRESSURE
 GFS THU 080703/1200V180 850 MB RELATIVE VORTICITY AND WIND
 080703/1200 METEOSAT9 VIS_0.6



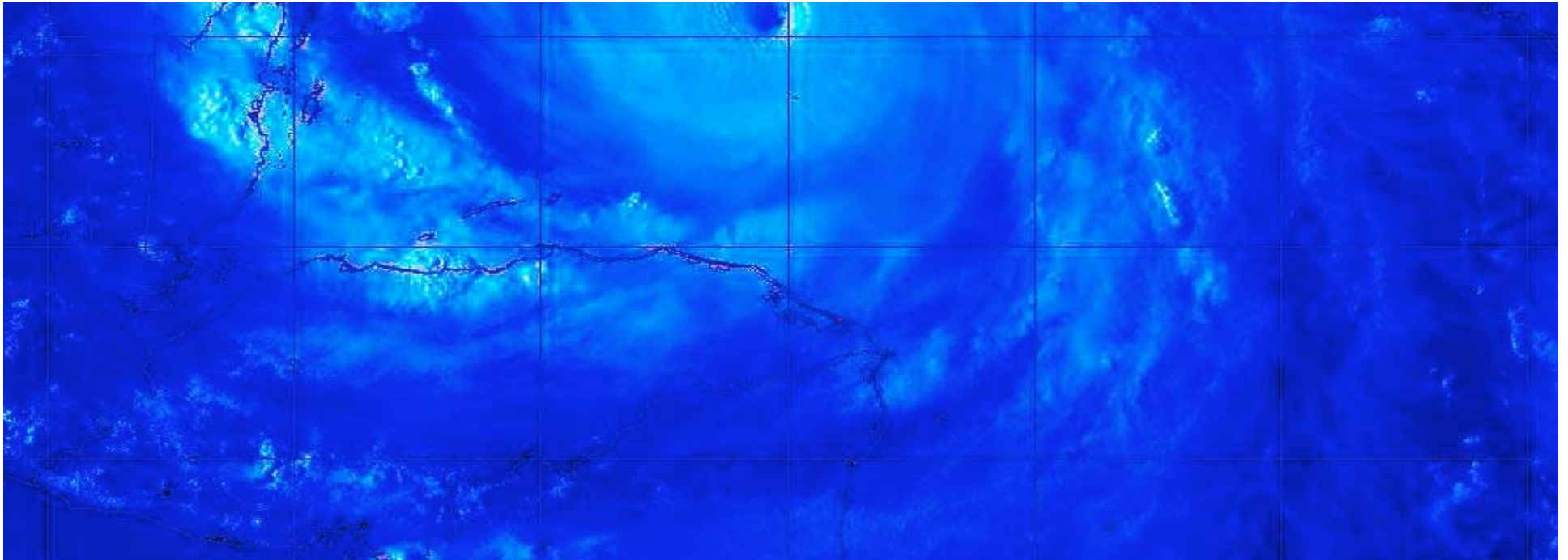
SERIES OF GFS FORECASTS VERIFYING NEAR OF GENESIS OF GUSTAV



GFS MON 080825/1200V156 MEAN SEA LEVEL PRESSURE
GFS MON 080825/1200V156 850 MB RELATIVE VORTICITY AND WIND
080825/1215 GOES12 VIS

Criteria for “Counting” Genesis in a Global Model Framework

1. A Low with two closed contours at 2 mb increment
2. Non-frontal (Cyclone Phase Space ≤ 10 of B)
3. Lower-trop Warm Core (Cyclone Phase Space ≥ 10 of VTL)



Genesis Consistently Predicted – Hours in Advance

Model	Ana	Bill	Claudette	Danny	Erika	Fred
CMC	48	144	Miss	132	144	96
ECMWF	72	96	Miss	12	18	72
GFS	60	144	Miss	36	Miss	120
NOGAPS	Miss	Miss	Miss	60	Miss	36
UKMET	Miss	48	Miss	24	Miss	72

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HURRICANE
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12 November 2009

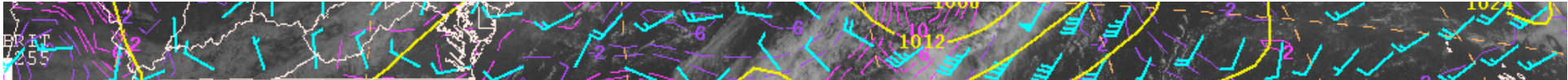


2008 East Pacific Genesis Forecasts

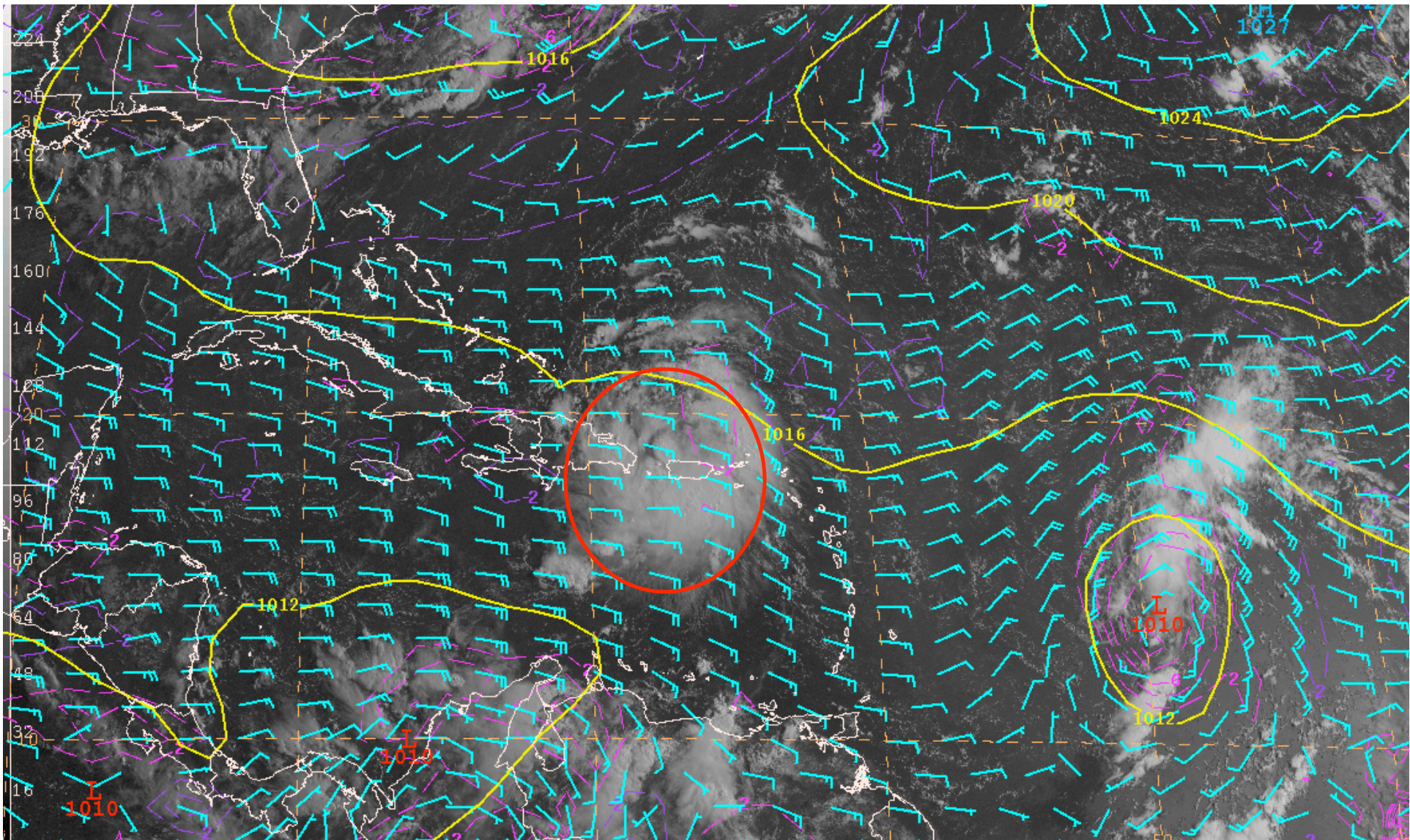
48 h Prior to TC Formation

Approximate Hours Prior to Genesis

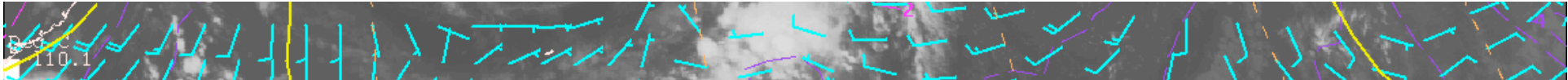
	-48	-42	-36	-30	-24	-18	-12	-6
Alma	10	10	20	30	40	50	60	60
Boris	10	10	20	30	30	50	70	80
Cristina				10	10	50	60	60
Douglas	40	50	50	60	60	60	60	70
Five	30	30	20	10	10	20	20	40
Elida	10	10	10	20	20	20	20	20
Fausto	50	50	60	70	70	50	50	50
Genevieve	50	70	70	70	70	80	80	80
Hernan				10	10	20	30	40
Iselle	10	20	10	10	10	10	40	40
Julio		10	20	20	20	30	20	20
Karina			0	10	10	10	20	50
Lowell			10	10	10	10	20	20
Marie			10	10	10	10	30	50
Norbert	70	70	50	50	50	50	50	90
Odile	50	40	40	30	30	30	40	40
Seventeen			10	10	10	10	10	10
Polo			10	10	10	10	30	30
Avg.	33.0	33.6	25.6	26.1	26.7	31.7	39.4	47.2



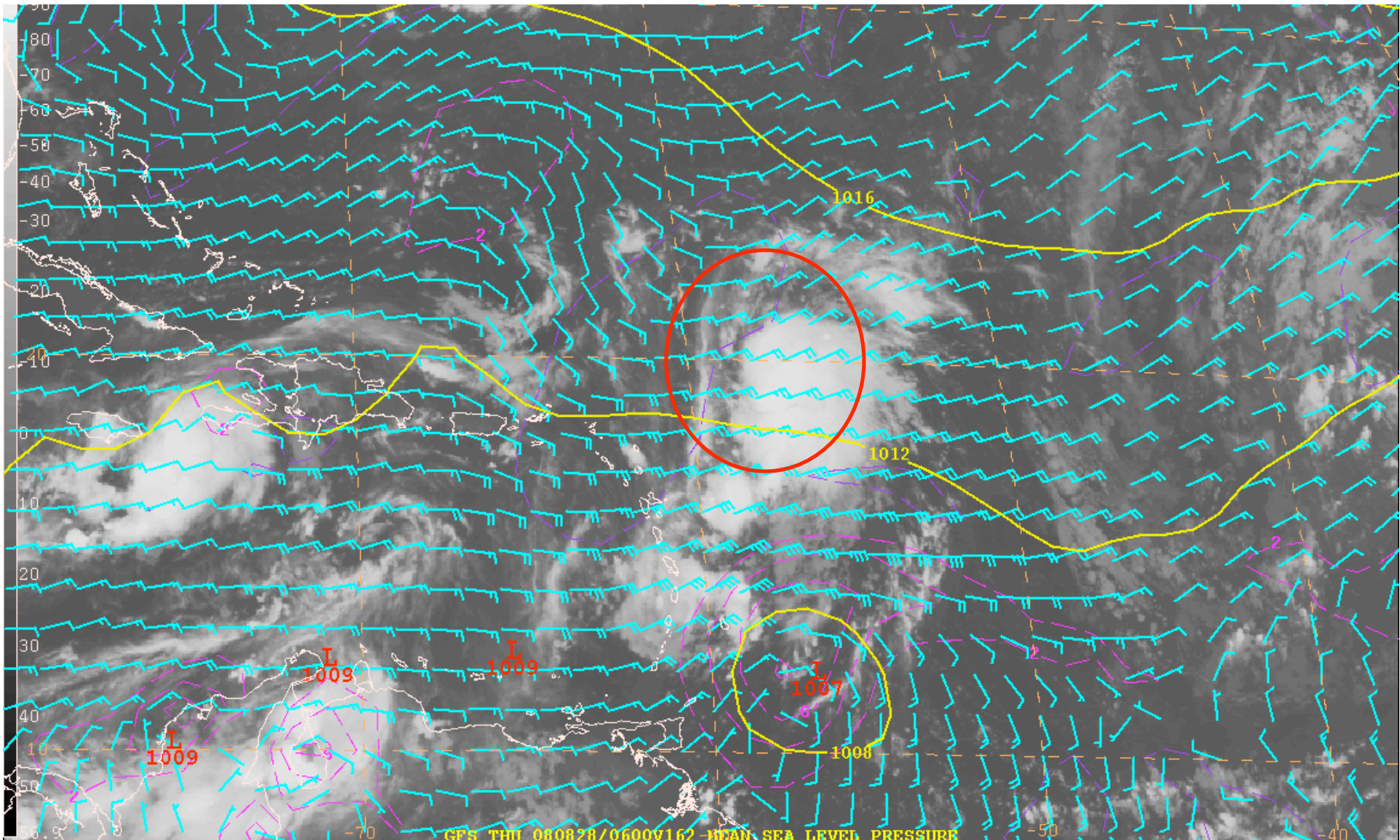
SERIES OF GFS FORECASTS VERIFYING NEAR OF GENESIS OF FAY



GFS FRI 080815/1200V168 MEAN SEA LEVEL PRESSURE
GFS FRI 080815/1200V168 850 MB RELATIVE VORTICITY AND WIND
080815/1215 GOES12 VIS

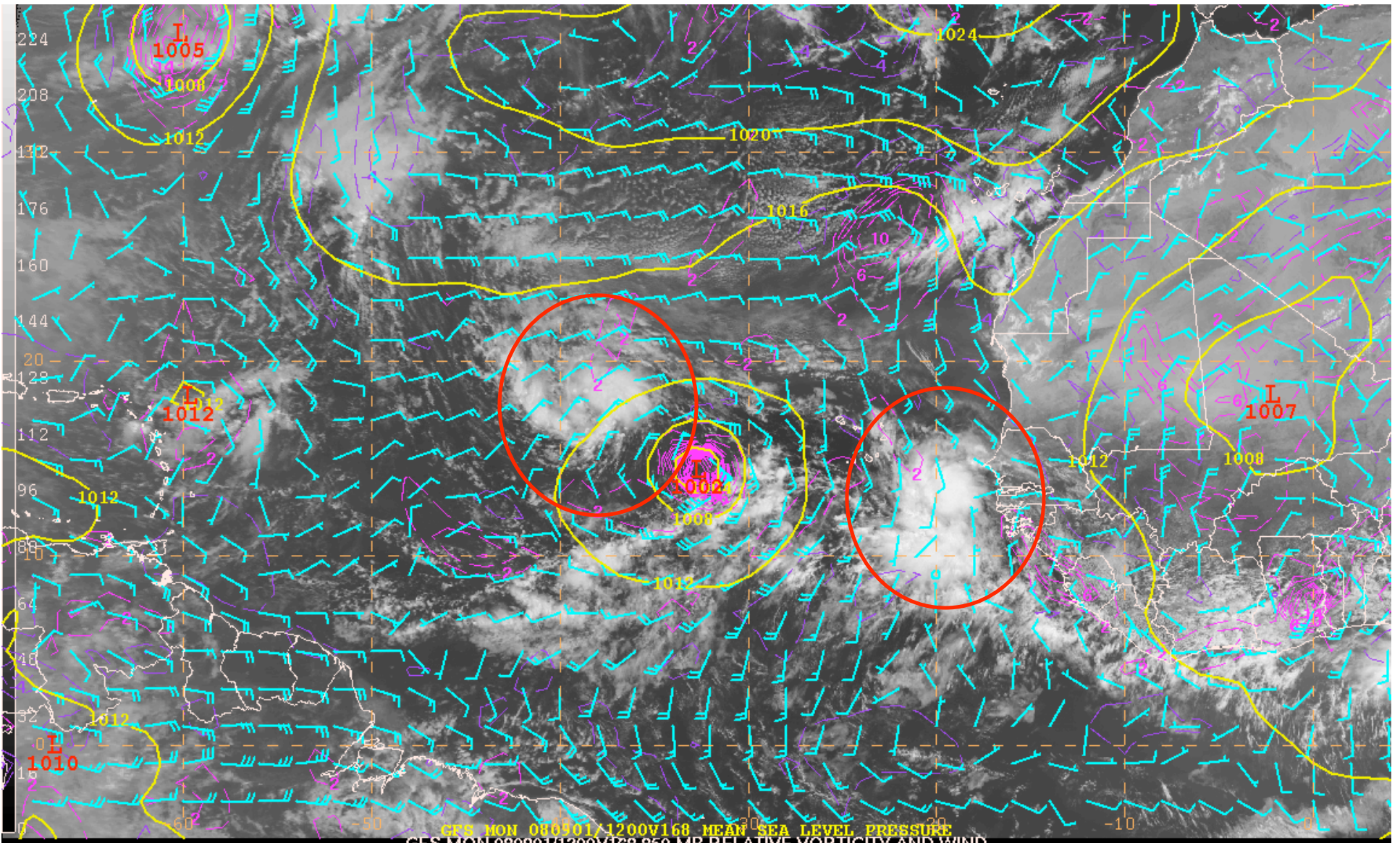


SERIES OF GFS FORECASTS VERIFYING NEAR OF GENESIS OF HANNA



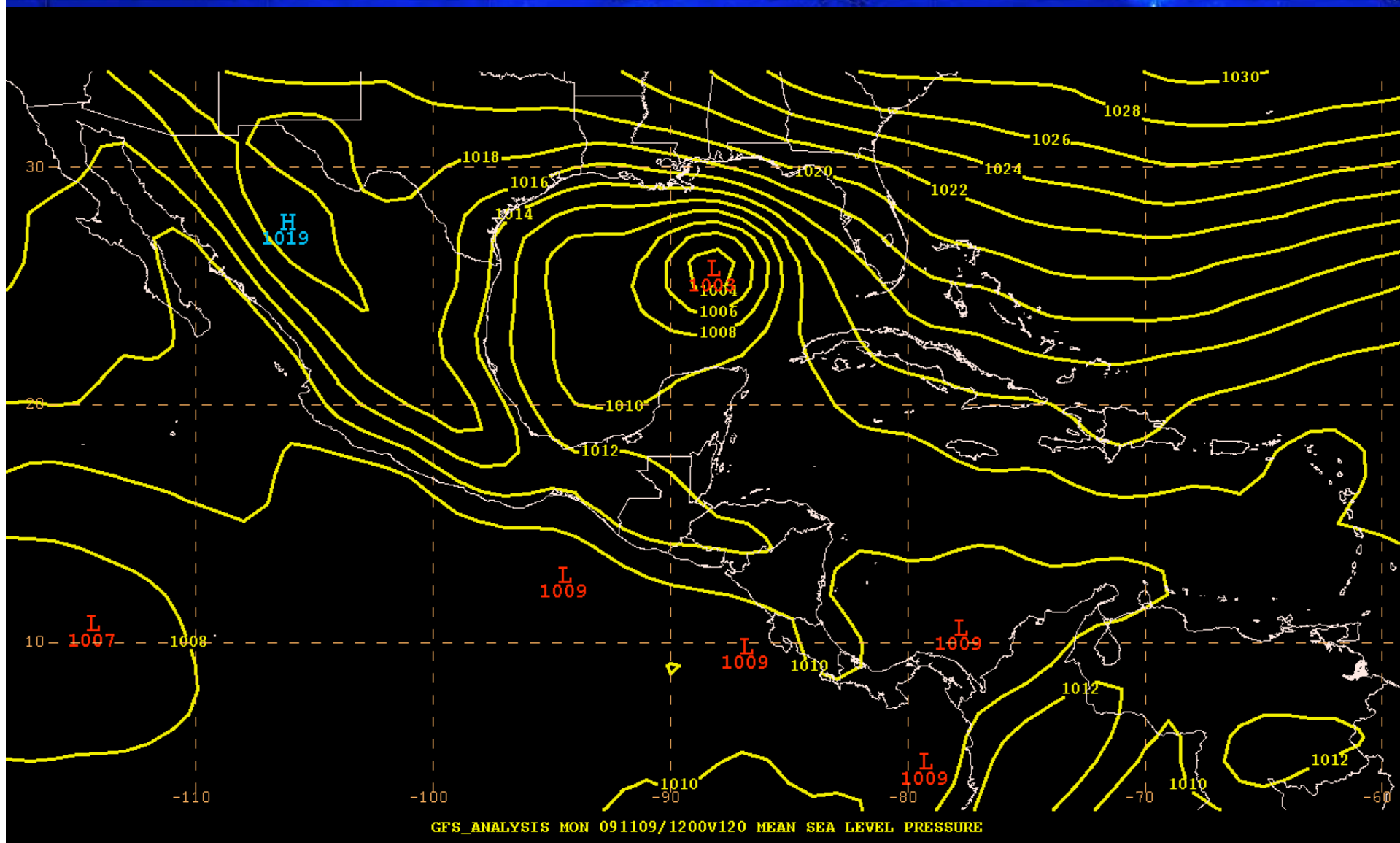
GFS THU 080828/0600V162 MEAN SEA LEVEL PRESSURE
GFS THU 080828/0600V162 850 MB RELATIVE VORTICITY AND WIND
080828/0615 GOES12 IR4

SERIES OF GFS FORECASTS VERIFYING NEAR OF GENESIS OF IKE/JOSEPHINE

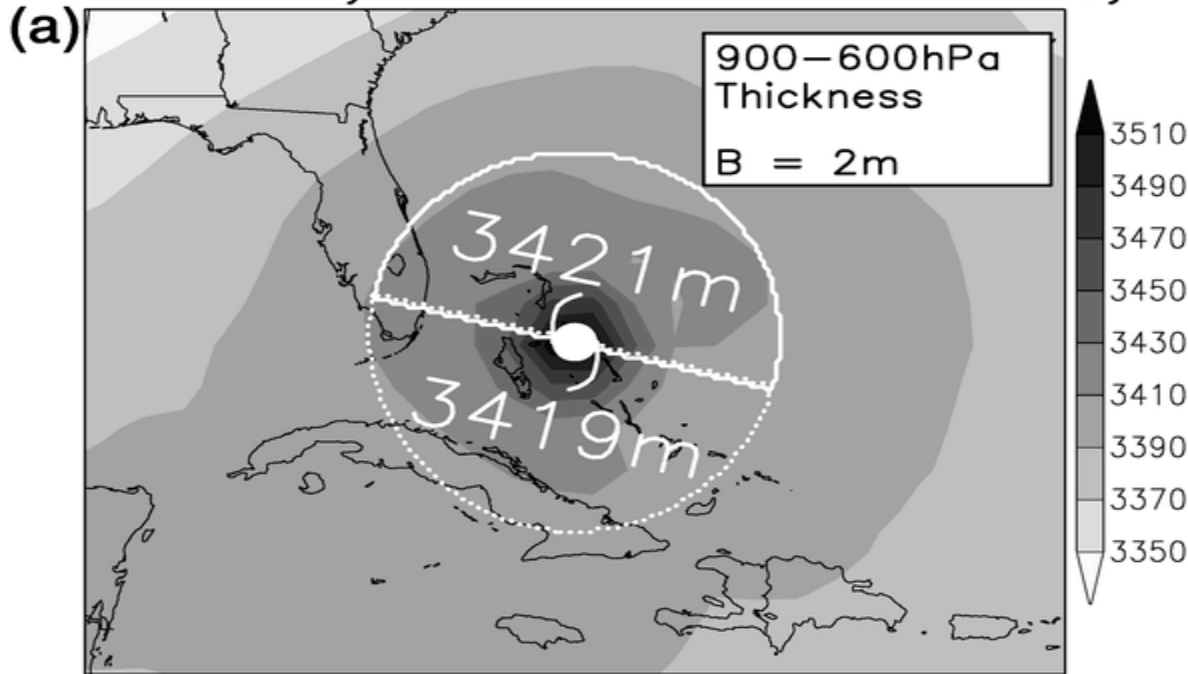


GFS MON 080901/1200V168 MEAN SEA LEVEL PRESSURE
GFS MON 080901/1200V168 850 MB RELATIVE VORTICITY AND WIND
080901/1200 METEOSAT9 VIS_0.6

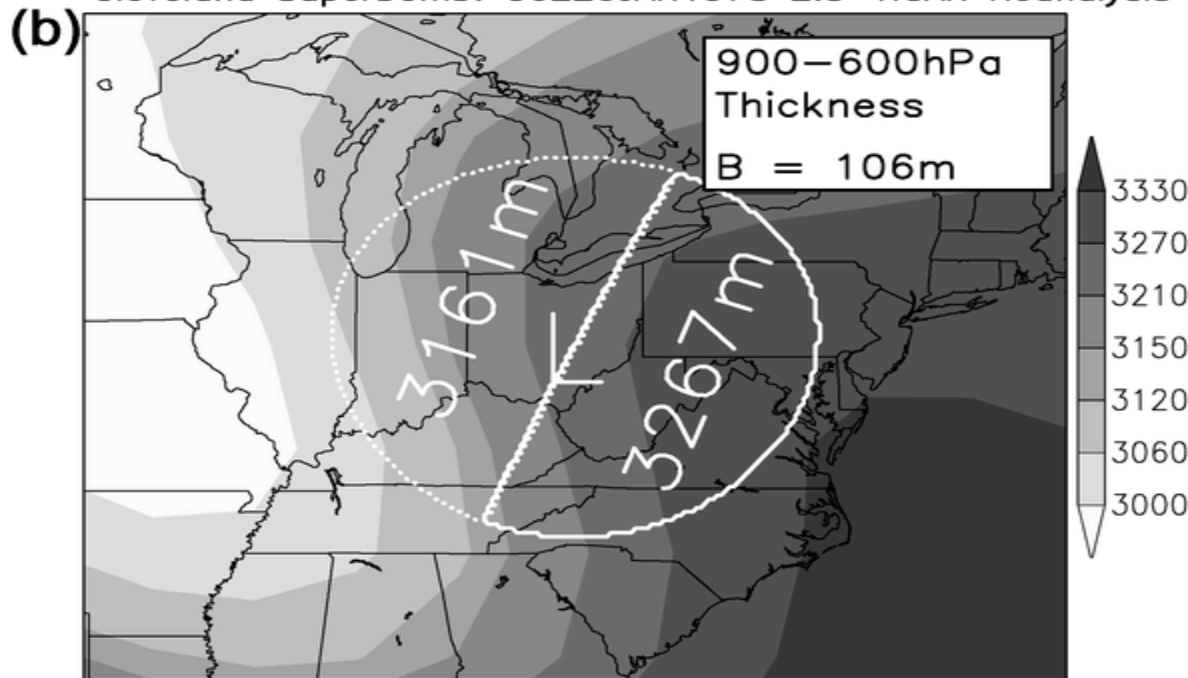
Analysis for 12Z Monday, November 9th



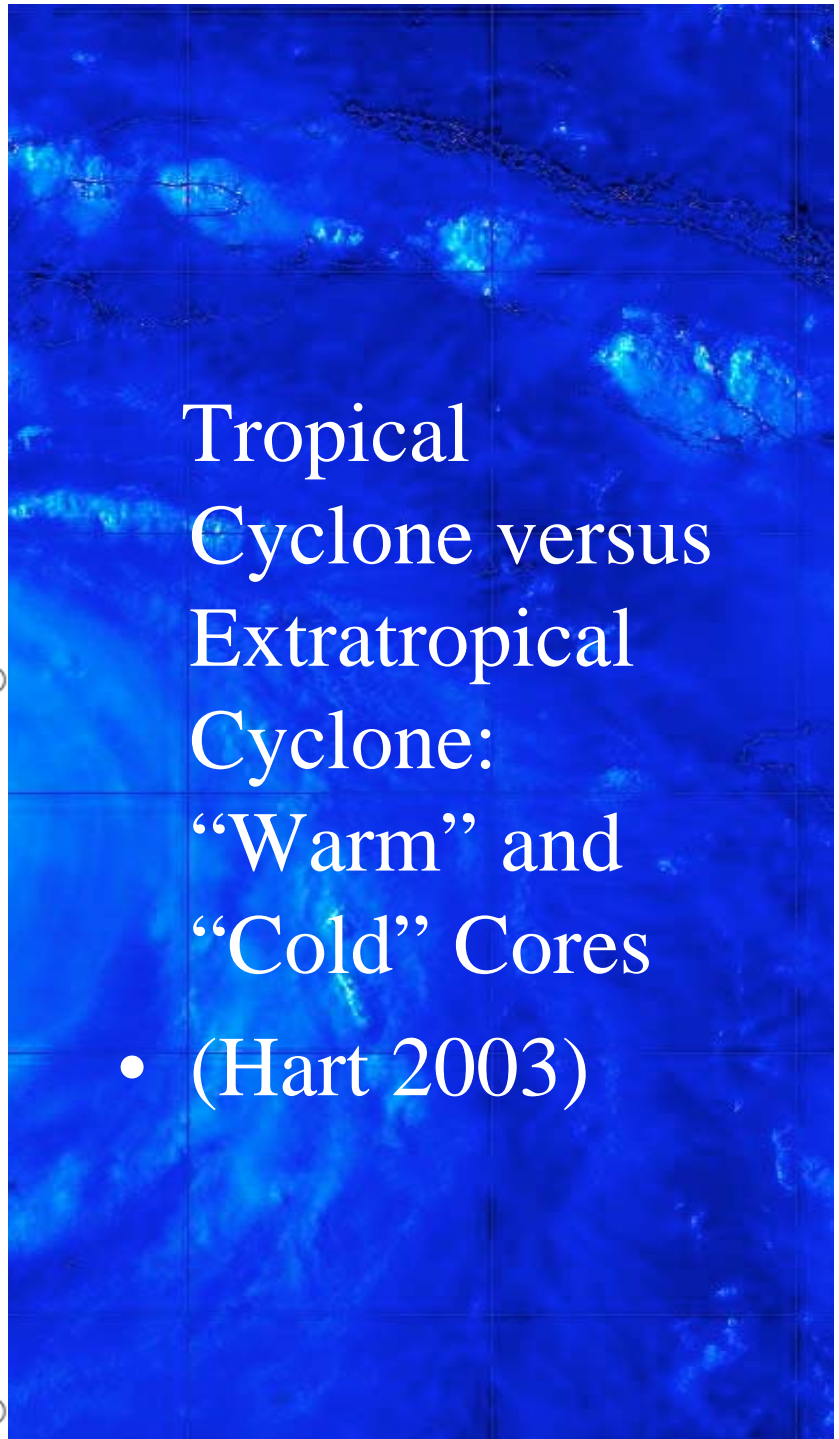
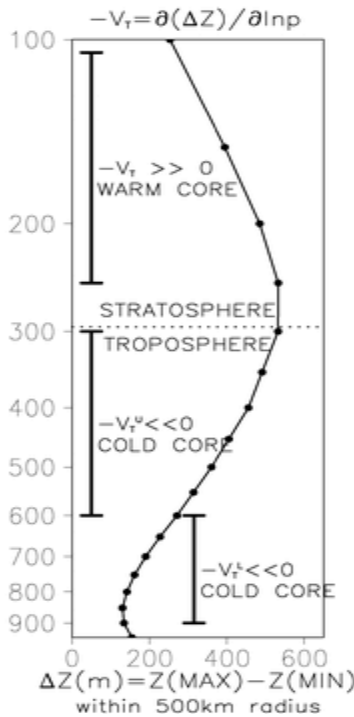
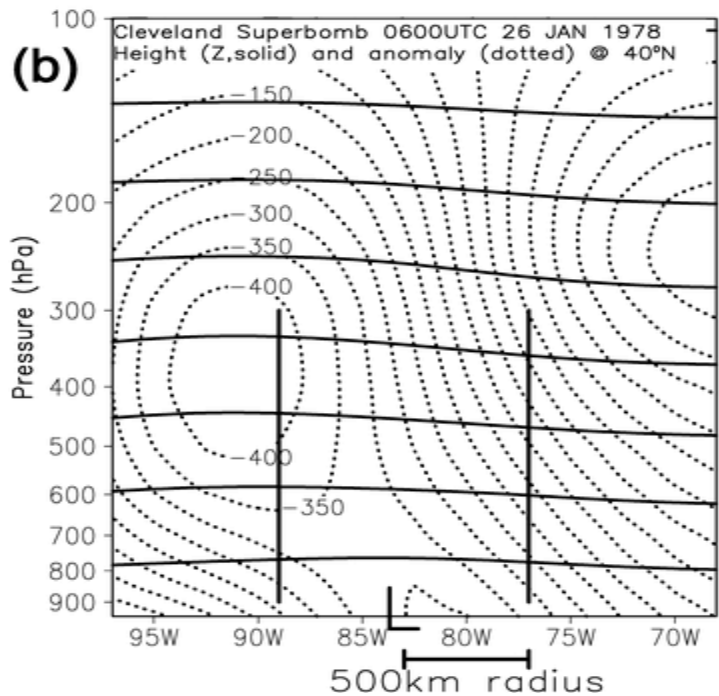
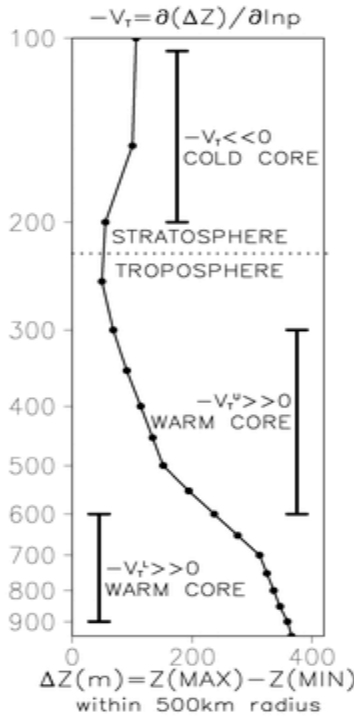
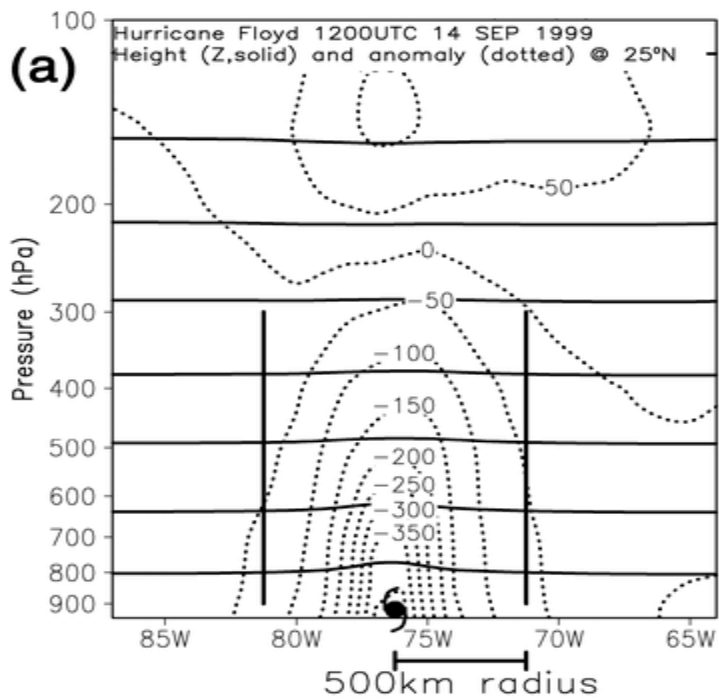
Hurricane Floyd: 12Z14SEP1999 1.0° NOGAPS Analysis



Cleveland Superbomb: 06Z26JAN1978 2.5° NCAR Reanalysis



Tropical
Cyclone versus
Extratropical
Cyclone:
Non-frontal
versus frontal
(Hart 2003)

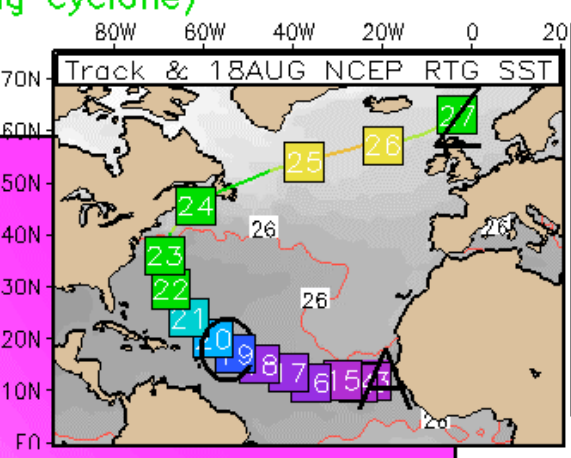
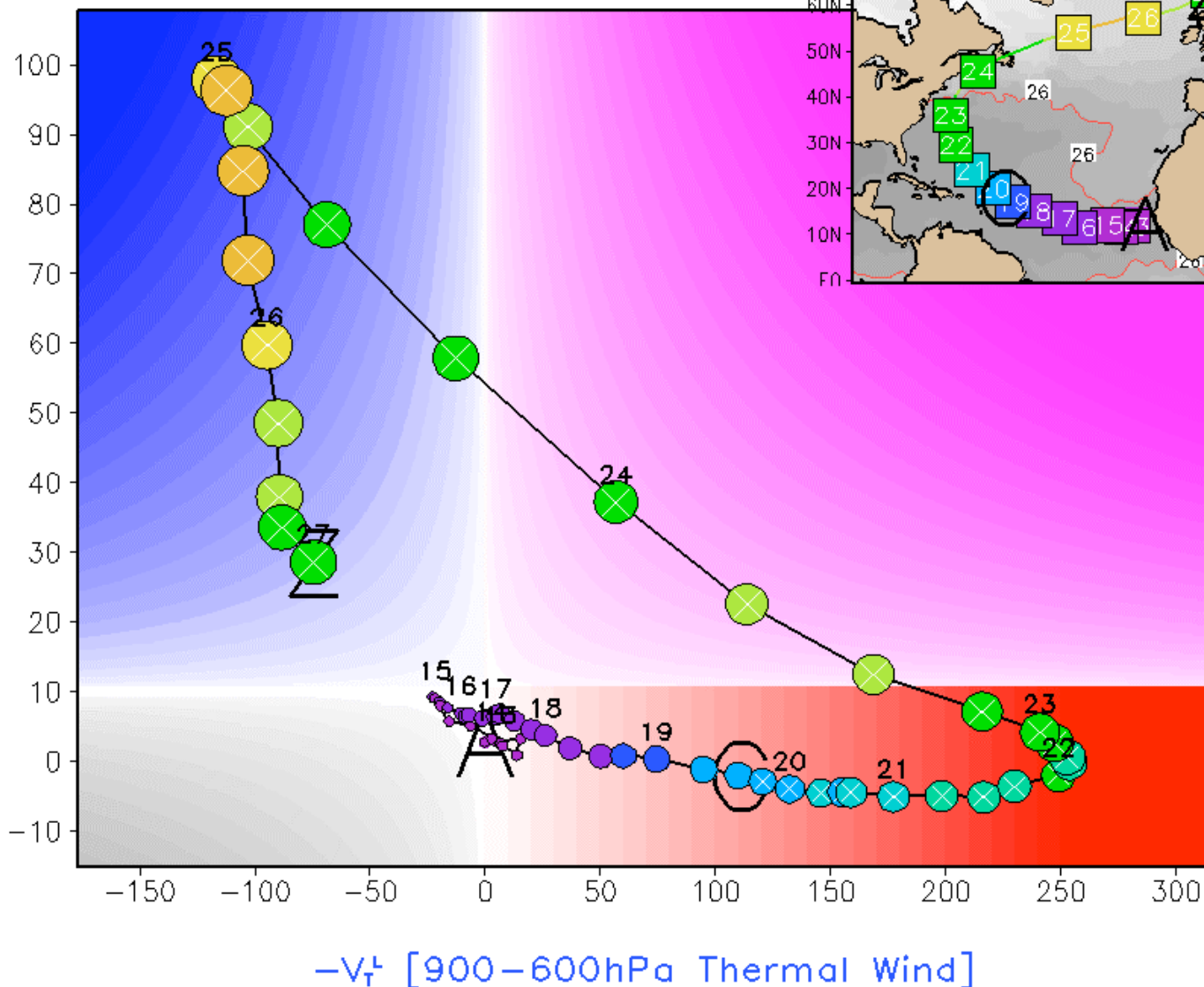


Cyclone Phase Space for Bill

0.5° NCEP GFS (12Z19AUG2009 run) Cyclone #3 (Existing cyclone)

Start (A): 06Z12AUG2009 (Wed) (-174h)
 Current (C): 12Z19AUG2009 (Wed) (0h)
 End (Z): 00Z27AUG2009 (Thu) (+180h)

B [900-600hPa Storm-Relative Thickness Symmetry]



Marker Style:

- Analysis: ●
- Forecast: ⊗

Intensity (hPa):

- 1015 (black)
- 980 (green)
- 1010 (purple)
- 970 (yellow)
- 1000 (blue)
- 960 (orange)
- 990 (cyan)
- 950 (pink)

Mean radius of 925hPa gale force wind (km):

- <100 (smallest dot)
- 200
- 300
- 500
- 750 (largest dot)

NOTE: A 24hr running mean smoother is applied to the CPS trajectory.

5 Day Genesis Forecasts

Model	Ana	Bill	Claudette	Danny	Erika	Fred
CMC	Miss	Miss	Miss	Hit (+0 hr)	Hit (+66 hr)	Miss
ECMWF	Miss	Miss	Miss	Miss	Miss	Miss
GFS	Miss	Hit (+54 hr)	Miss	Miss	Miss	Hit (+6 hr)
NOGAPS	Miss	Miss	Miss	Miss	Miss	Miss
UKMET	Miss	Miss	Miss	Miss	Miss	Miss

Verification Lead-Time Analysis for Disturbances that became Tropical Cyclones

Atlantic

Time wrt/Genesis	-48 h	-42 h	-36 h	-30 h	-24 h	-18 h	-12 h	-6 h
Avg. %	31%	31%	34%	37%	41%	45%	53%	61%

Eastern North Pacific

Time wrt/Genesis	-48 h	-42 h	-36 h	-30 h	-24 h	-18 h	-12 h	-6 h
Avg. %	29%	30%	28%	30%	31%	35%	42%	52%