

# **The Halloween Nor'easter of 1991**

## **The No-Name Storm**

## **The Perfect Storm**

## **The Killer Storm**

Meteorological recollections

(condensed highlights)

Walter Drag

Formerly NWS BOS-BOX 1989-2010,  
since then, PHI

# Acknowledgements

**Frank Rosenstein- NMC extended branch**

**Numerous forecasters within and adjacent BOS**

**Natural Disaster Survey Report  
MPC-OPC for the imagery loops**

**Cardone et al (Evaluation of the Contemporary  
Ocean Wave models ...**

**Glenn Field and staff for tirelessly copying data  
for this presentation**

# Acknowledgements

NCEI (CWC): Meteorologists Scott Stevens and Axel Graumann IR satellite imagery to support John Spillane's encountered highly adverse conditions

ECMWF: Tim Hewson for the ECMWF N. American forecast imagery from 12z 10/25

Bill Babcock WFO BOX – CHH RAOB

Mitchell Gaines – Met intern PHI for some ppt guidance

Mathieu Ouellet Oceans Science Branch  
Fisheries and Oceans Canada (44137,44139)

Joseph M. Sienkiewicz Chief, Ocean Applications Branch,  
**NOAA/NWS Ocean Prediction Center**

# Overview

Western Atlantic from the Maritimes to FL and Puerto Rico  
(10/28-11/1)

\*surge and coastal flooding (BOS worst Wed aftn Oct 30, CT-NY-NJ morning 31<sup>st</sup>, MD-VA-NC afternoon 31st). Lost homes, lengthy road closures-infrastructure damage and multiple high tide cycles of tidal flooding to varying degrees (w little of the typical preceding rains).

YET: NCDC CPI adjusted does not rank this storm in its yearly table 1980- (Katrina #1 153B, Sandy #2 68B, Andrew #3 46B, various droughts & floods, Matthew 20B, Bob 2.7B, est 1938 5B)

\*HOWEVER: MARINE was the much bigger story...USCG SAR 75 mariners in distress. (13 deaths including 8 at sea)

# The ANDREA GAIL



# Surge relationships

ET 33mb pressure drop (1" mercury) = 1ft surge

× Remainder surge is wind and Ekman transport

× Tropical (much tighter pressure gradient

× 25mb pressure drop (.75" mercury) = 3 ft surge

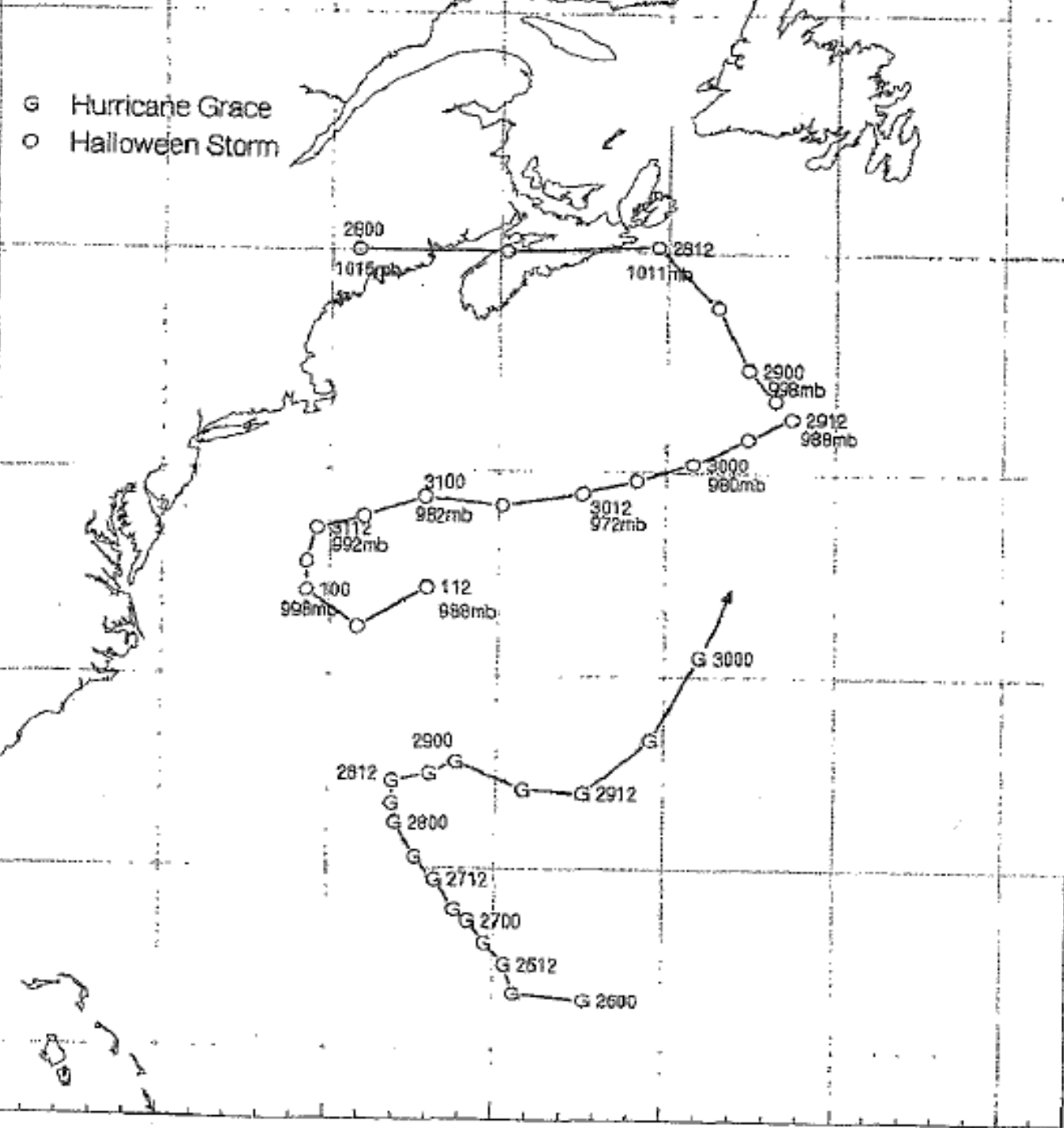
× 50mb pressure drop (1.5" mercury) = 6.5 surge

× 100mb pressure drop (3" mercury) = 14 ft surge

× Remainder surge is wind and Ekman transport

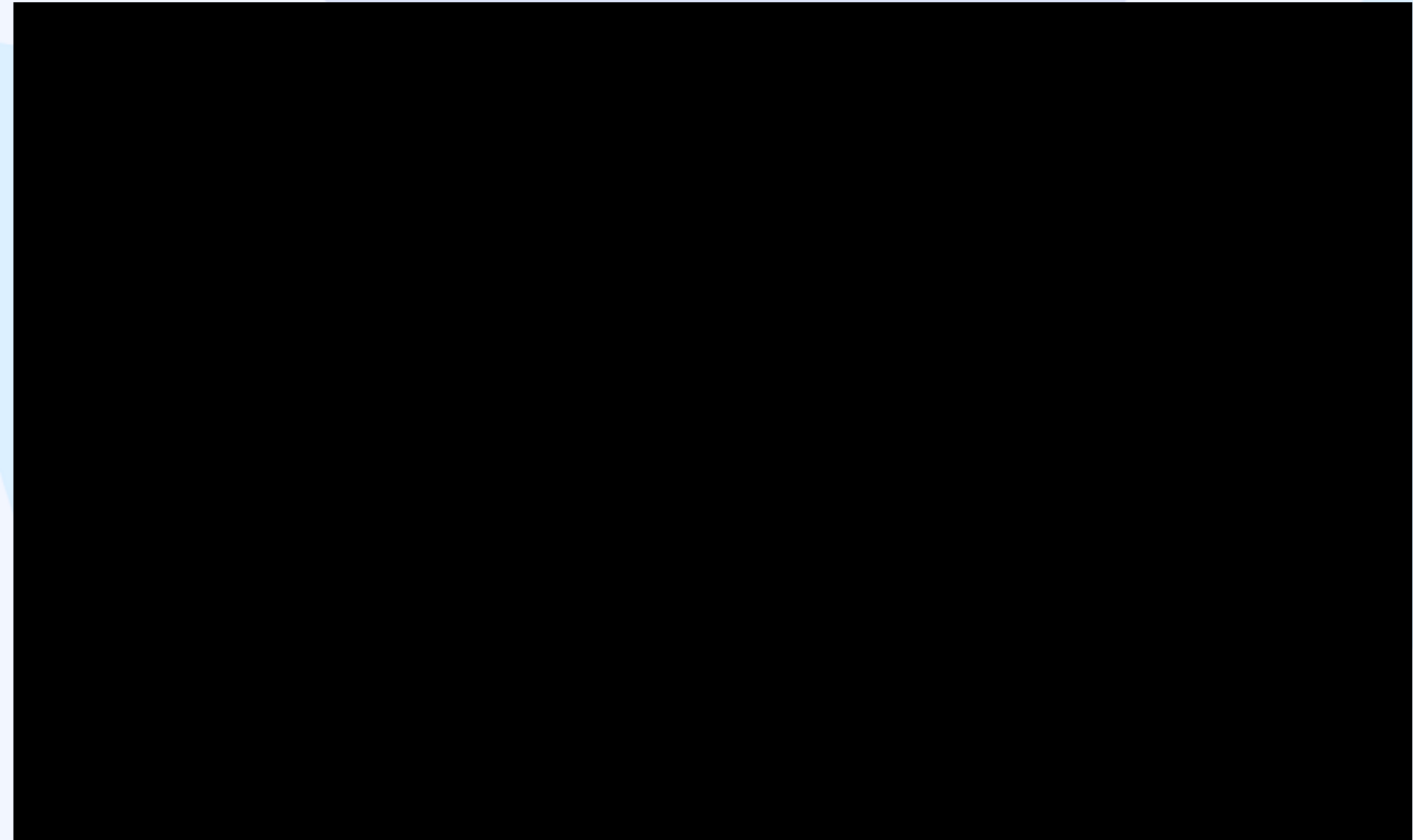
Bays and inlets with special enhancements wind related.

G Hurricane Grace  
 O Halloween Storm



SUN 10/2  
 MON 10/2  
 TUE 10/2  
 WED 10/3

# Satellite loop 55 sec-1:55



# Loop 925MB left 500MB right

[www.opc.ncep.noaa.gov/perfectstorm/mpc  
\\_ps\\_js.shtml](http://www.opc.ncep.noaa.gov/perfectstorm/mpc_ps_js.shtml)

# Buoy comparison then and now

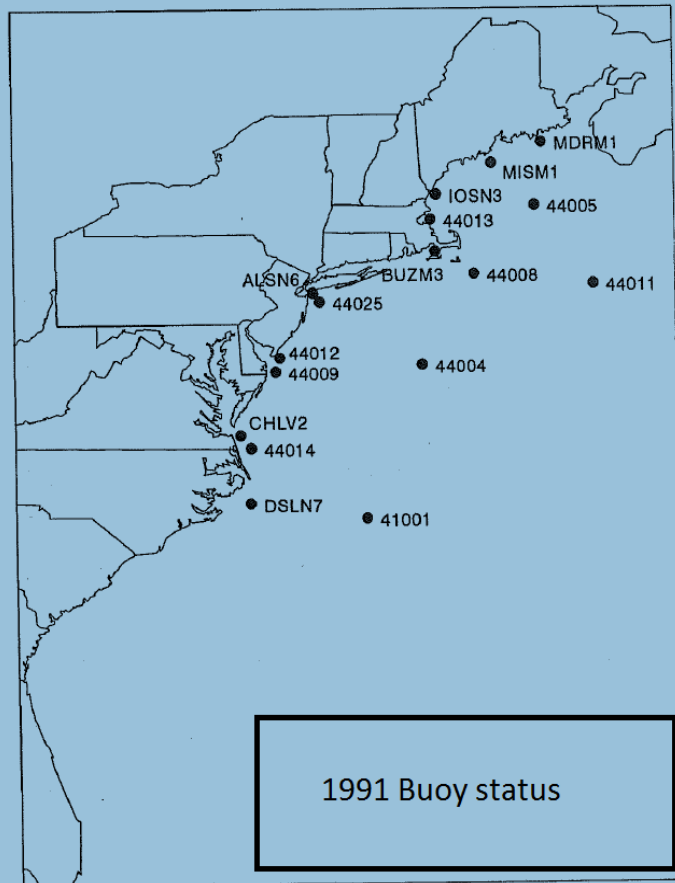
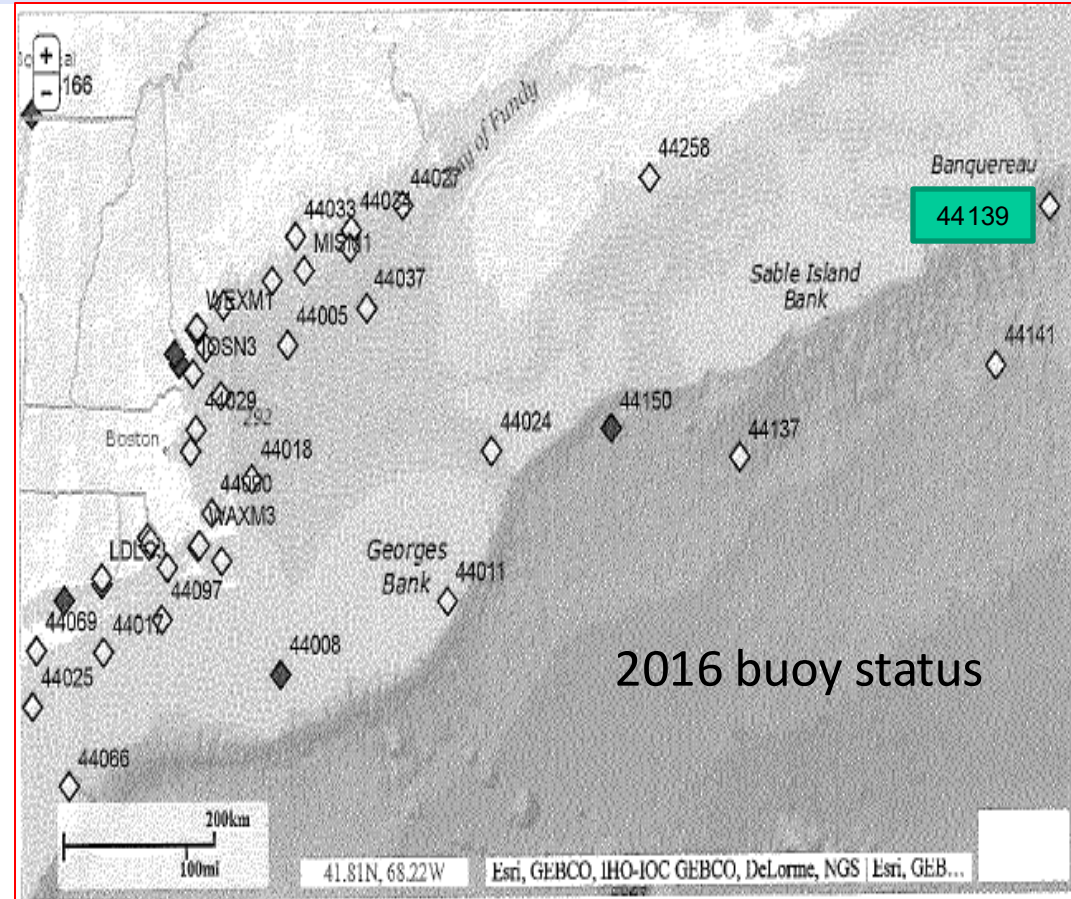


Figure 3. Buoy and C-MAN Stations - Mid-Atlantic and Northeast United States.



*Buoy documentation: Scotian plateau 44137 44139*

Peak sig WH exceeded 50 ft.

Max crest-trough amplitude near 100 ft, both PS & Superstorm of March 1993. (exceeded 100 year existing estimated design of wave ht by 50%)

Extreme storm waves are mathematically capable about 2X of highest third (sig wave height HS). Hindcasts validated!

Cardone Journal of Atmospheric and Oceanic Technology 1996 Vol 13 pp198, 201

Closer to home 44011, 44008, 44013

44011 <sub>41.1 66.6</sub> HS 39 15z/30 (170 E of HYA)  
(50g67kt)

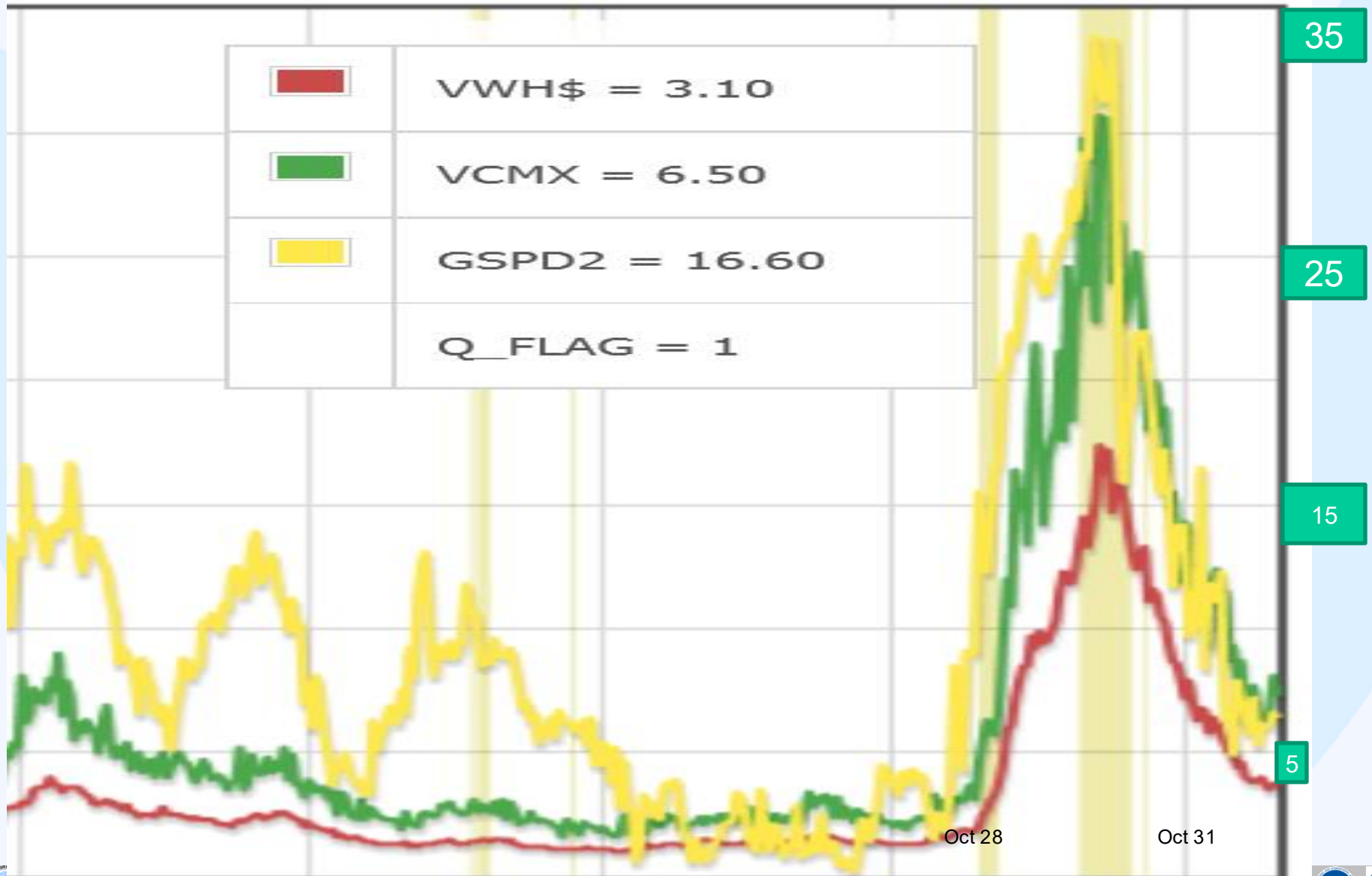
44008 <sub>40.5 69.5</sub> HS 31' 00z/31 (54 SE ACK)  
(53g67kt)

44013 <sub>42.4 70.6</sub> HS 30' 02z/31 (16E of BOS)  
(44G55kt)

Could have been worse along New England coast!!! Just like Sandy could have, along NJ-LI-CT coasts.

# 44137

East Scotian Slope **Sig WH (m)**, **Highest WH (m)**, **Gust (m/s)**



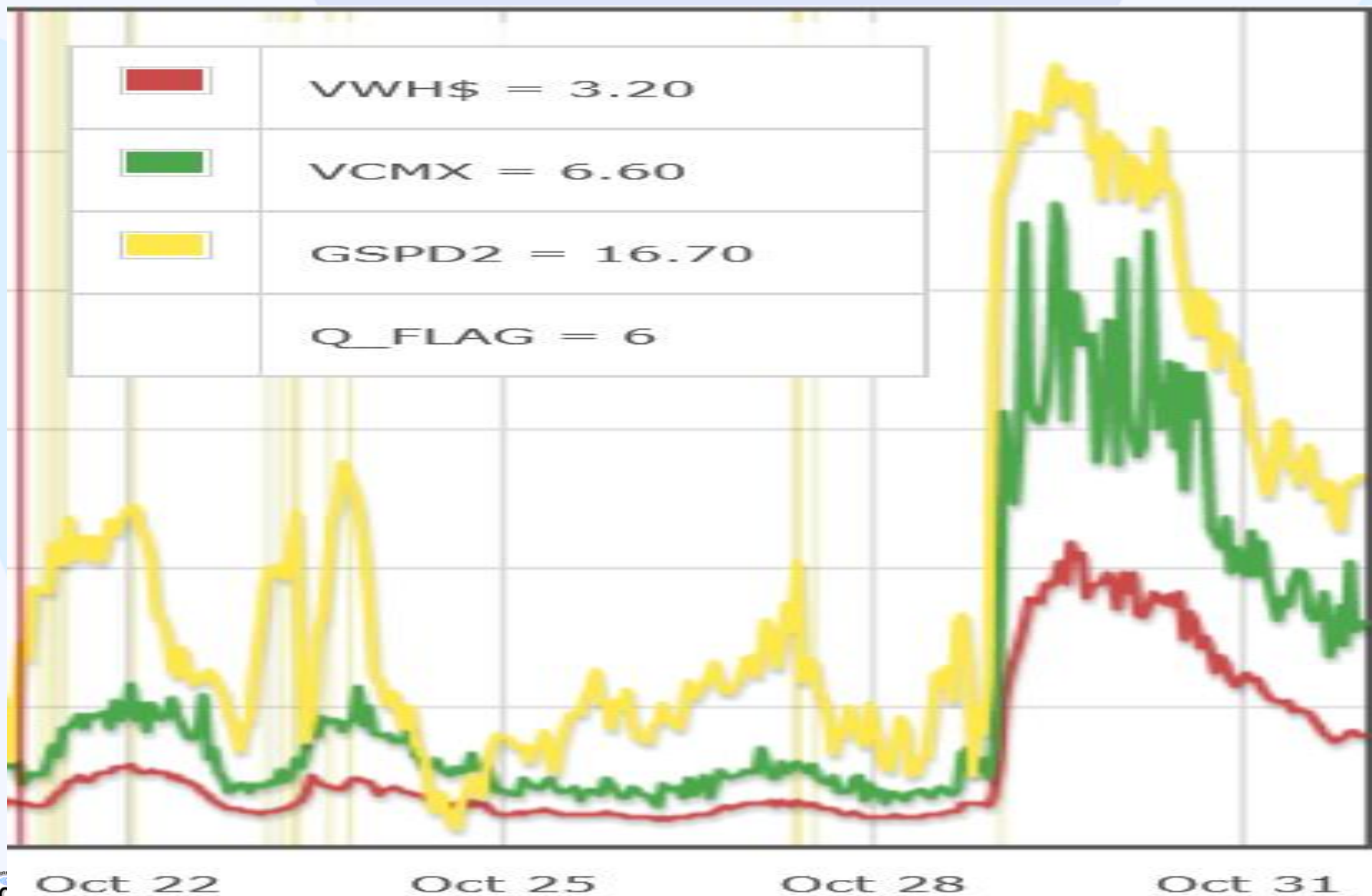
# 44139

x 23z/28      6 feet, max 11 feet G 38 kt

x 01z/29      20 feet, max 51 feet G48 kt

x The time section follows

**44139** (44.3N 57.3W) AG 44.0 56.6 Sig WH(m), Max WH(m) Gust(m/s)



# Andrea Gail possibilities

Hatch open (too much load), center of gravity shift, lost engine power?

Buoys show unusually rapid degradation of conditions from routine to violent to extreme. Winds and seas from the northeast or east , would have been on the stern of the westward heading Andrea Gail. Conditions changed explosively.

Vince Cardone diagnosed a low level jet that developed WSW in the NE flow and migrated at a resonance speed that would move with the swell it generated. Such resonance (trapped or dynamic fetch) would account for the extremely rapid degradation of seas.

# 12z/27 Sunday morning syn gradient

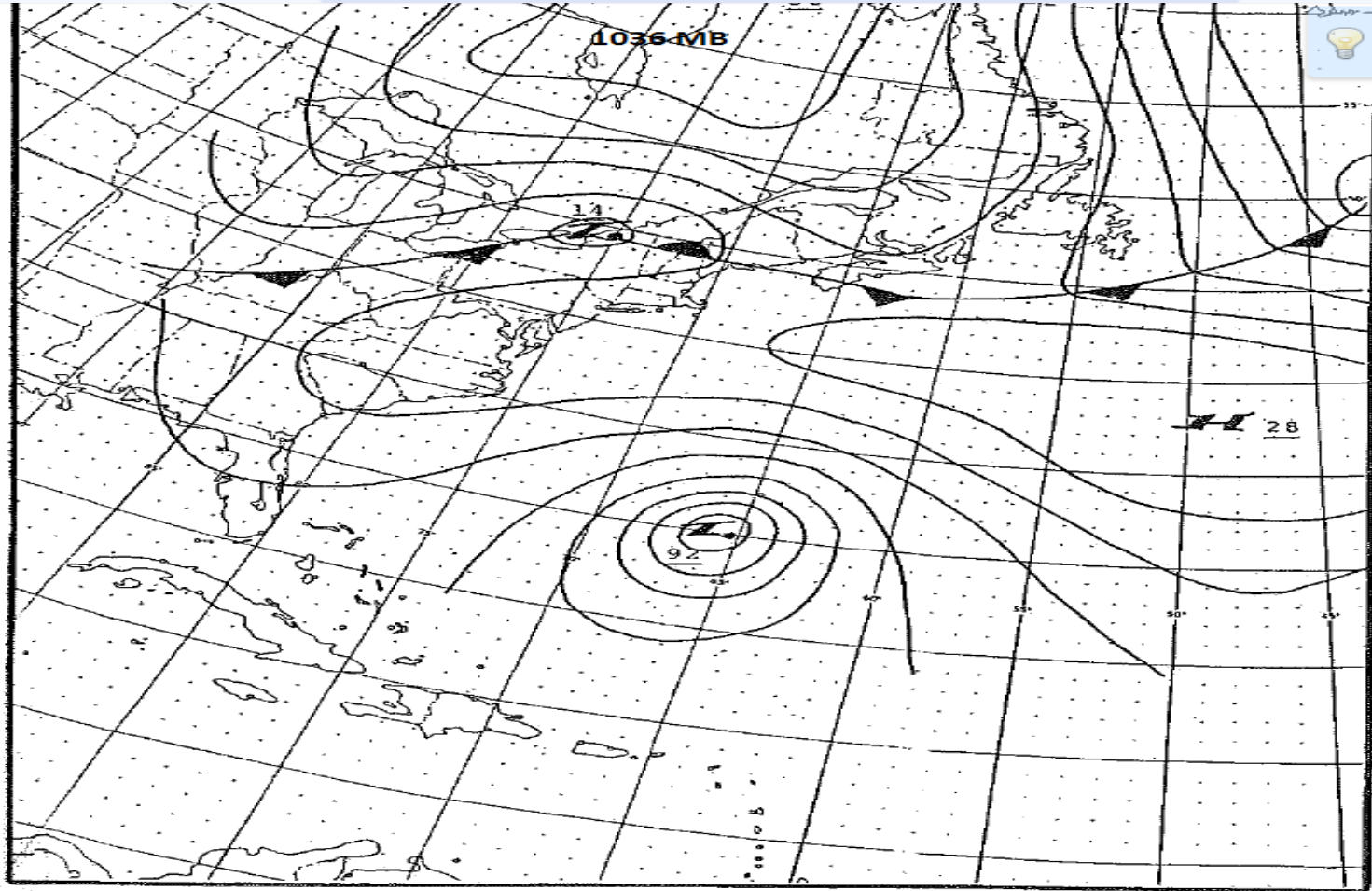


Figure 7. 1200 UTC Surface Analysis - 27 October 1991.

# 00z/28 - Sunday eve

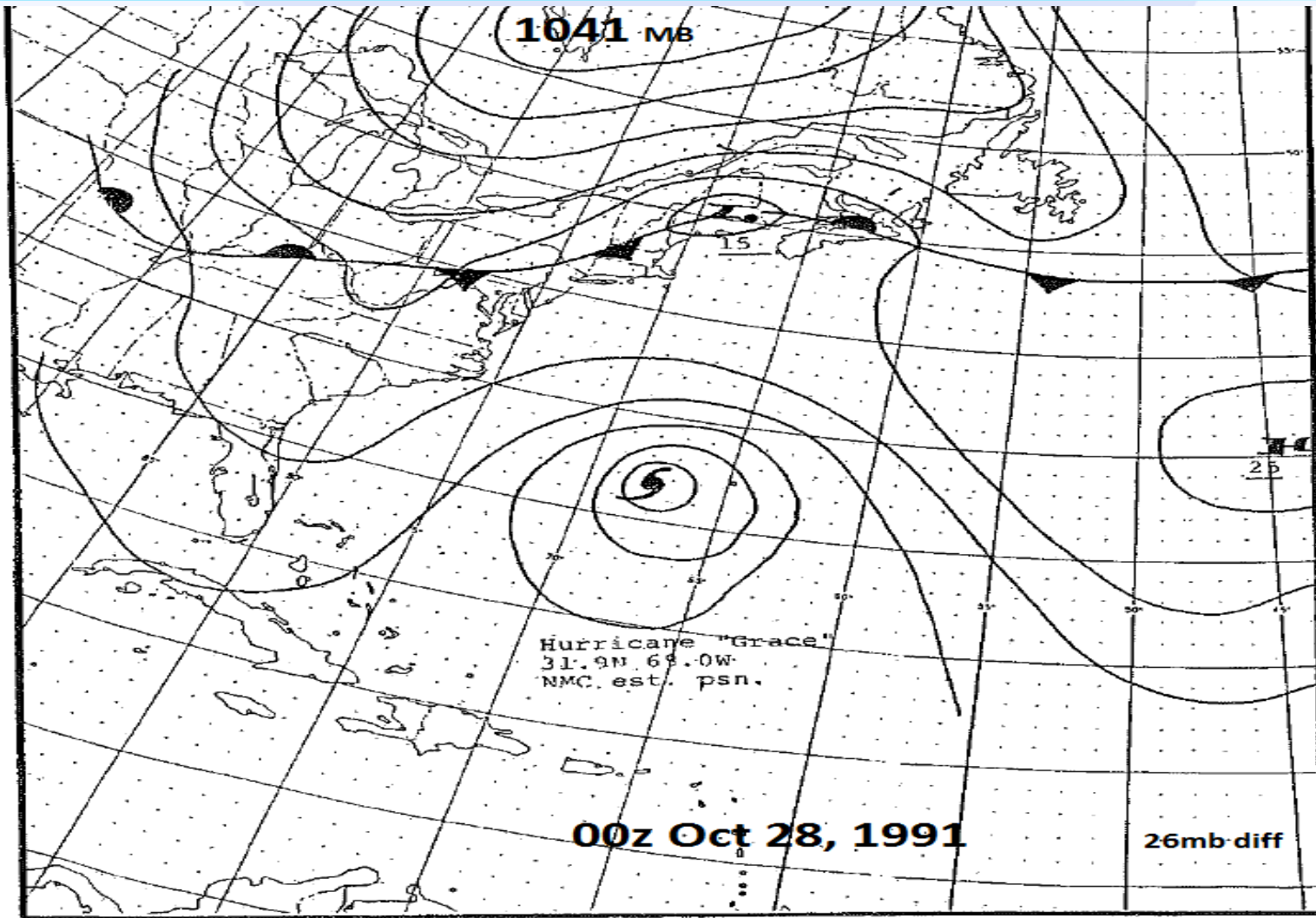
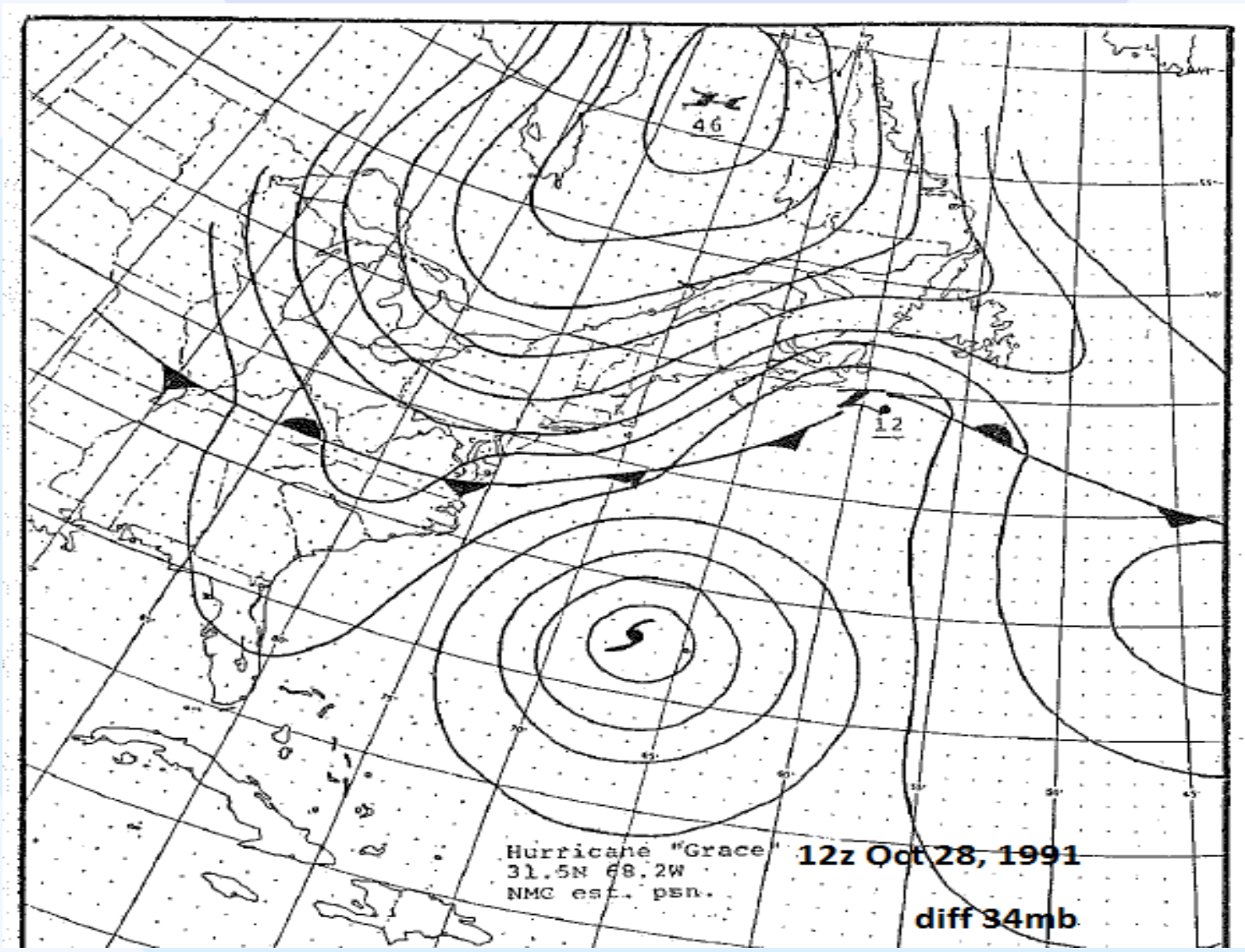
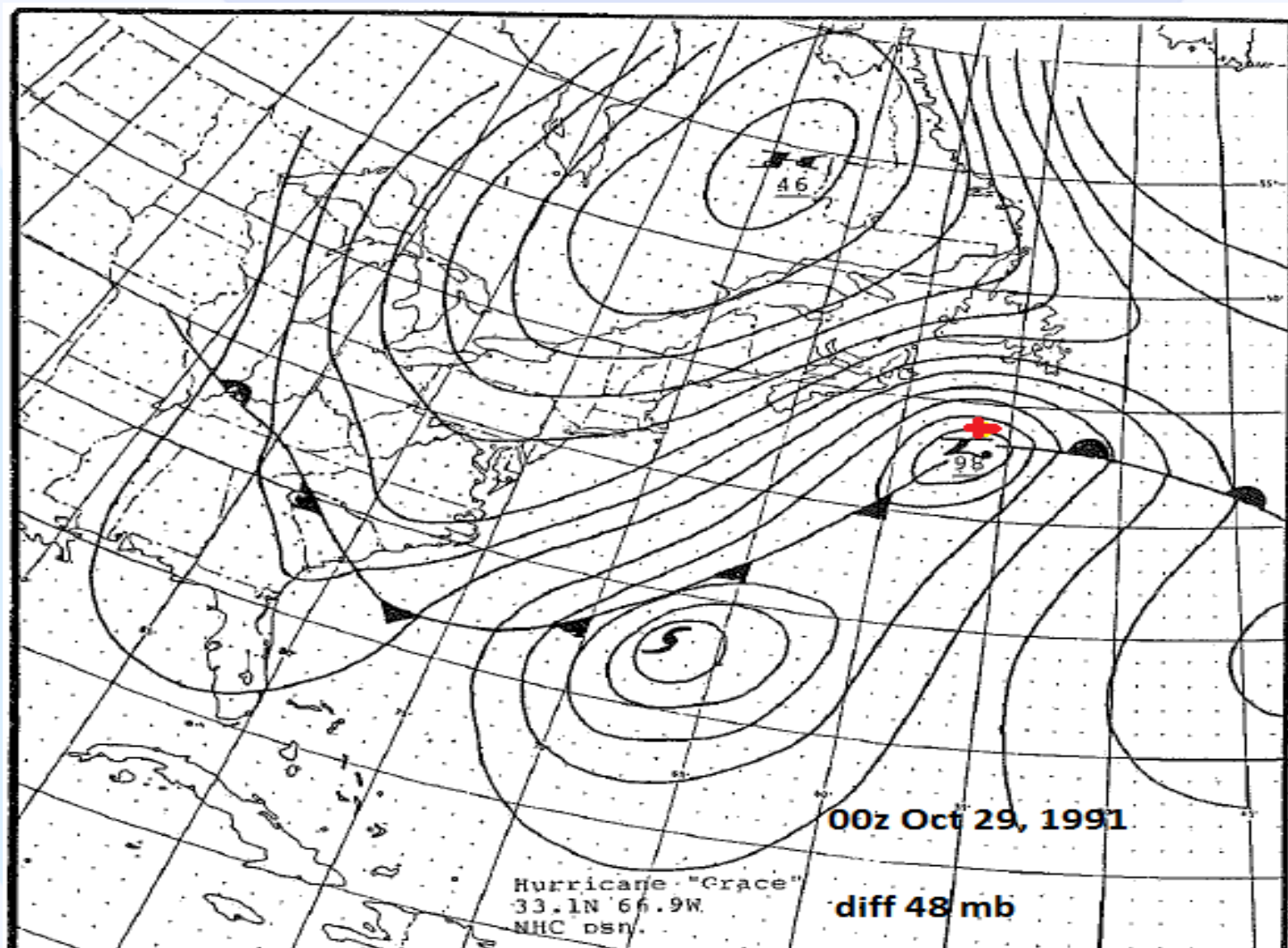


Figure 8. 0000 UTC Surface Analysis - 28 October 1991.

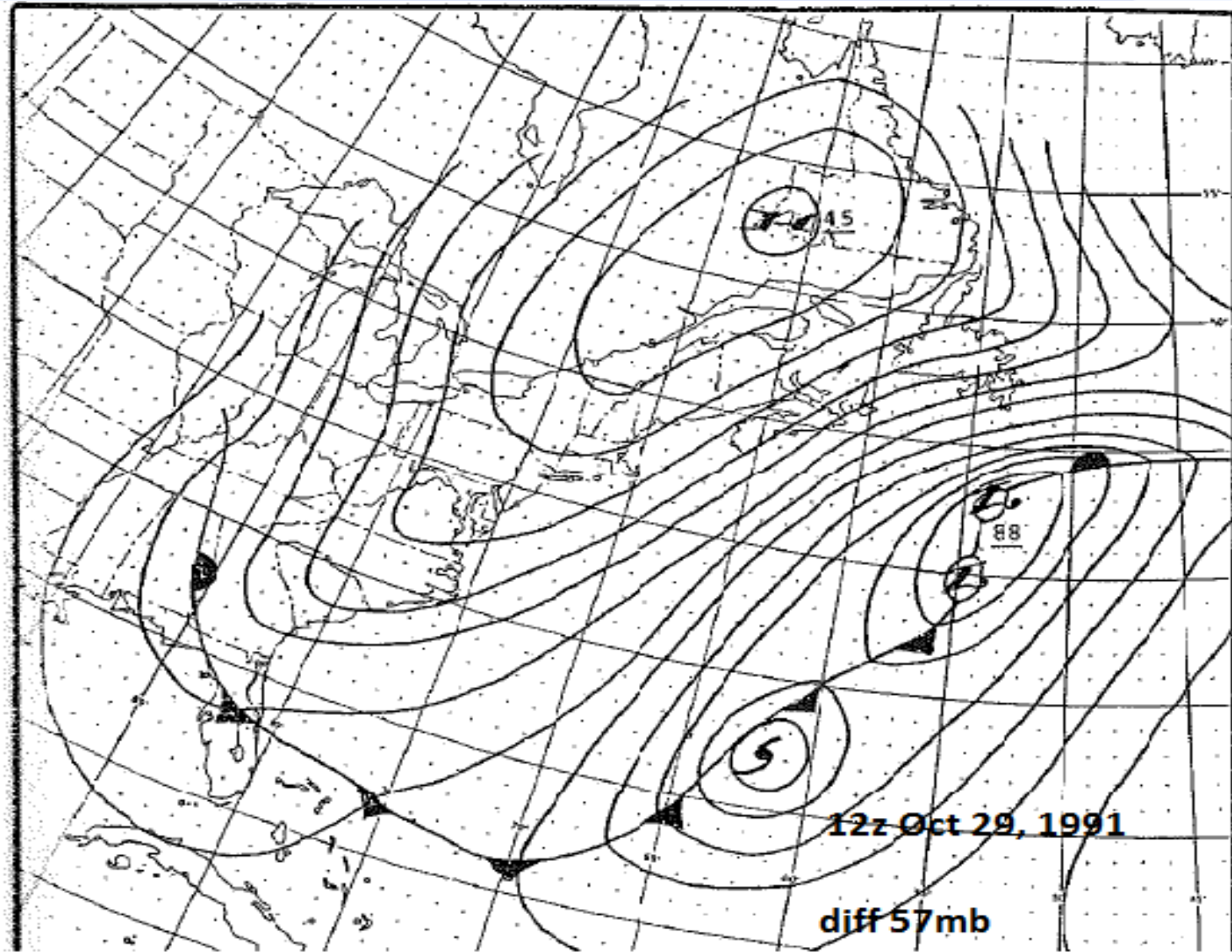
# 12z/28 Monday morning



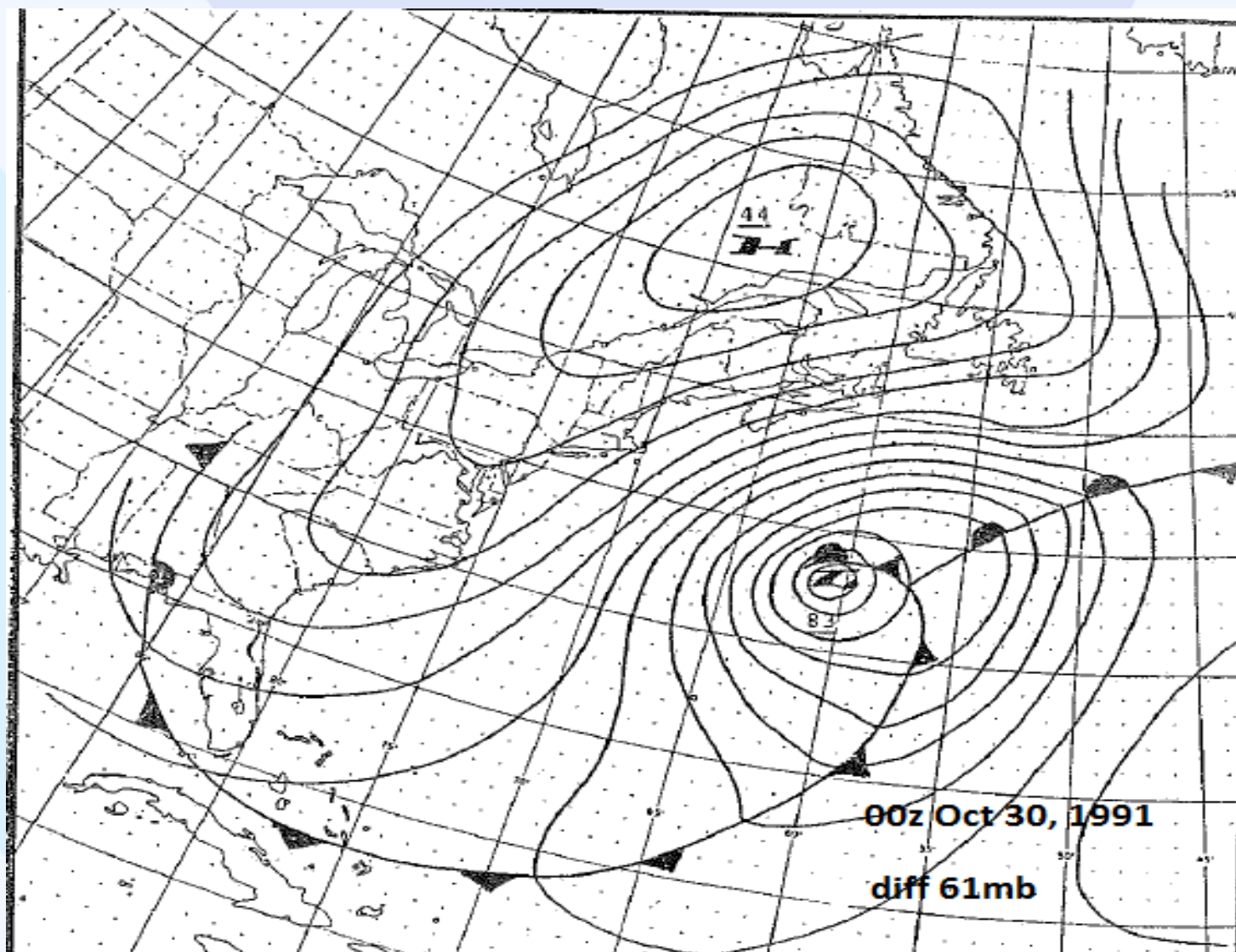
# 00z/29 Monday evening (AG lost 44/56)



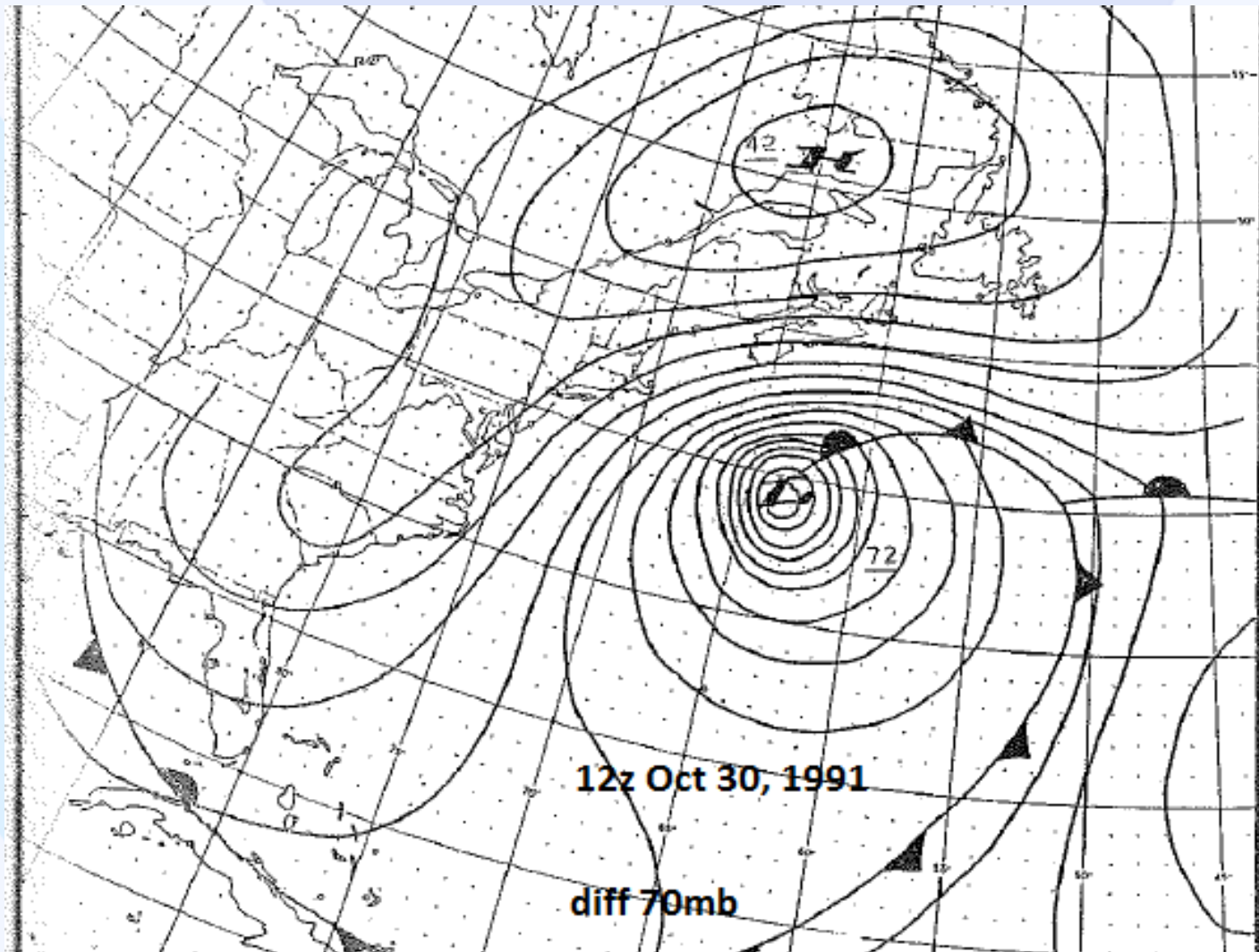
# 12z/29 Tuesday morning



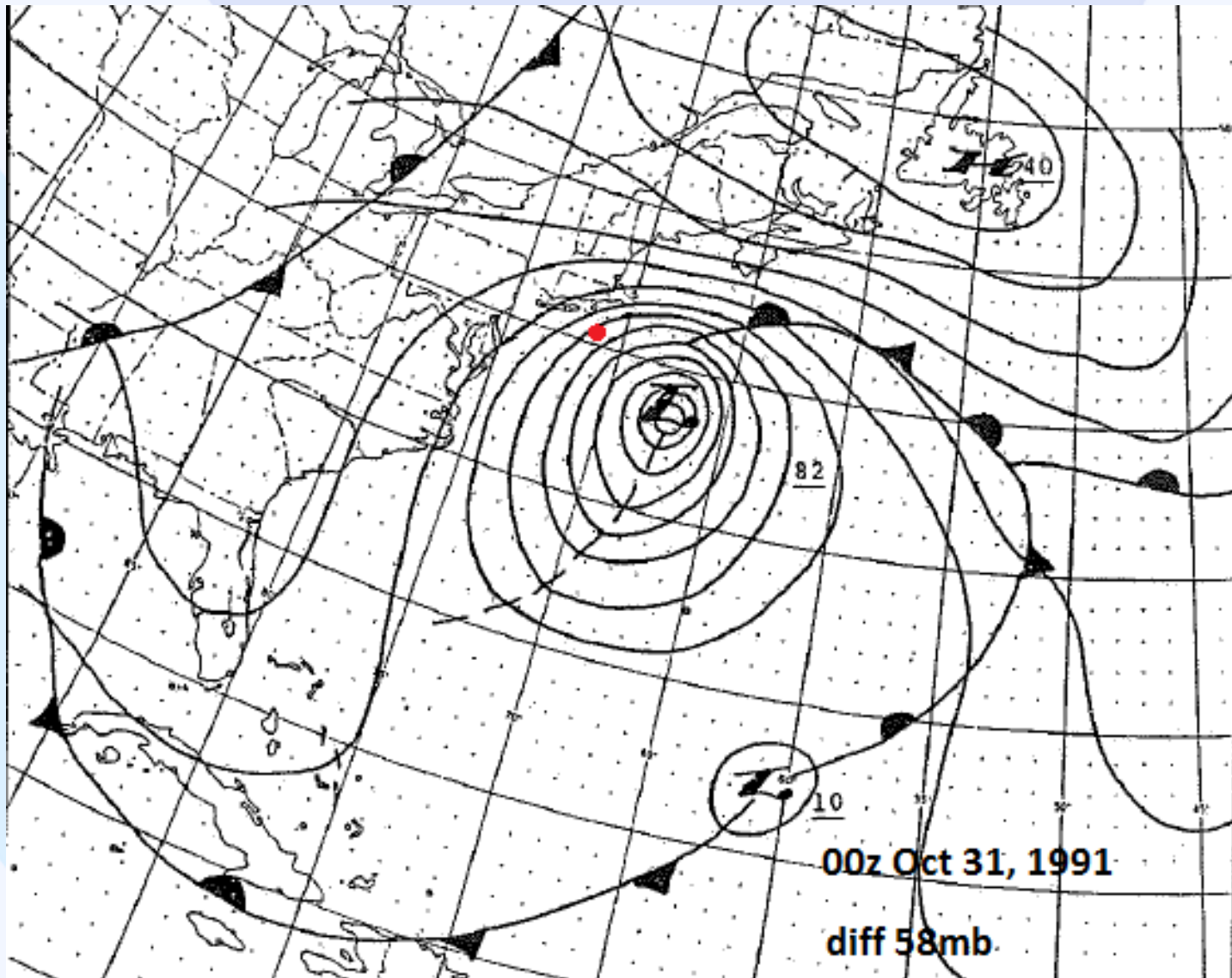
# 00z/30 Tuesday evening



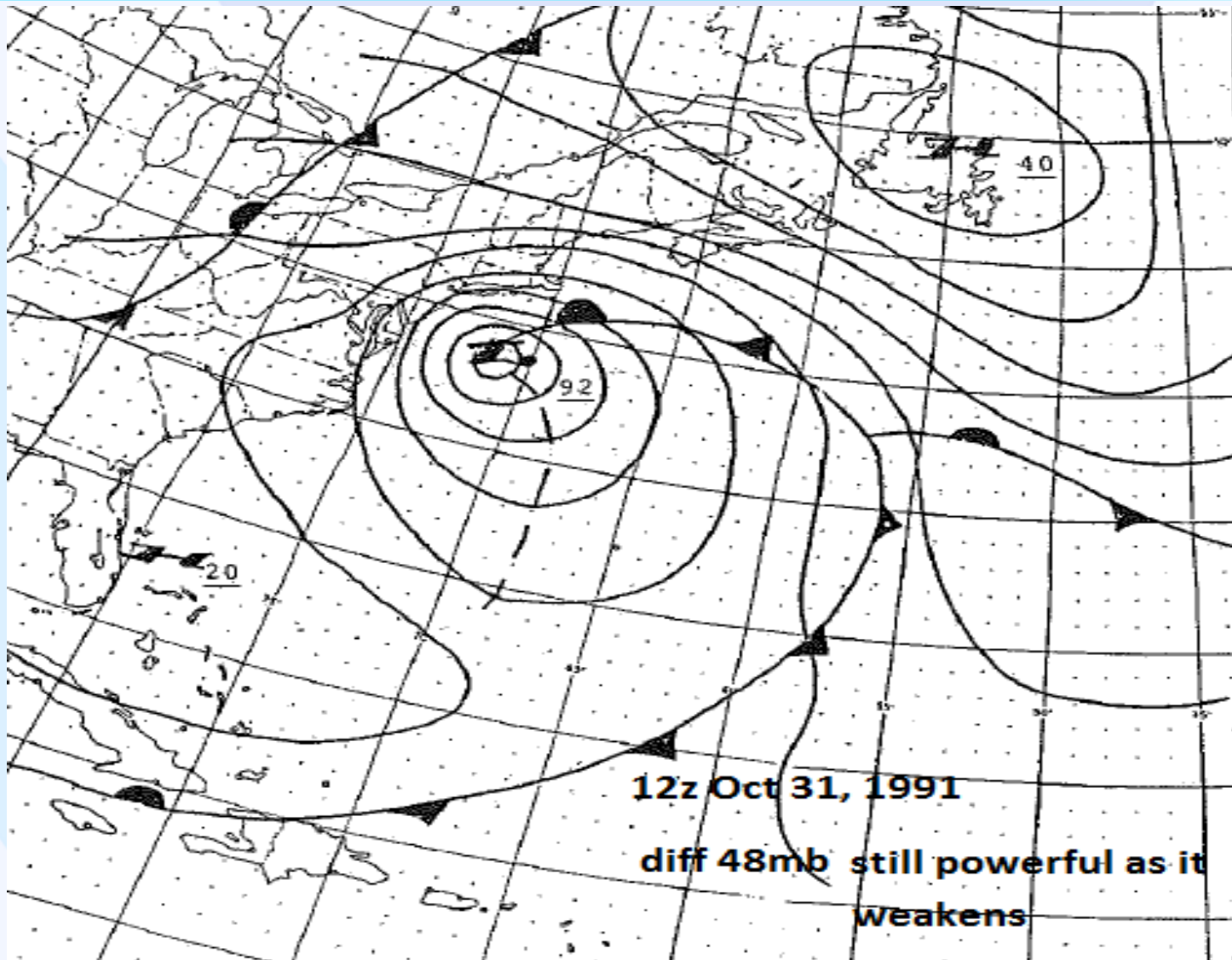
# 12z/30 Wednesday – our day



# 00Z/31 (Wed eve) – H60 ditch 60 se MTK

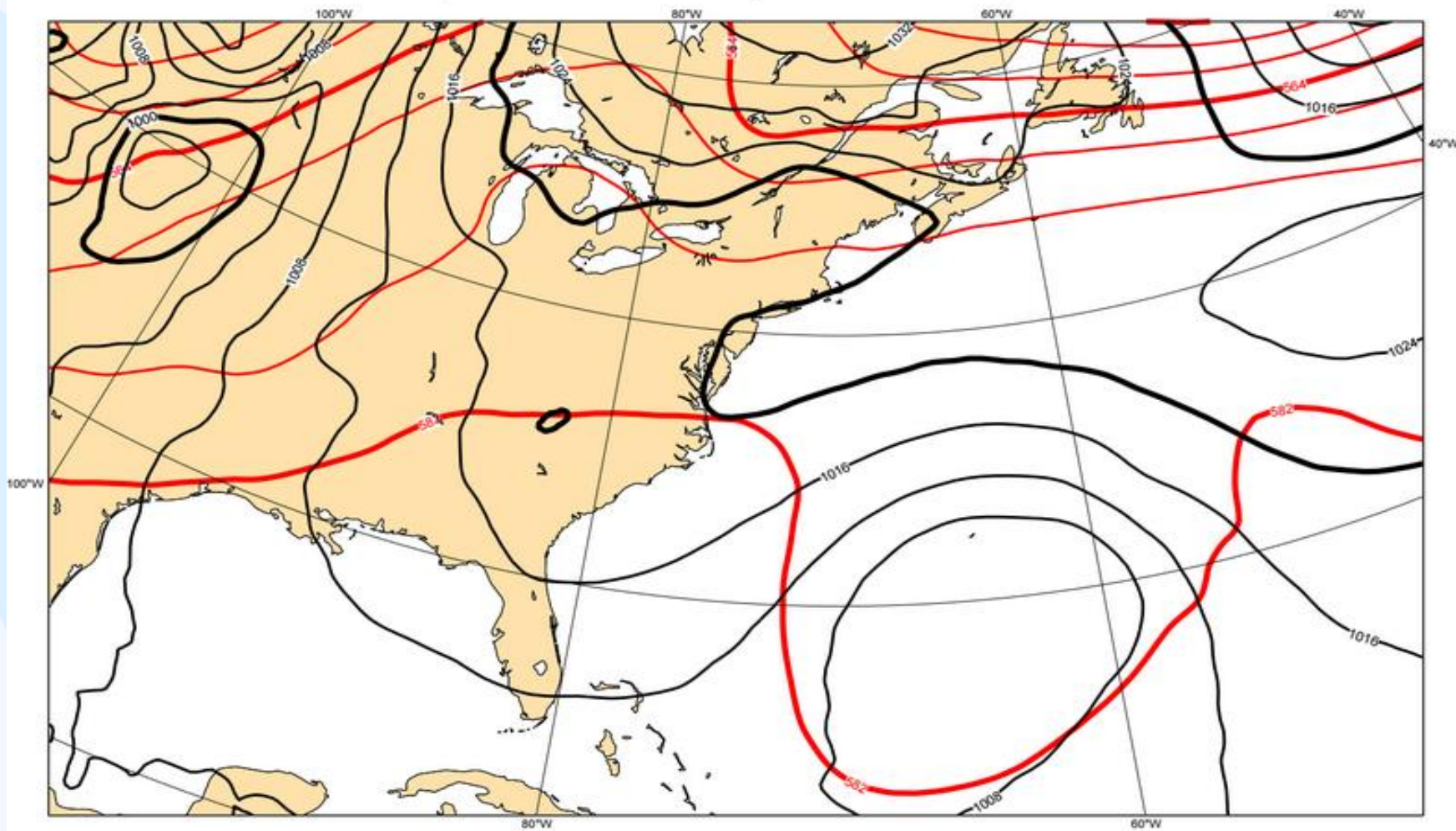


# 12z/31 (Thursday morning)



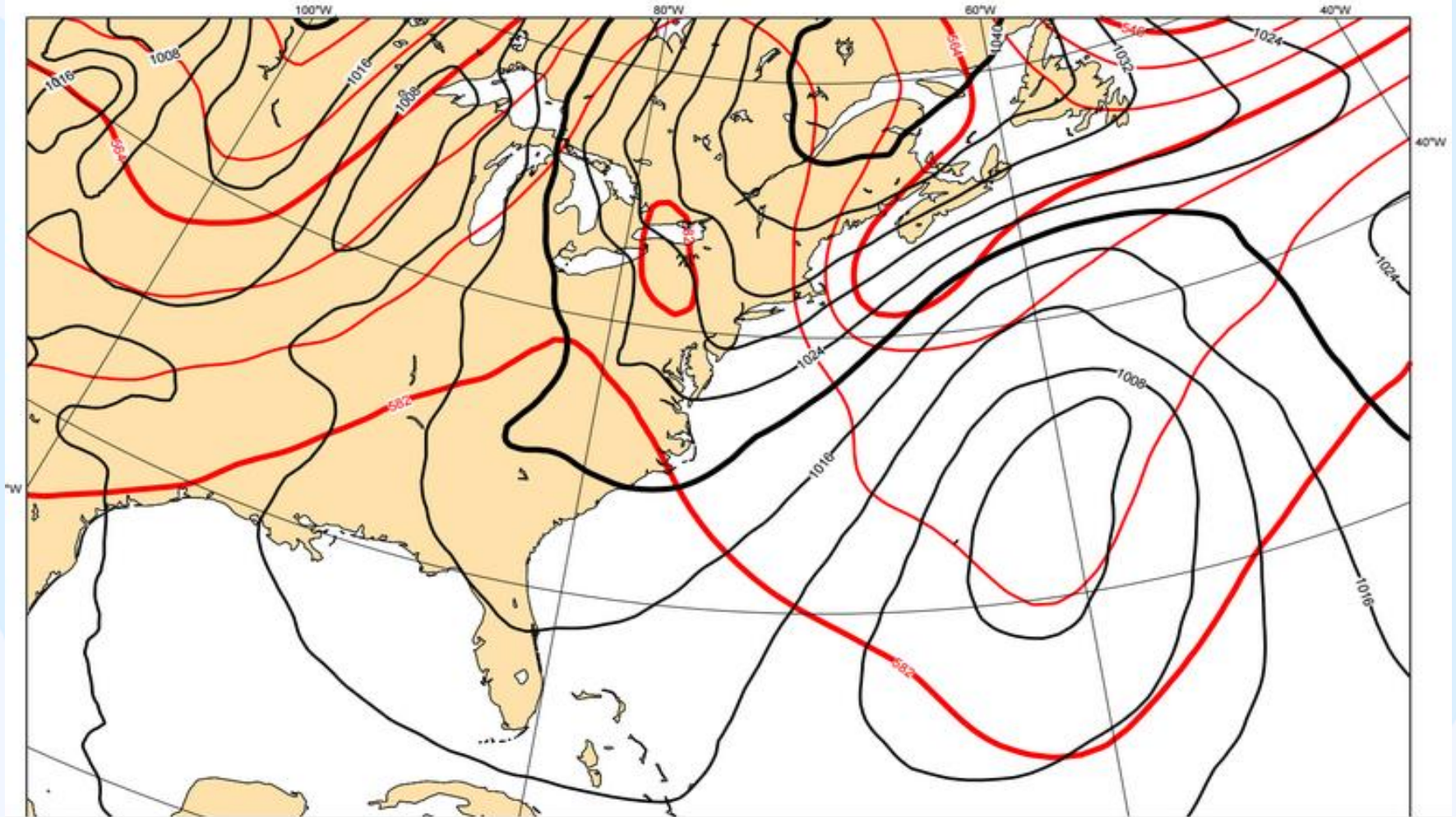
# EC 12z 25 60 hr fcst 00z 28 500mb sfc

Friday 25 October 1991 12 UTC ecmf t+60 VT:Monday 28 October 1991 00 UTC surface Mean sea level pressure  
Friday 25 October 1991 12 UTC ecmf t+60 VT:Monday 28 October 1991 00 UTC 500 hPa Geopotential



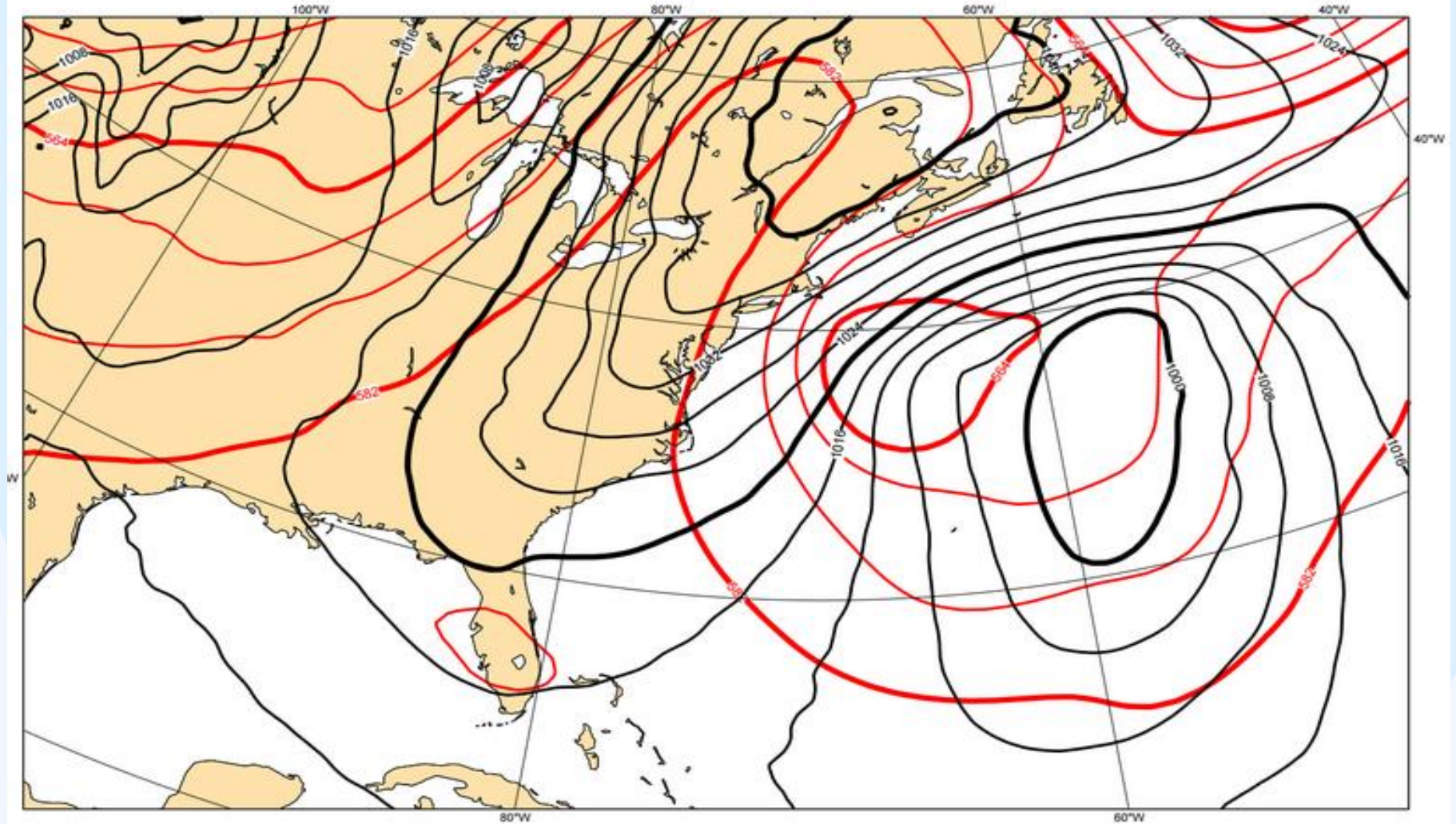
# EC 12z 25 84 hr fcst 00z 29 500mb sfc

Friday 25 October 1991 12 UTC ecmf t+84 VT: Tuesday 29 October 1991 00 UTC surface Mean sea level pressure  
Friday 25 October 1991 12 UTC ecmf t+84 VT: Tuesday 29 October 1991 00 UTC 500 hPa Geopotential



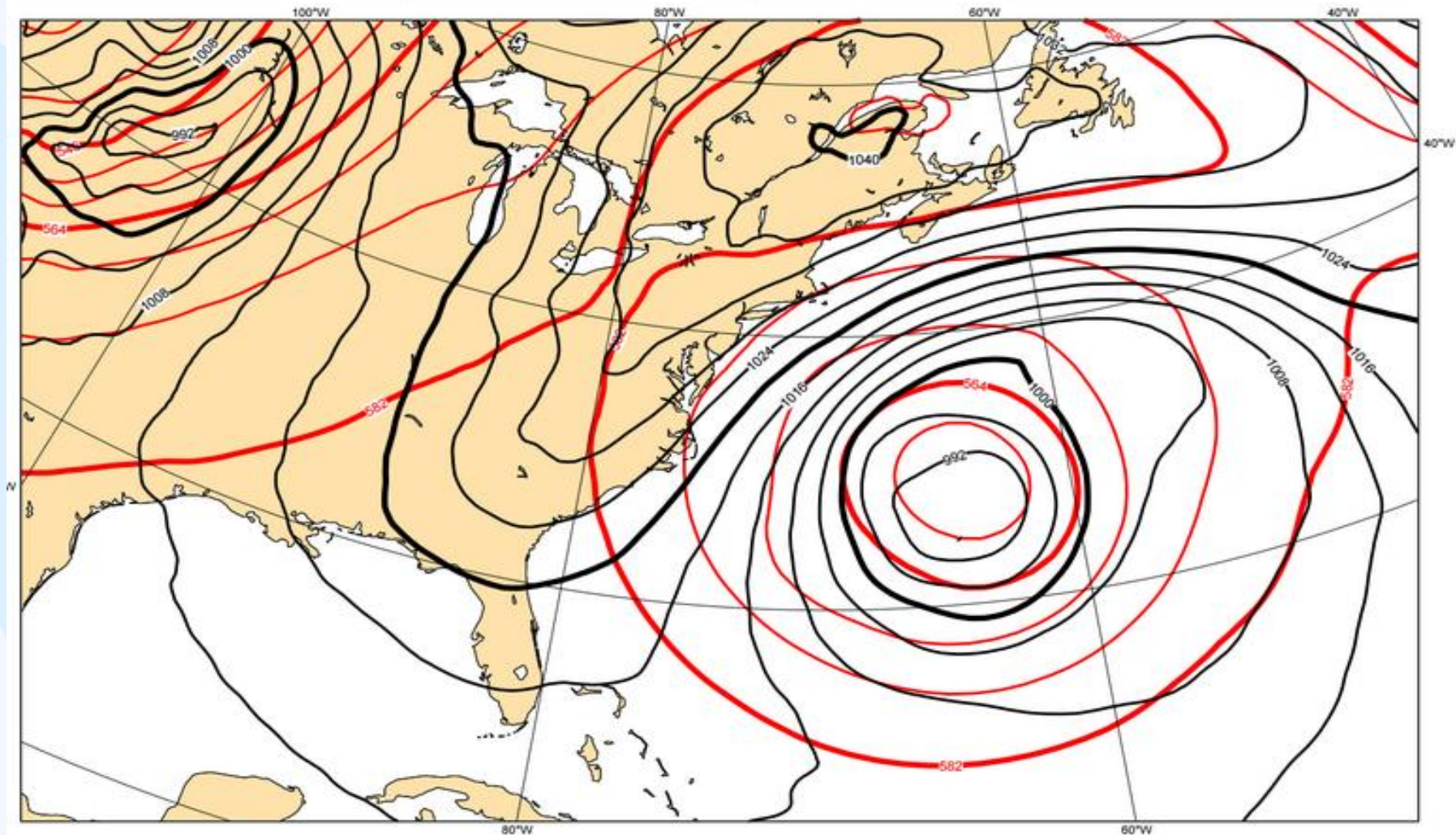
# EC 12z 25 96 hr fcst 12z 29 500mb sfc

Friday 25 October 1991 12 UTC ecmf t+96 VT: Tuesday 29 October 1991 12 UTC surface Mean sea level pressure  
Friday 25 October 1991 12 UTC ecmf t+96 VT: Tuesday 29 October 1991 12 UTC 500 hPa Geopotential



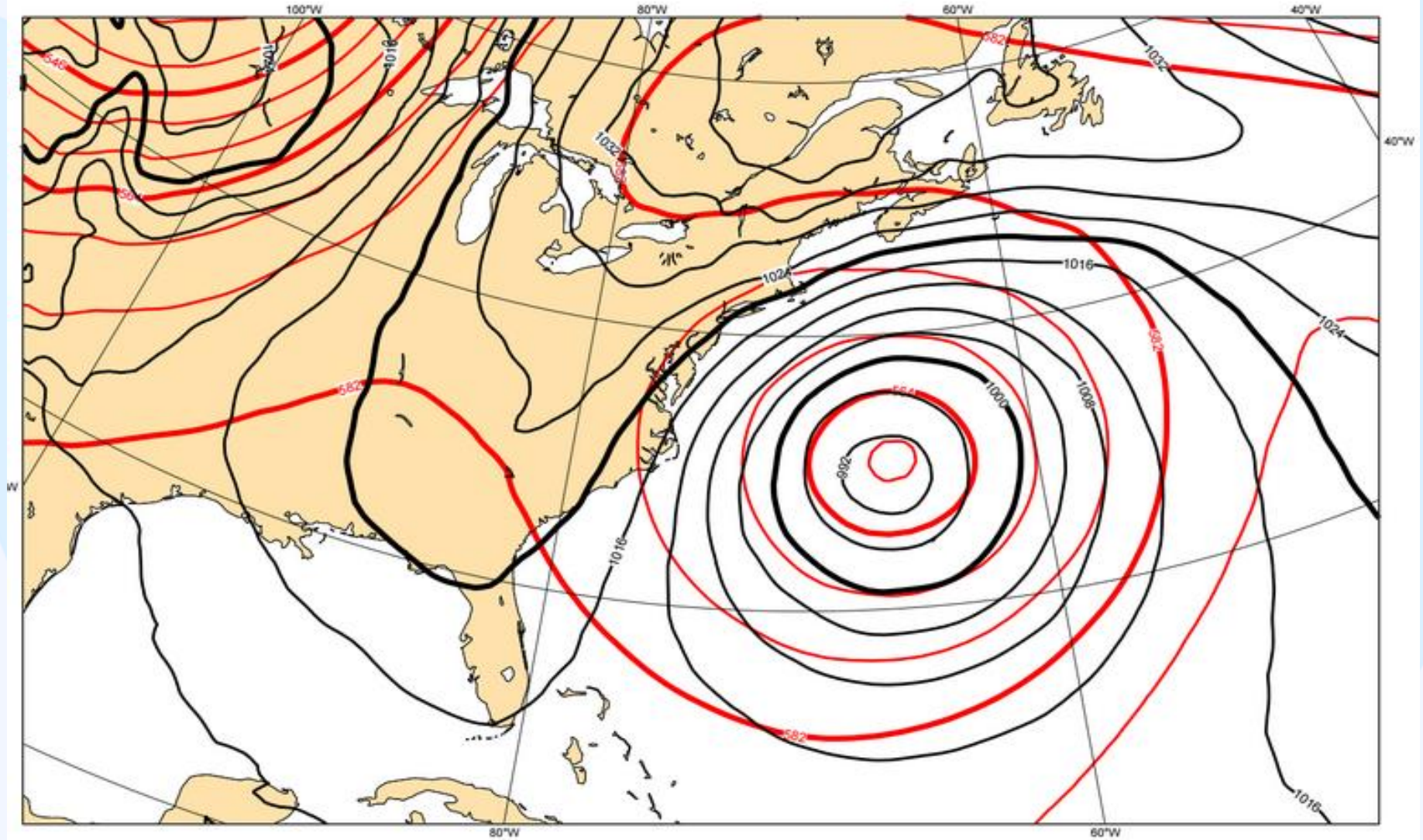
# EC12z 25 120 hr fcst 12z 30 500mb sfc

Friday 25 October 1991 12 UTC ecmf t+120 VT:Wednesday 30 October 1991 12 UTC surface Mean sea level pressure  
Friday 25 October 1991 12 UTC ecmf t+120 VT:Wednesday 30 October 1991 12 UTC 500 hPa Geopotential



# EC 12z 25 144 hr fcst 12z 31 500mb sfc

Friday 25 October 1991 12 UTC ecmf t+144 VT:Thursday 31 October 1991 12 UTC surface Mean sea level pressure  
Friday 25 October 1991 12 UTC ecmf t+144 VT:Thursday 31 October 1991 12 UTC 500 hPa Geopotential



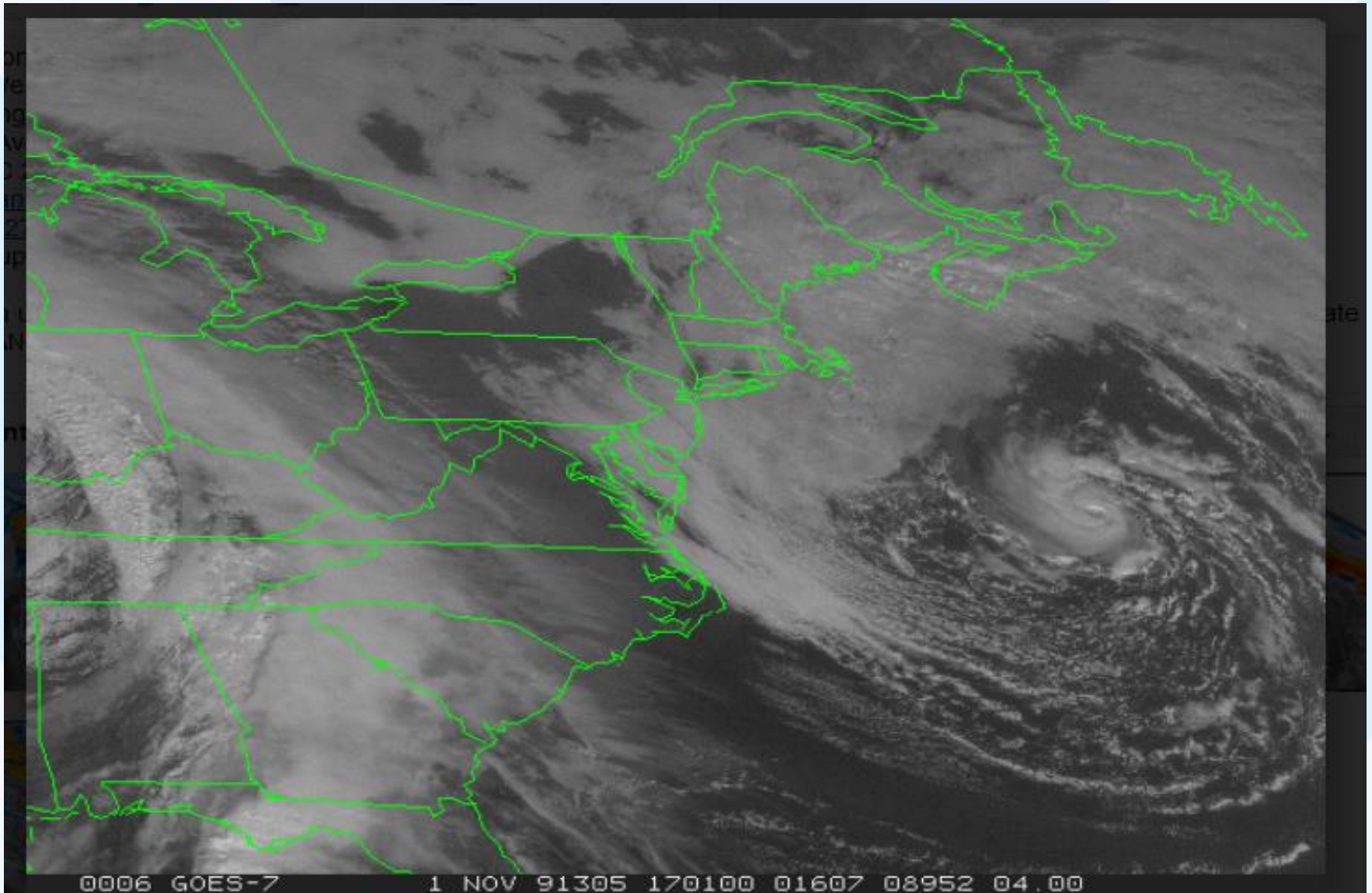
# Final stages

On the 31<sup>st</sup>, MSP endured a historic Blizzard.

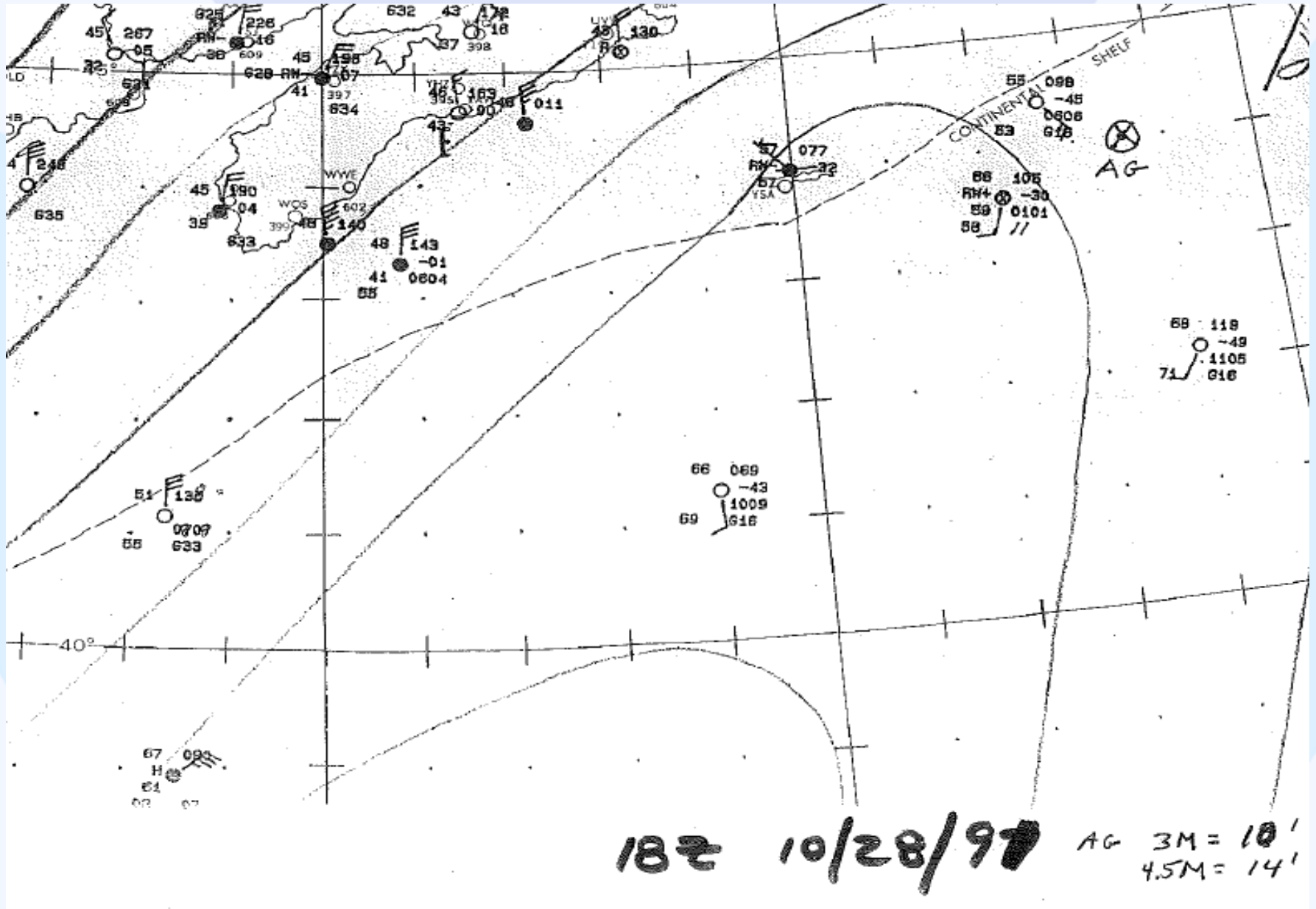
Meanwhile, the Perfect Storm began evolving over warmer water back to an unnamed Hurricane on Nov 1 spinning itself down on Nov 2 near Nova Scotia.

Grace Cat 2, unnamed Hurricane Cat 1.

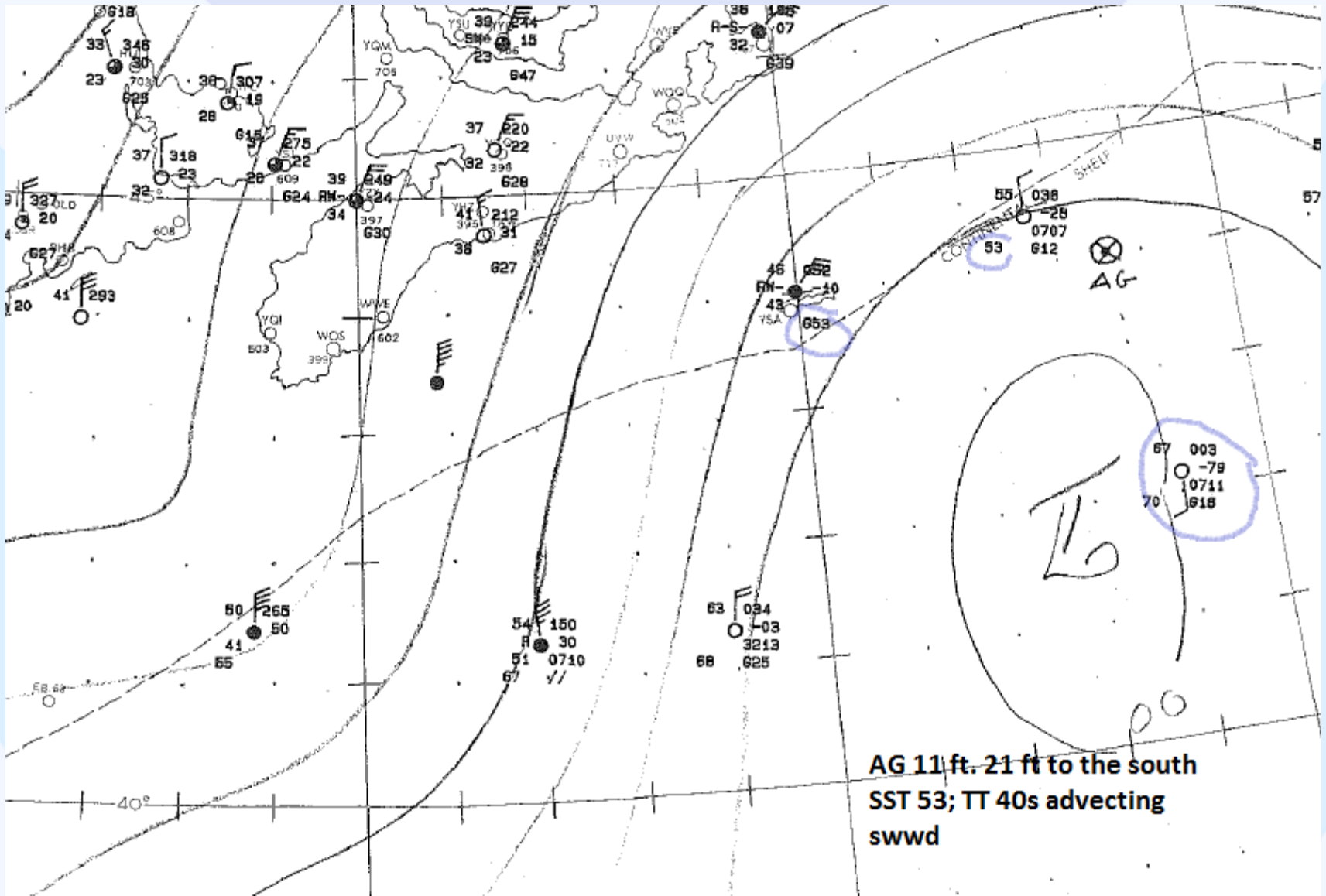
# The unnamed Hurricane of Nov 1, 1991



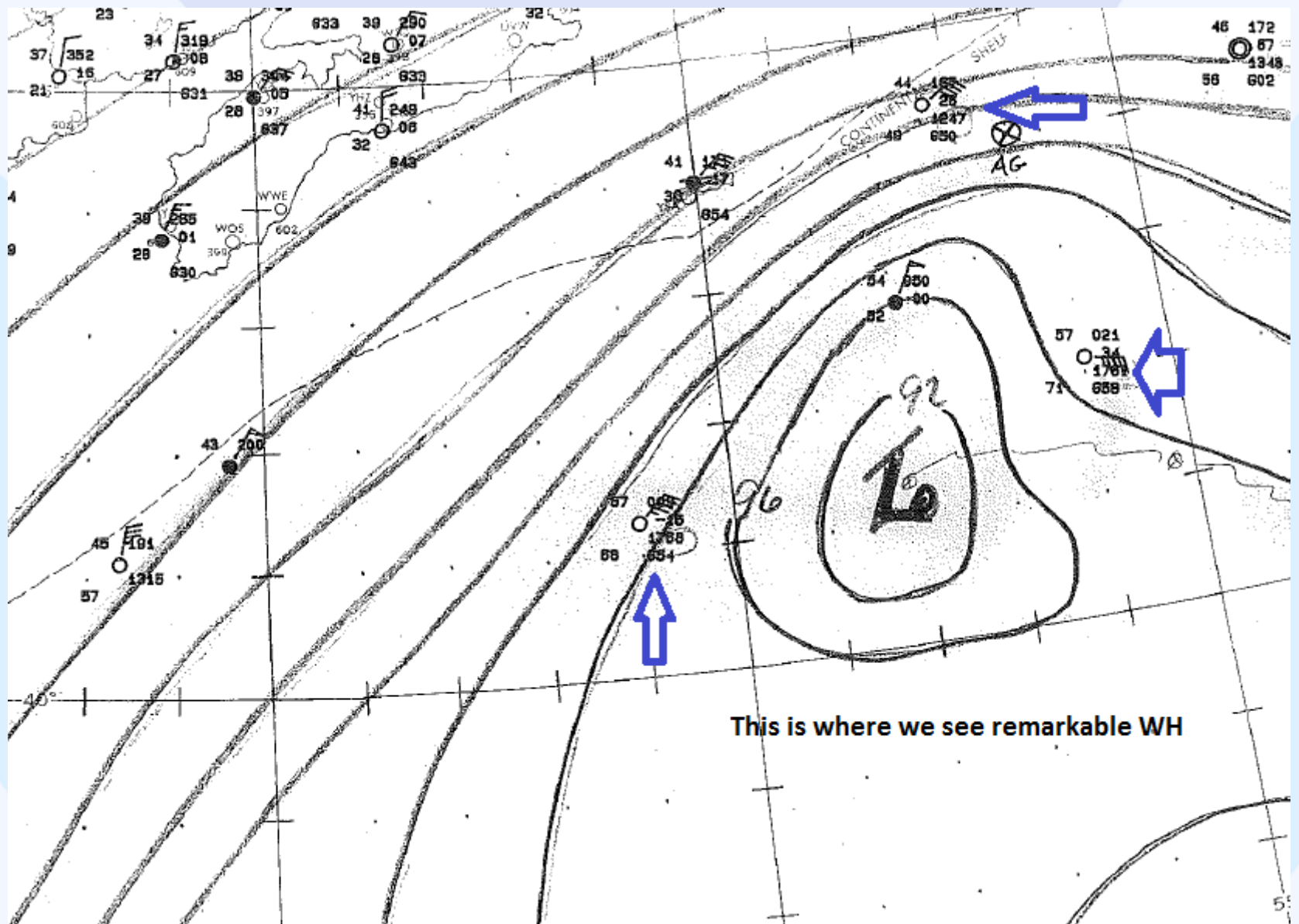
# 18z/28 WFO BOS Analysis



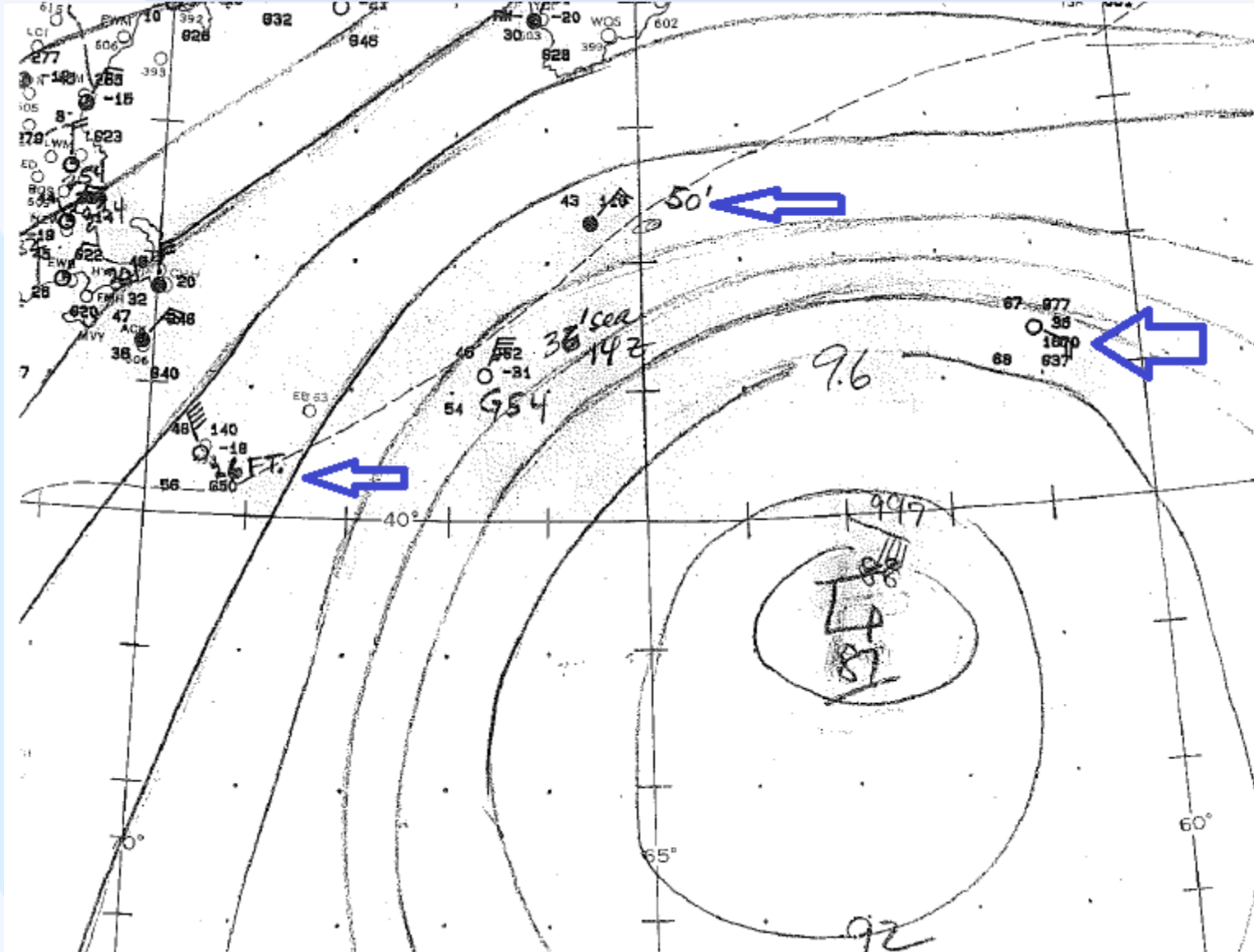
# 00z/29 WFO BOS analysis (AG lost contact)



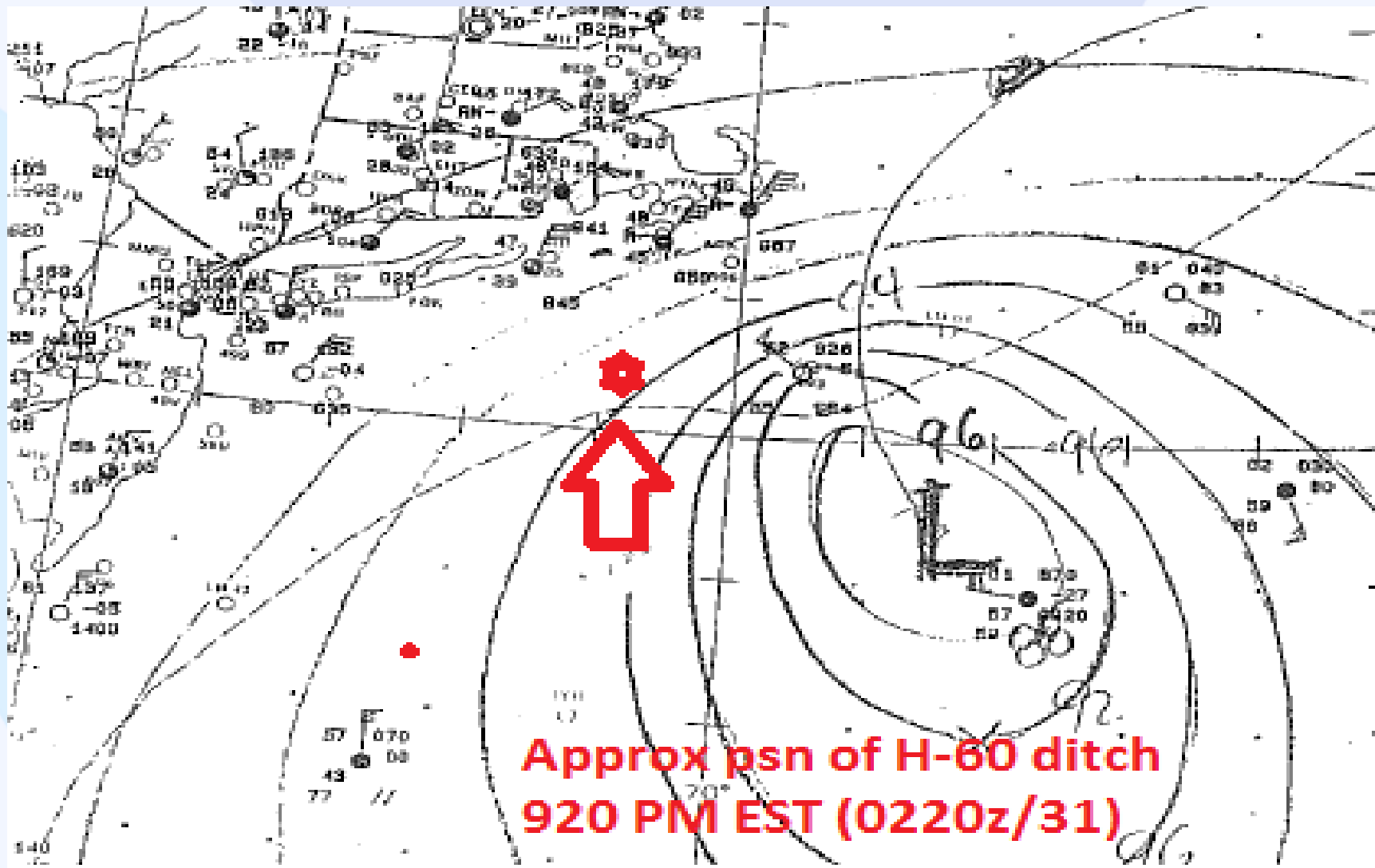
# 00z/30 WFO BOS Analysis



# 12z/30 WFO BOS Analysis

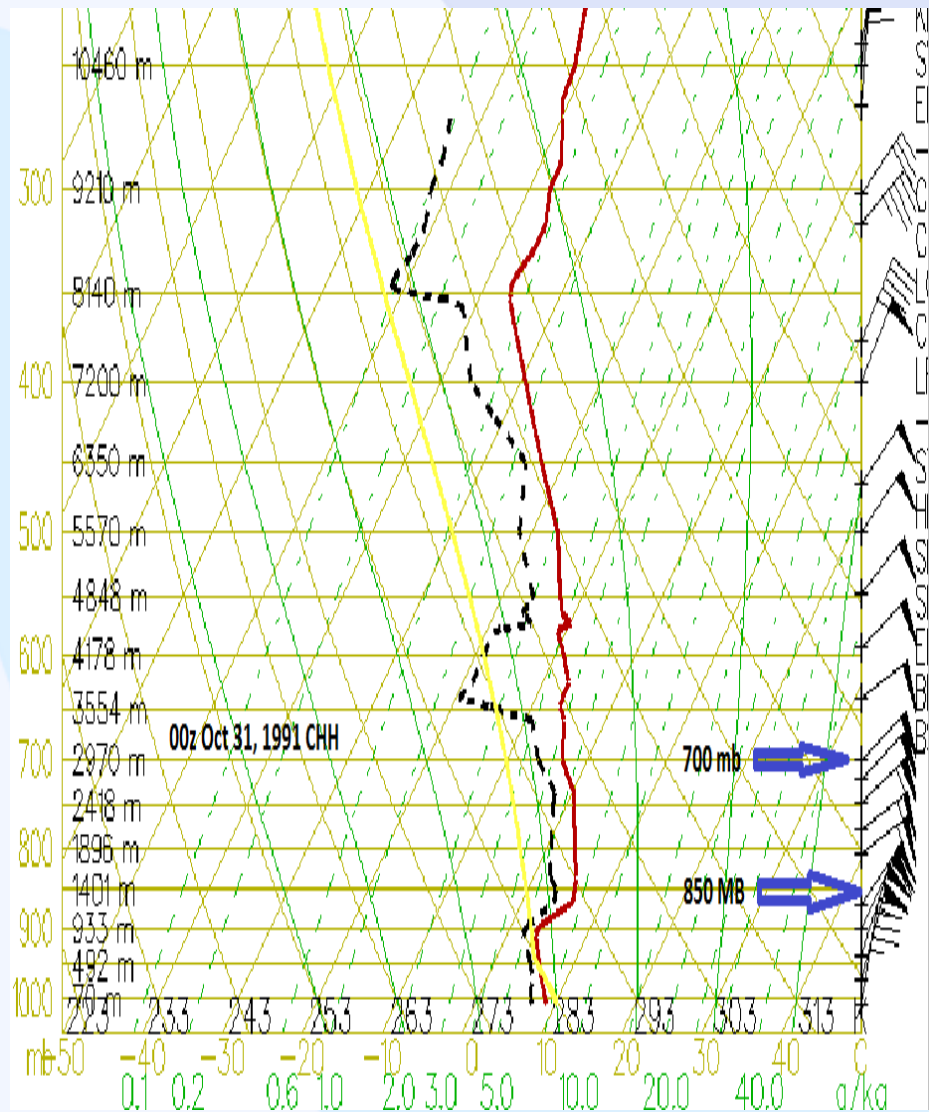


# 00z/31 WFO BOS Analysis (H-60 ditch)



# CHH sounding and SGL 00z Oct 31, 1991

## 74494 CHH Chatham Observations at 00Z 31



PRES hPa	HGHT m	TEMP C	DWPT C	RELH %	MIXR g/kg	DRCT deg	SKNT knot
1007.0	16	8.8	6.9	88	6.23	20	45
1000.0	70	8.6	6.7	88	6.19	20	47
972.5	300	6.9	5.6	92	5.90	30	56
962.0	389	6.2	5.2	93	5.80	31	57
937.5	600	5.2	4.0	92	5.47	35	59
903.7	900	3.7	2.3	90	5.02	45	65
896.0	970	3.4	1.9	90	4.92	47	66
871.1	1200	5.8	3.7	86	5.76	55	68
867.0	1238	6.2	4.0	86	5.91	57	67
850.0	1401	6.0	3.8	86	5.95	65	65
809.0	1800	3.7	1.3	84	5.23	70	58
779.6	2100	1.9	-0.6	83	4.73	70	56
751.2	2400	0.2	-2.4	82	4.28	65	55
723.8	2700	-1.5	-4.3	81	3.86	65	53
700.0	2970	-3.1	-6.0	80	3.51	65	51

## 60 southeast Montauk 0220z/31

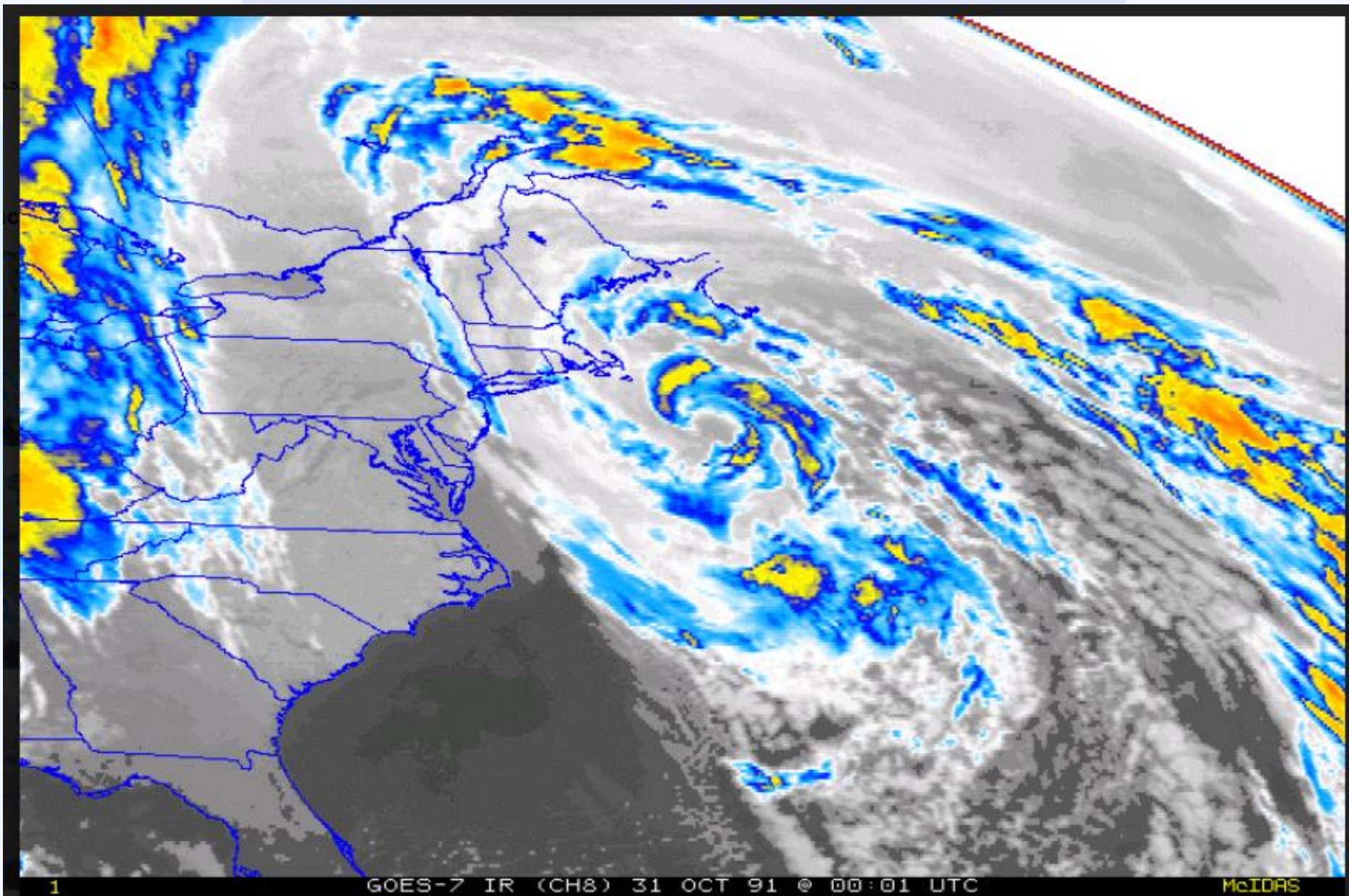
Limited available data

44008 to the east. Lowest pressure ~992MB at 01z, sustained NW at 00z becomes NE by 02z 45-55kt, gusts ~ 65 kt, ~30ft seas 9-11 second period, Air 55-57F, SST 55F

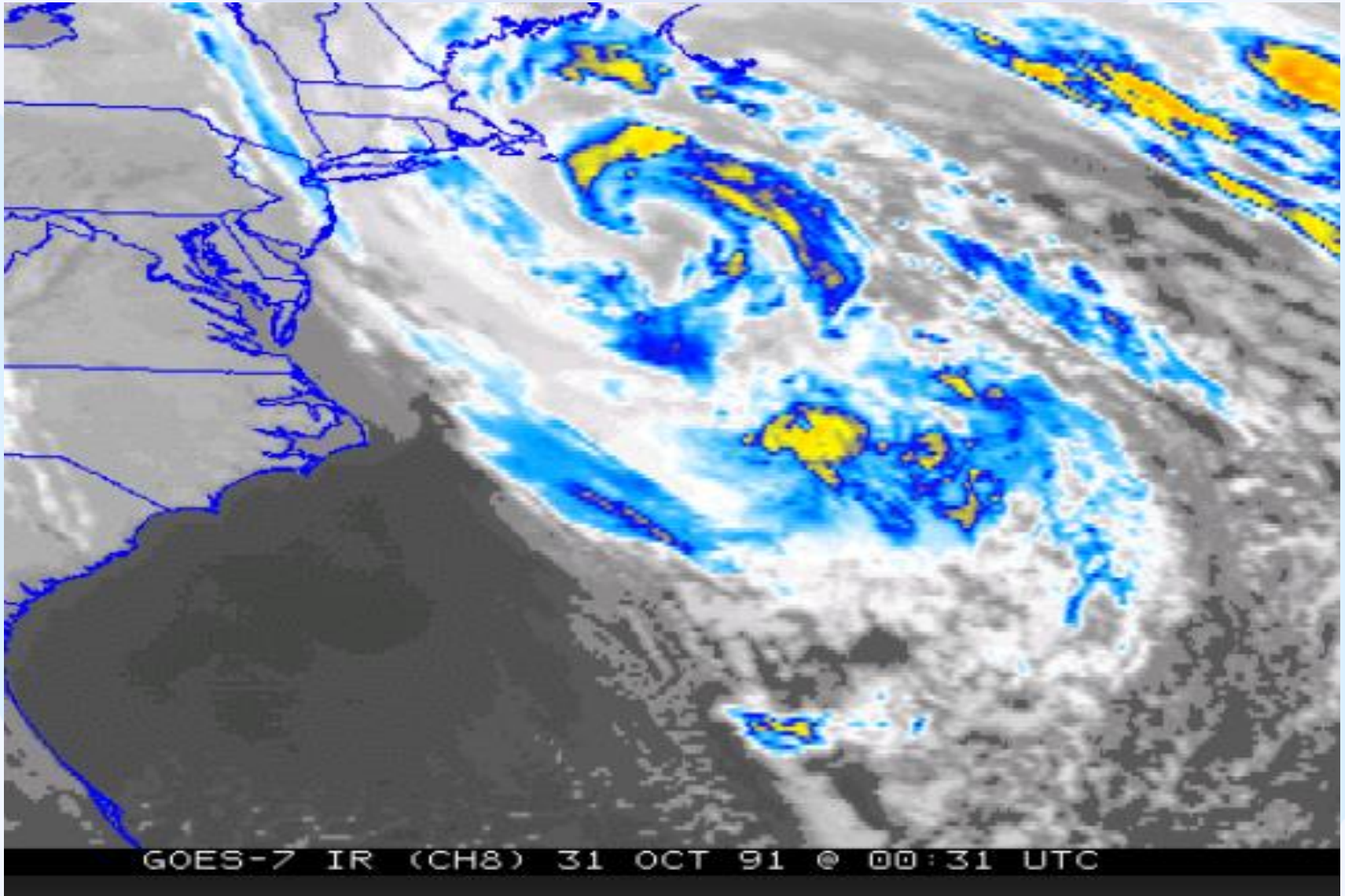
44025 to the west of the ditch: NNE 30-35kt gust 40-45kt, seas around 14kt 7-9 second period. Air 55F, SST 59F.

Knowing those conditions: It is worthy to read The Perfect Storm pp174-178 to appreciate the extraordinary training of the PJ's.

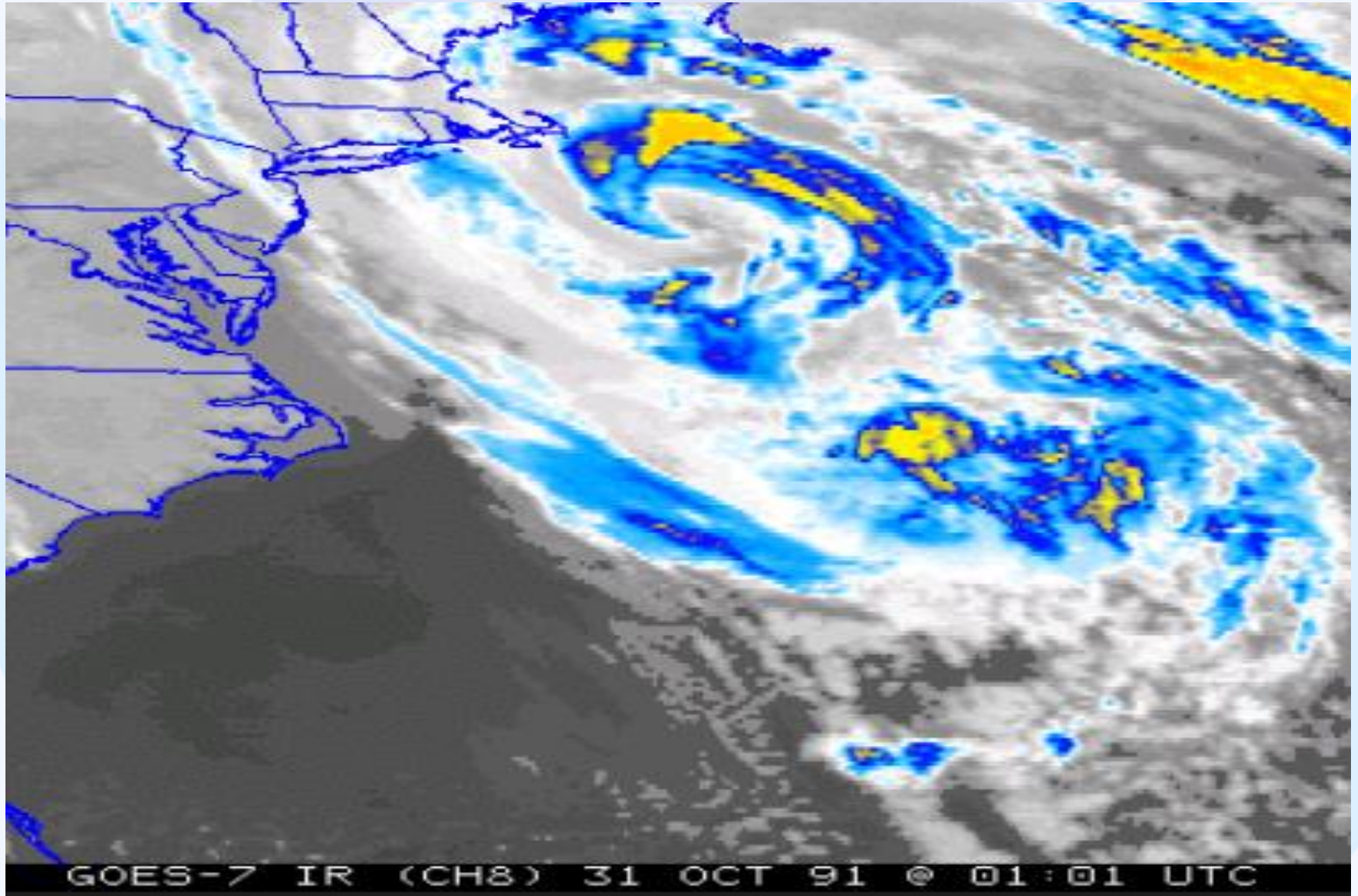
# Sequence every 30 min: IR 7PM EST (0001z/31) in flight attempted rescue



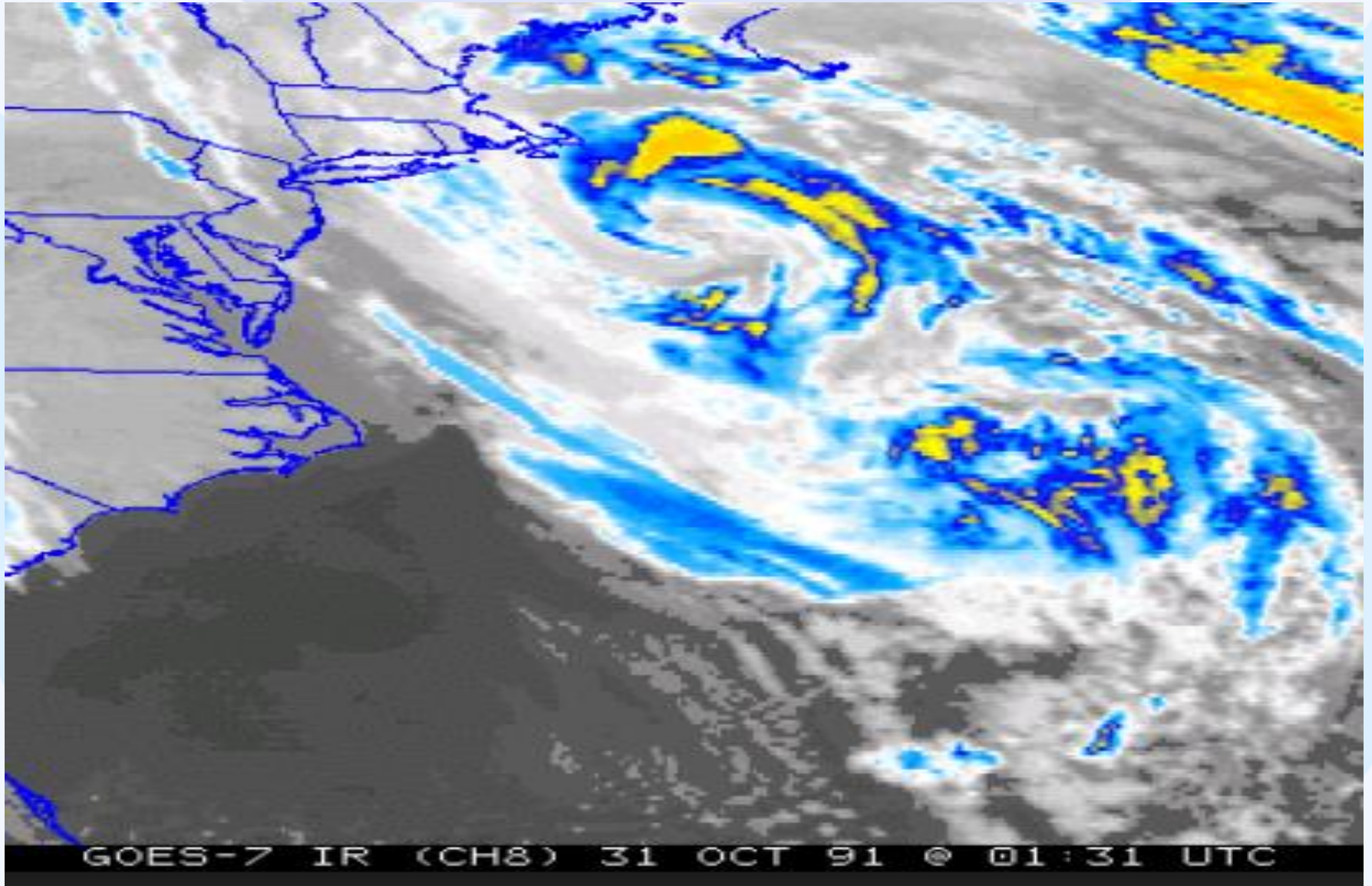
# IR 730 PM EST (0031z/31) in flight attempted rescue



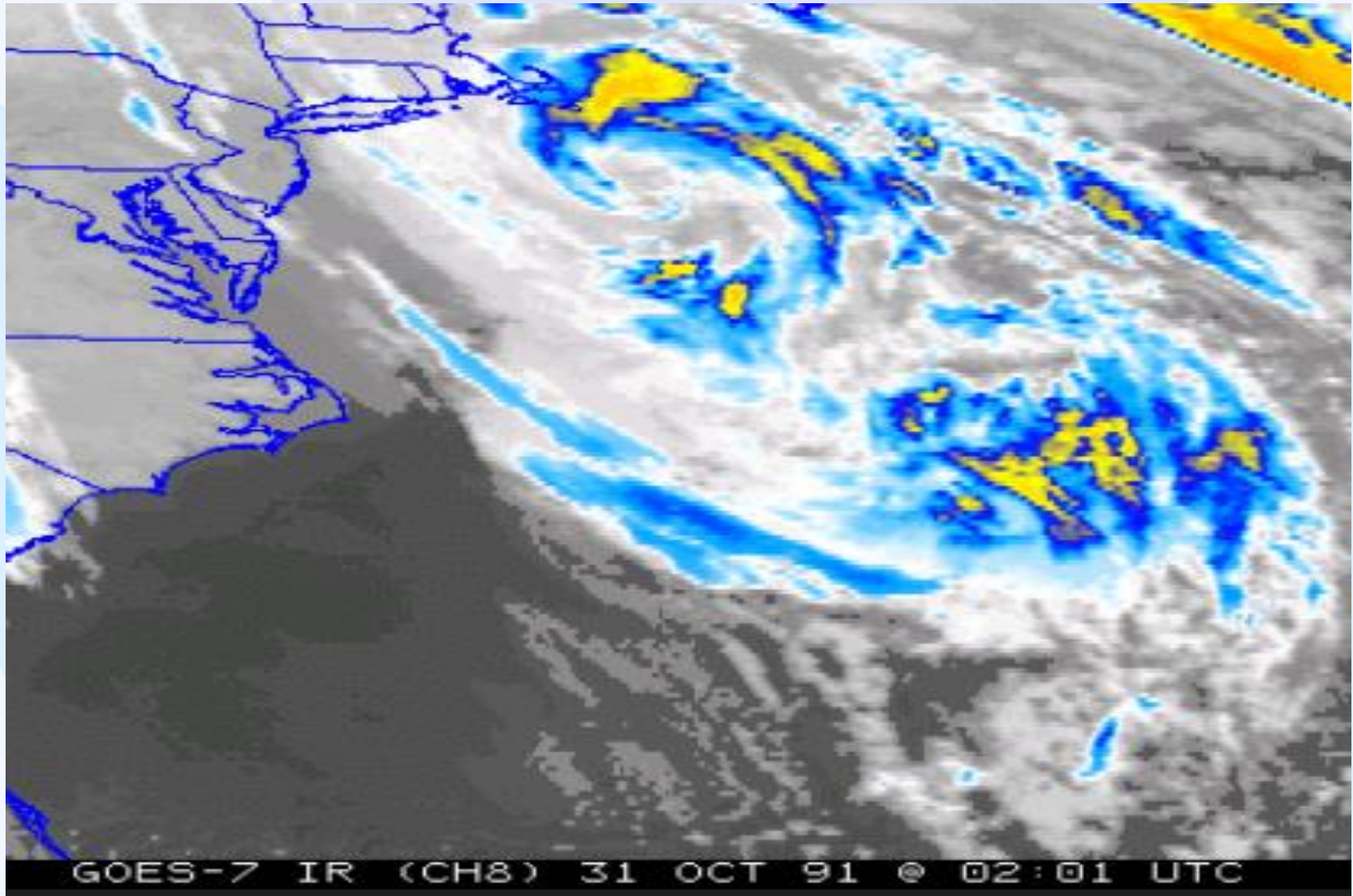
# IR 8 PM EST (0101z/31) in flight attempted rescue



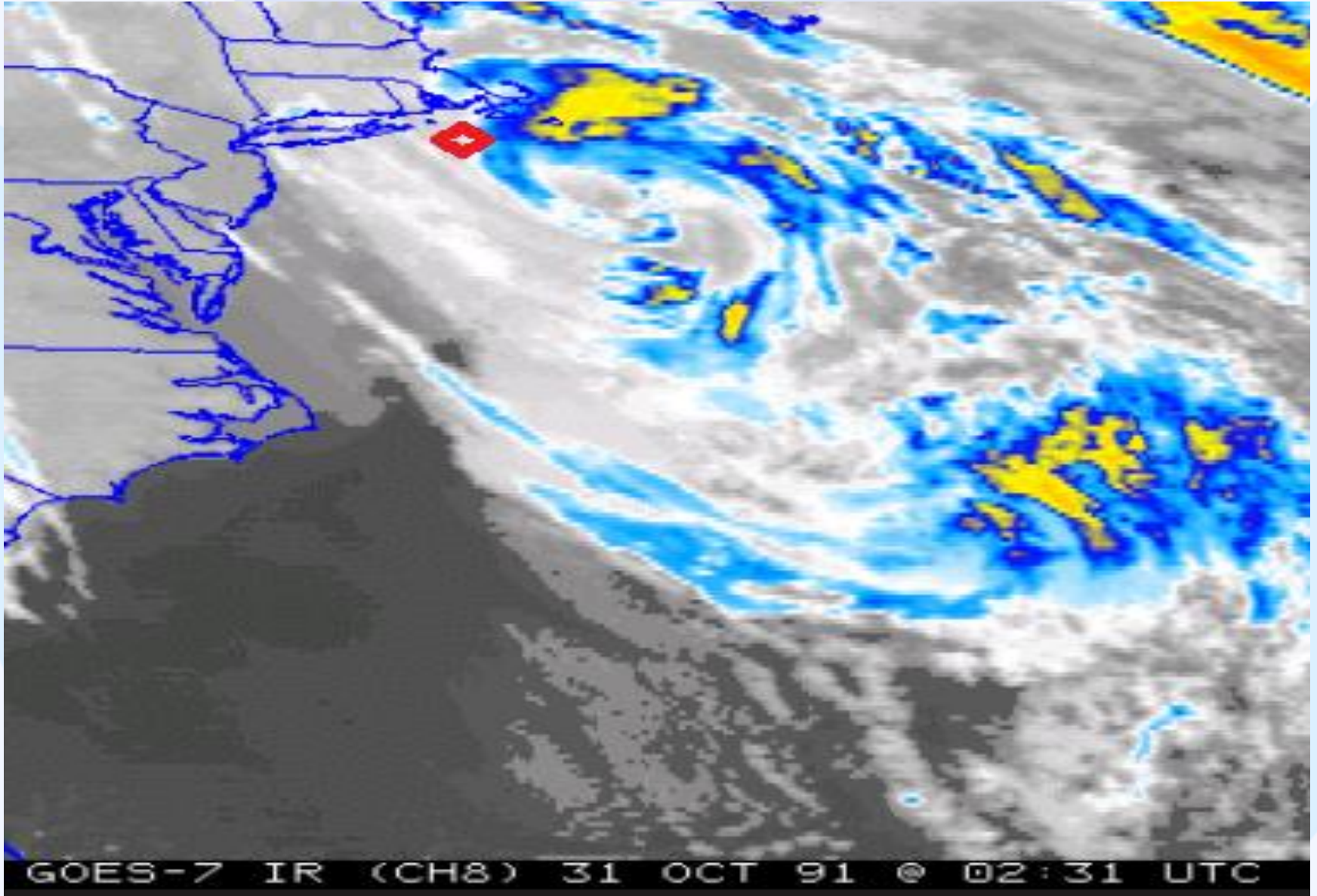
# IR 830 PM EST (0131z/31) in flight attempted rescue



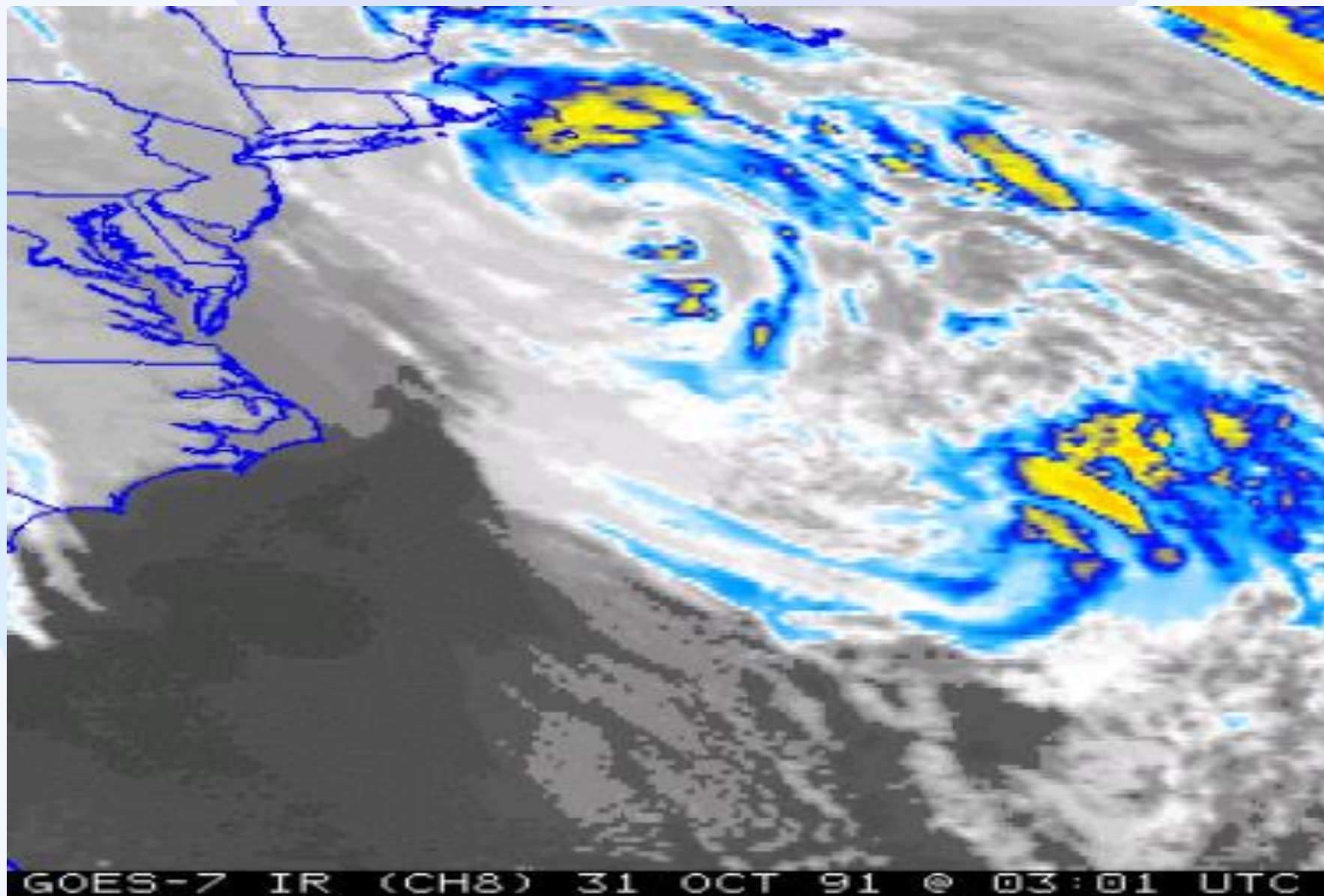
# IR 9 PM EST (0201z/31) in flight attempted rescue



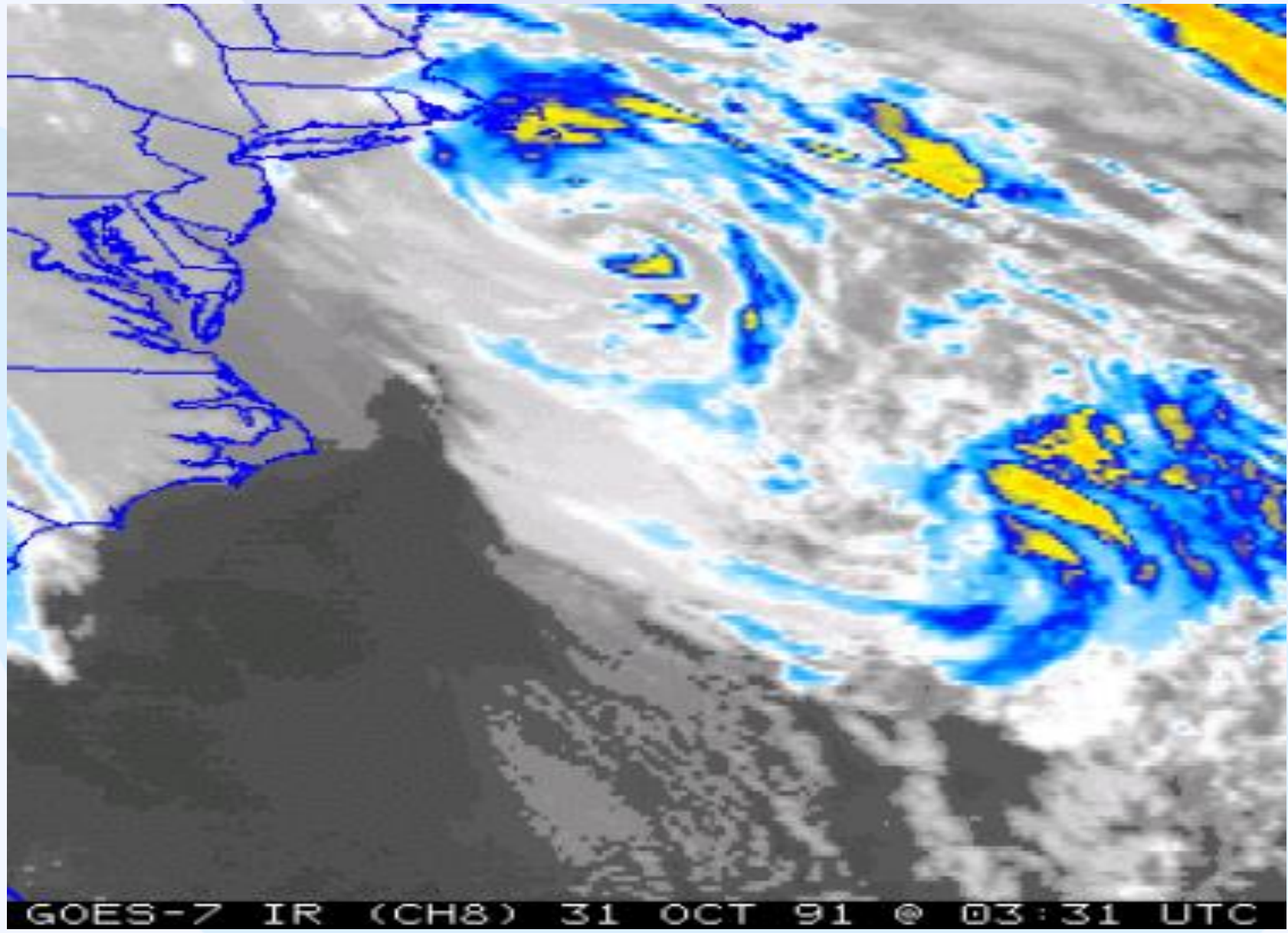
# IR 930 PM EST (0231z/31) rescuers forced to ditch (red)



# IR 10 PM EST (0301z/31)

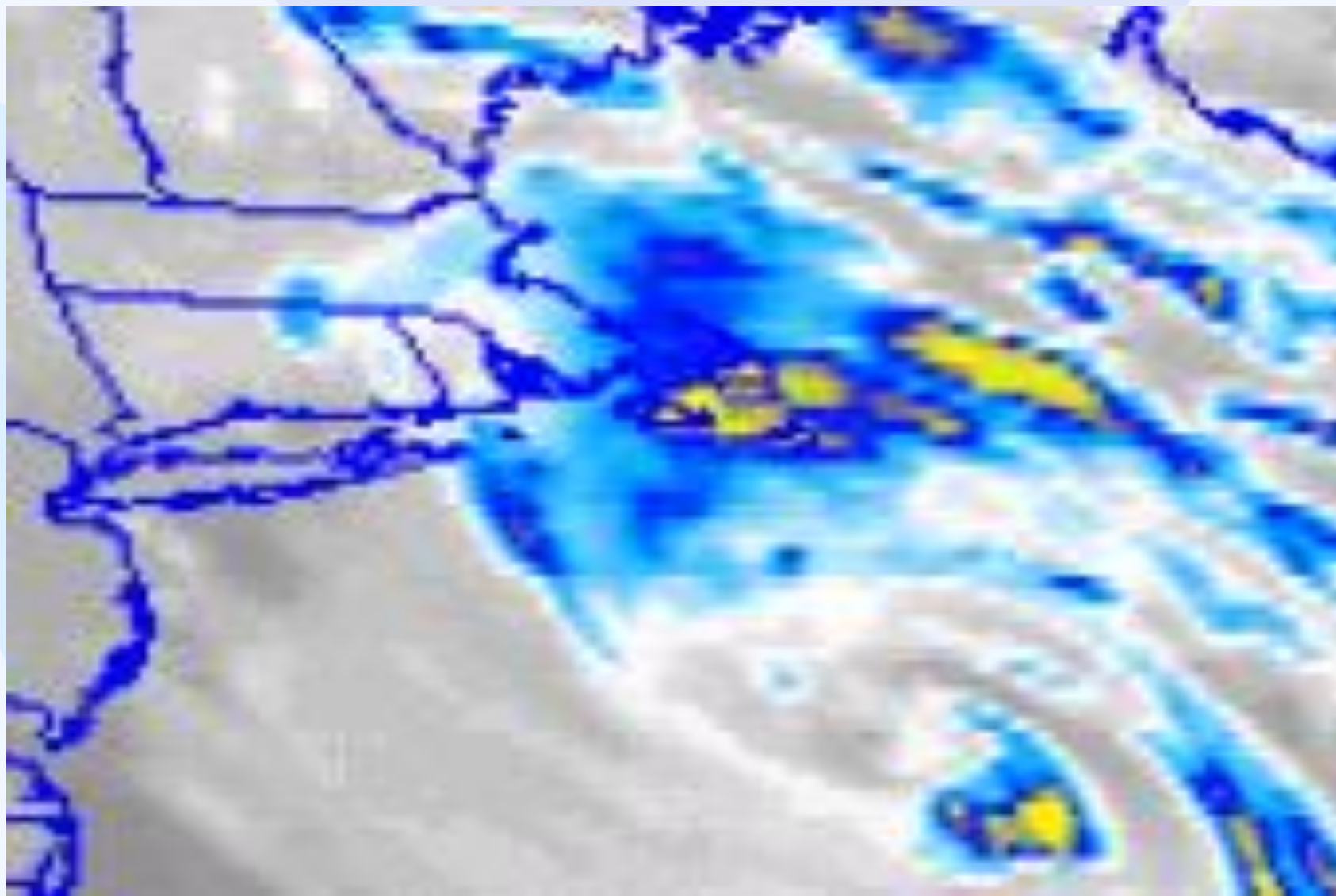


# IR 1030 PM EST (0231z/31)



GOES-7 IR (CH8) 31 OCT 91 @ 03:31 UTC

IR 11 PM EST (0401z/31)



**5 minutes for questions/comments/shares.**