

# **TPC'S 2007 REVIEW OF THE NCEP PRODUCTION SUITE**

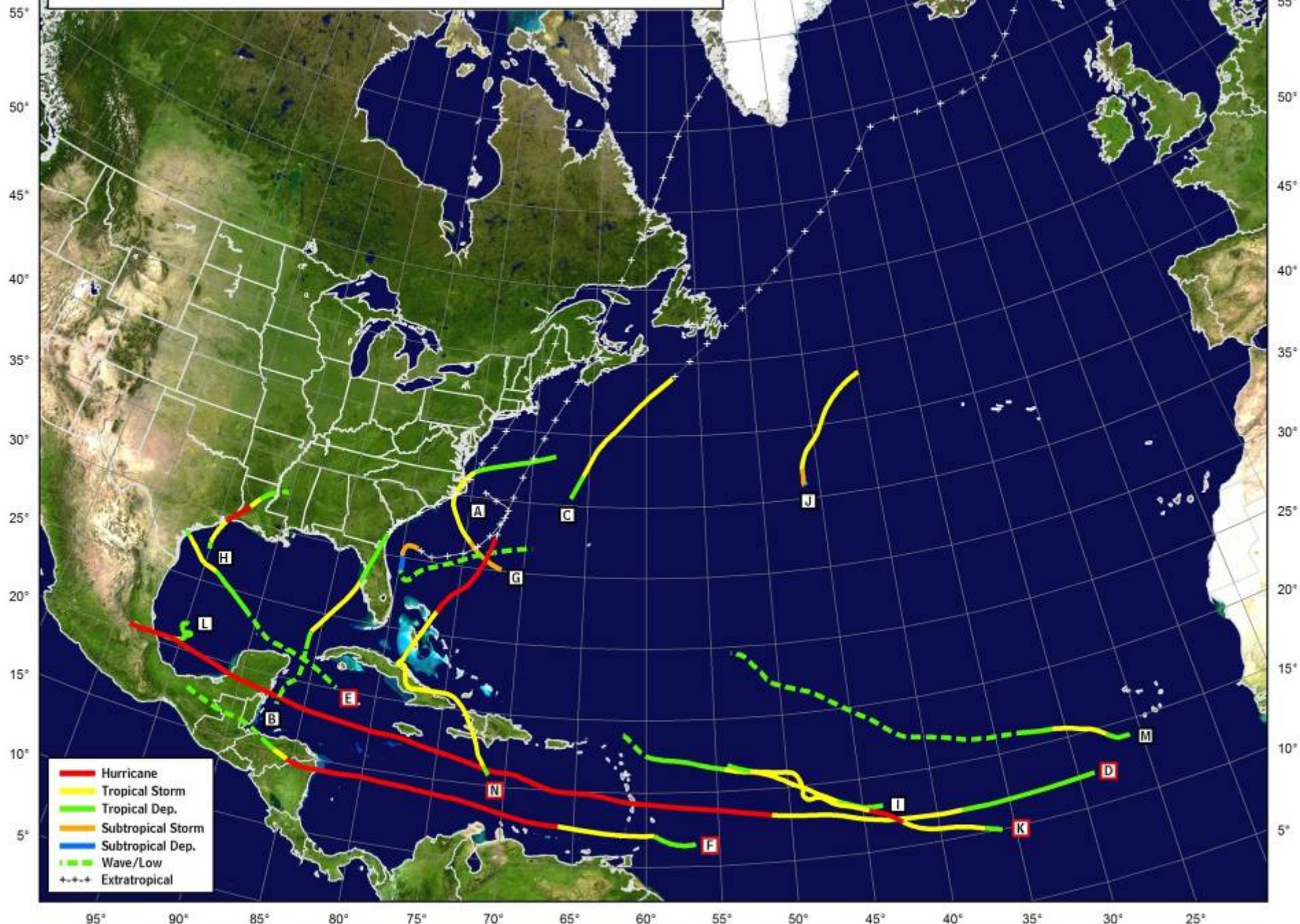
**RICHARD J. PASCH  
SENIOR HURRICANE SPECIALIST  
TROPICAL PREDICTION CENTER/  
NATIONAL HURRICANE CENTER  
12 DECEMBER 2007**



# OUTLINE

- **2007 SEASON OVERVIEW**
- **VERIFICATION – SUMMARY OF MODEL AND OFFICIAL FORECAST PERFORMANCE**
- **FORECAST ISSUES DURING 2007**
- **OUR 2008 “WISH LIST”**

# North Atlantic Tropical Storms and Hurricanes of 2007



# 2007 ATLANTIC HURRICANE SEASON STATISTICS

(\*operational estimates)

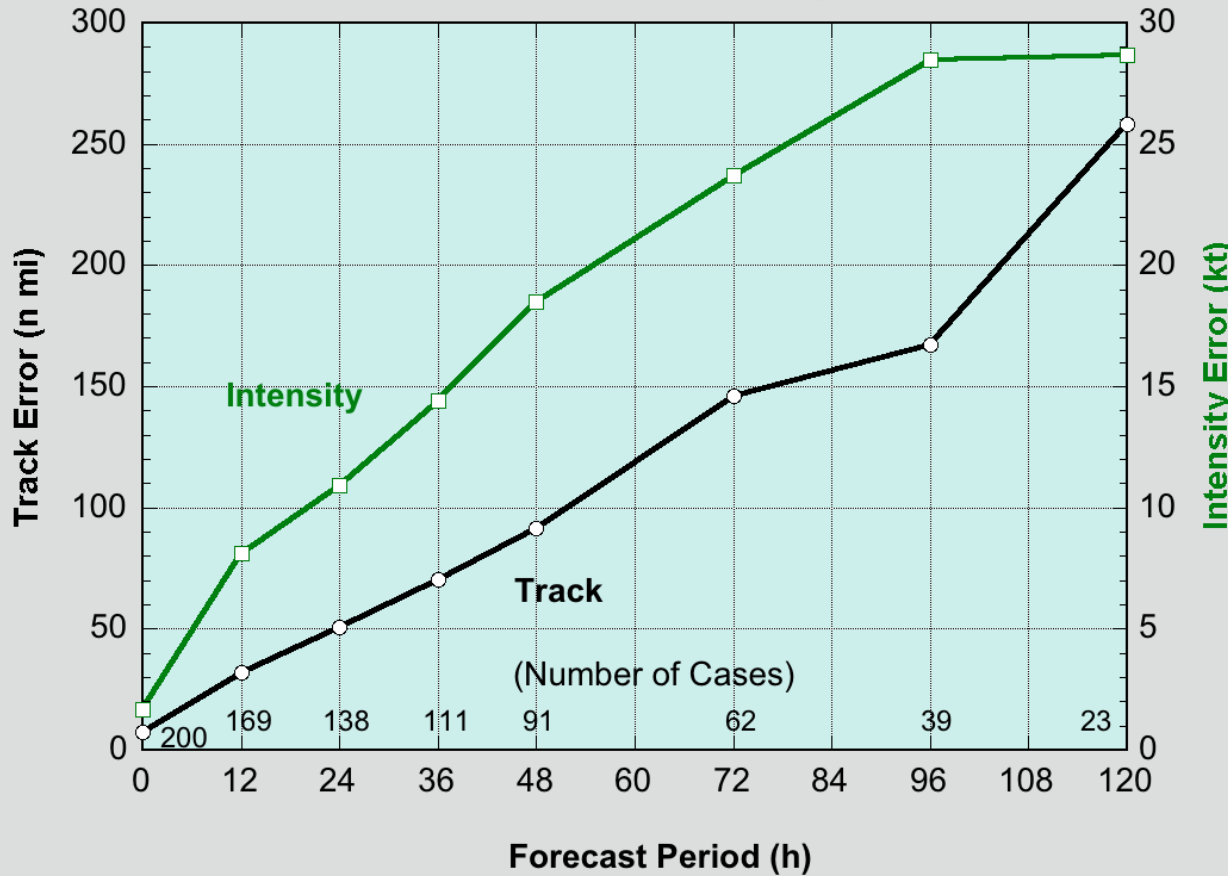
NAME	DATES	MIN PRESS (MB)	MAX. WINDS (MPH)	DIRECT DEATHS	U.S. DAMAGE (\$ million)
STS ANDREA	9-11 MAY	1001	60	0	0
TS BARRY	1-2 JUN	997	60	0	minor
TS CHANTAL	31 JUL-1 AUG	994	50	0	0
H DEAN*	13-23 AUG	906	165 (5)	40	0
TS ERIN*	15-19 AUG	1003	40	9	?
H FELIX*	31 AUG-5 SEP	929	165 (5)	130	0
TS GABRIELLE	8-11 SEP	1004	60	0	minor
H HUMBERTO	12-14 SEP	985	90 (1)	1	50
TS INGRID	12-17 SEP	1002	45	0	0
TS JERRY	23-24 SEP	1003	40	0	0
H KAREN	25-29 SEP	990	75 (1)	0	0
H LORENZO	25-28 SEP	990	80 (1)	6	0
TS MELISSA	28-30 SEP	1005	40	0	0
H NOEL*	28 OCT – 2 NOV	980	80 (1)	147	0
TS OLGA*	11- DEC	1003	60		

# Operational Highlights

- ~206 TC forecasts issued for Atlantic basin, compared to 246 in 2006 and around 600 in 2005
- HWRF introduced into operations – it was stable, reliable, and produced credible forecasts. Bravo, EMC, for 5 years of hard work culminating in the operational implementation of this next-generation hurricane model! Also, kudos to NCO for getting the HWRF into the Production Suite!
- Implementation of GSI and Hybrid Coordinates into GFS – coincided with mostly outstanding performance by that model over the tropical Atlantic during 2007
- Began in-house testing of TC genesis probabilities and a graphical Tropical Weather Outlook

# Preliminary 2007 Atlantic Verification

**NHC Official Forecasts  
2007 - Atlantic Basin**



VT (h)	NT	TRACK (n mi)	INT (kt)
000	200	7.5	1.7
012	169	32.1	8.1
024	138	50.6	10.9
036	111	70.2	14.4
048	91	91.6	18.5
072	62	145.9	23.7
096	39	167.1	28.5
120	23	258.2	28.7

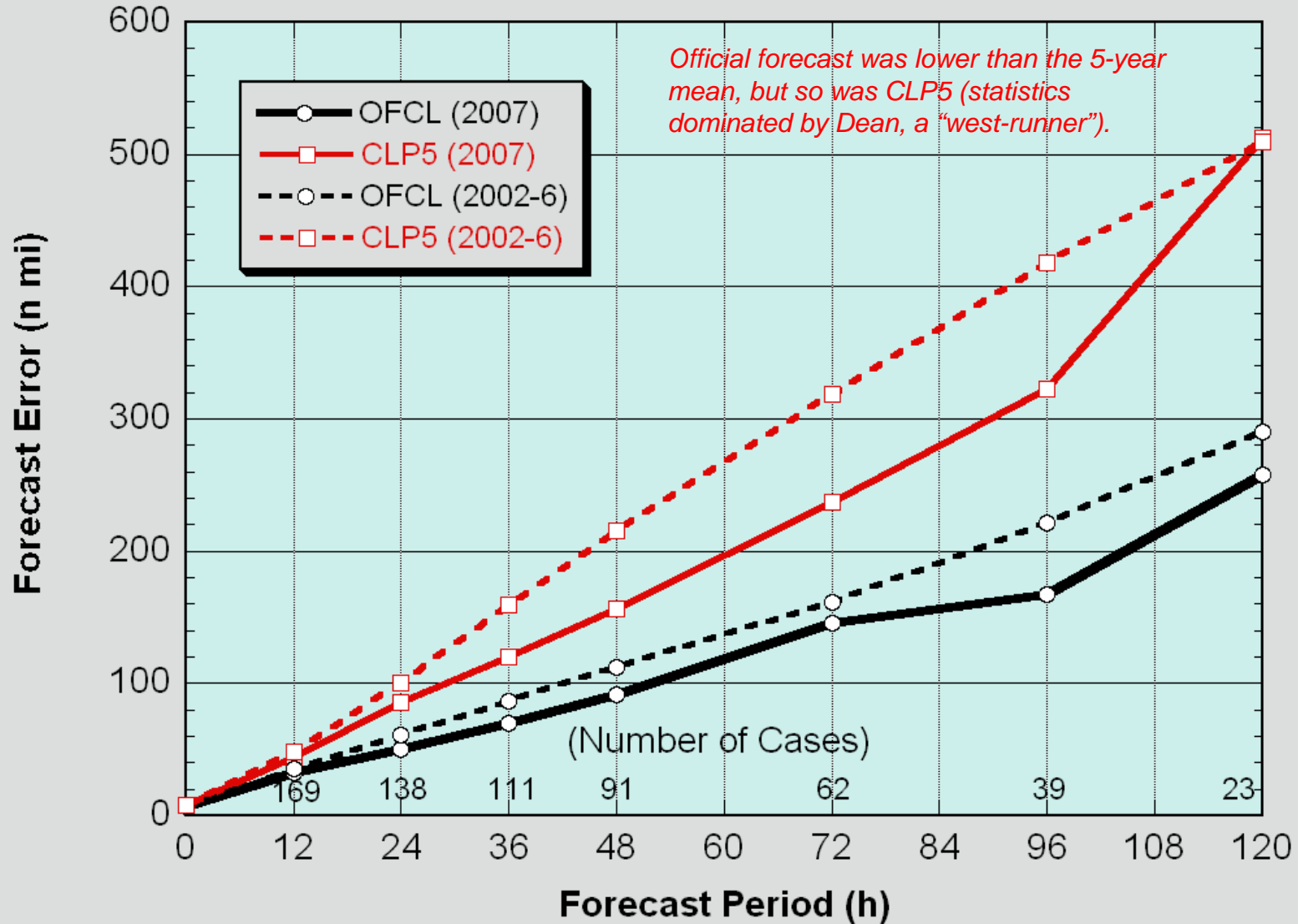
Values in green meet or exceed all-time records.

48 h track error for TS and H only was 86.4 n mi, a record.

Small number of cases, esp. at 120 h where only Dean and Noel (mostly Dean) had any 5-day forecasts

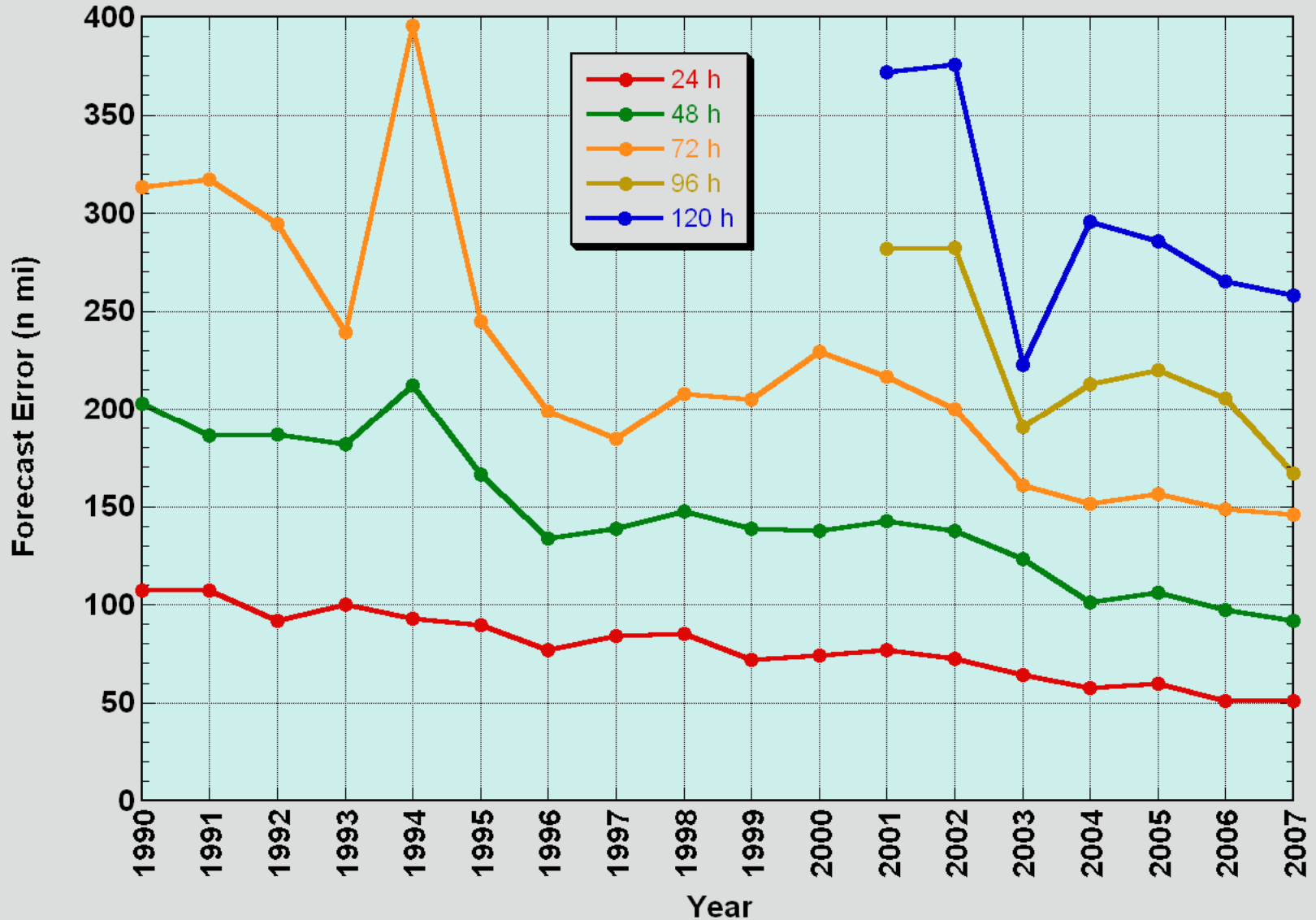
# Track: 2007 vs. 5-Year Mean

## NHC Official vs. CLP5 Track Forecasts Atlantic Basin



# Errors Continue Downward Trend - Cut in half since 1990

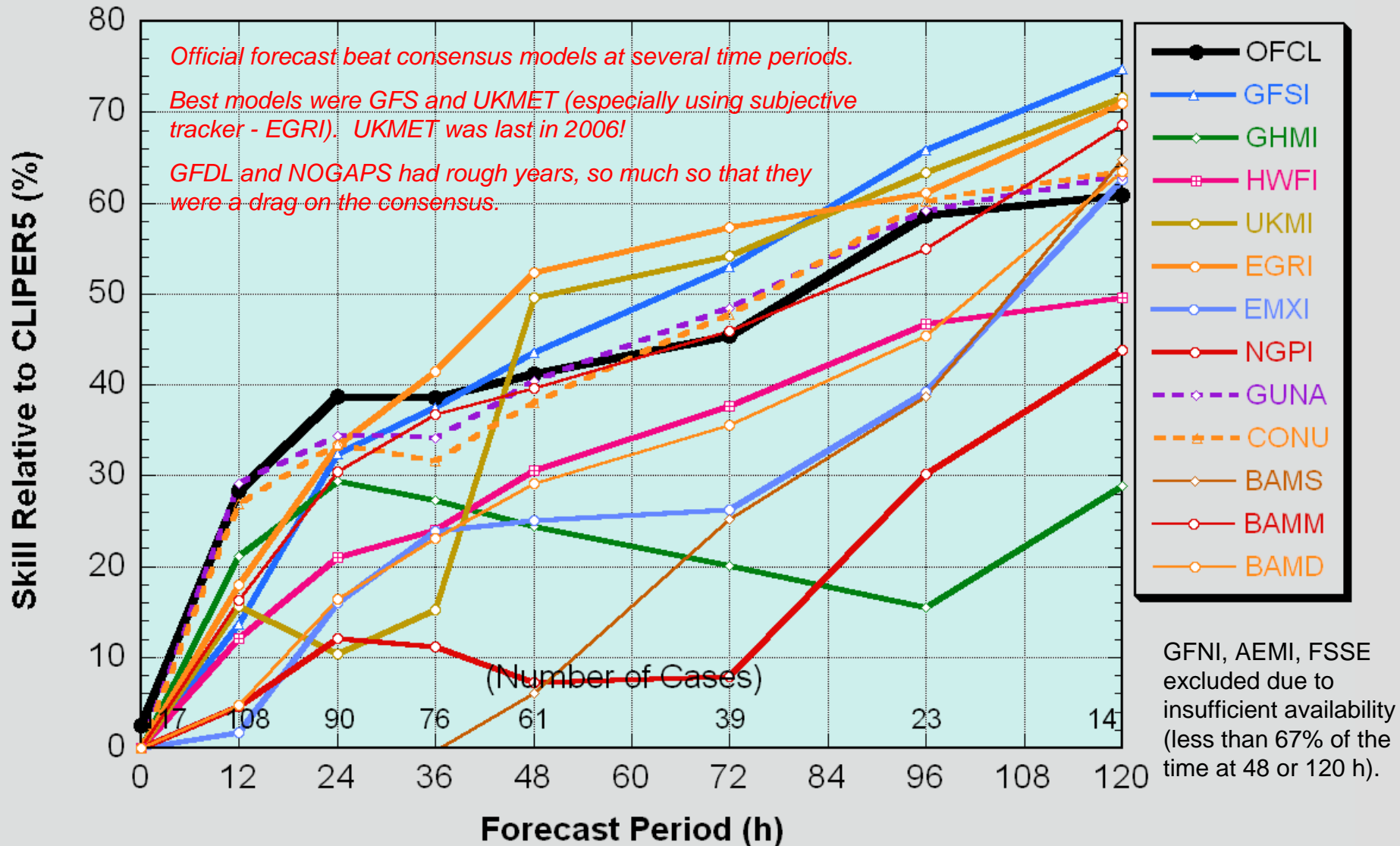
NHC Official Track Error Trend  
Atlantic Basin





# 2007 Track Guidance

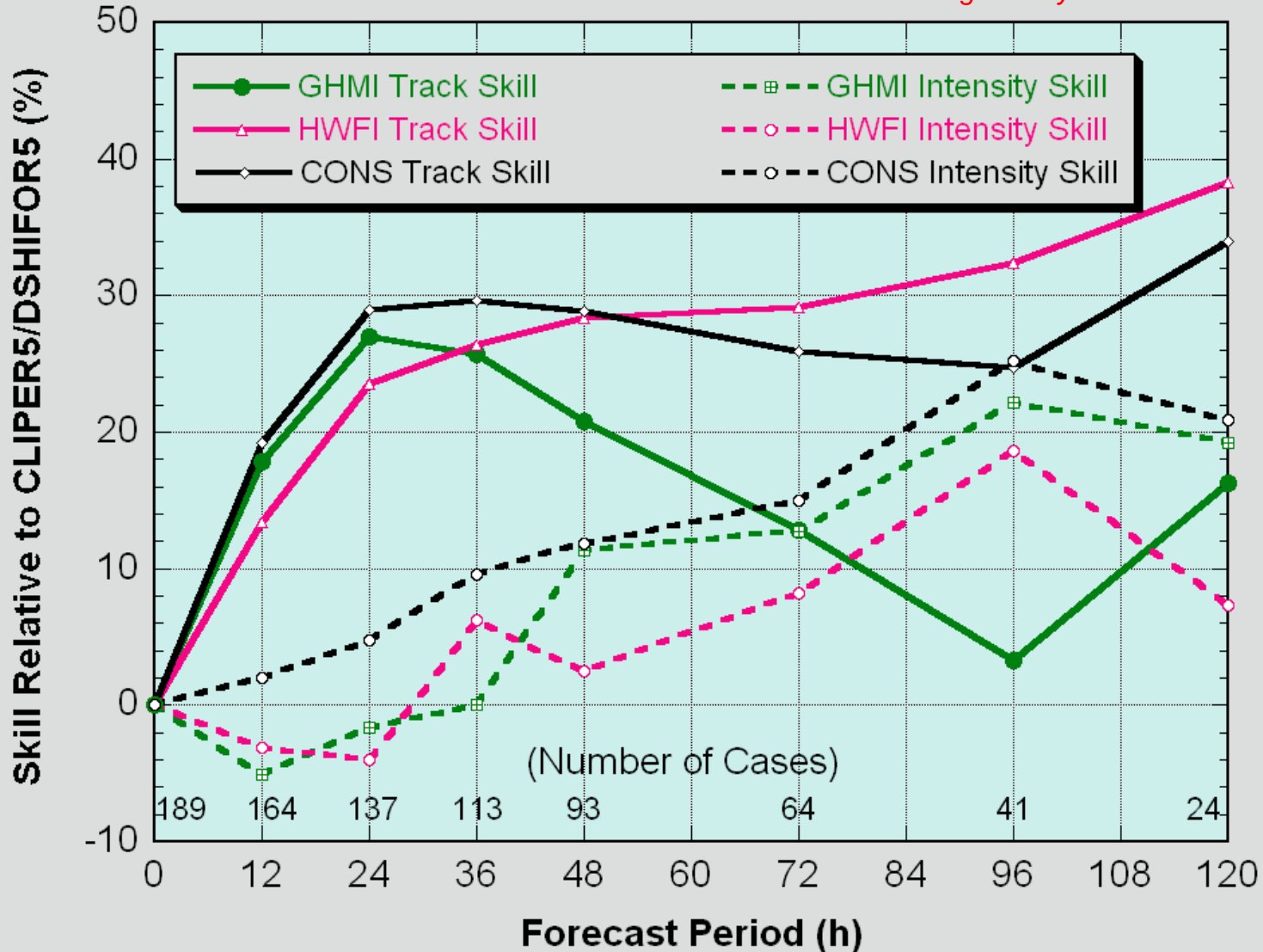
## Track Forecast Skill (Early Models) 2007 - Atlantic Basin



# GFDL and HWRF Provide Independent Information

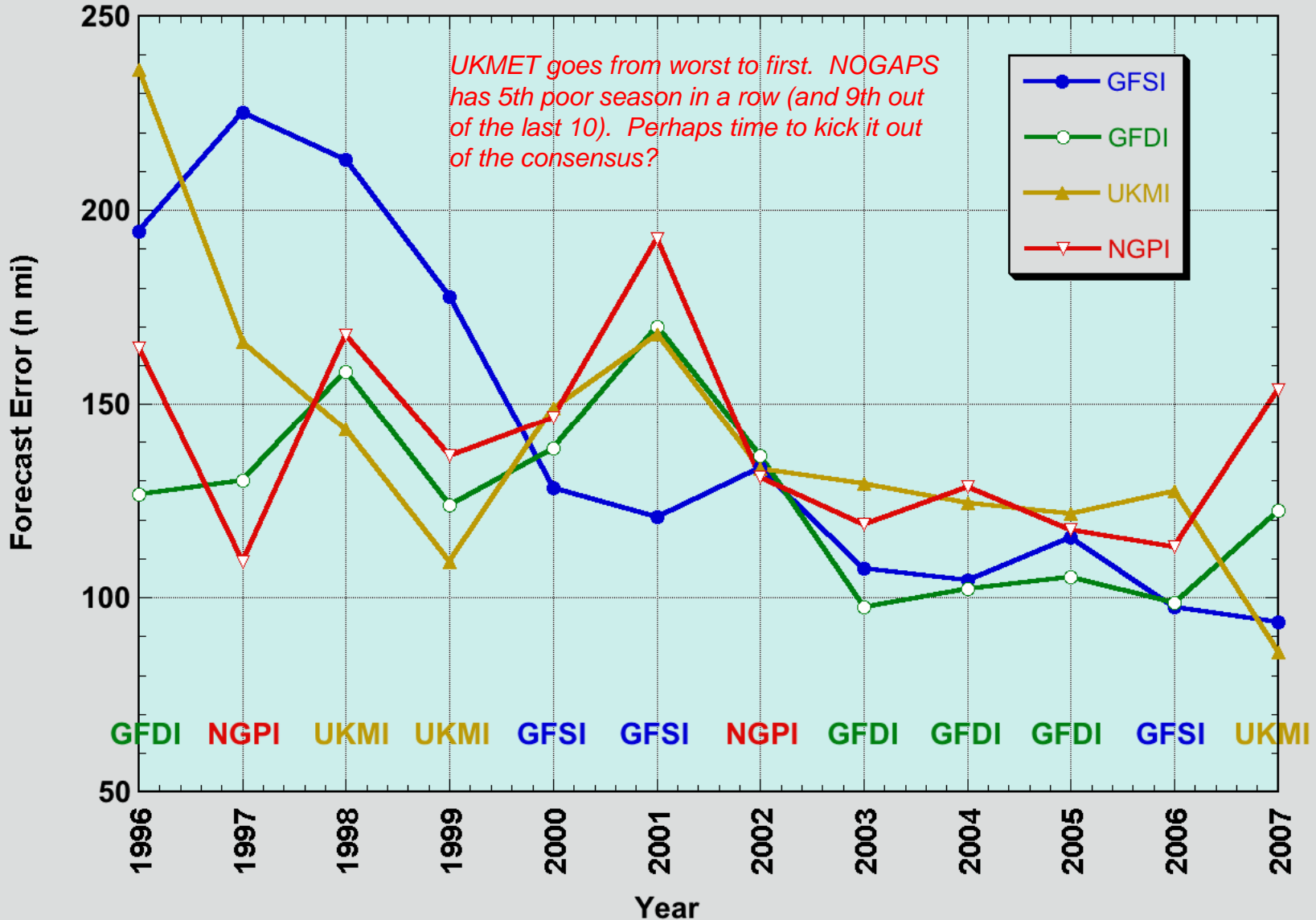
## GFDL vs HWRF 2007 - Atlantic Basin

*Good first year for the HWRF; competitive for intensity, better than GFDL for track (mainly Dean). Consensus of the two generally better than either alone.*



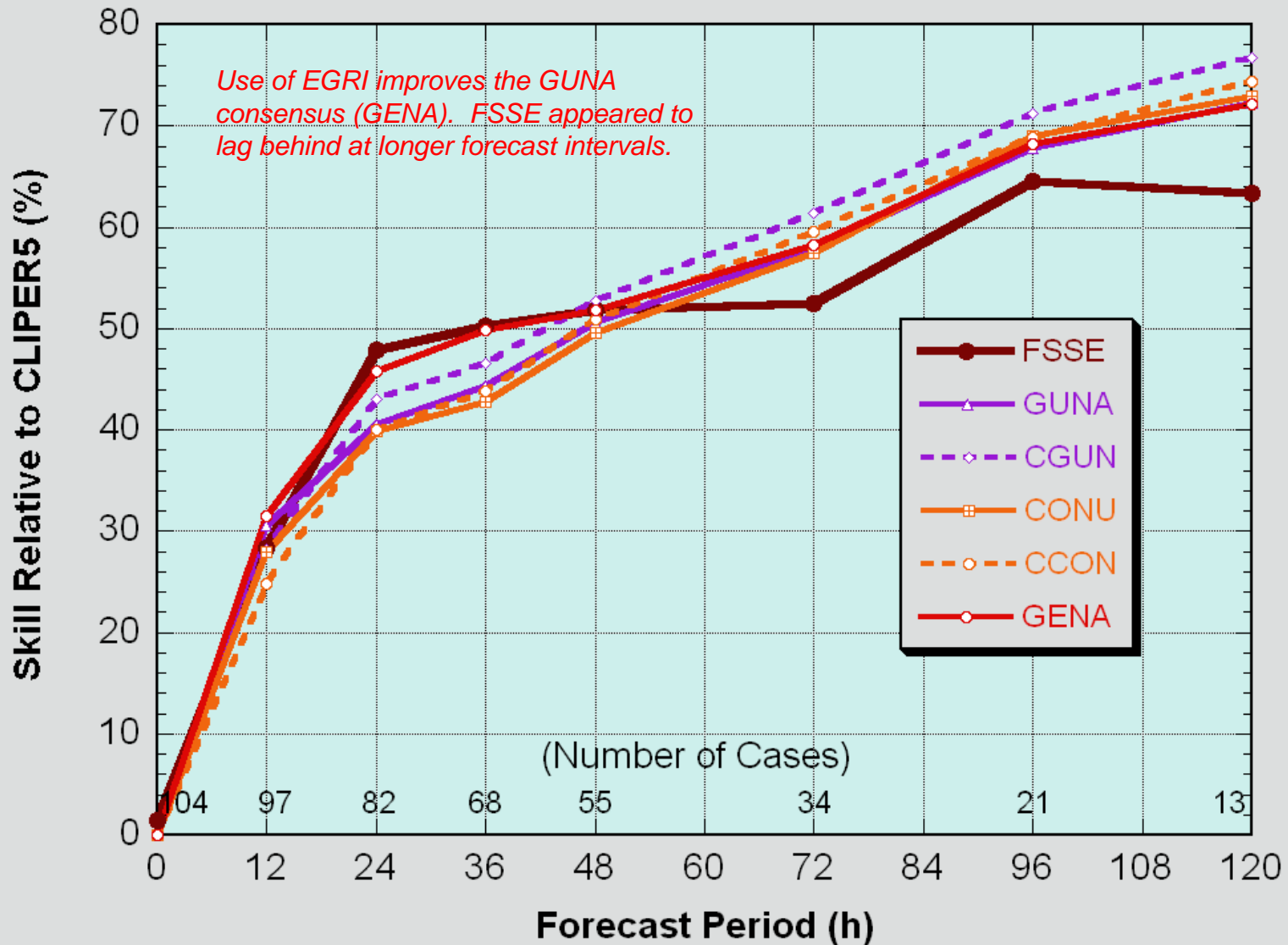
# Guidance Trends

## 48-h Track Forecast Guidance Trends Atlantic Basin



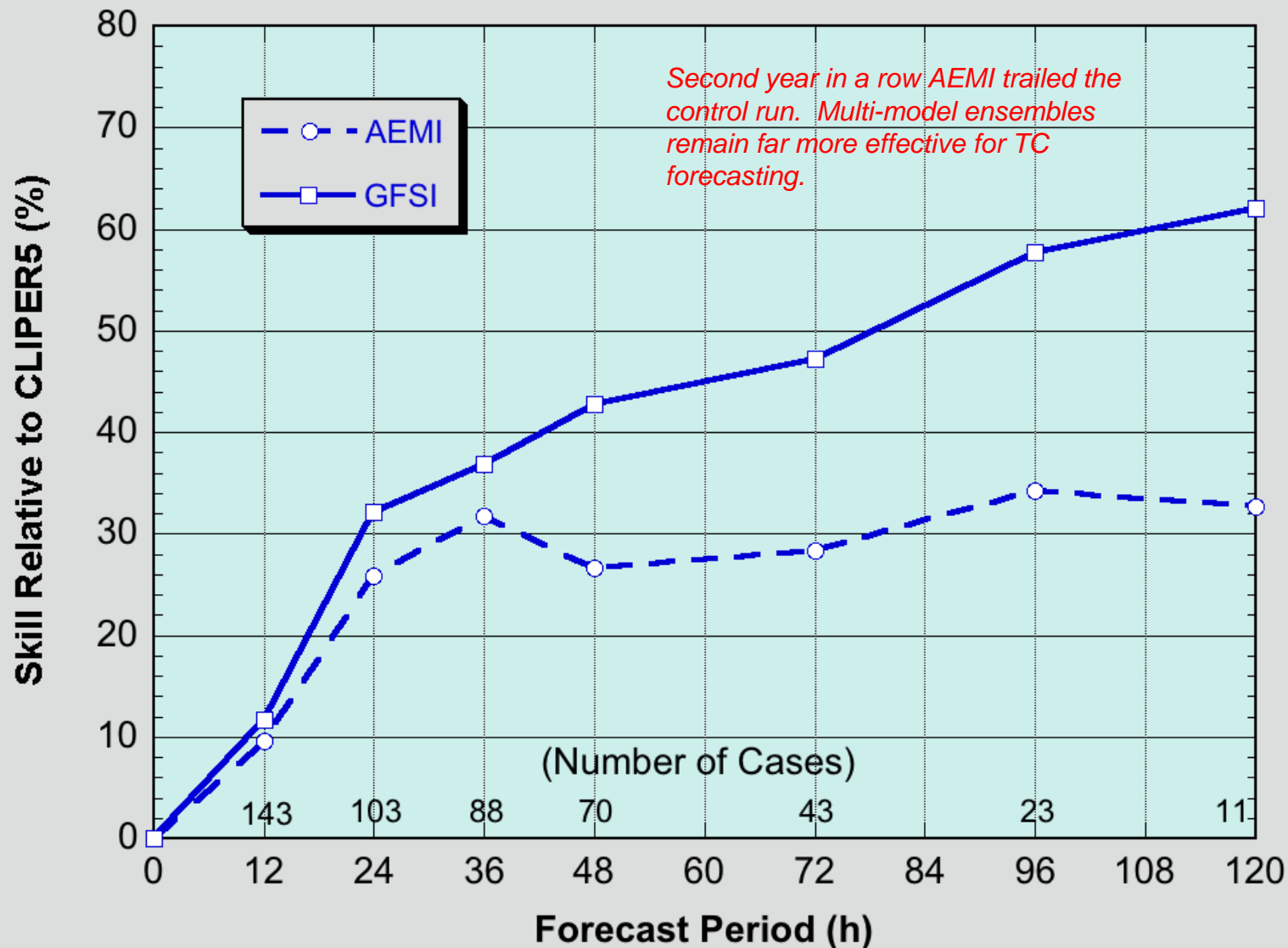
# Consensus Models

## Track Forecast Skill (Consensus Models) 2007 - Atlantic Basin



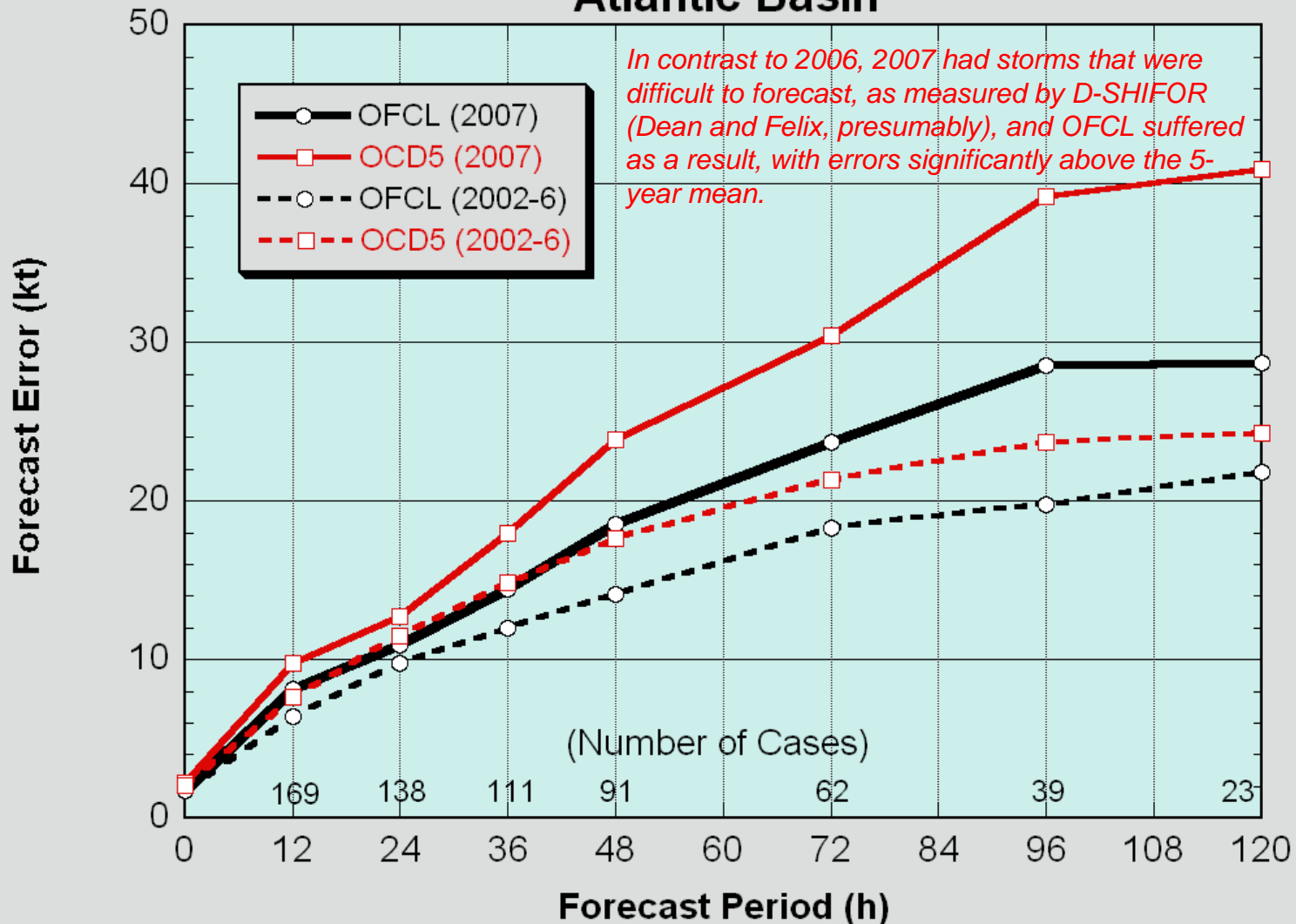
# Consensus Models

## GFS vs GFS Ensemble Mean Atlantic Basin - 2007



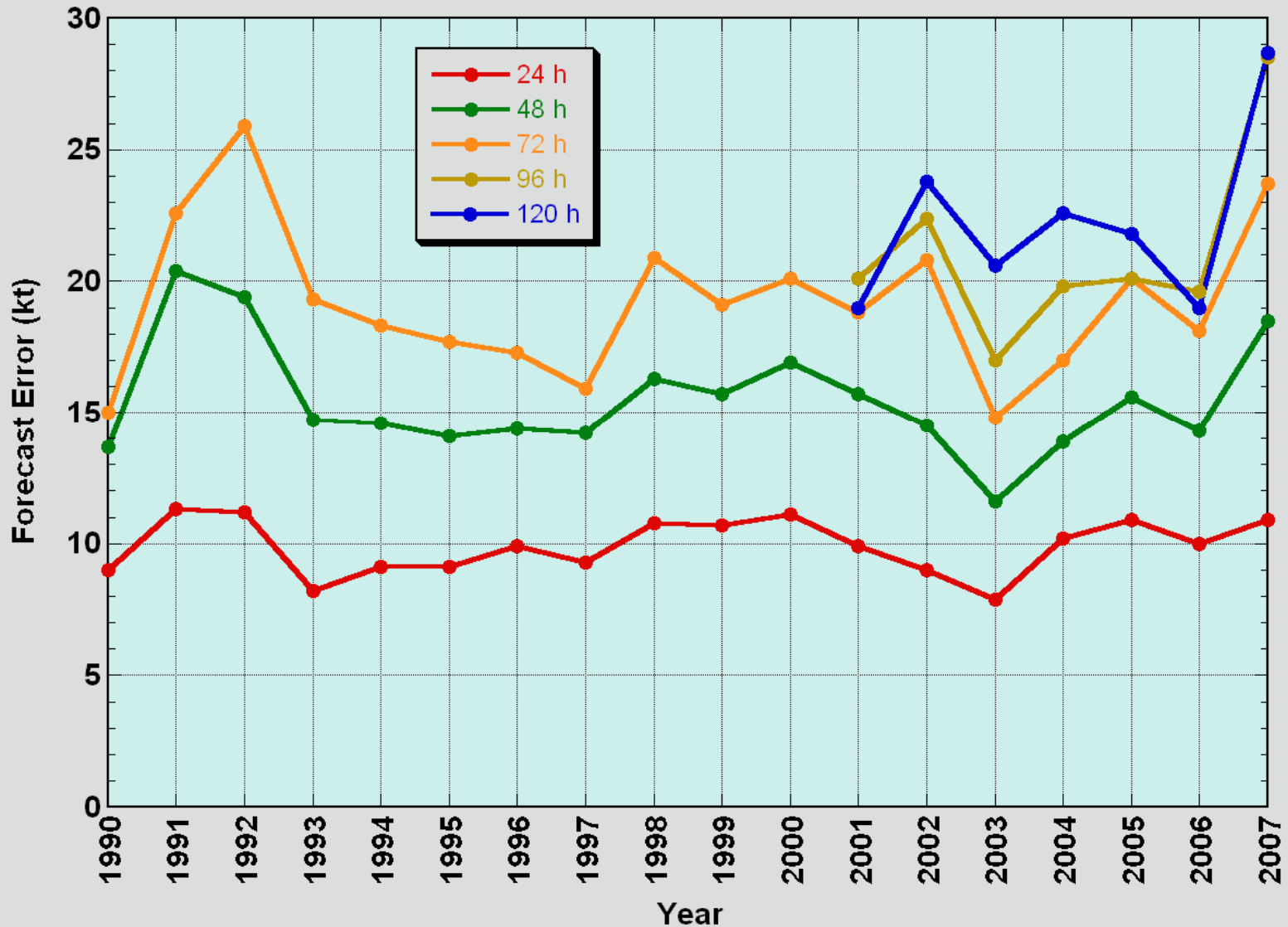
# Intensity: 2007 vs 5-Year Mean

## NHC Official vs. Decay-SHIFOR Intensity Forecasts Atlantic Basin



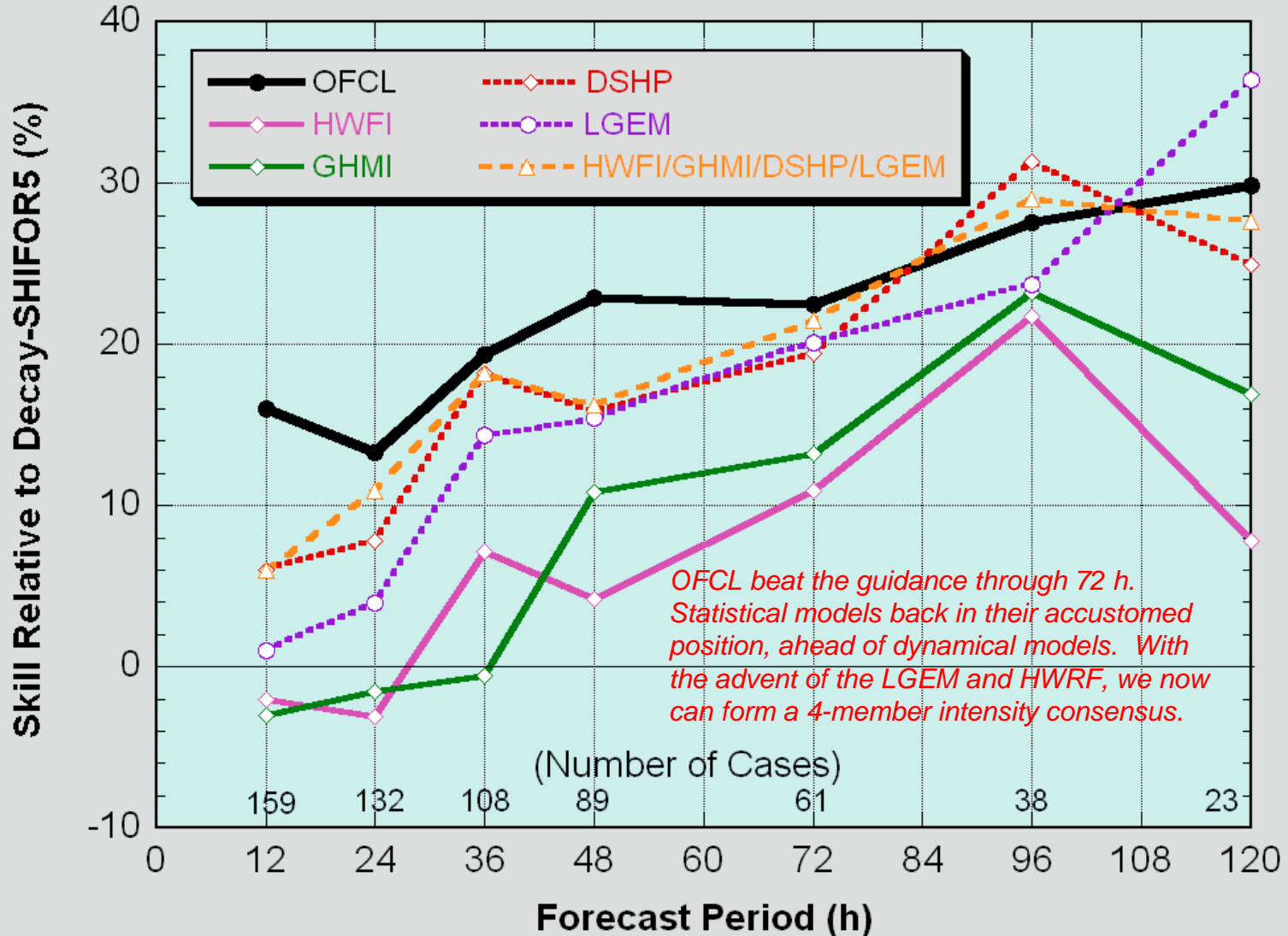
# No progress with intensity

NHC Official Intensity Error Trend  
Atlantic Basin



# Intensity Guidance

## Intensity Forecast Skill (Early Models) 2007 - Atlantic Basin

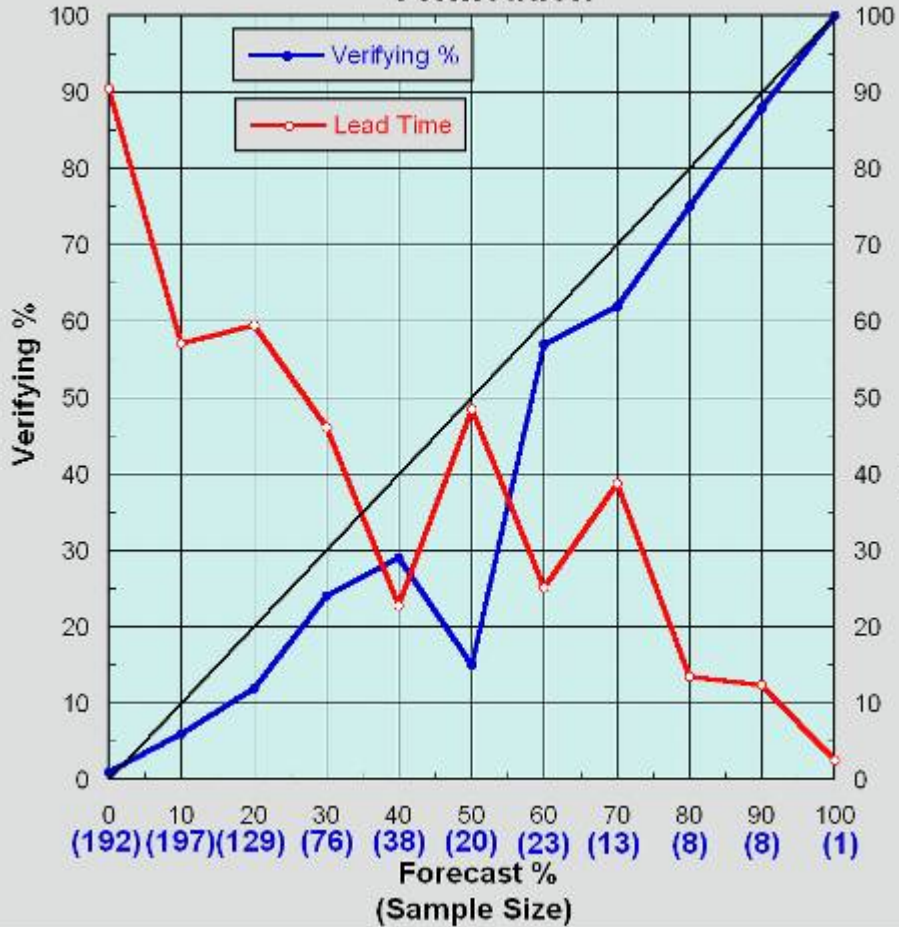




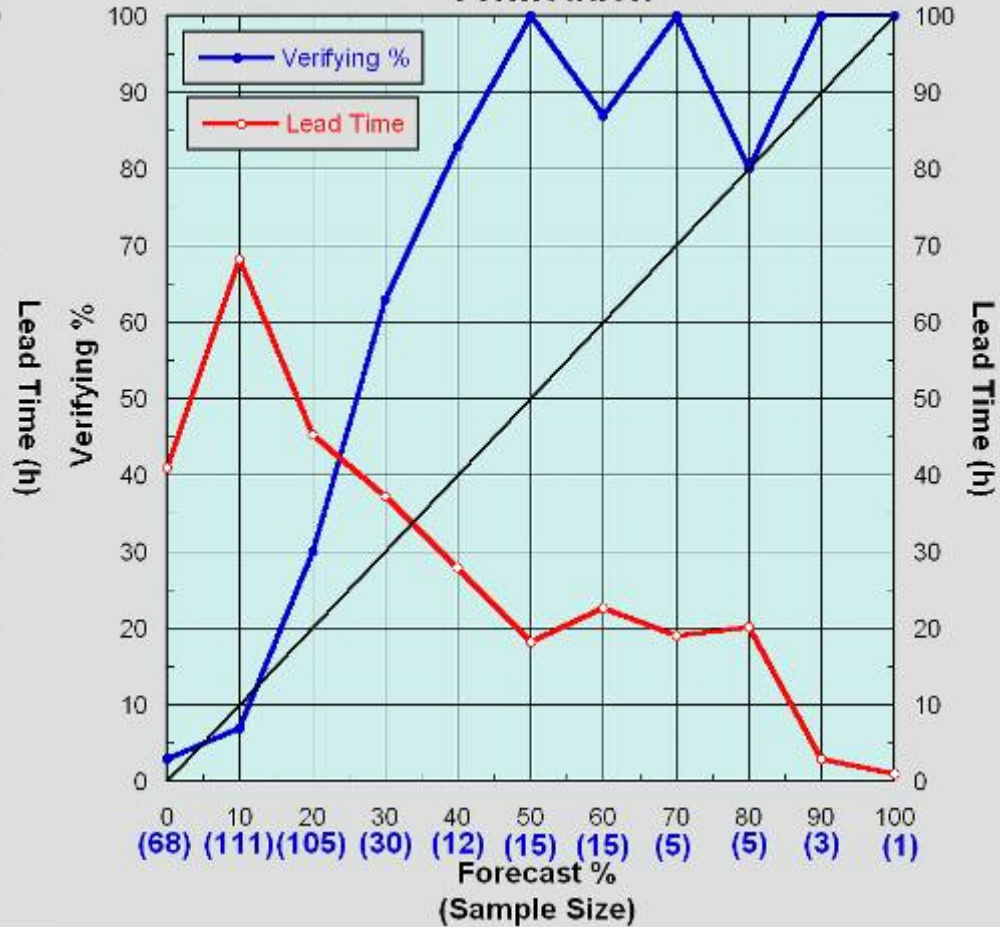
# Verification of 2007 Genesis Probabilities

(Through 19 November)

### Atlantic TWO Verification



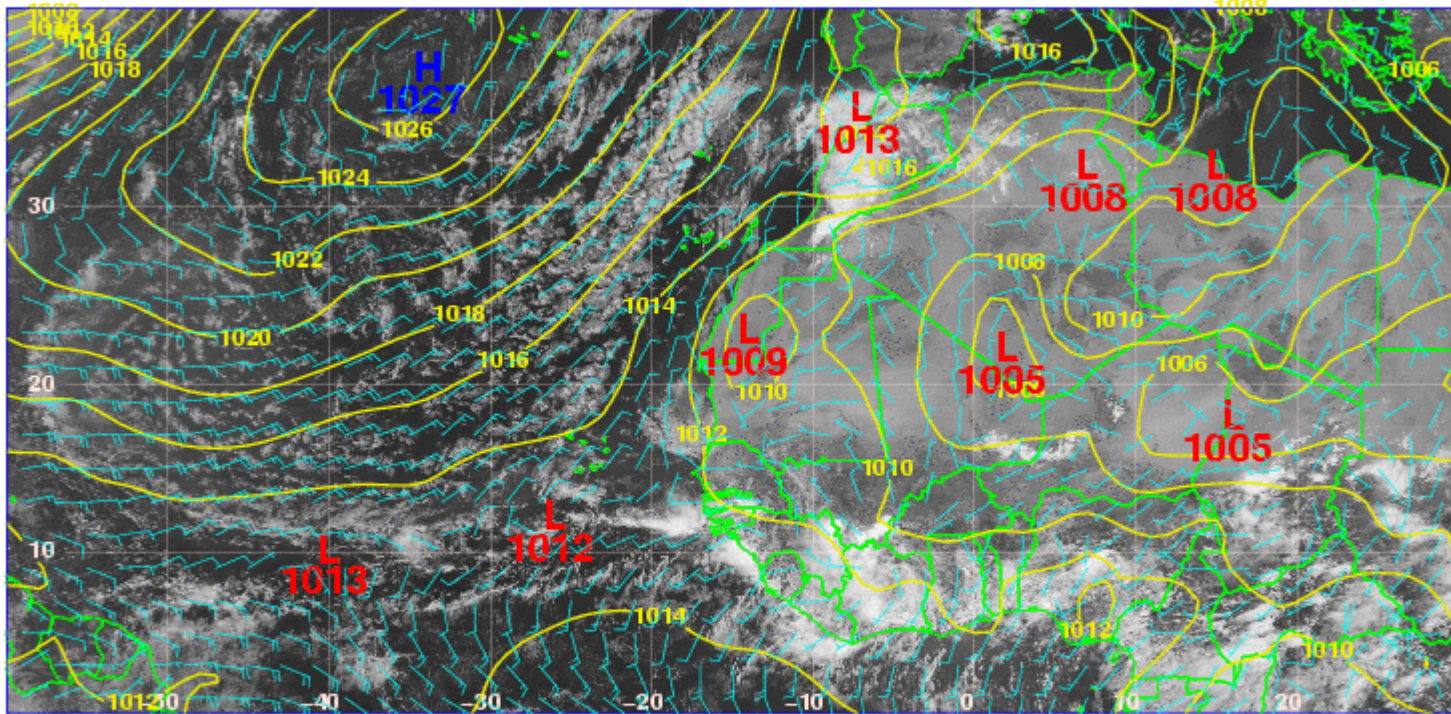
### East Pacific TWO Verification



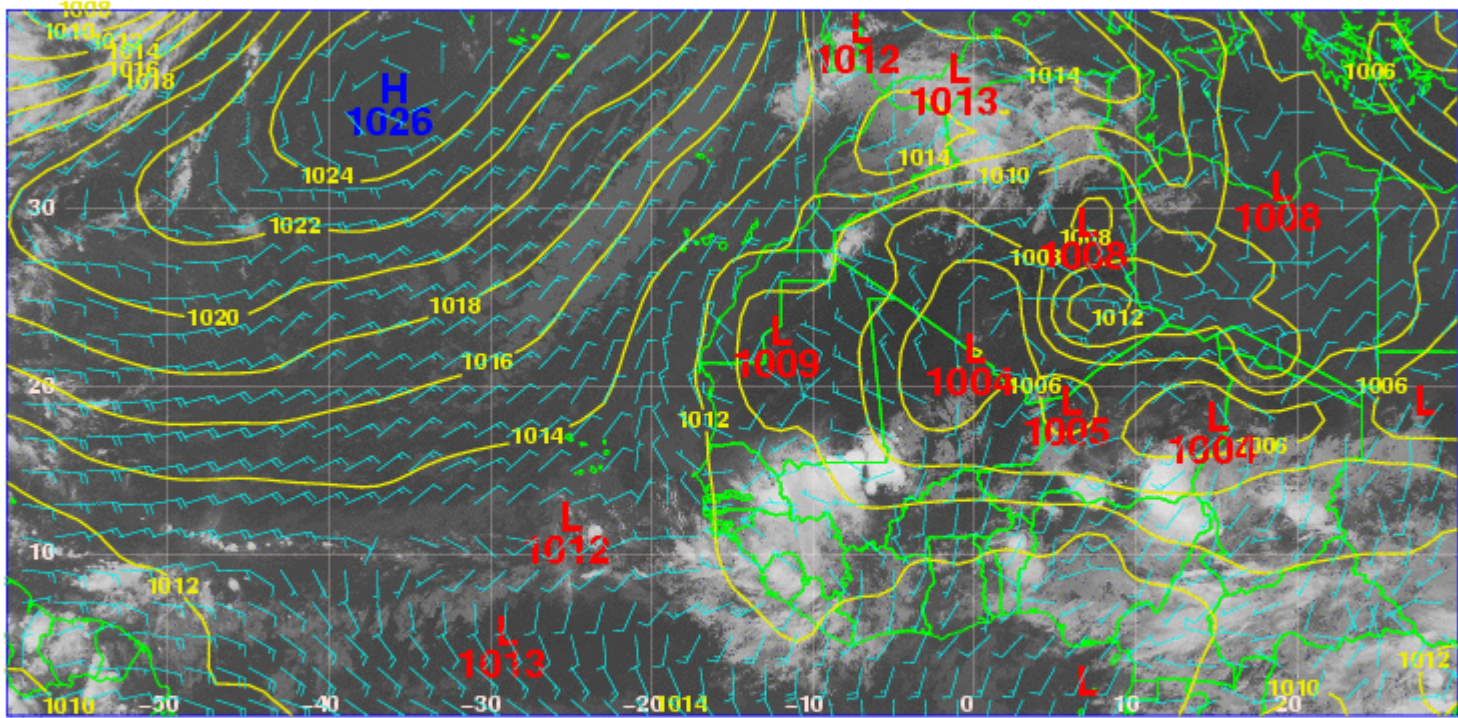
# **Some Operational Forecast Issues during 2007**

- **Global model forecasts of genesis of Dean and Felix**
- **Intensification of Dean and Felix**
- **Rapid development and intensification of Humberto close to the Texas coast, with track to the right of guidance**
- **GFDL vs. HWRF forecasts of the tracks of Dean and Felix**
- **Erratic track of Noel**
- **Henriette and Kiko in the eastern North Pacific**
- **TAFB issues**

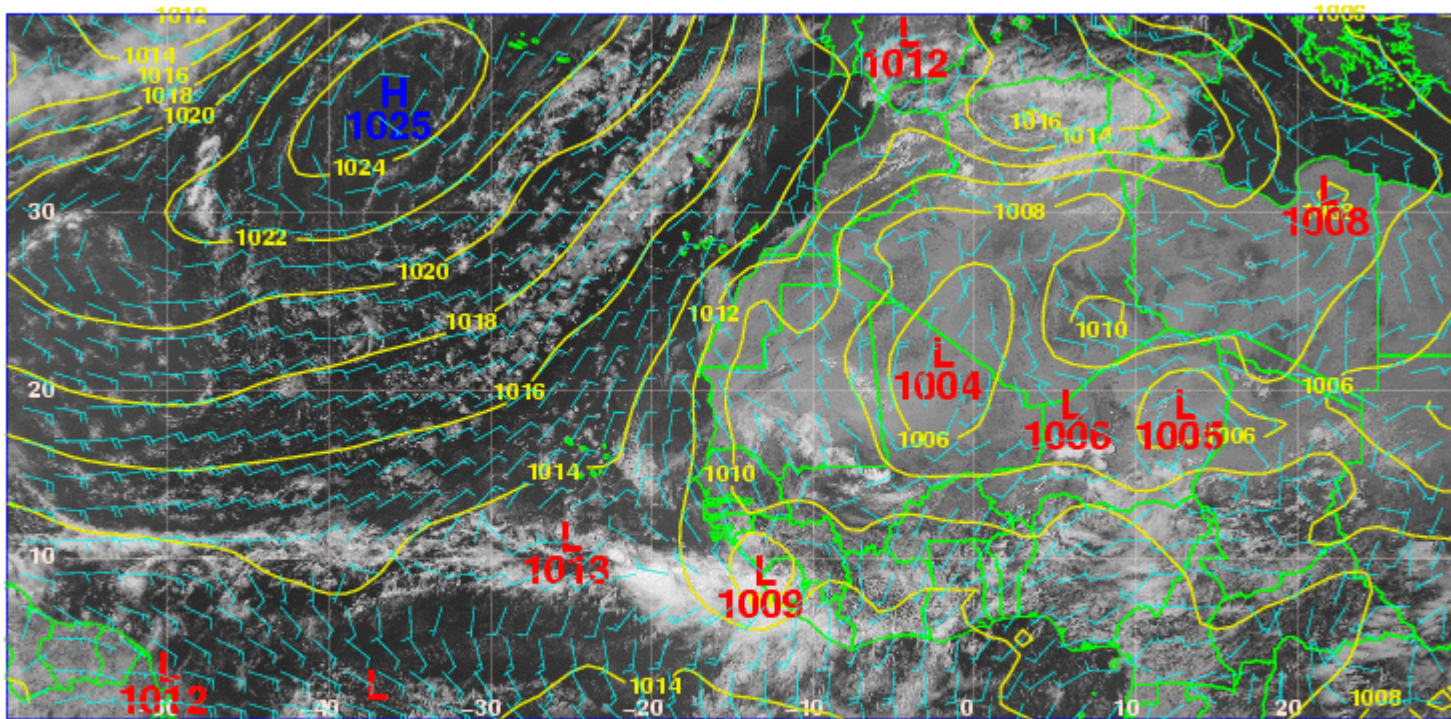
**GFS did a reasonably good job of predicting the genesis of Dean**



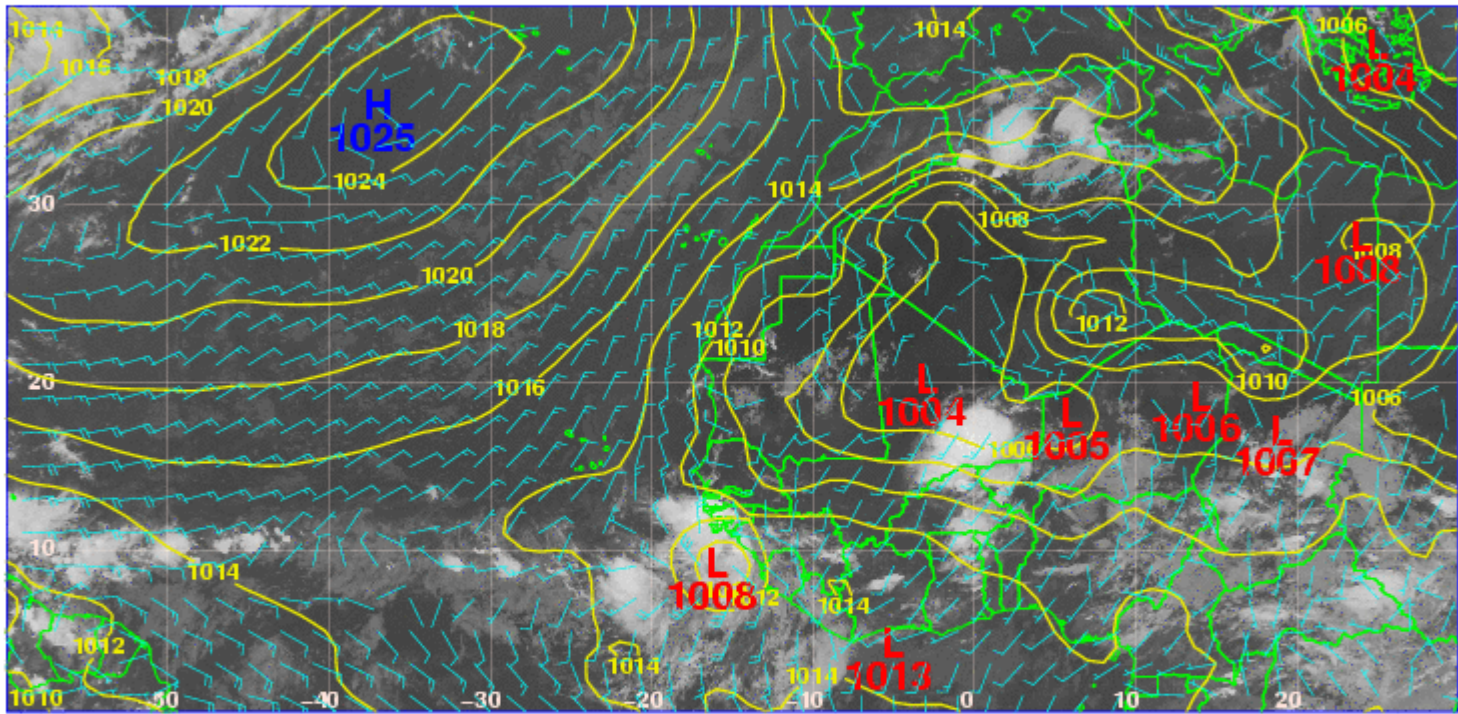
**GFS 070809/1200V000 PMSL AND BL WIND (KTS) FCST AND MET-9 070809 1200 UTC IMAGERY**



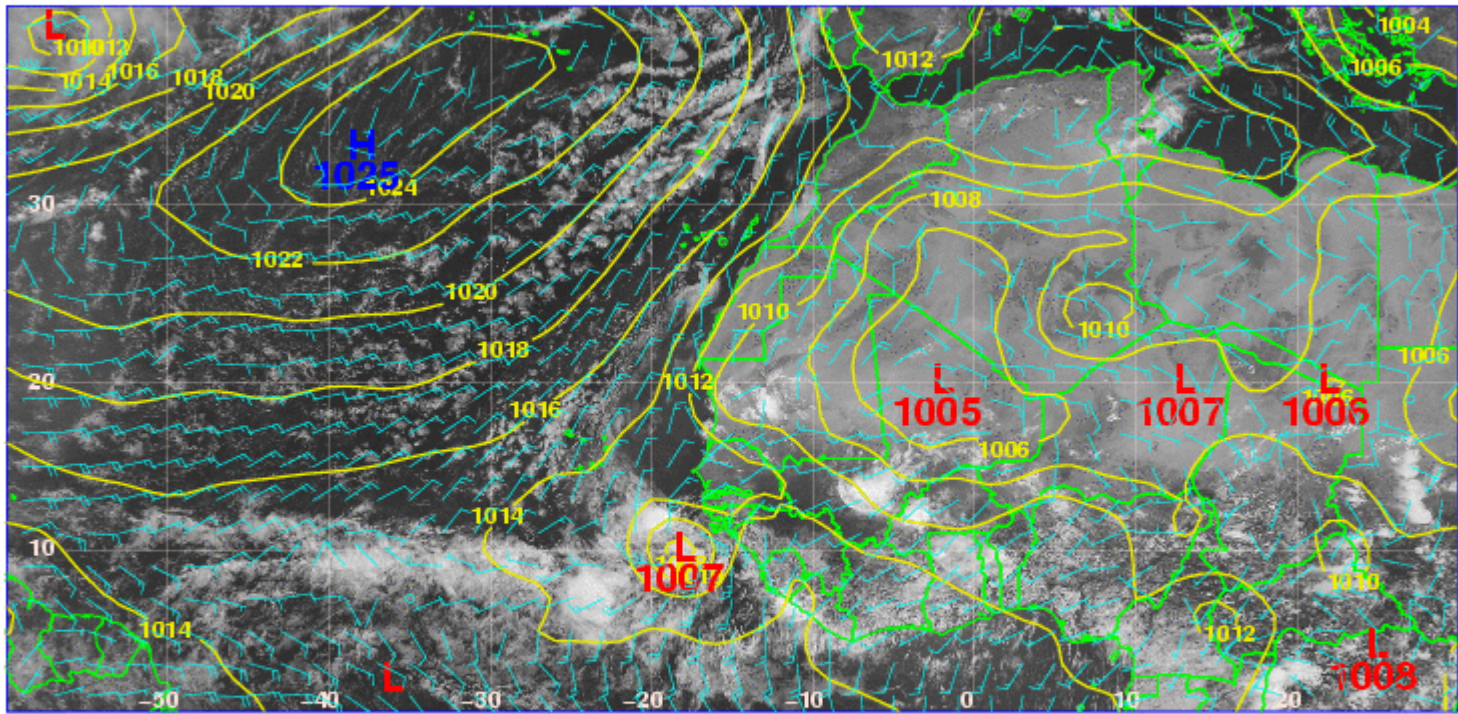
GFS 070810/0000V012 PMSL AND BL WIND (KTS) FCST AND MET-9 070810 0000 UTC IMAGERY



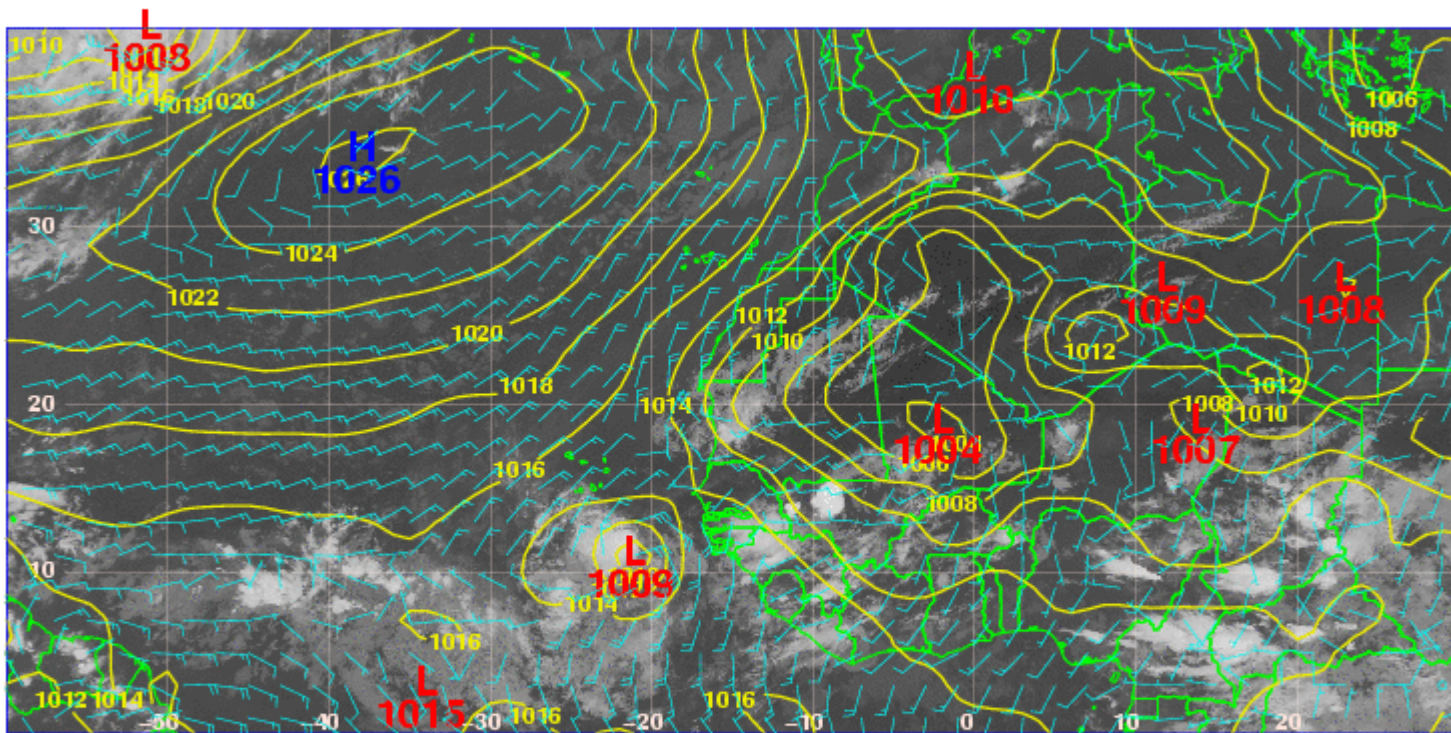
GFS 070810/1200V024 PMSL AND BL WIND (KTS) FCST AND MET-9 070810 1400 UTC IMAGERY



GFS 070811/0000V036 PMSL AND BL WIND (KTS) FCST AND MET-9 070811 0000 UTC IMAGERY

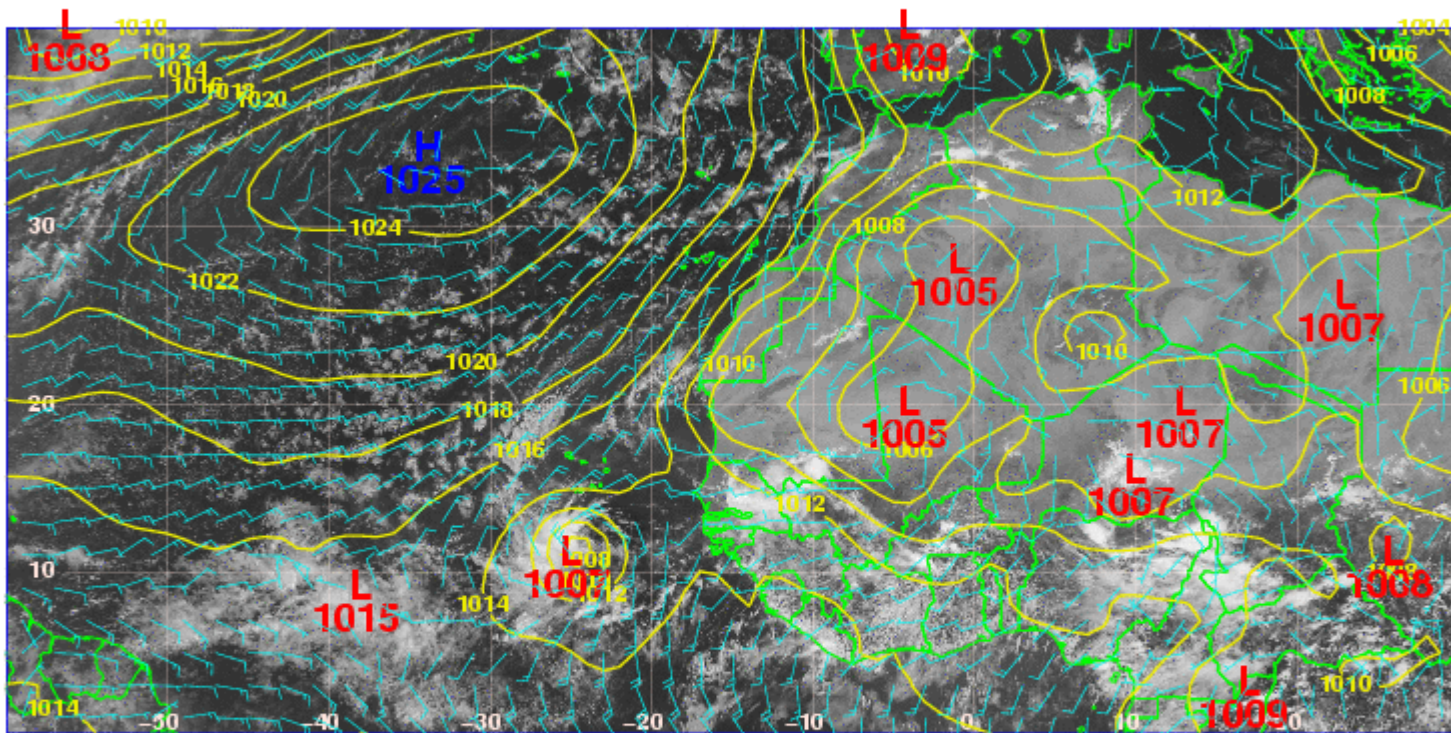


**GFS 070811/1200V048 PMSL AND BL WIND (KTS) FCST AND MET-9 070811 1200 UTC IMAGERY**

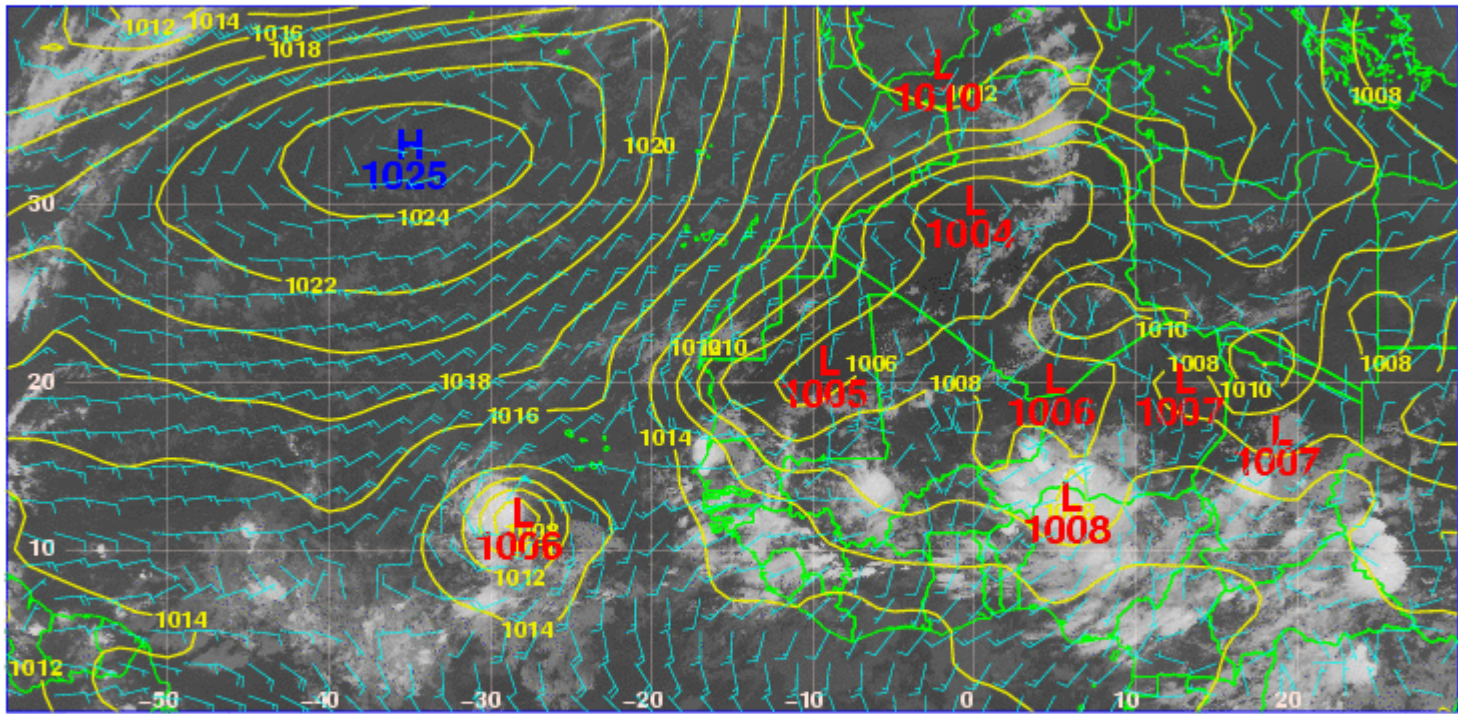


GFS 070812/0000V060 PMSL AND BL WIND (KTS) FCST AND MET-9 070812 0000 UTC IMAGERY

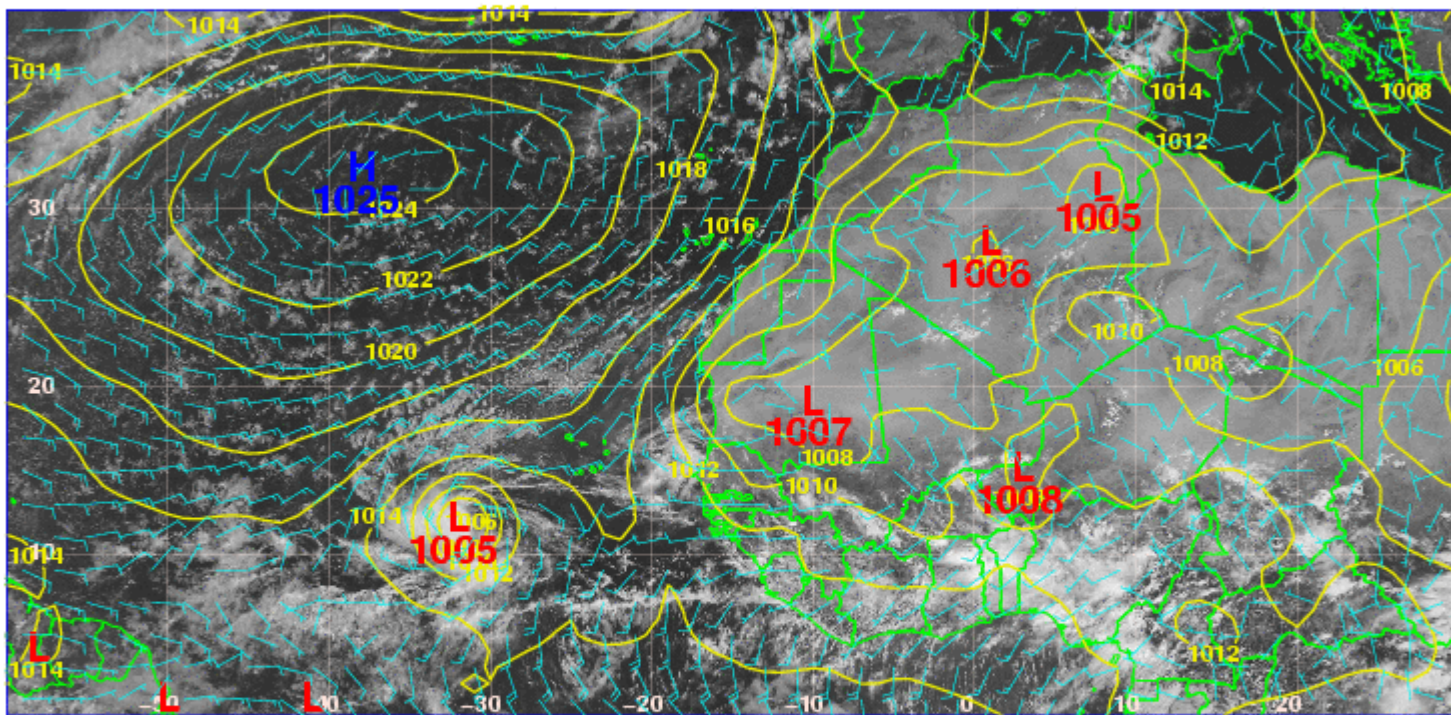




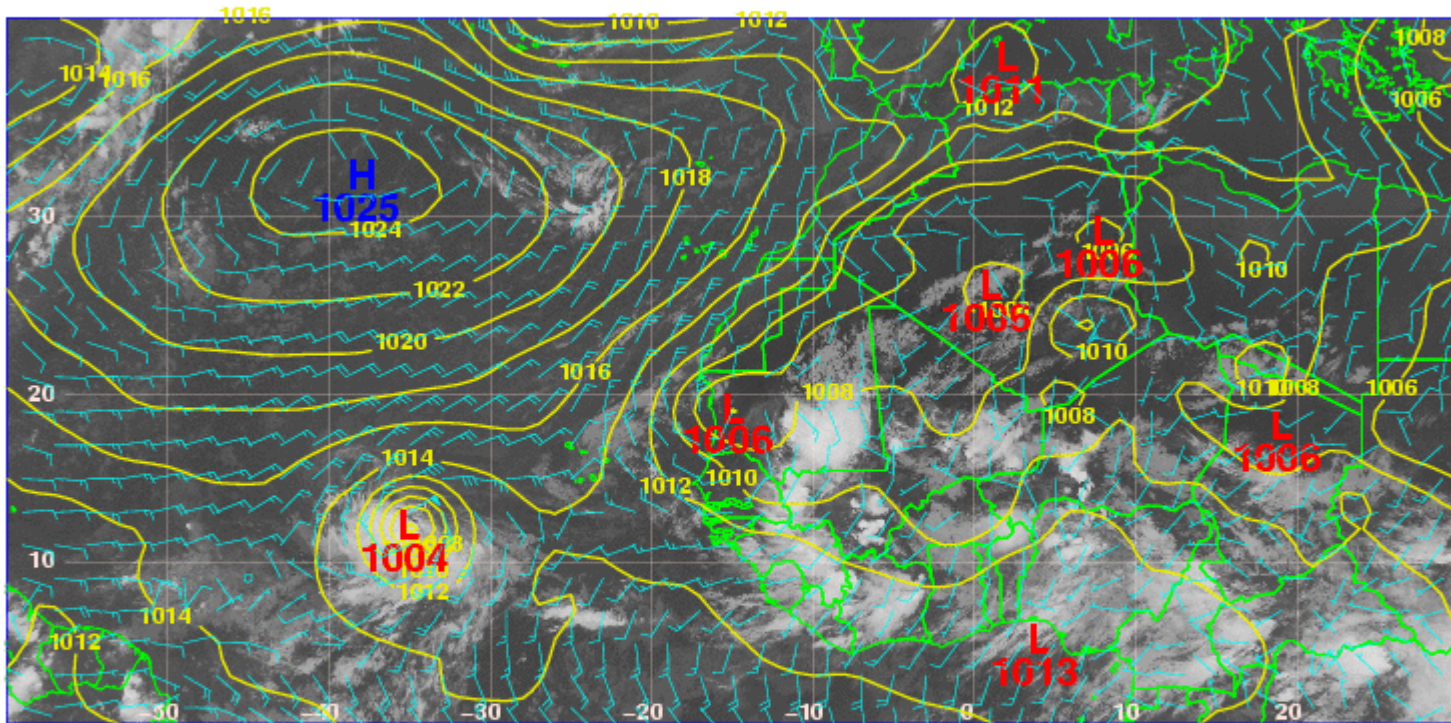
GFS 070812/1200V072 PMSL AND BL WIND (KTS) FCST AND MET-9 070812 1200 UTC IMAGERY



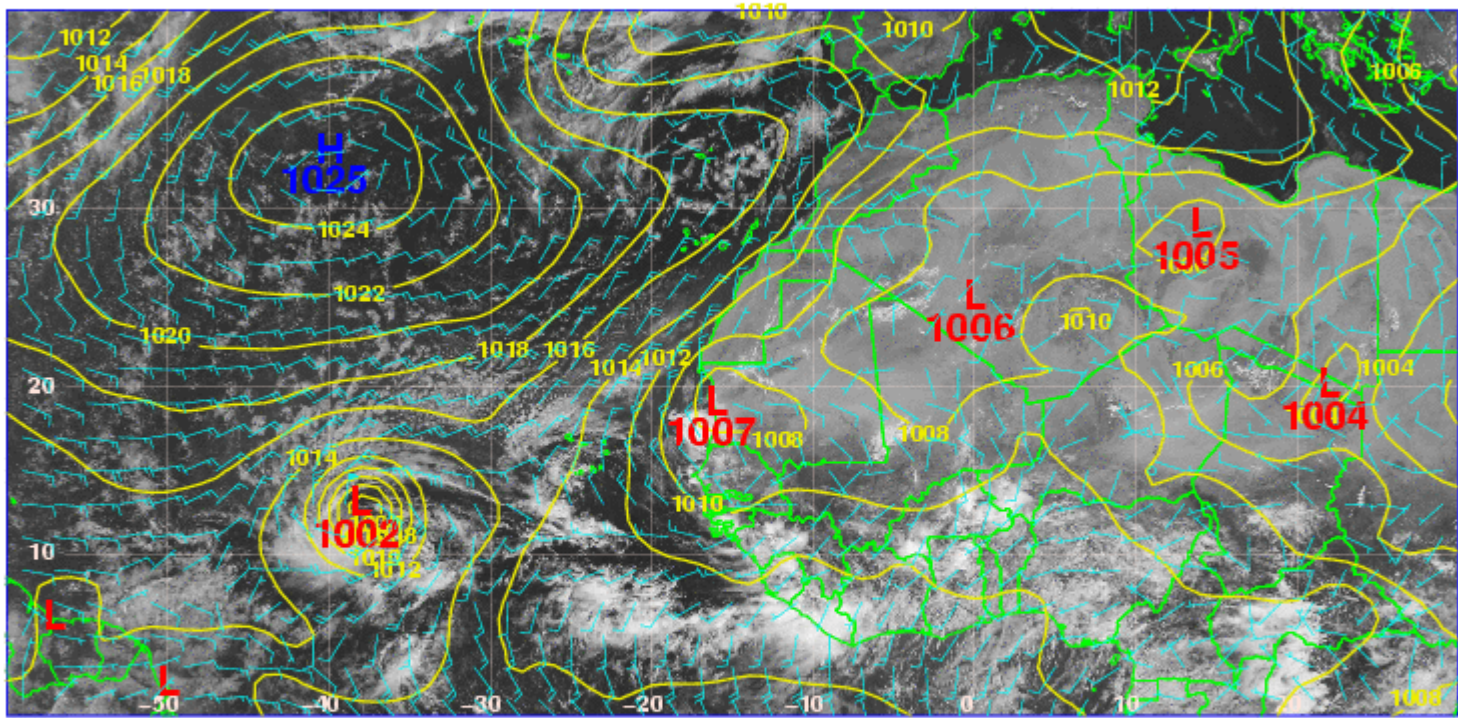
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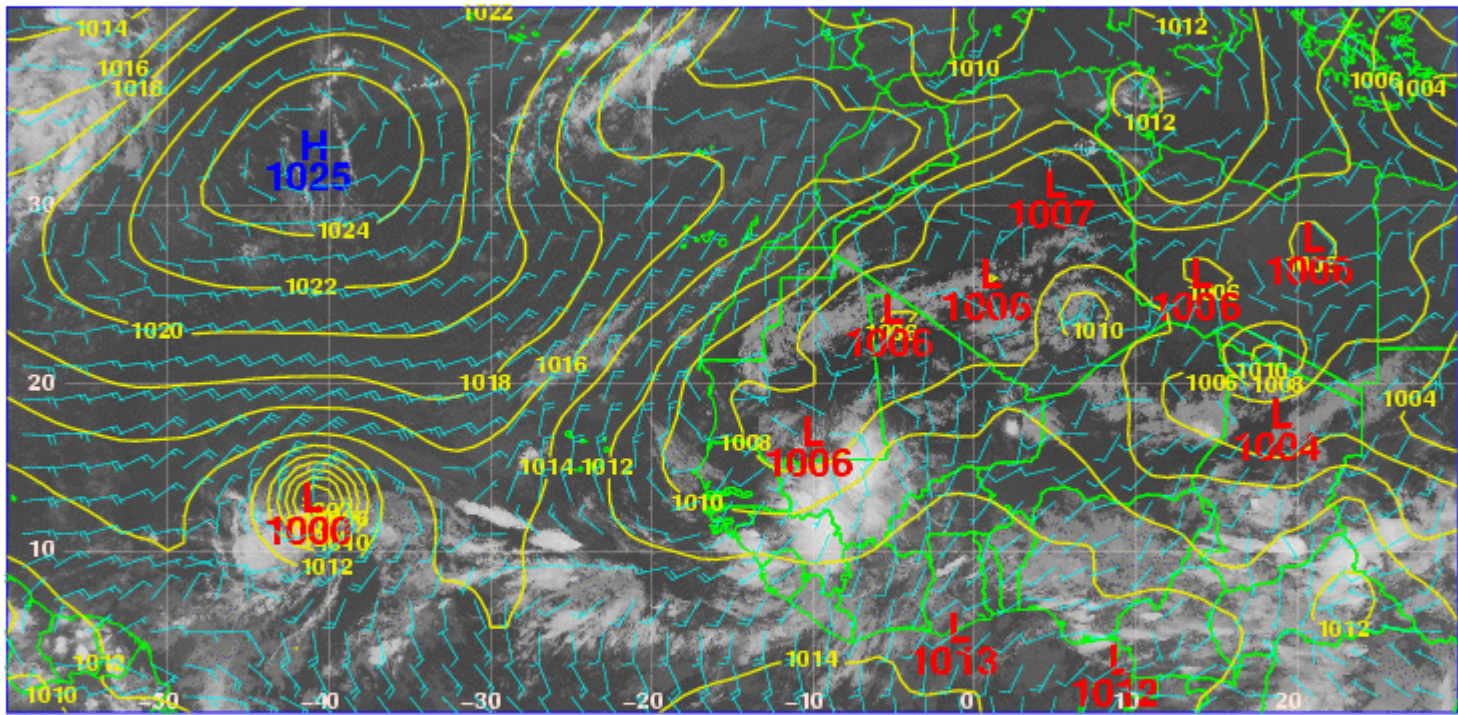
GFS 070813/1200V096 PMSL AND BL WIND (KTS) FCST AND MET-9 070813 1200 UTC IMAGERY



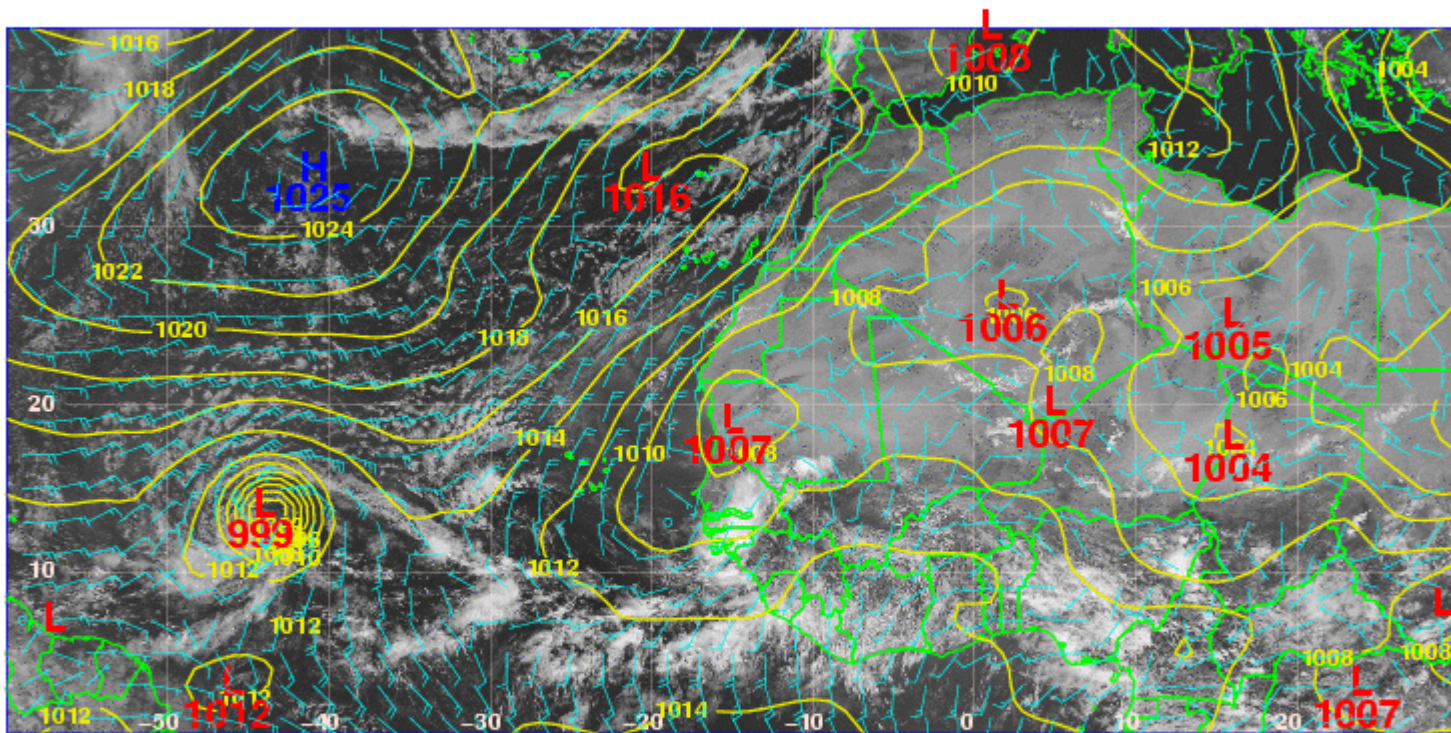
GFS 070814/0000V108 PMSL AND BL WIND (KTS) FCST AND MET-9 070814 0000 UTC IMAGERY



**GFS 070814/1200V120 PMSL AND BL WIND (KTS) FCST AND MET-9 070814 1200 UTC IMAGERY**

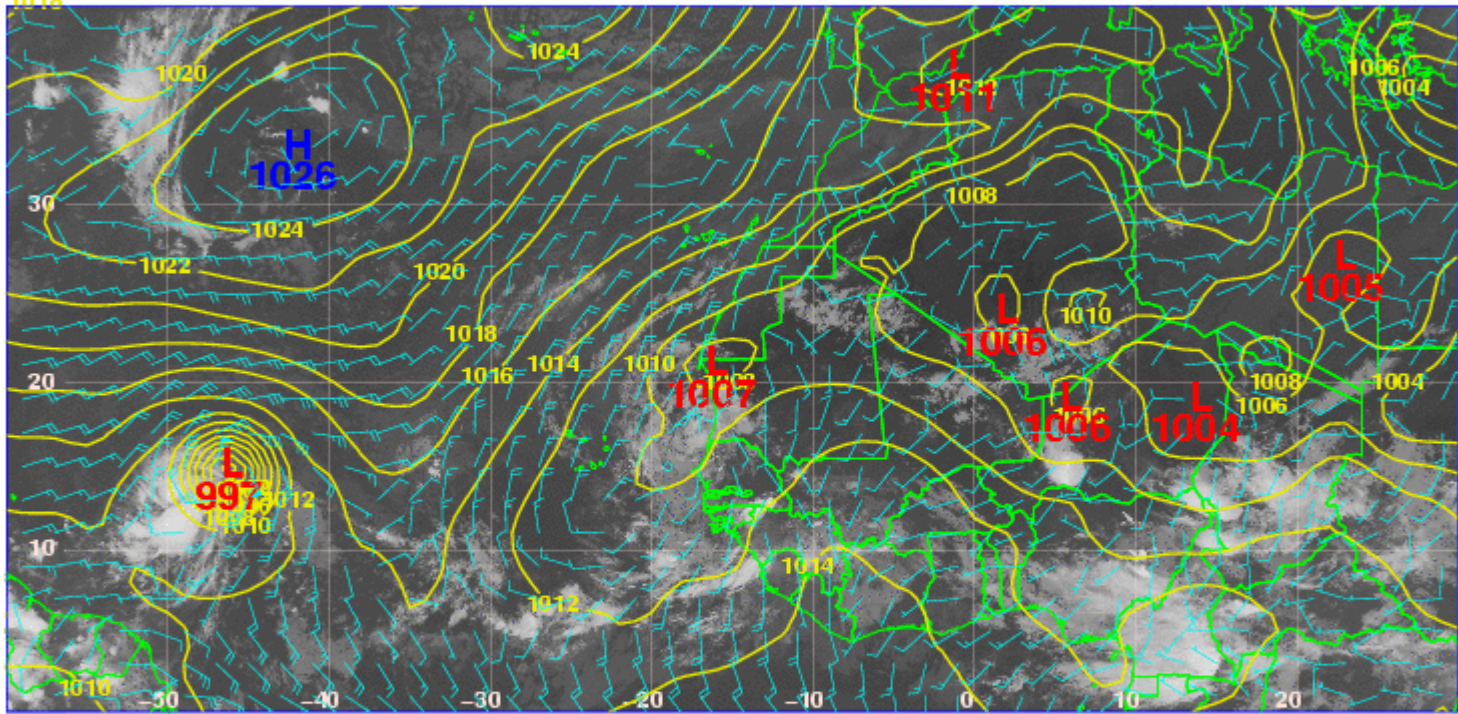


GFS 070815/0000V132 PMSL AND BL WIND (KTS) FCST AND MET-9 070815 0000 UTC IMAGERY



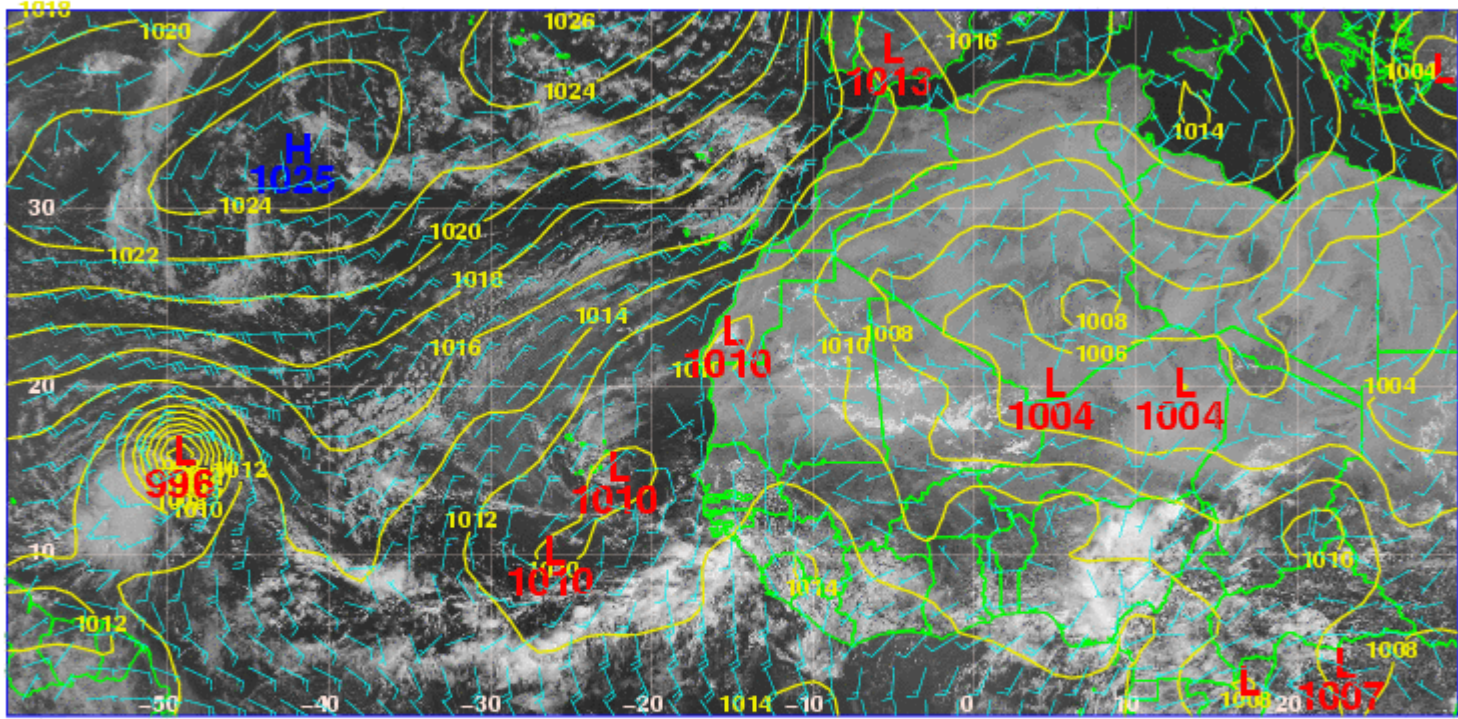
GFS 070815/1200V144 PMSL AND BL WIND (KTS) FCST AND MET-9 070815 1200 UTC IMAGERY

1018



GFS 070816/0000V156 PMSL AND BL WIND (KTS) FCST AND MET-9 070816 0000 UTC IMAGERY

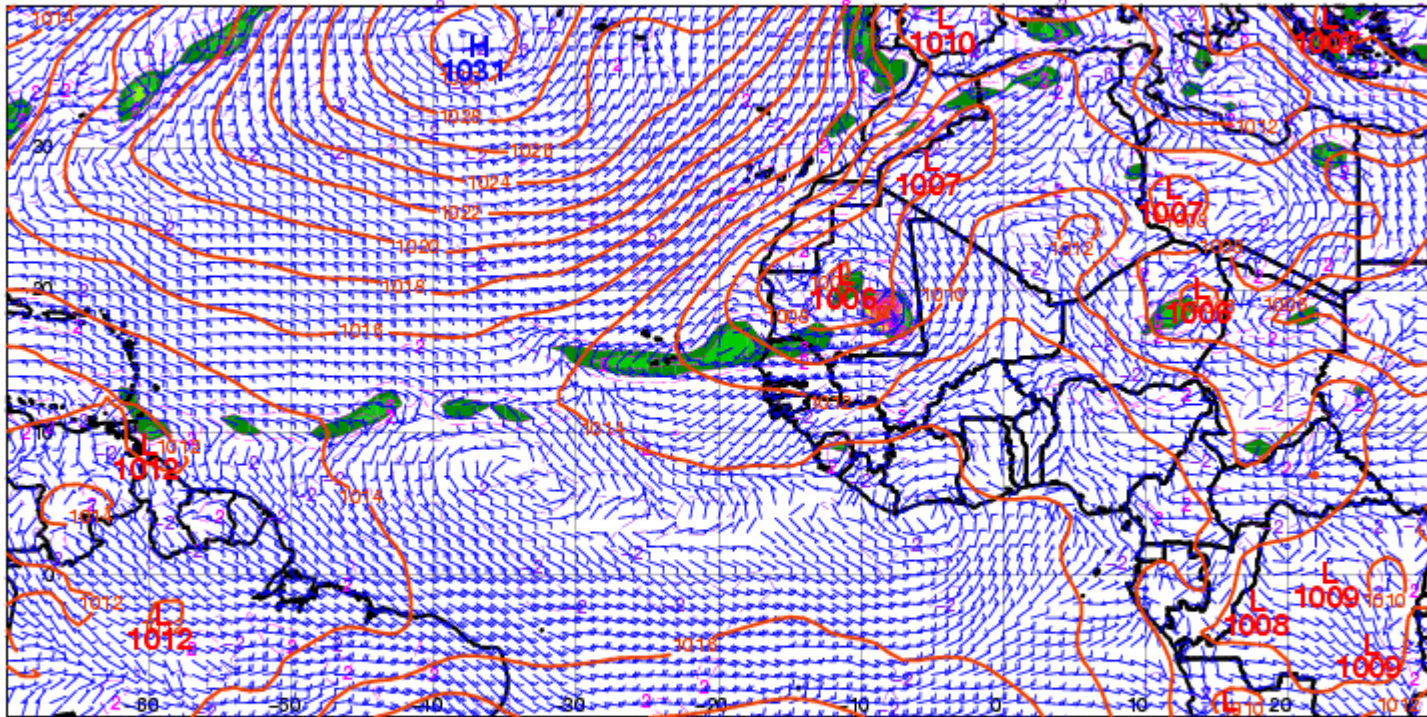




GFS 070816/1200V168 PMSL AND BL WIND (KTS) FCST AND MET-9 070816 1200 UTC IMAGERY

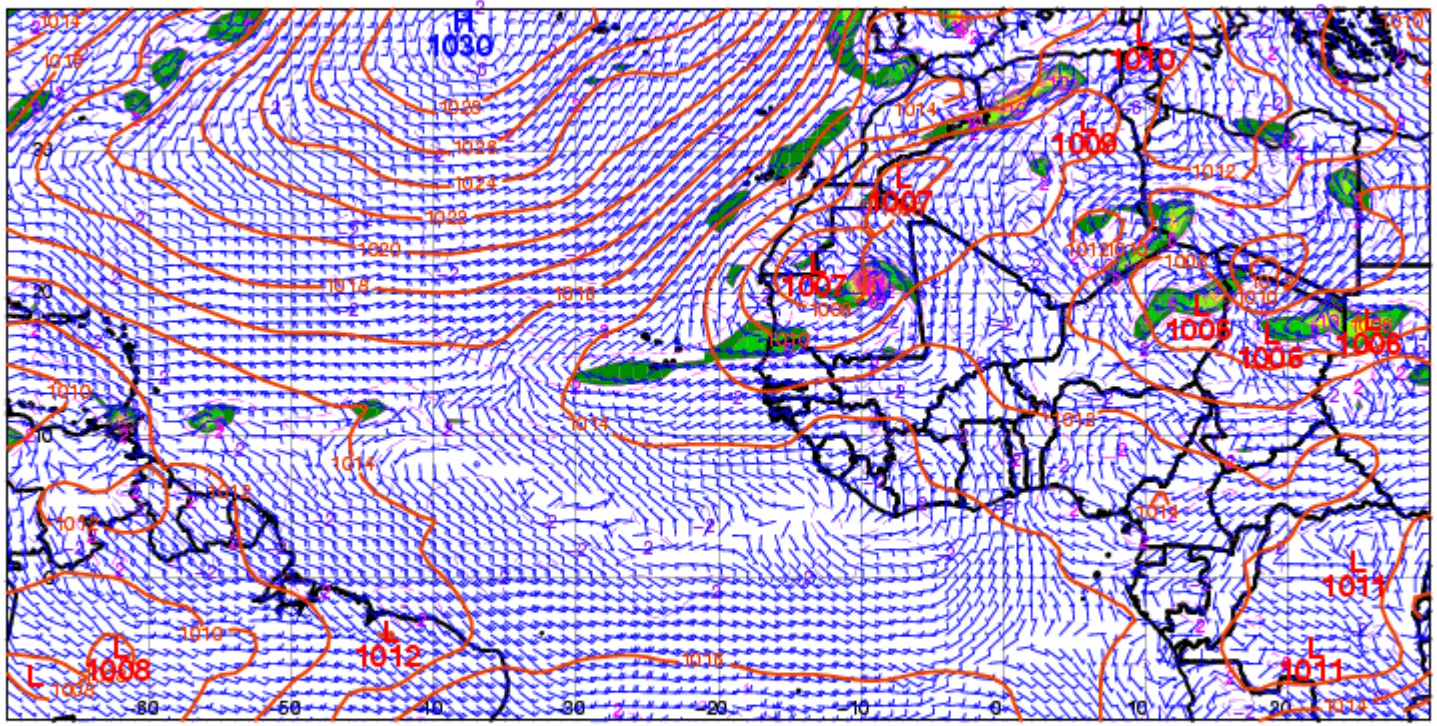
# GFS consistently forecast the genesis of Dean

GFS 07080712 RUN



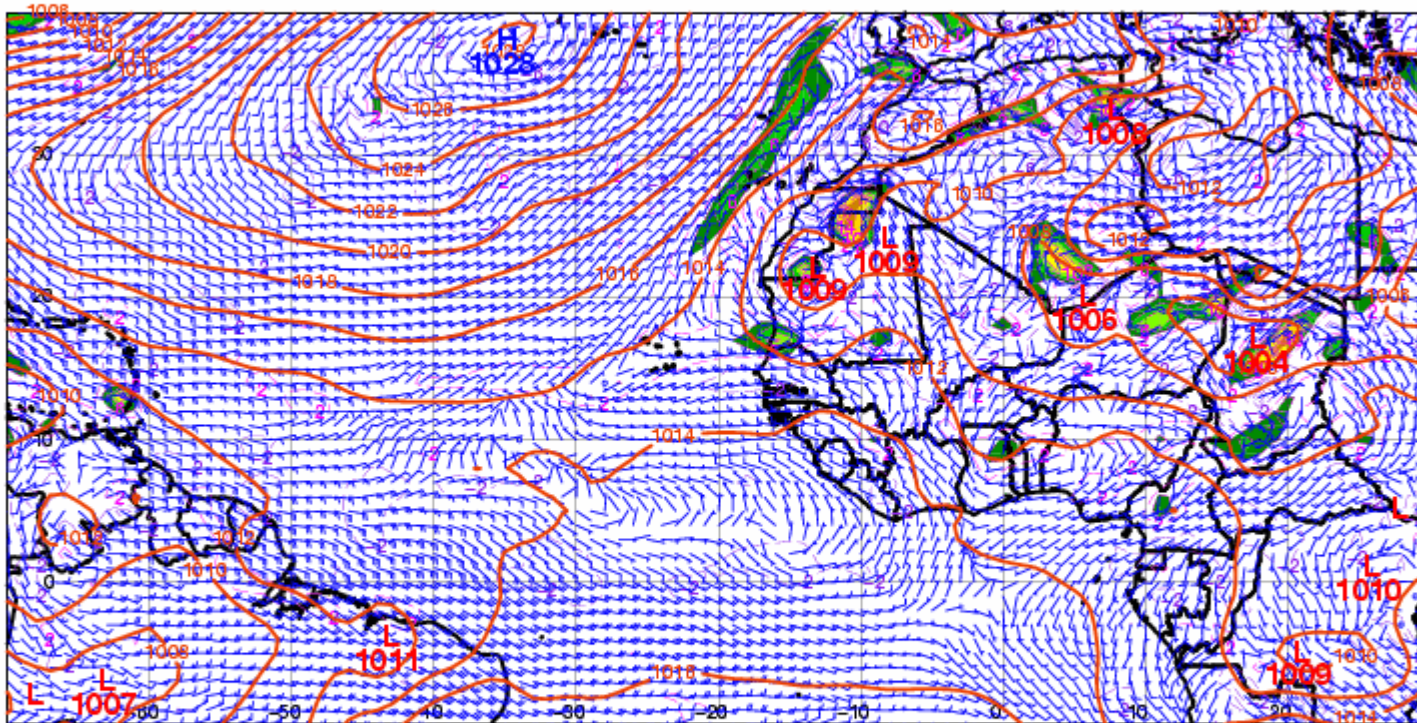
070807/1200V000 GFS 850 MB WIND AND VORTICITY (°5) AND PMSL FORECAST

# GFS 07080812 RUN



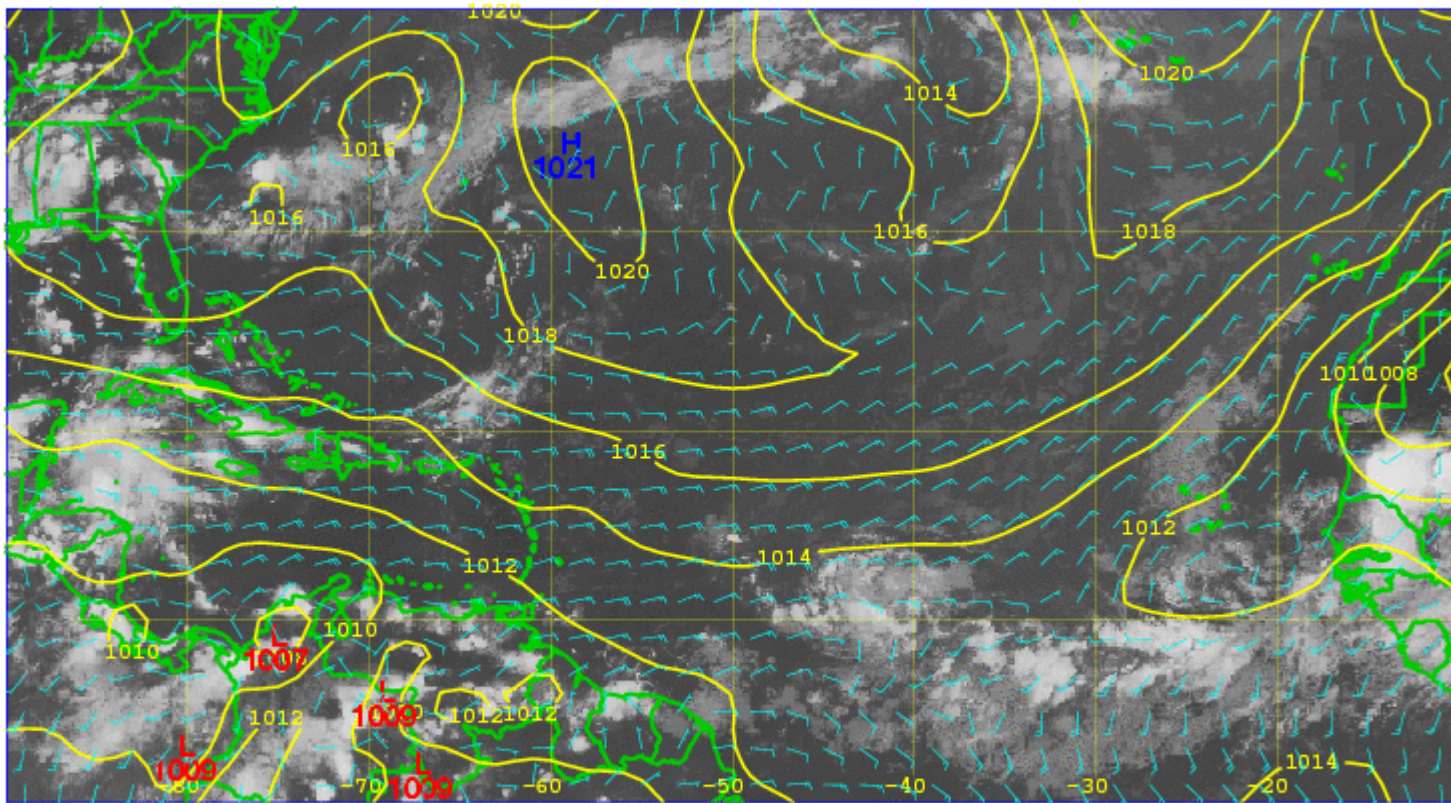
070808/0000V000 GFS 850 MB WIND AND VORTICITY ( $^{\circ}5$ ) AND PMSL FORECAST

# GFS 07080900 RUN

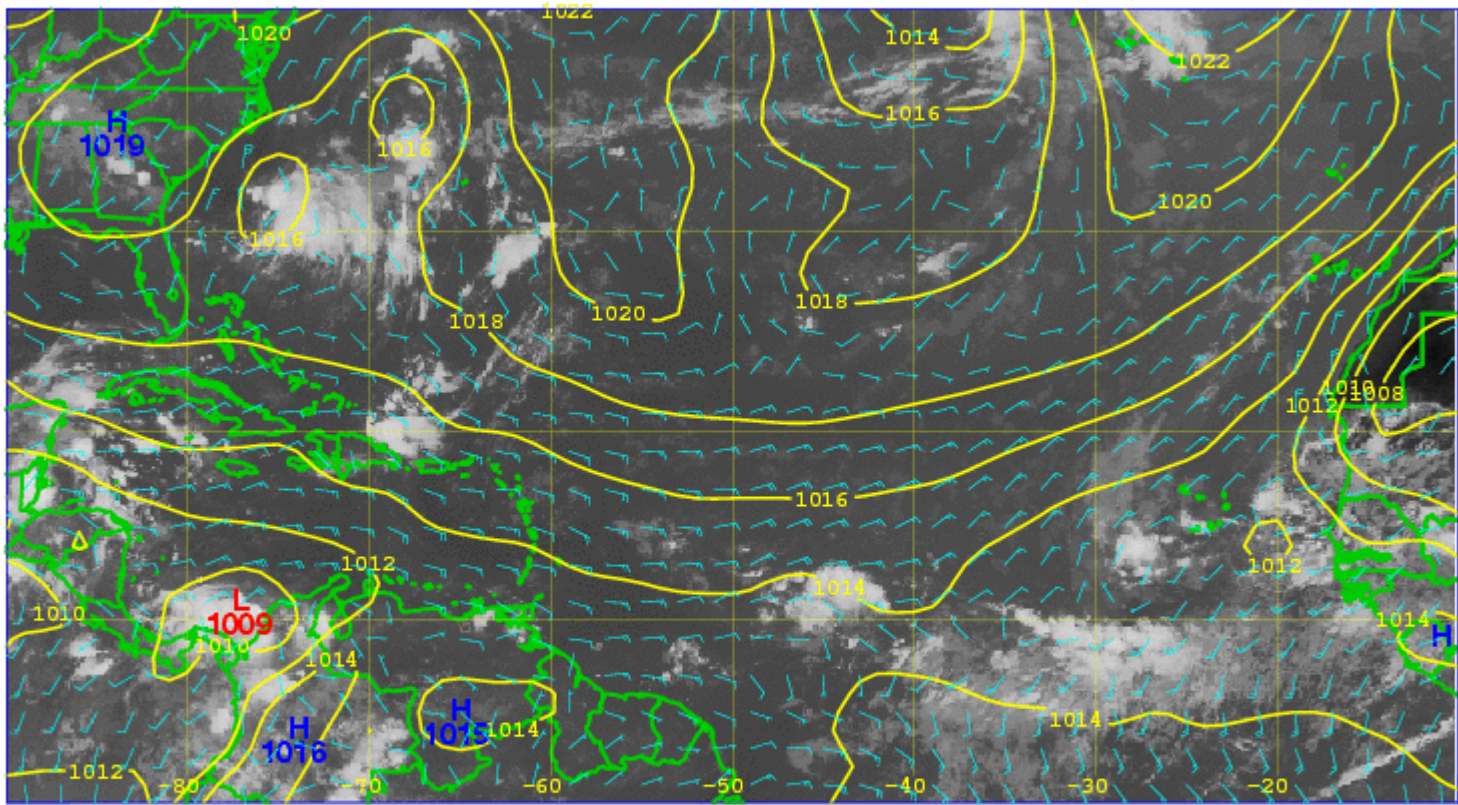


070809/0000V000 GFS 850 MB WIND AND VORTICITY ( $^{\circ}5$ ) AND PMSL FORECAST

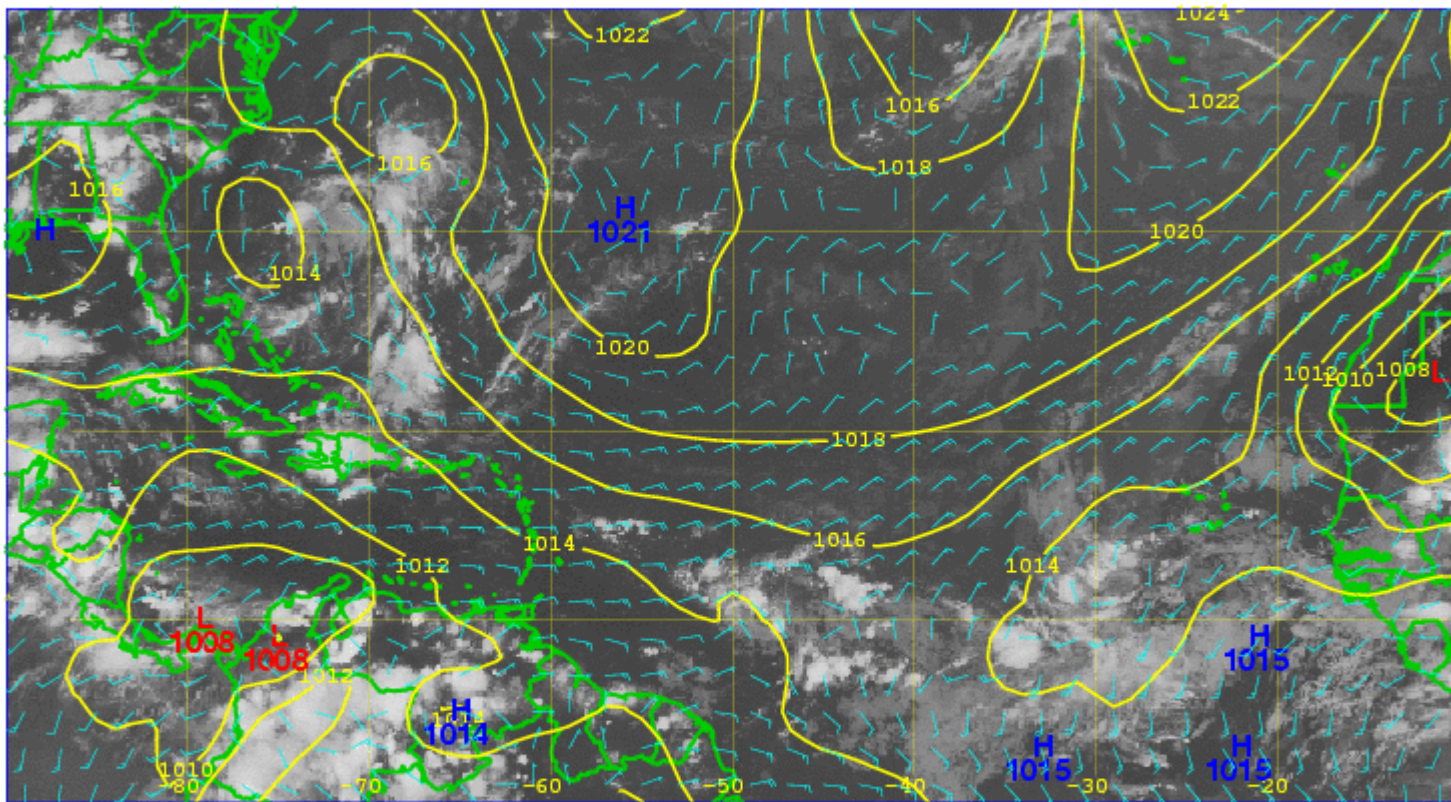
# GFS was unable to predict the genesis of Felix



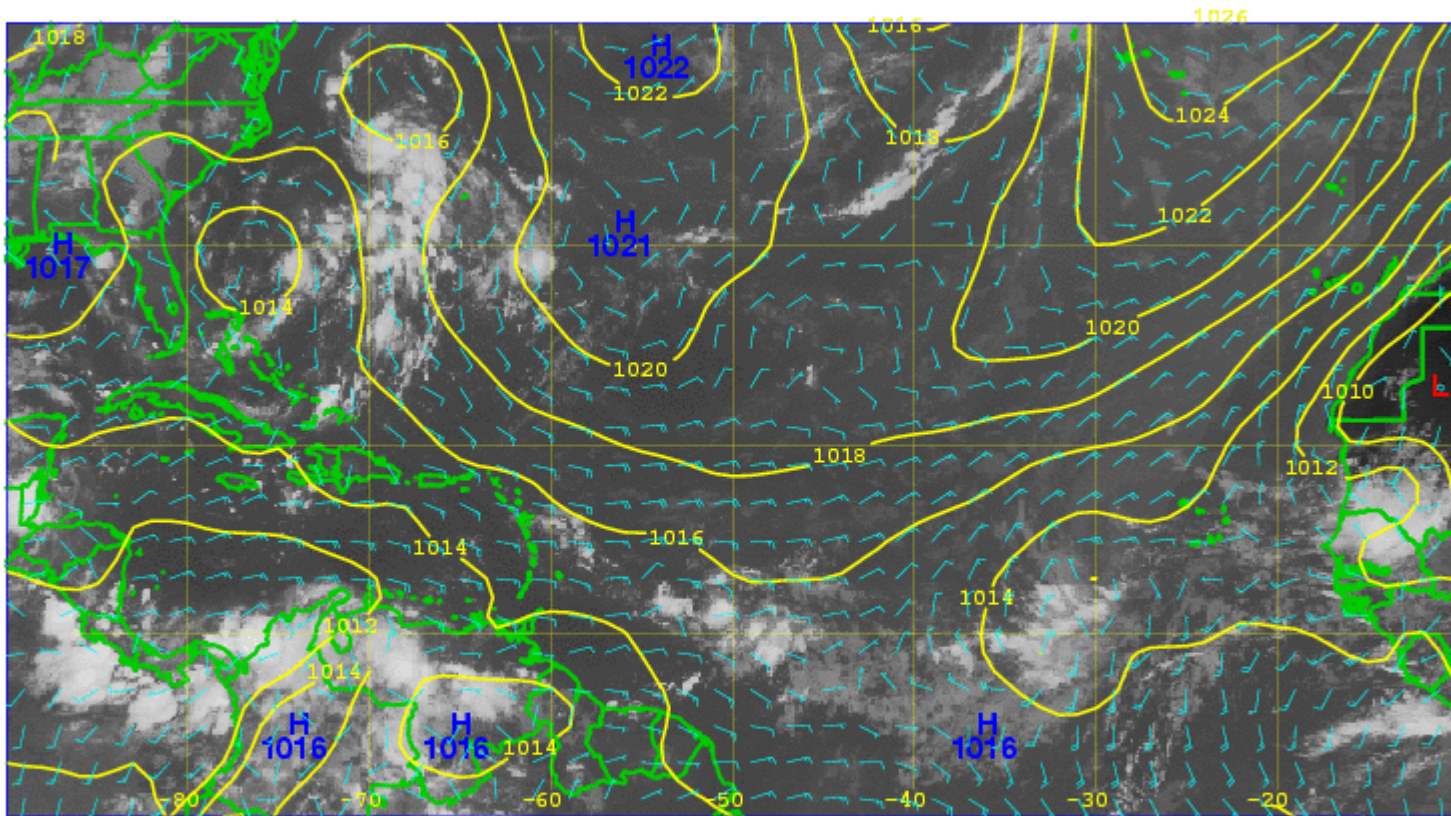
070829/0000V000 GFS VERIFICATION: PMSL & 1000 MB WIND (KT)



070829/1200V012 GFS VERIFICATION: PMSL & 1000 MB WIND (KT)

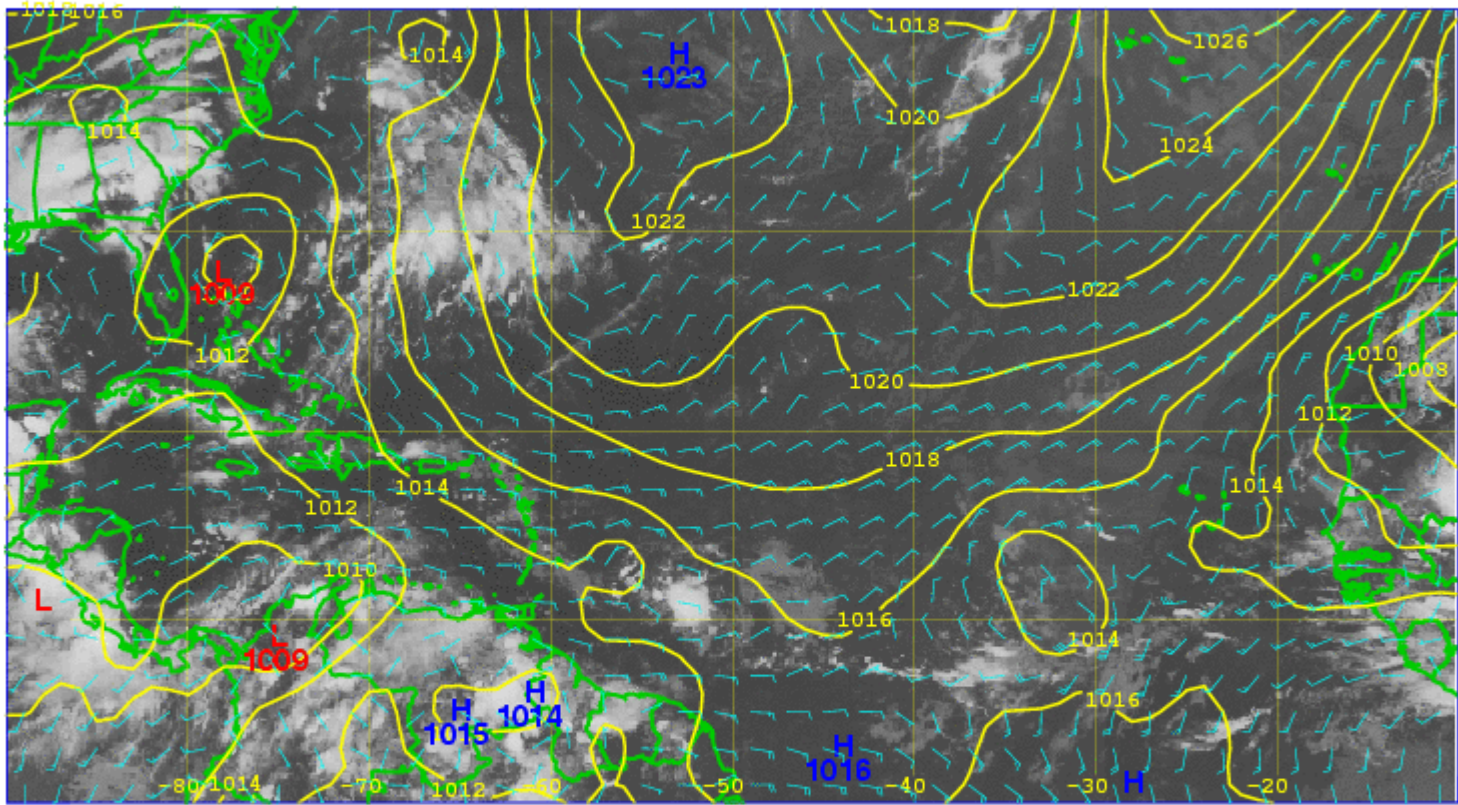


070830/0000V024 GFS VERIFICATION: PMSL & 1000 MB WIND (KT)

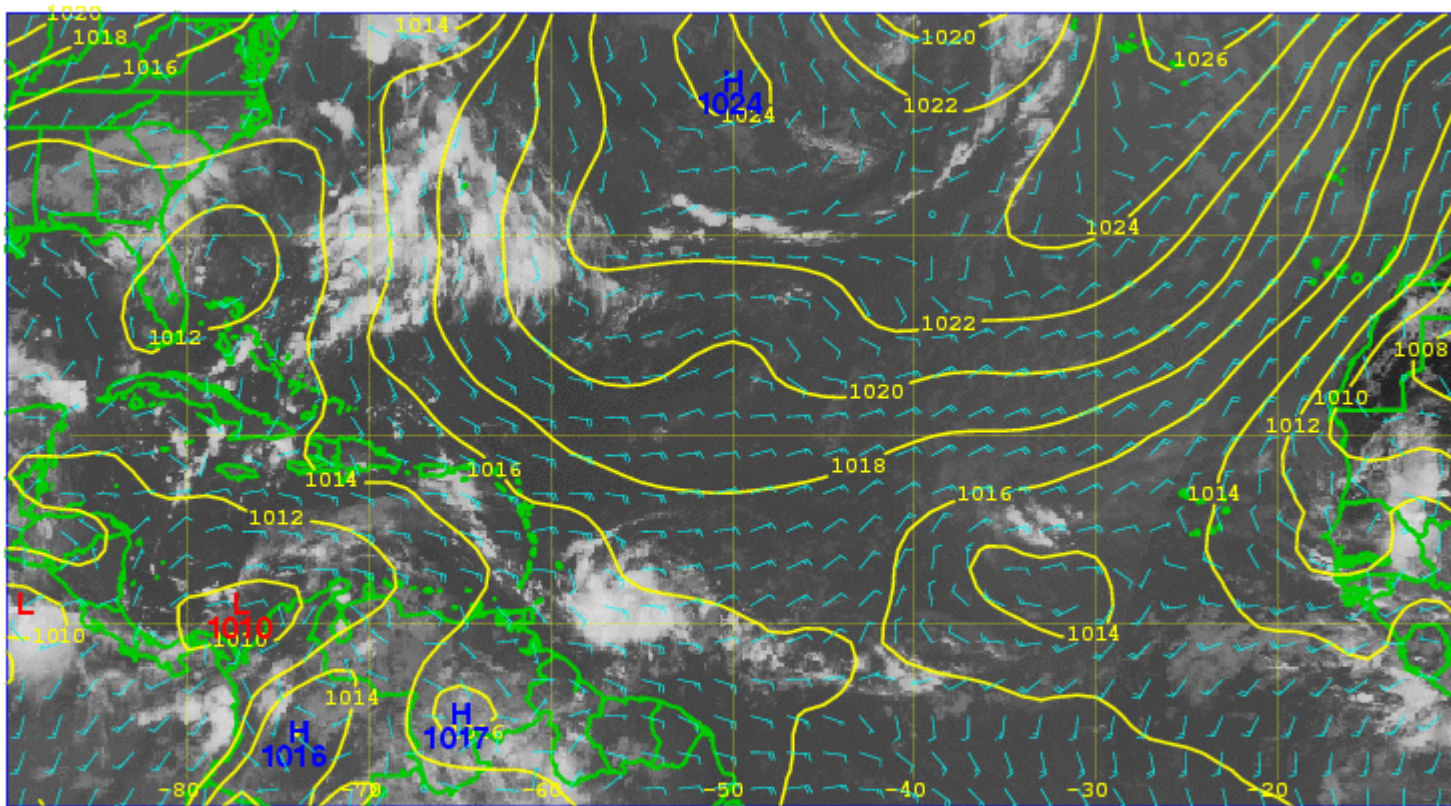


070830/1200V036 GFS VERIFICATION: PMSL & 1000 MB WIND (KT)

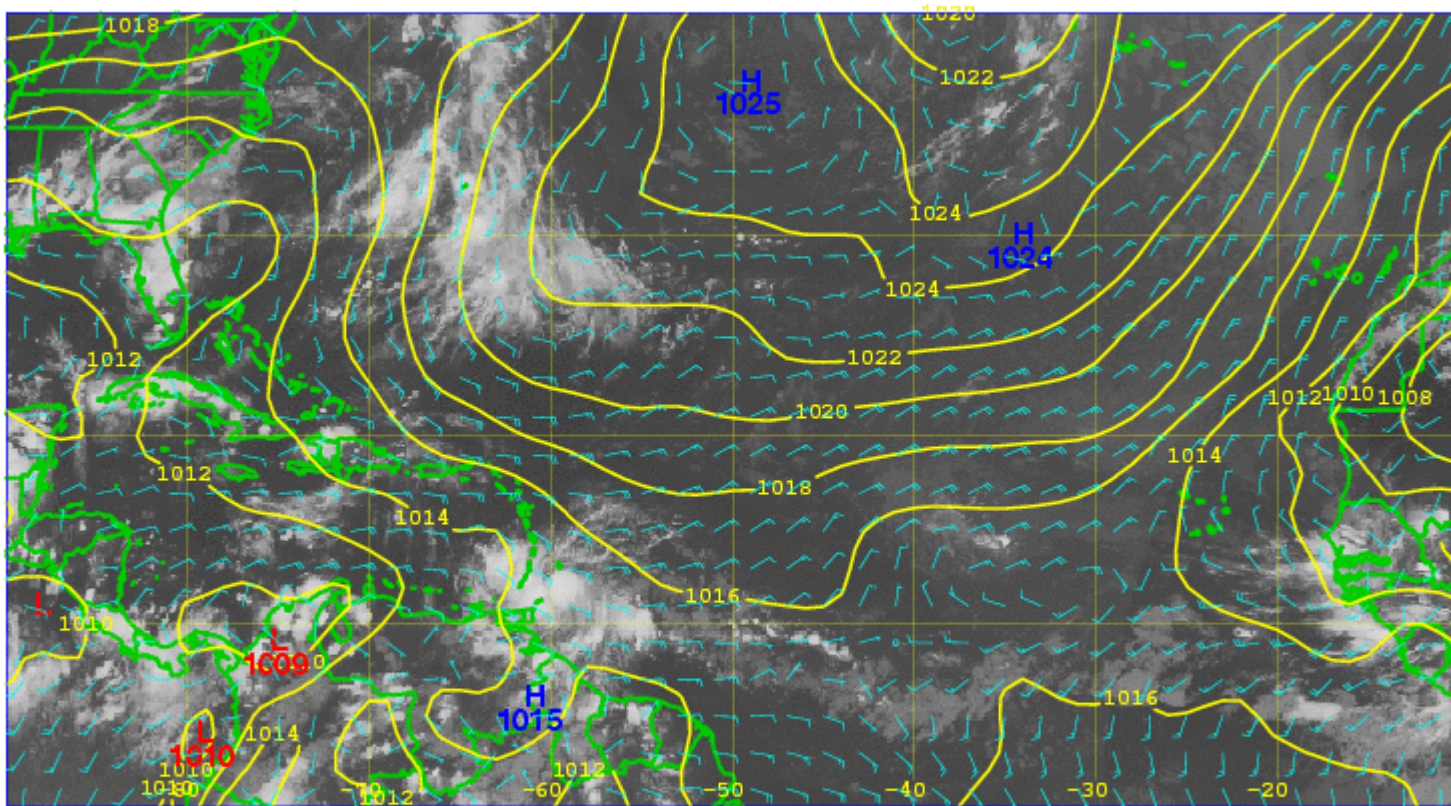




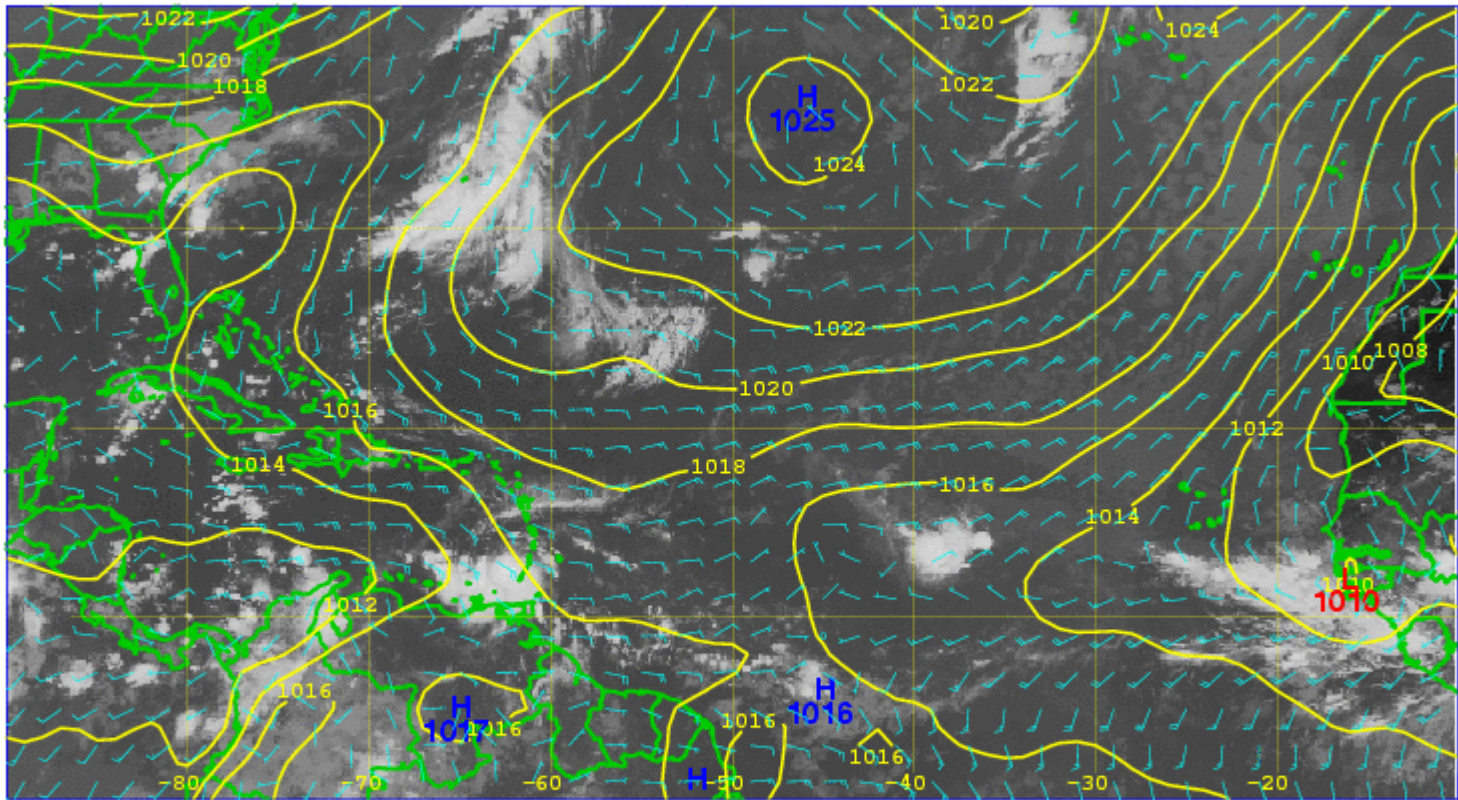
070831/0000V048 GFS VERIFICATION: PMSL & 1000 MB WIND (KT)



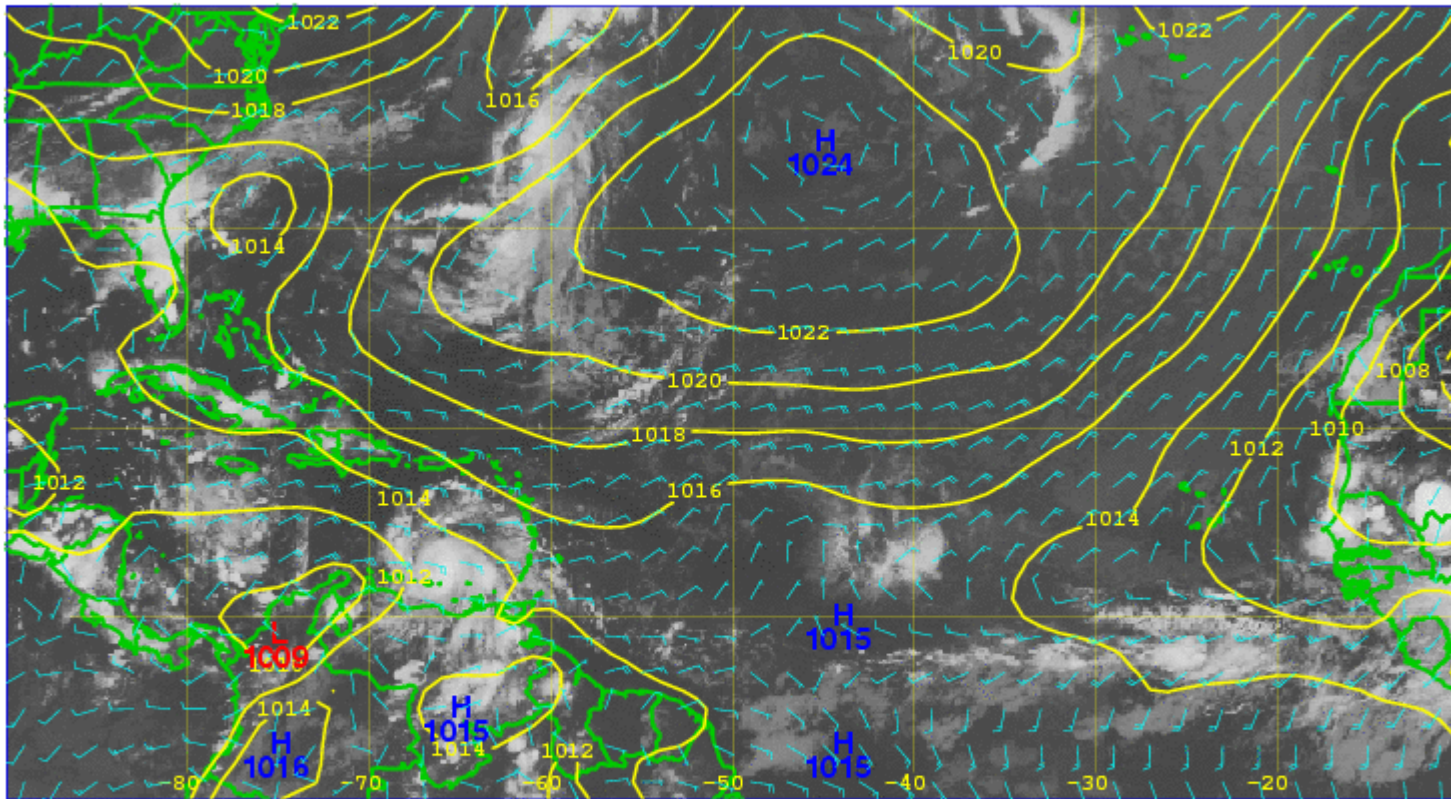
070831/1200V060 GFS VERIFICATION: PMSL & 1000 MB WIND (KT)



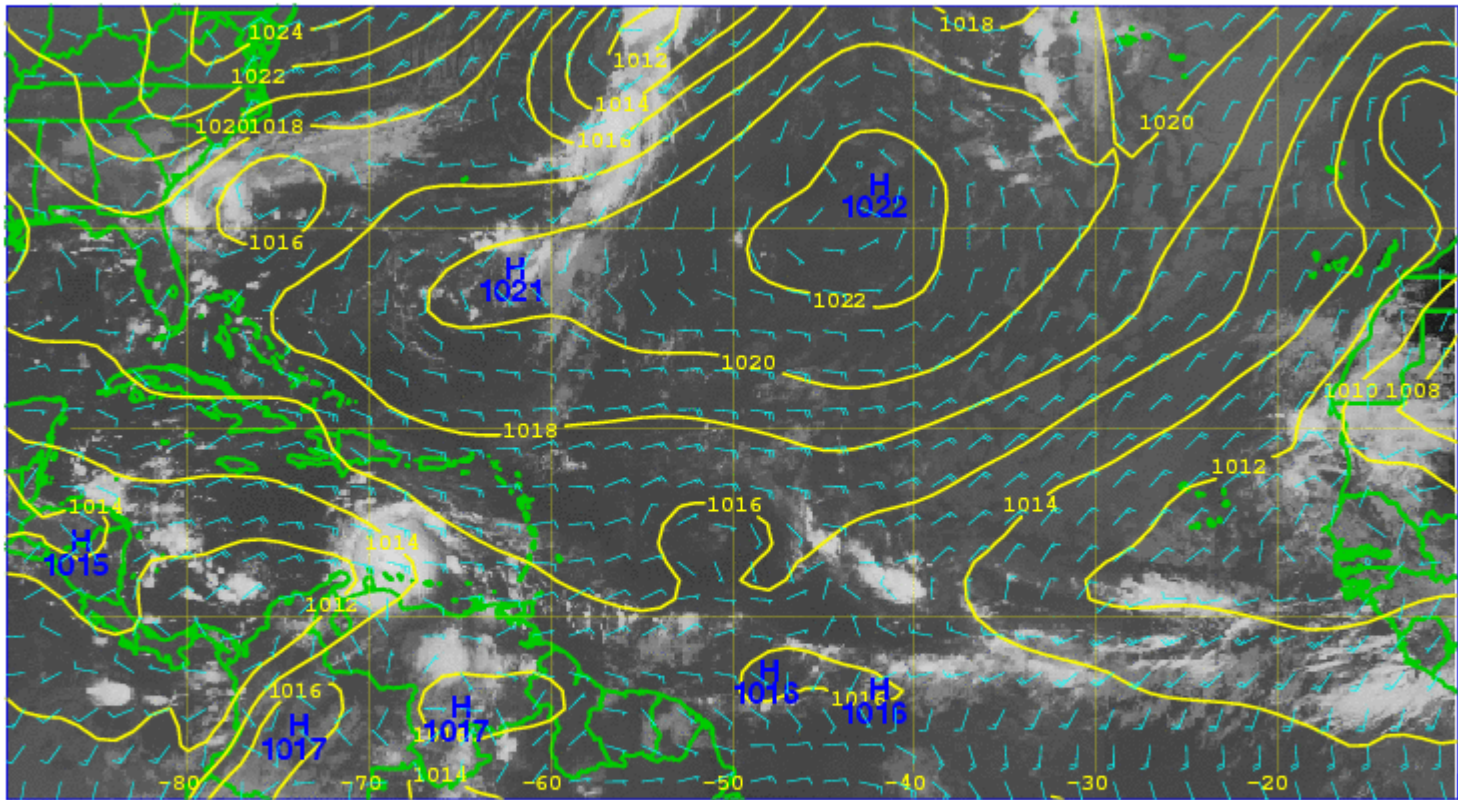
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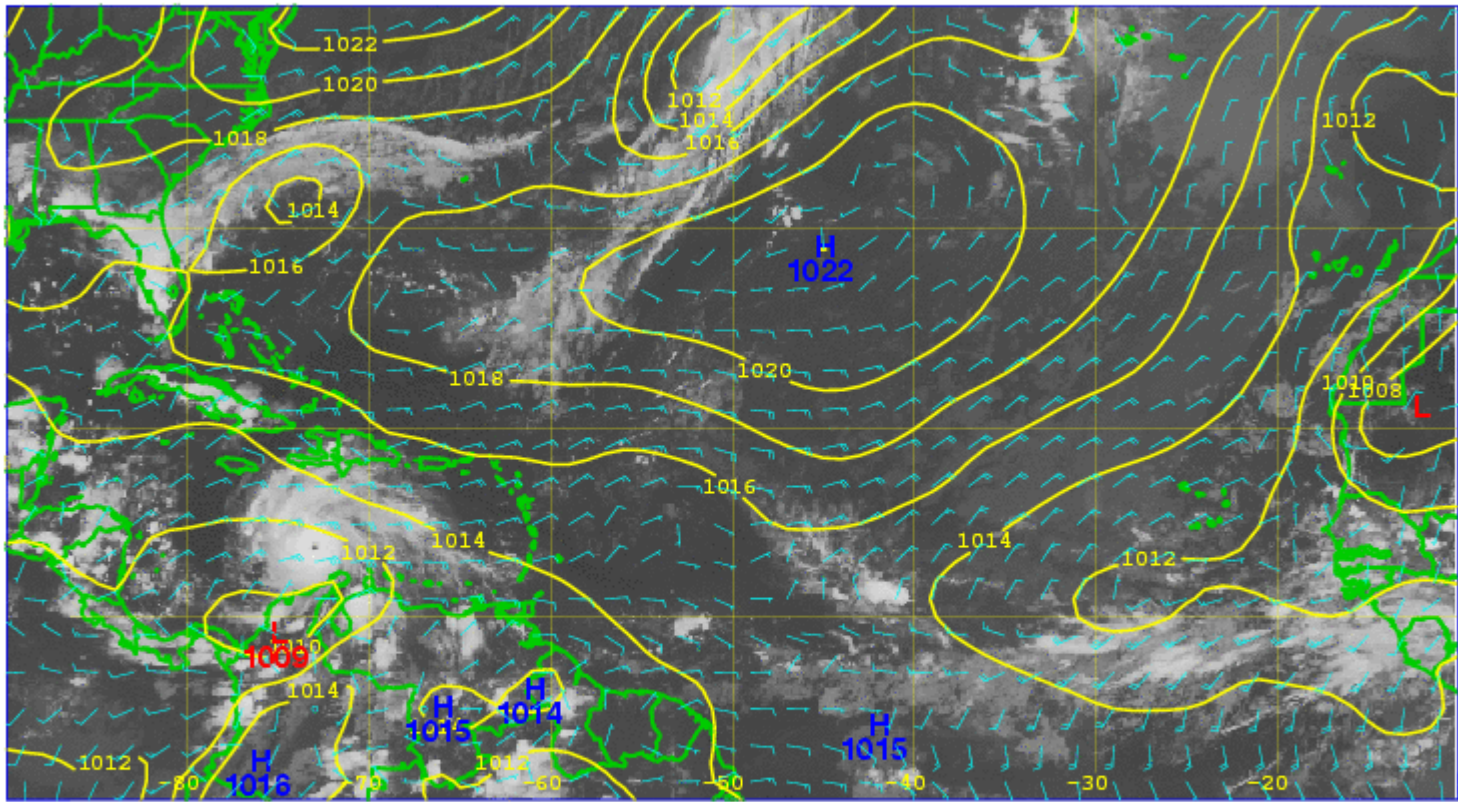
070901/1200V084 GFS VERIFICATION: PMSL & 1000 MB WIND (KT)



070902/0000V096 GFS VERIFICATION: PMSL & 1000 MB WIND (KT)

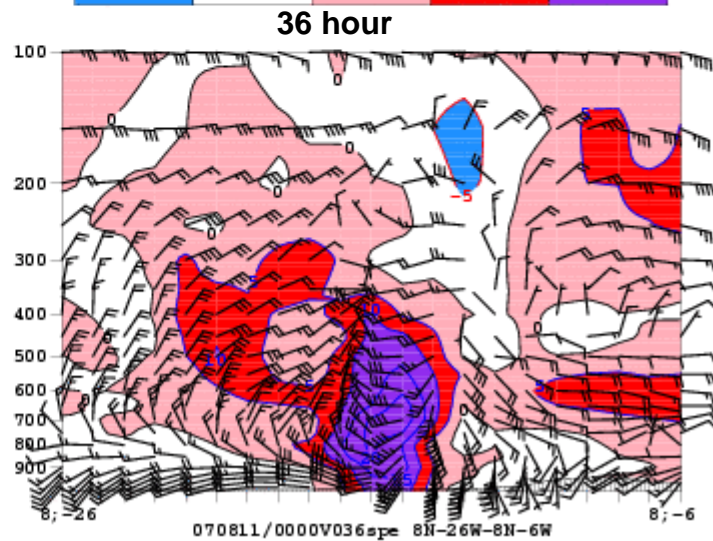
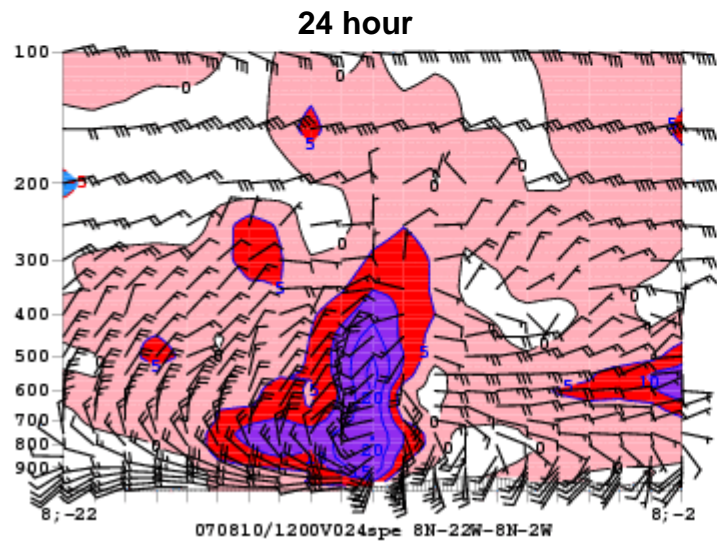
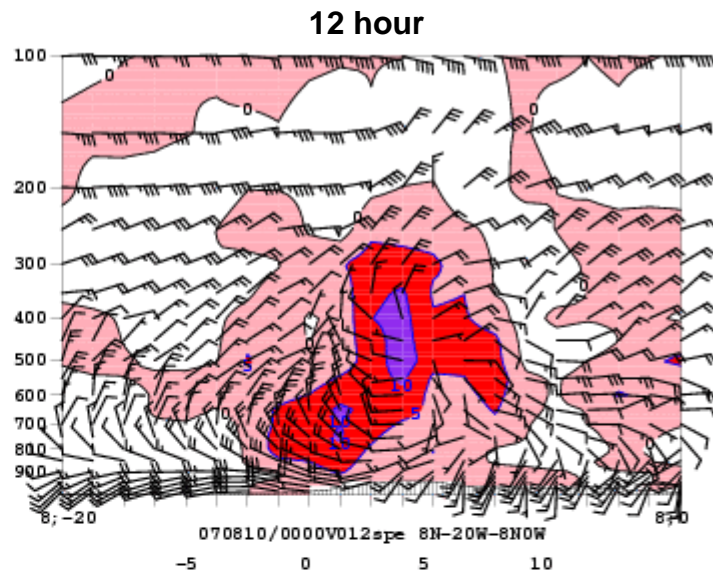
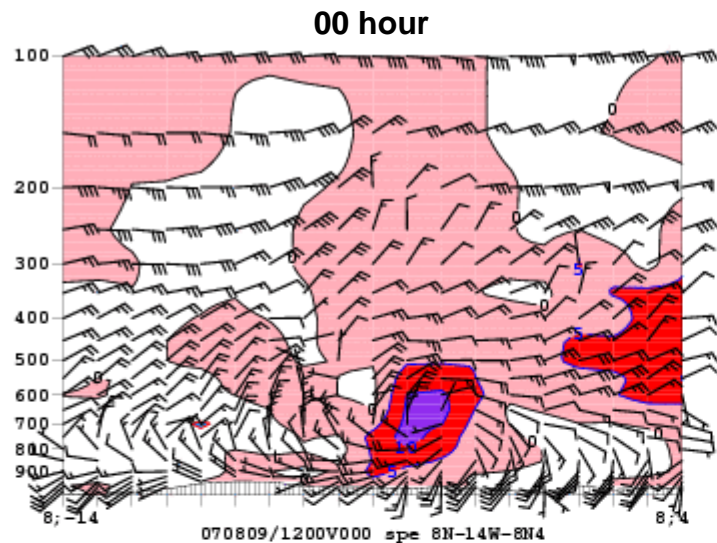


070902/1200V108 GFS VERIFICATION: PMSL & 1000 MB WIND (KT)



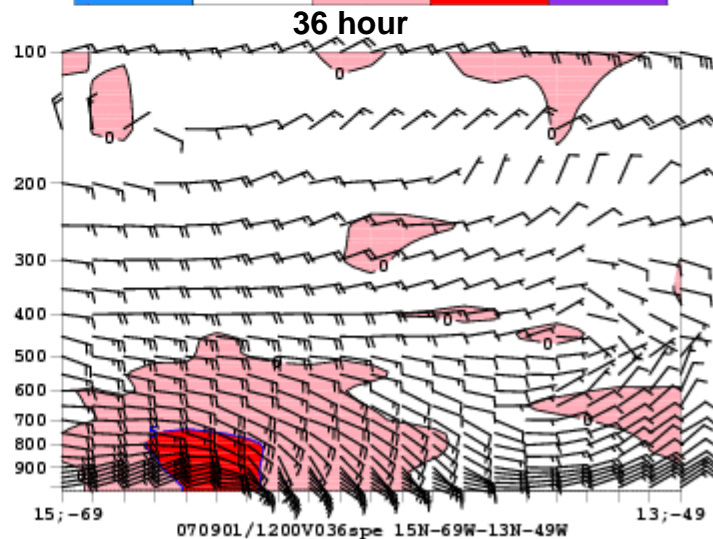
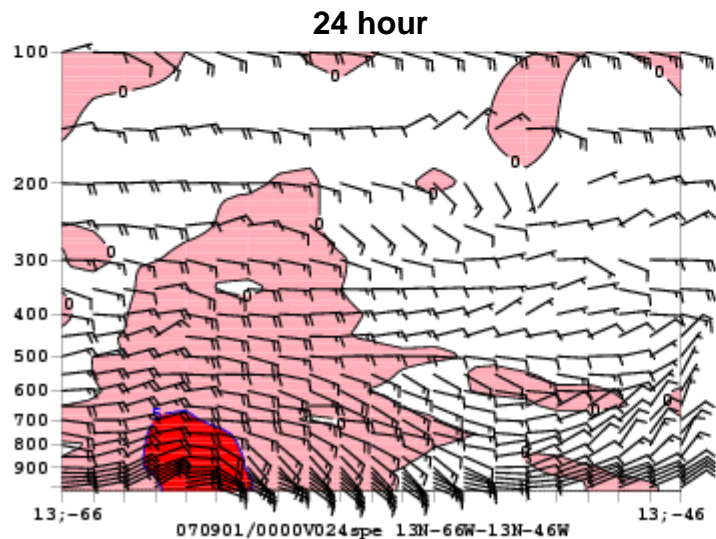
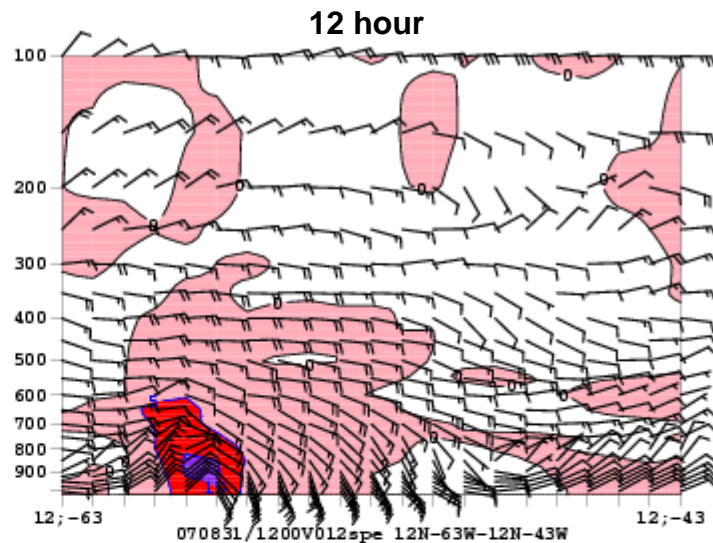
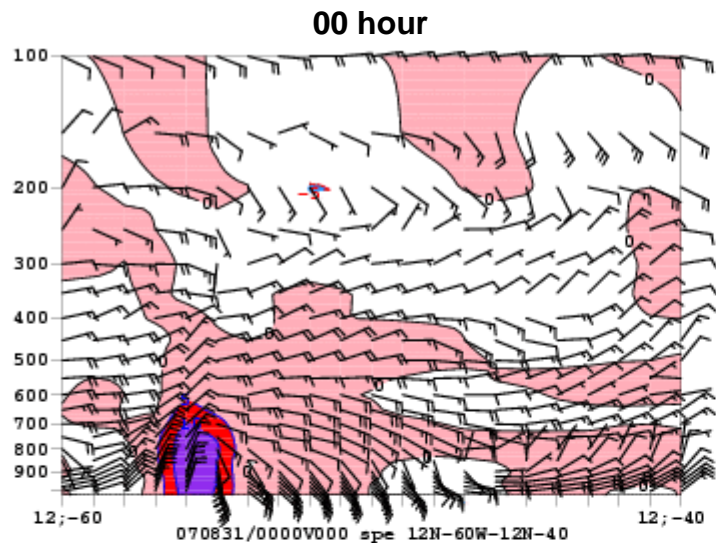
070903/0000V120 GFS VERIFICATION: PMSL & 1000 MB WIND (KT)

# GFS forecast wind and relative vorticity cross-section through Dean's precursor tropical wave as it moves from Africa into the eastern tropical Atlantic





# GFS forecast wind and relative vorticity cross-section through Felix's precursor tropical wave as it moves over the tropical Atlantic



# BOTH THE GFDL AND HWRF MODELS PREDICTED THE INTENSIFICATION OF DEAN TO CATEGORY 5 STATUS

NCEP COUPLED GFDL HURRICANE MODEL FORECAST MADE FOR

HURRICANE DEAN 04L

INITIAL TIME 12Z AUG 16

HOUR	LAT	LONG	PRES	WIND	DIR/SPD
0	13.5	-53.3	990	76	275/21
6	13.9	-55.4	989	81	280/20
12	14.3	-57.3	986	85	282/19
18	14.5	-59.6	985	86	277/22
24	14.7	-61.8	987	78	273/21
30	15.2	-63.9	982	85	283/21
36	15.2	-65.8	978	80	271/18
42	15.4	-67.5	972	89	277/17
48	15.8	-69.3	964	101	283/17
54	16.2	-71.1	965	98	281/18
60	16.6	-72.9	960	99	282/18
66	17.0	-74.7	952	114	283/17
72	17.6	-76.5	945	118	289/18
78	18.2	-78.5	951	114	287/20
84	18.8	-80.1	949	118	289/16
90	19.5	-81.8	939	123	292/18
96	20.4	-83.3	925	135	301/18
102	21.4	-84.8	923	139	304/17
108	22.6	-86.2	916	142	311/17
114	23.8	-87.7	916	143	307/18
120	25.0	-89.1	913	142	312/18
126	26.2	-90.5	913	139	311/17

NCEP COUPLED HWRF HURRICANE MODEL FORECAST MADE FOR

HURRICANE DEAN 04L

INITIAL TIME 12Z AUG 16

HOUR	LAT	LON	PRES	WIND	DIR/SPD
0	13.6	-53.6	982	78	275/21
6	13.8	-55.9	980	69	275/22
12	14.2	-57.9	980	78	281/20
18	14.4	-60.2	967	90	275/22
24	14.8	-62.1	962	87	282/19
30	15.1	-64.0	957	85	279/19
36	15.5	-65.8	948	93	283/18
42	15.8	-67.4	940	102	281/16
48	16.1	-68.9	933	115	281/15
54	16.4	-70.3	928	110	282/14
60	16.5	-71.5	926	114	275/12
66	16.6	-72.8	919	121	274/12
72	16.9	-74.1	921	117	283/13
78	17.5	-75.4	914	132	295/14
84	18.1	-77.0	919	118	291/16
90	18.6	-78.6	921	121	287/16
96	19.0	-80.1	905	135	285/15
102	19.4	-81.7	899	127	284/16
108	19.8	-83.0	898	132	287/13
114	20.3	-84.3	889	135	291/13
120	21.0	-85.5	888	145	300/13
126	21.6	-86.9	890	138	293/14

ZCZC MIATCDAT4 ALL  
TTAA00 KNHC DDHHMM  
HURRICANE DEAN DISCUSSION NUMBER 14  
NWS TPC/NATIONAL HURRICANE CENTER MIAMI FL AL042007  
500 PM EDT THU AUG 16 2007

AN AIR FORCE HURRICANE HUNTER AIRCRAFT HAS BEEN IN THE EYE OF DEAN AND THE DATA SO FAR INDICATE THAT THE MINIMUM PRESSURE HAS BEEN FLUCTUATION BETWEEN 974 AND 979 MB. MAXIMUM WINDS ARE ESTIMATED AT 85 KNOTS. THE CURRENT CONVECTIVE BANDING STRUCTURE AND THE EXPANSION OF THE UPPER-LEVEL OUTFLOW OBSERVED ON SATELLITE IMAGES SUGGEST THAT DEAN IS STRENGTHENING AT THIS TIME. DEAN IS EXPECTED TO CARRY AN UPPER-LEVEL ANTICYCLONE WITH IT...ON ITS WESTWARD TRACK ACROSS THE CARIBBEAN. THIS PATTERN IS CONDUCIVE TO STRENGTHENING. ONCE DEAN REACHES THE WESTERN CARIBBEAN AND MOVES OVER AN AREA OF VERY HIGH OCEAN HEAT...IT COULD BECOME A CATEGORY FOUR HURRICANE. **THIS IS CONSISTENT WITH THE SHIPS MODEL AND WITH DYNAMICAL GUIDANCE...MAINLY THE GFDL AND THE HWRF WHICH MAKE DEAN A VERY INTENSE HURRICANE.**

DEAN IS MOVING TOWARD THE WEST OR 280 DEGREES AT 20 KNOTS. A STRONG AND DEEP ANTICYCLONE IS FORECAST TO REMAIN ANCHORED NORTH OF DEAN. THIS PATTERN WOULD PROVIDE A CONTINUED WESTWARD STEERING DURING THE NEXT 3 TO 4 DAYS WITH SOME WEST-NORTHWESTWARD COMPONENT AS THE HURRICANE REACHES THE EDGE OF THE HIGH BY DAY FIVE. TRACK MODELS ARE IN OUTSTANDING AGREEMENT BRINGING THE HURRICANE ACROSS THE CARIBBEAN SEA. THIS ADDS CONFIDENCE TO THE TRACK FORECAST.

THE FRENCH BUOY...41001...RECENTLY REPORTED SUSTAINED WINDS OF 50 KNOTS. THIS INFORMATION HELPED WITH ESTIMATES OF THE WIND RADII.

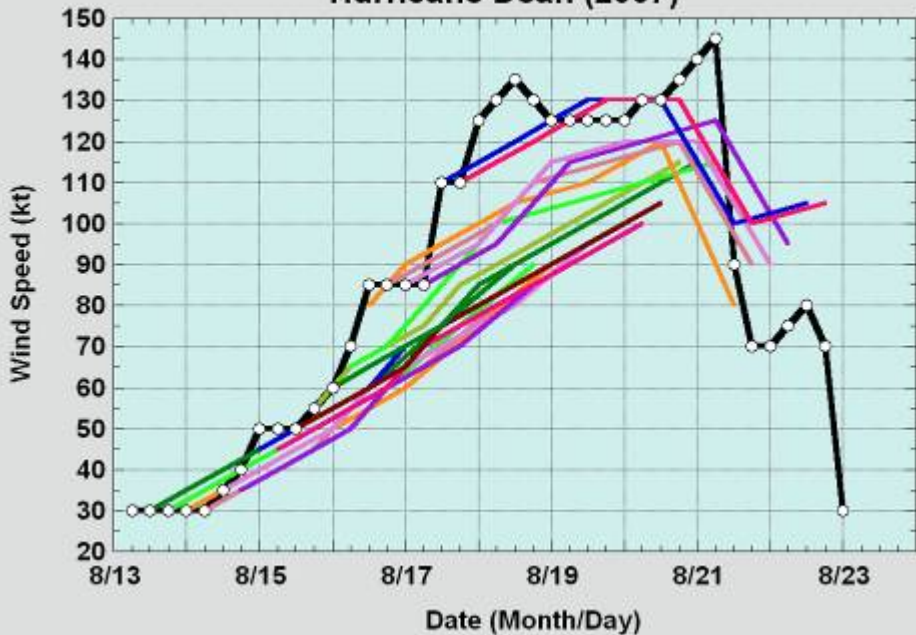
FORECAST POSITIONS AND MAX WINDS

INITIAL	16/2100Z	14.0N	56.5W	85 KT
12HR VT	17/0600Z	14.4N	59.7W	90 KT
24HR VT	17/1800Z	15.0N	63.5W	95 KT
36HR VT	18/0600Z	15.5N	67.0W	100 KT
48HR VT	18/1800Z	16.0N	70.5W	110 KT
72HR VT	19/1800Z	17.5N	78.0W	115 KT
96HR VT	20/1800Z	19.5N	84.5W	120 KT
120HR VT	21/1800Z	22.0N	90.5W	90 KT

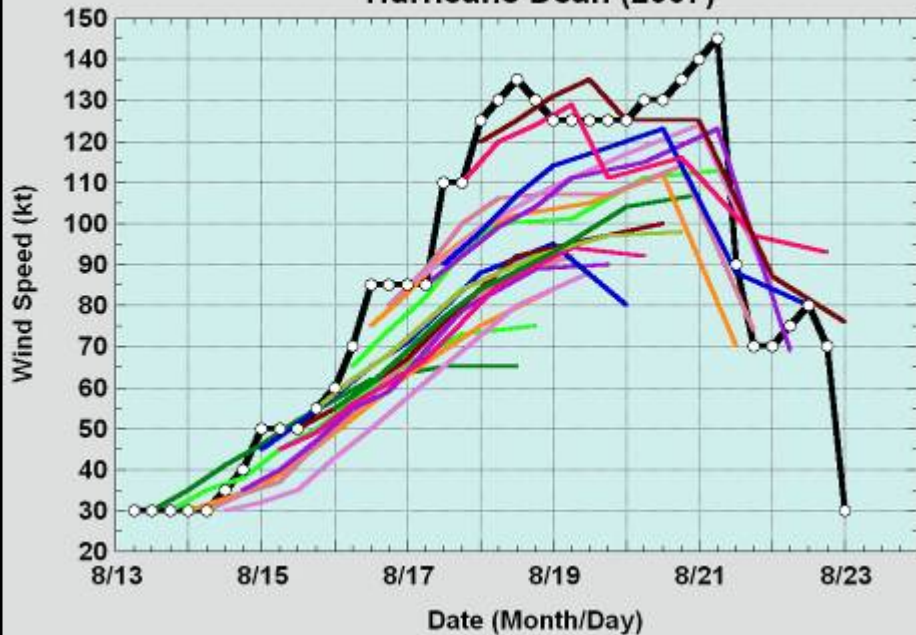
\$\$

FORECASTER AVILA/BLAKE

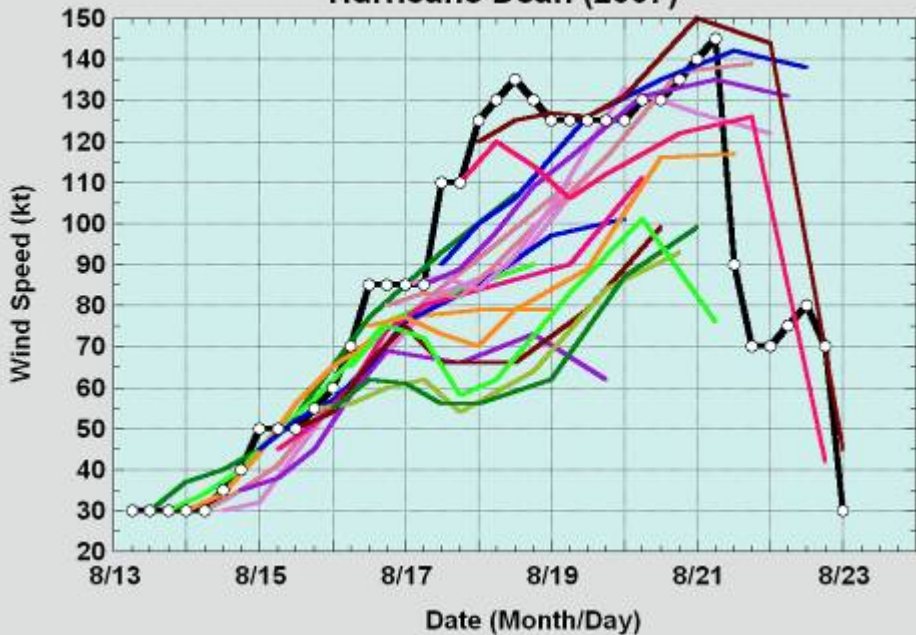
**NHC Official Forecasts  
Hurricane Dean (2007)**



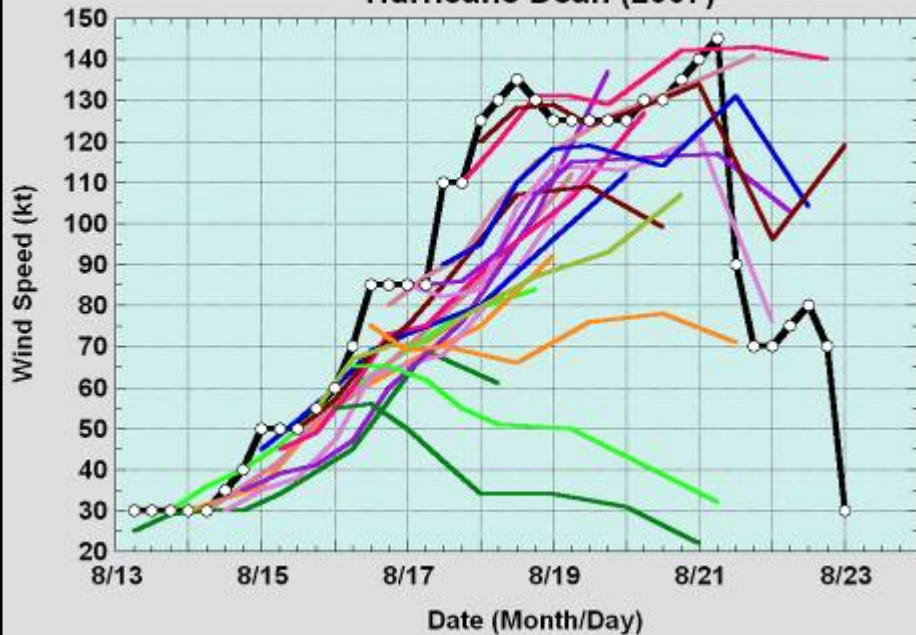
**DSHIP Forecasts  
Hurricane Dean (2007)**



**GHMI Forecasts  
Hurricane Dean (2007)**



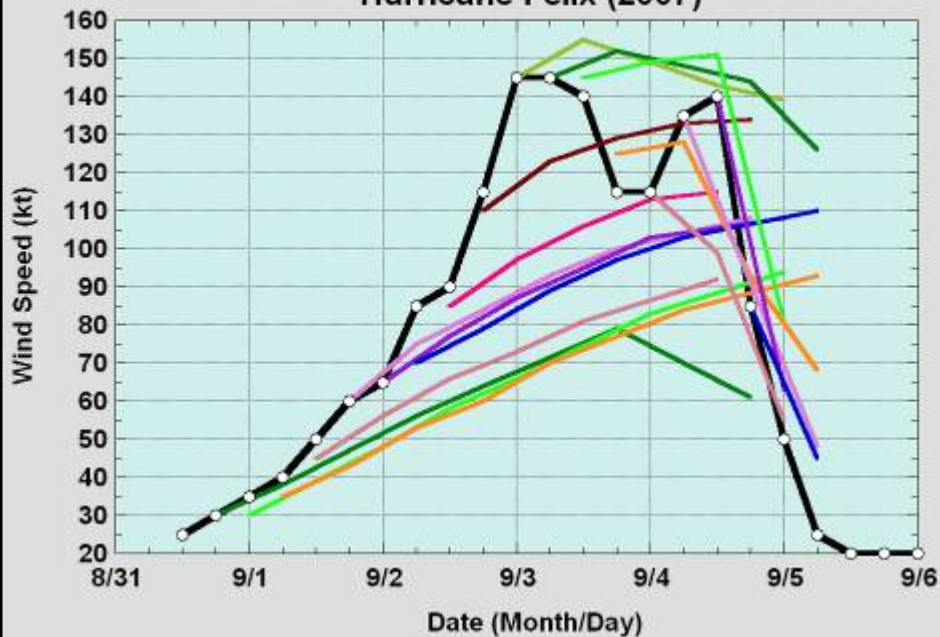
**HWFI Forecasts  
Hurricane Dean (2007)**



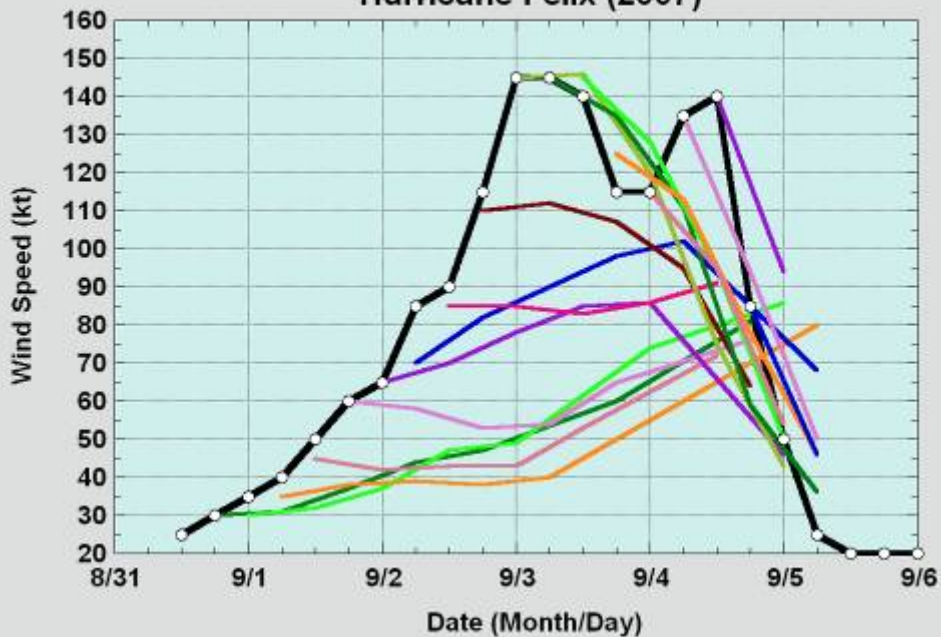
**NHC Official Forecasts  
Hurricane Felix (2007)**



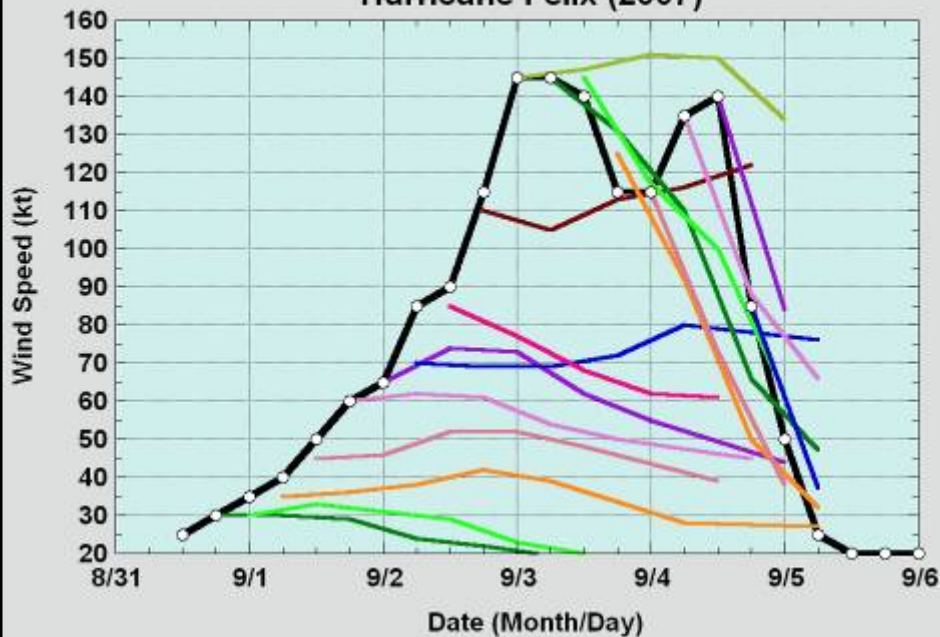
**DSHIP Forecasts  
Hurricane Felix (2007)**

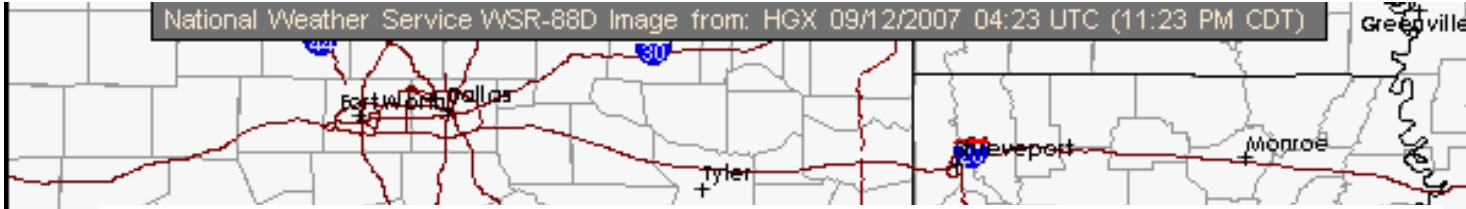


**GHMI Forecasts  
Hurricane Felix (2007)**



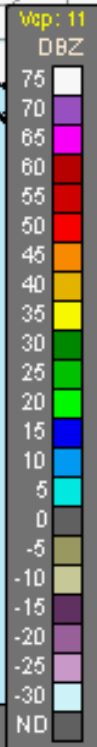
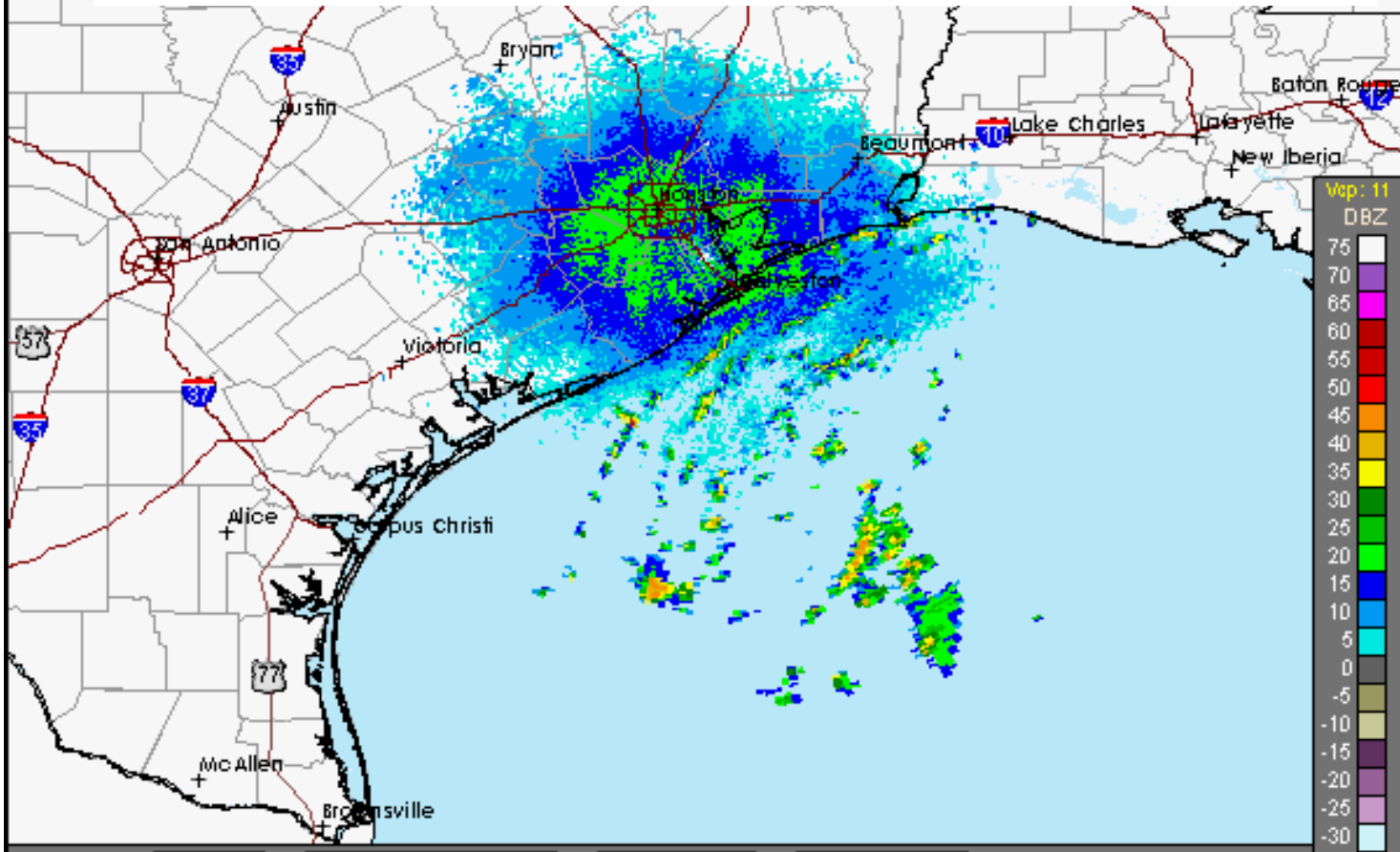
**HWFI Forecasts  
Hurricane Felix (2007)**





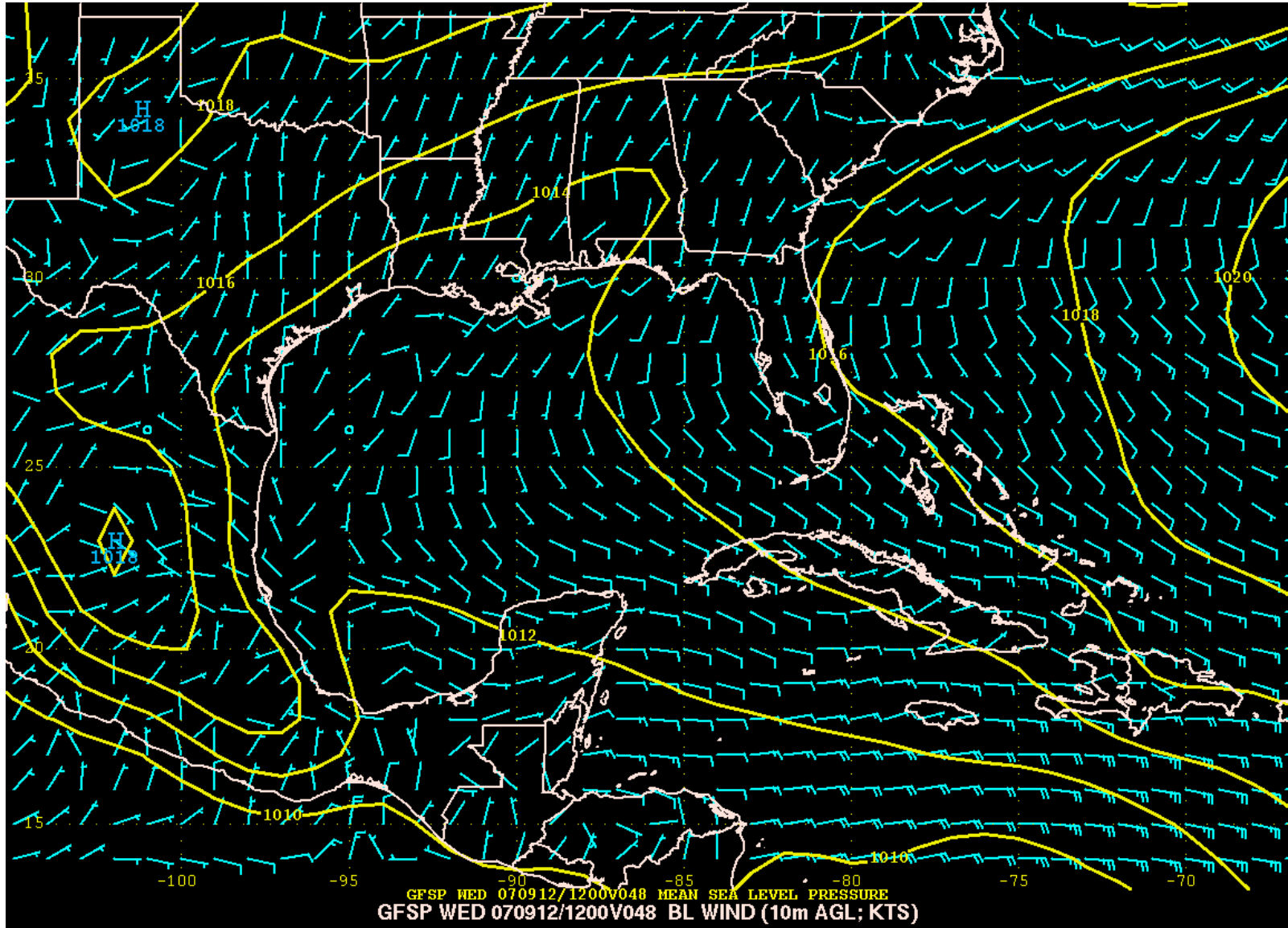
**HUMBERTO INTENSIFIED FROM A WEAK AREA OF LOW PRESSURE INTO A HURRICANE IN LESS THAN 24 HOURS!**

**CAN THIS BE MODELED?**



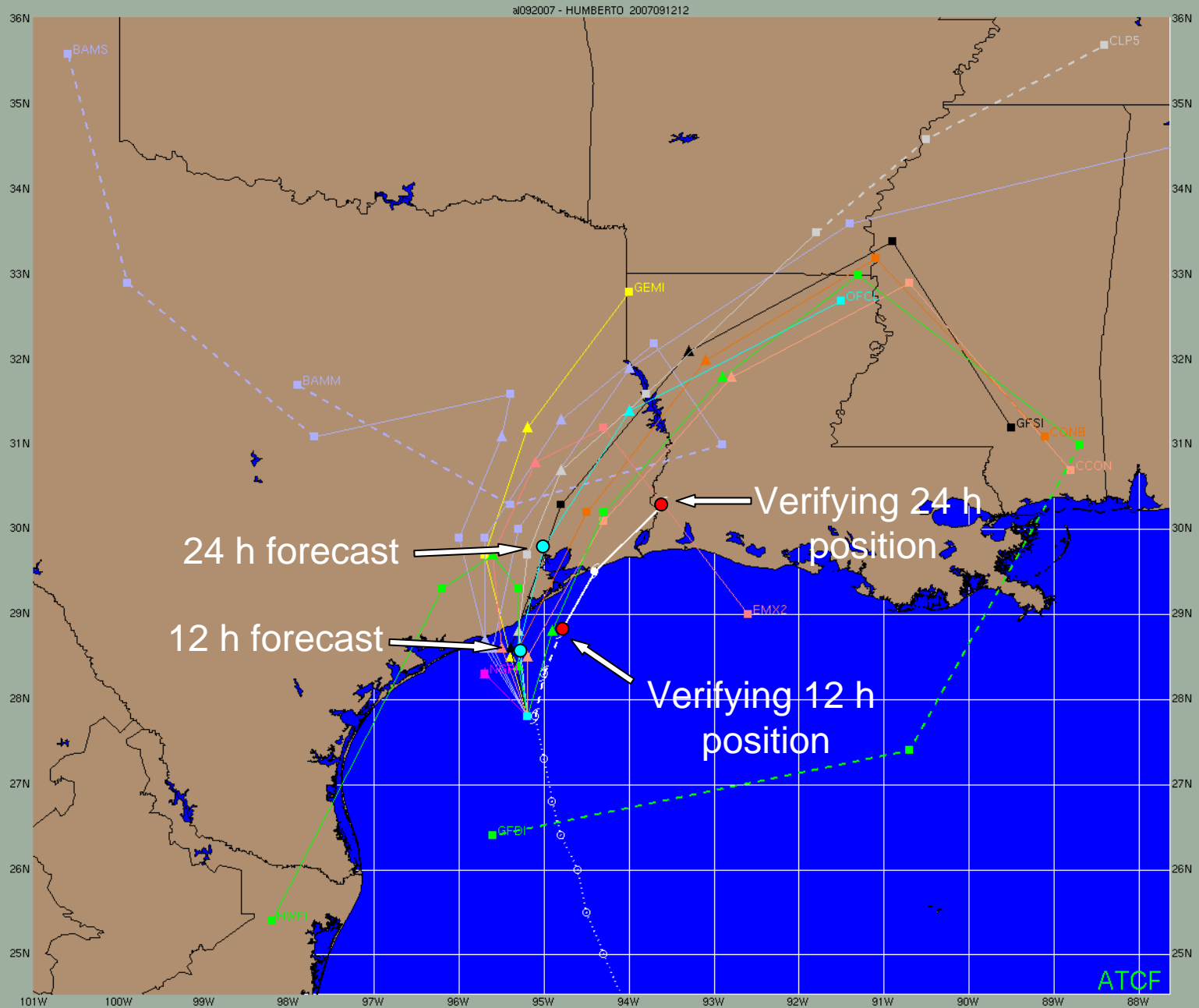
Warnings: **Tornado** **Severe Thunderstorm** **Flash Flood** **Special Marine**

# GFS 48-H SEA-LEVEL PRES. FCST FROM 9/10/07 1200 UTC



**THE GFS FAILED TO DEPICT THE GENESIS OF HURRICANE HUBERTO**

# Humberto Track Guidance For First Advisory

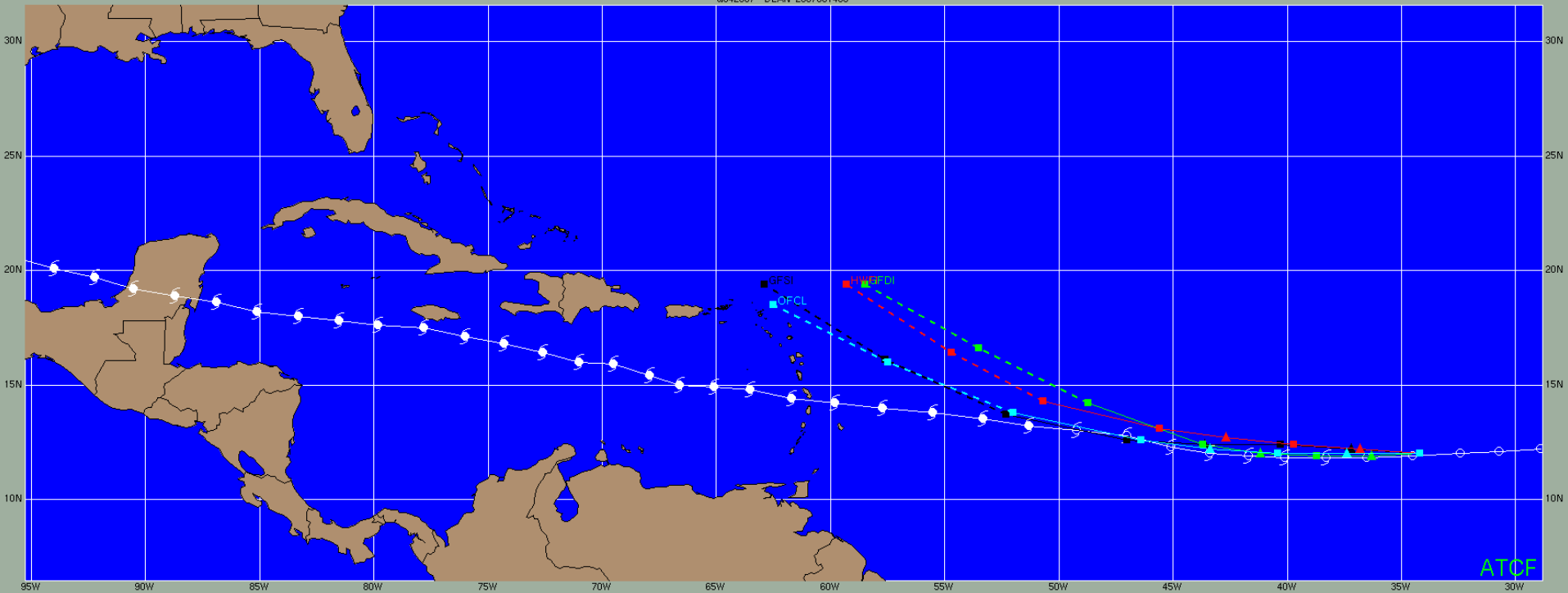




# NCEP Track Guidance and NHC Official Forecasts for Dean

## 14 August 0000 UTC

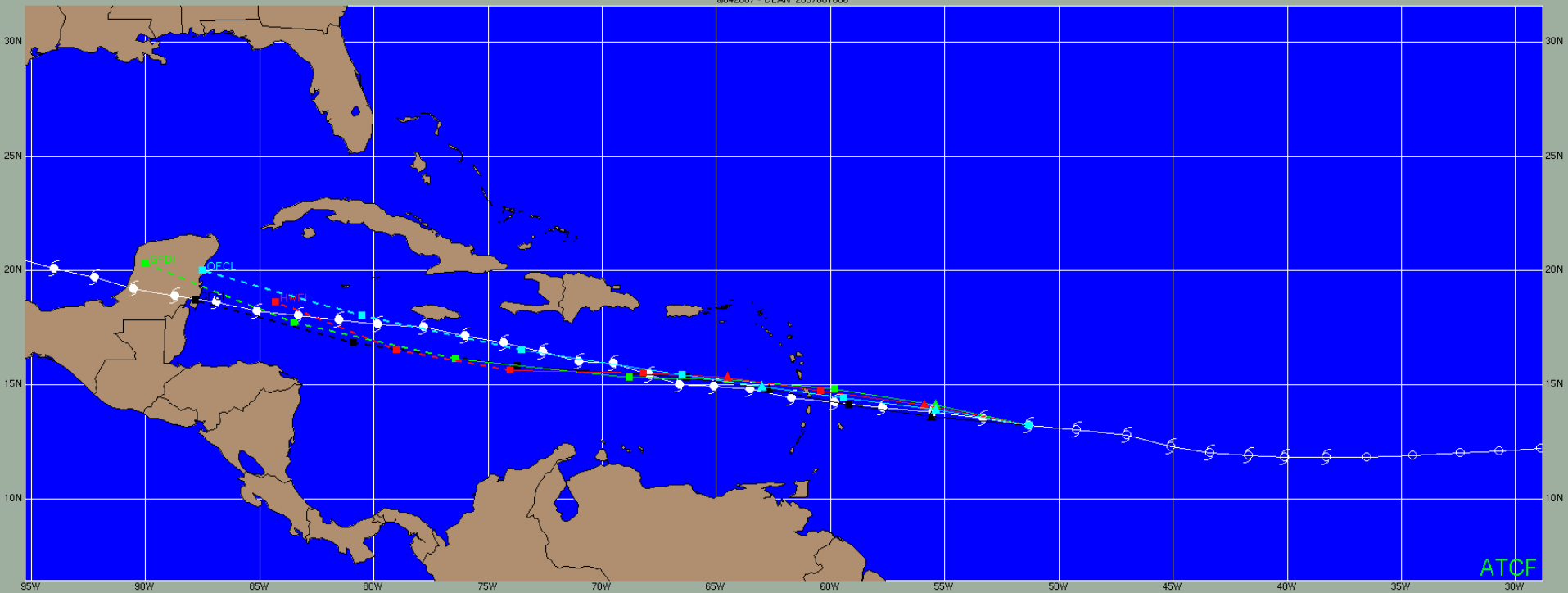
al042007 - DEAN 2007081400



# NCEP Track Guidance and NHC Official Forecasts for Dean

16 August 0600 UTC

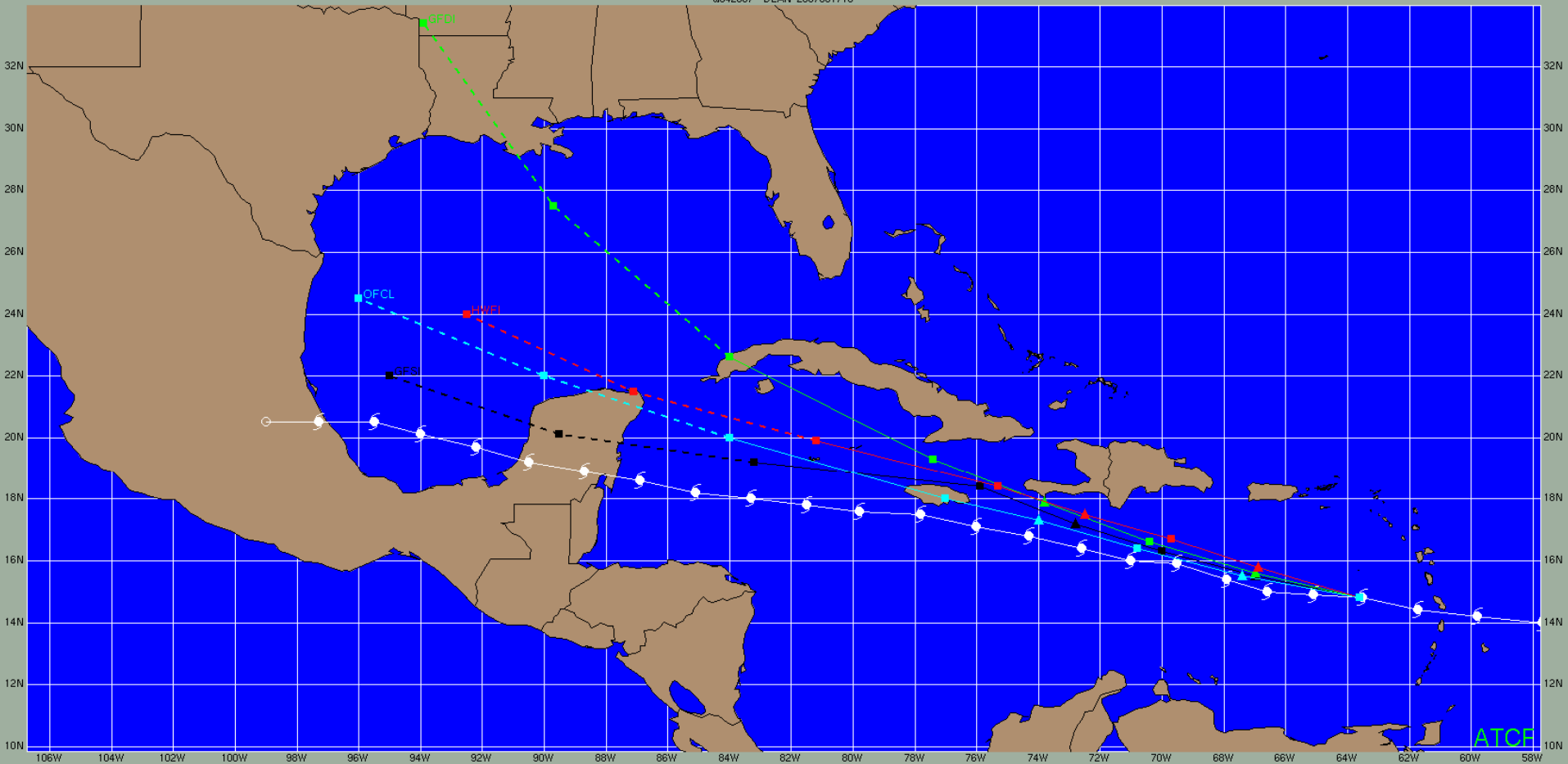
al042007 - DEAN 2007081606



# NCEP Track Guidance and NHC Official Forecasts for Dean

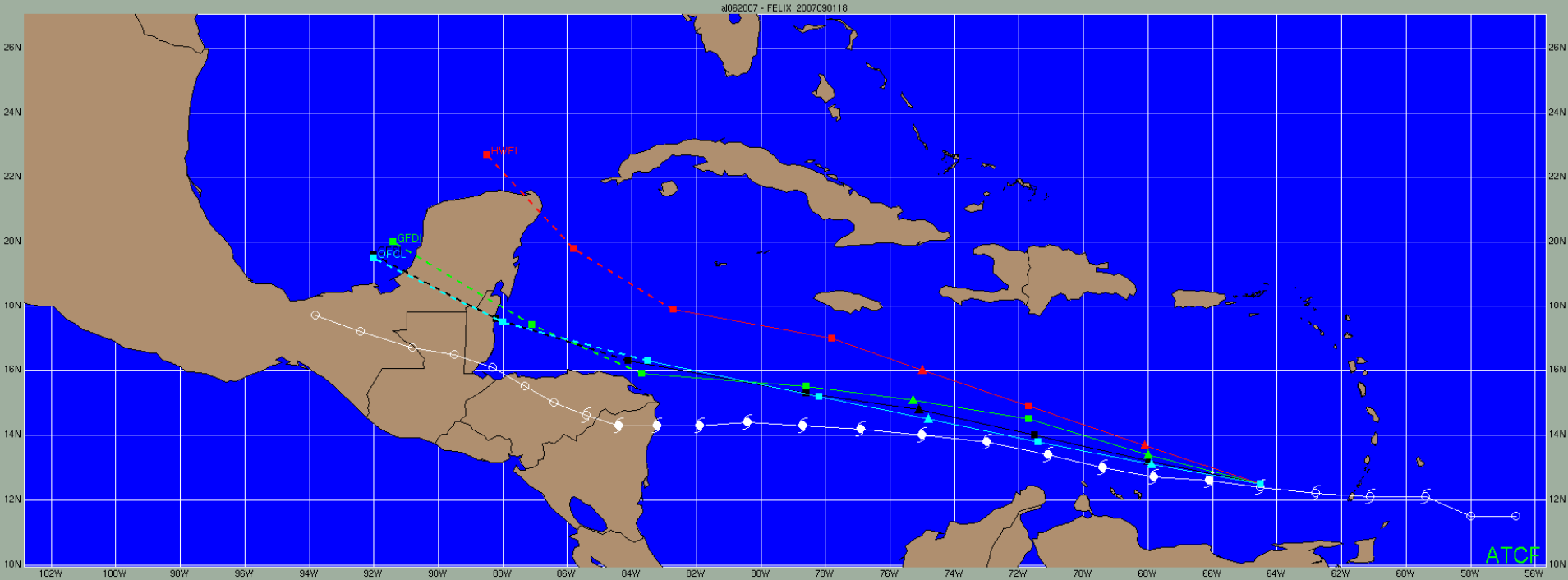
17 August 1800 UTC

al042007 - DEAN 2007081718



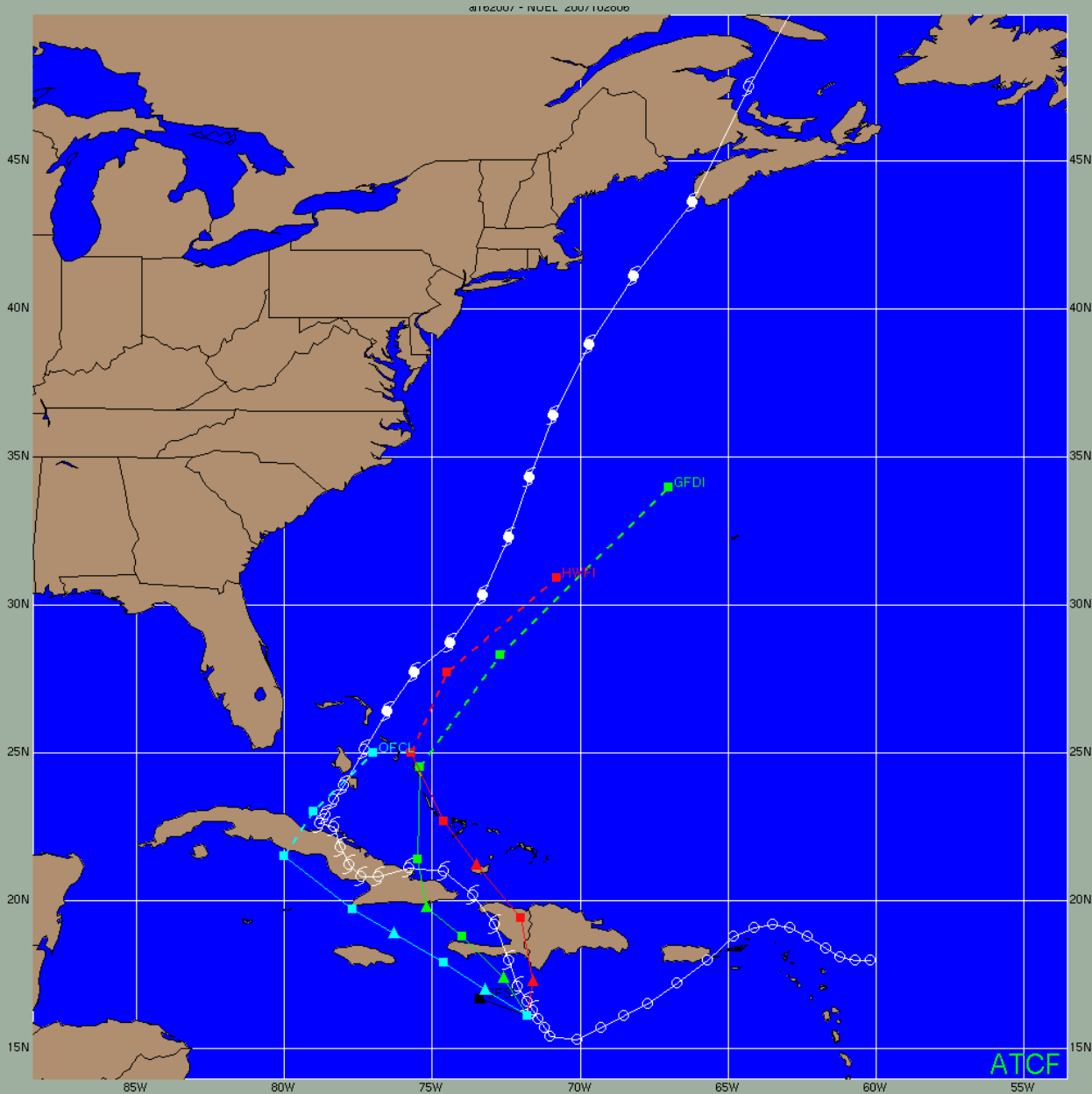
# NCEP Track Guidance and NHC Official Forecasts for Felix

1 September 1800 UTC

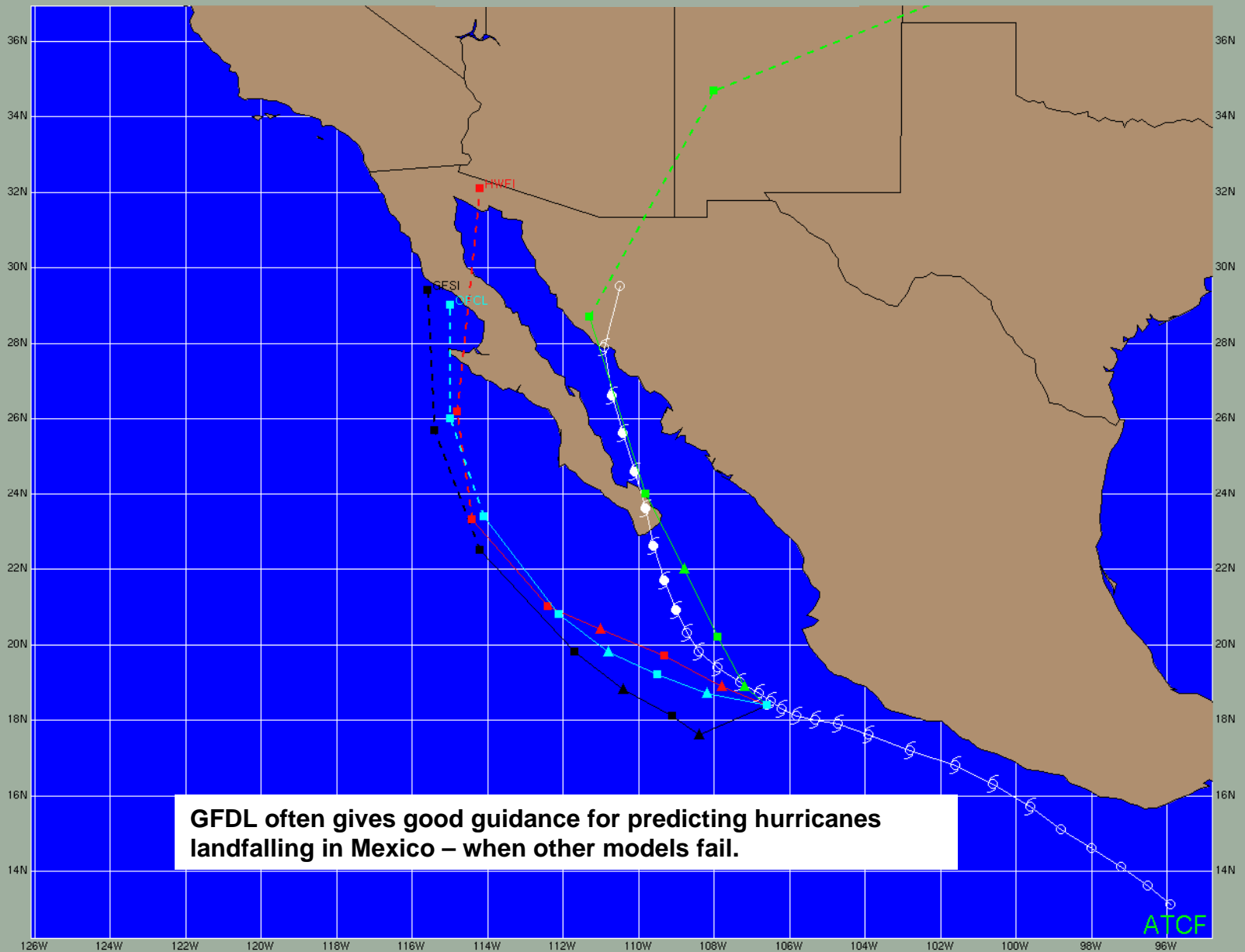


# NCEP Track Guidance and NHC Official Forecasts for Noel

## 28 October 0600 UTC



# NCEP Track Guidance and NHC Official Forecasts for Henriette 2 September 0600 UTC



**GFDL often gives good guidance for predicting hurricanes landfalling in Mexico – when other models fail.**

ATCF

# Kiko

17 Oct 2007

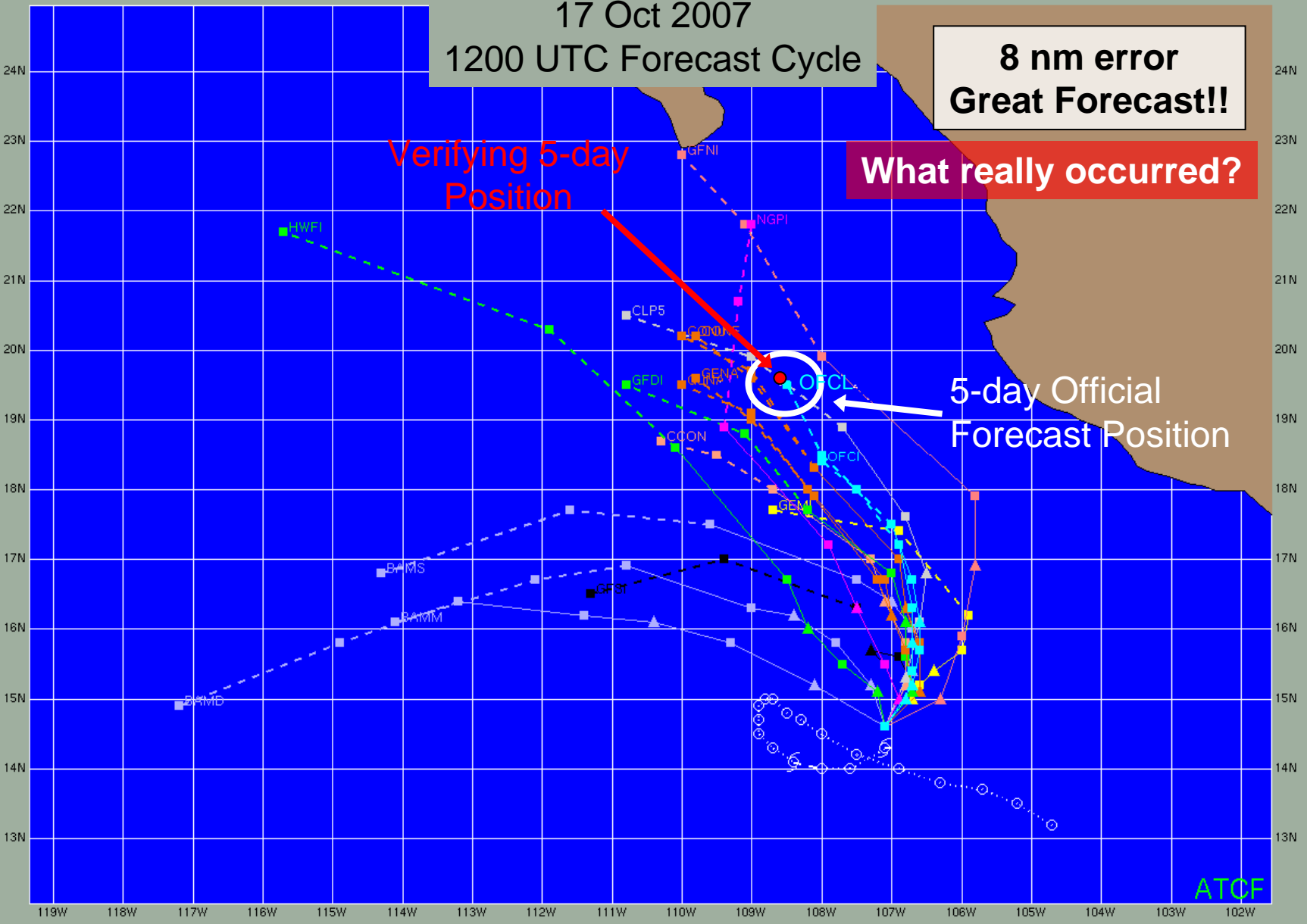
1200 UTC Forecast Cycle

**8 nm error  
Great Forecast!!**

**What really occurred?**

**Verifying 5-day  
Position**

**5-day Official  
Forecast Position**



ATCF

# Kiko

17 Oct 2007

1200 UTC Forecast Cycle

**8 nm error  
Great Forecast!!**

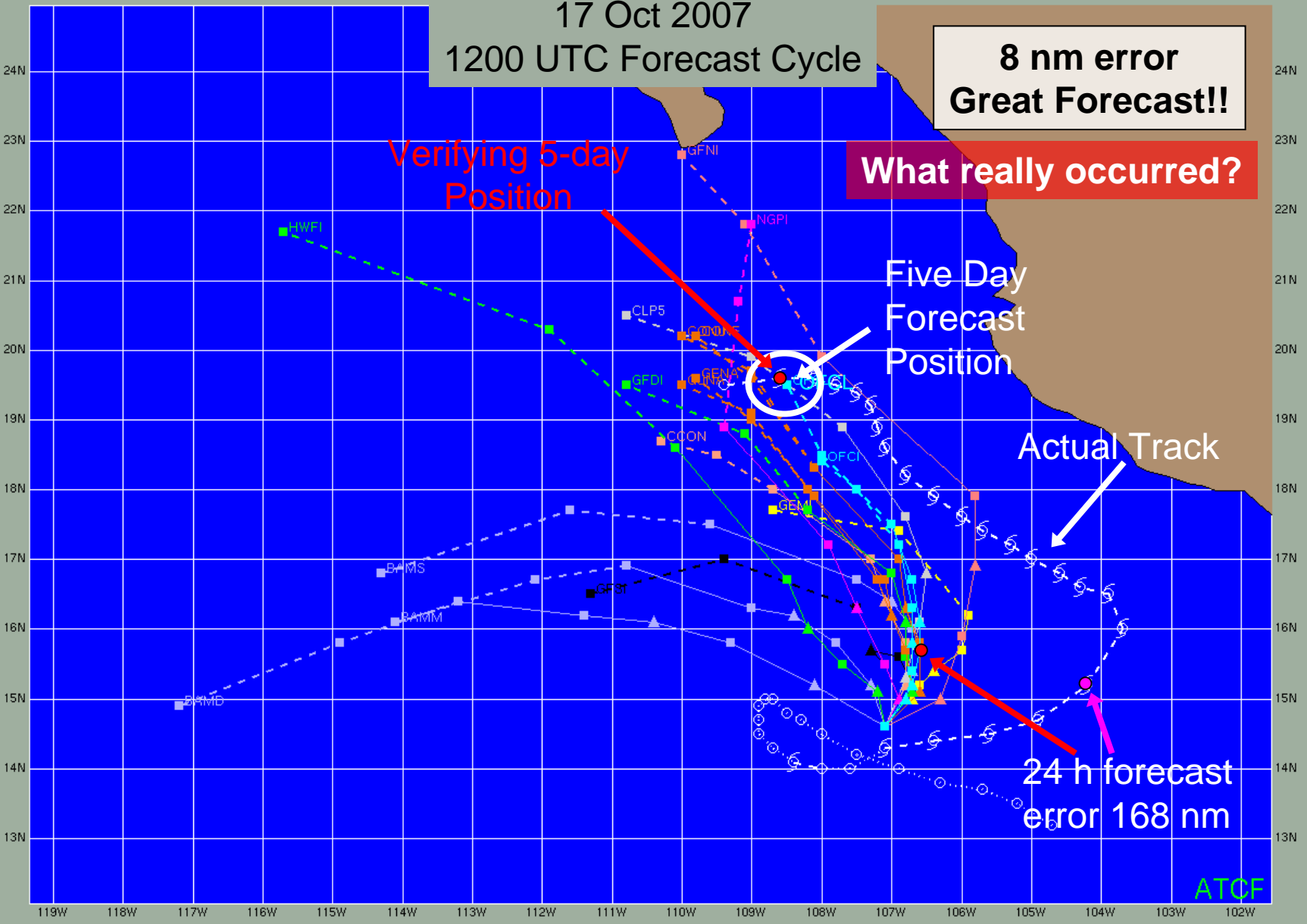
**What really occurred?**

Verifying 5-day  
Position

Five Day  
Forecast  
Position

Actual Track

24 h forecast  
error 168 nm

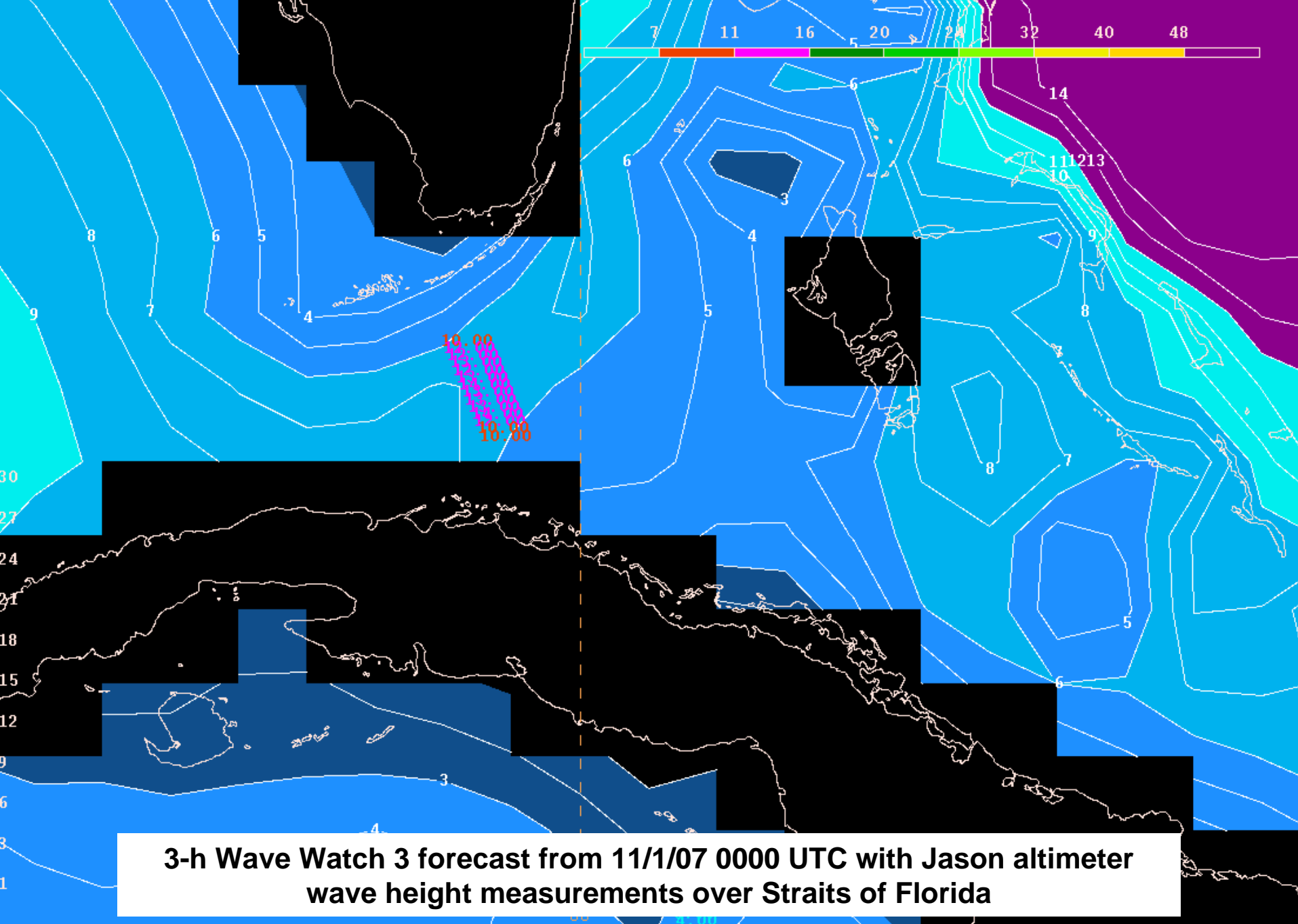


ATCF



# **From the Tropical Analysis and Forecast Branch (TAFB):**

- **Wave Watch model (WW3) still underforecasts wave heights behind Gulf of Mexico cold fronts (partially due to erroneous surface wind forecasts by the GFS)**
- **Problem with WW3 overestimating wave height and period over eastern Caribbean appears to have been mostly fixed**
- **Happy with the newly-implemented Multi-Grid WW3 output; it provides an efficient way to view the regional- and larger-scale wave forecasts on a single map**
- **WW3 had some problems with wave forecasts over Straits of Florida during Noel**
- **GFS continues to under-forecast 10-m winds in East Pacific gap wind and funneled wind events (e.g. Gulf of Tehuantepec/Sea of Cortez)**
- **Average 10-m winds 5-10 kt too low in significant wind events**



**3-h Wave Watch 3 forecast from 11/1/07 0000 UTC with Jason altimeter wave height measurements over Straits of Florida**

# TPC/NHC's "Wish List"

- Continue to run GFDL Hurricane Model
- Capability to run HWRF and GFDL on up to 5 systems per forecast cycle for TPC/NHC & CPHC combined
- High-resolution hurricane model ensembles
- More tests of data impacts on model TC forecasts
- NCEP Tropical Cyclone tracker run on high-resolution UKMET fields out to 120 h
- More collaboration (not just e-mail) between EMC, NCO, and TPC for evaluation of model changes

# Acknowledgements to:

**James Franklin, Rick Knabb, Dan Brown,  
Jiann-Gwo Jiing, Michelle Mainelli,**

**and**

**My Other Colleagues at the TPC/NHC**

