Satellite Ocean Winds and Waves Use at the NOAA Ocean Prediction Center

Overview

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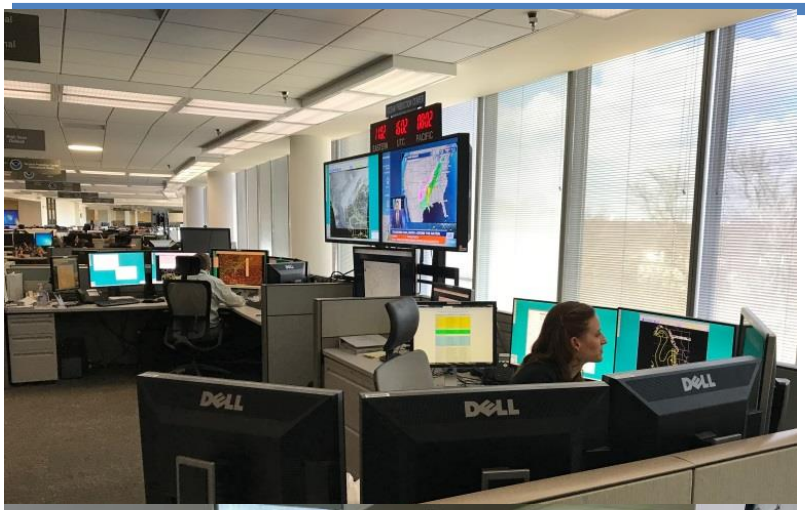
Chief, Ocean Application Branch

7 November 2018

https://ocean.weather.gov

NOAA
Ocean Prediction Center



ocean.weather.gov

Mission: Protection of Life and Property, Economic Enhancement

Products

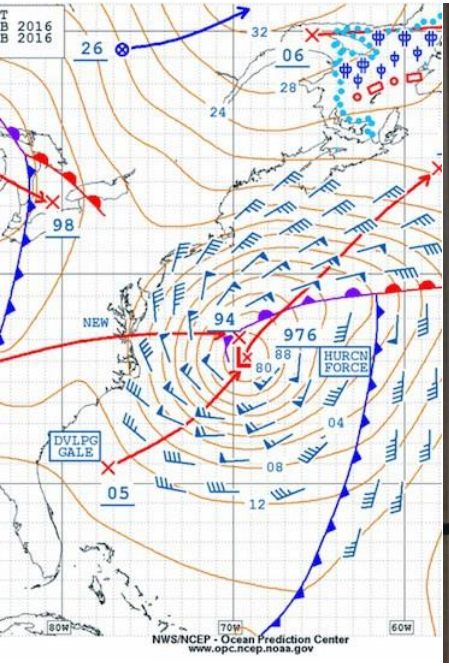
Text - Metarea Sat-C bulletins, NAVTEX

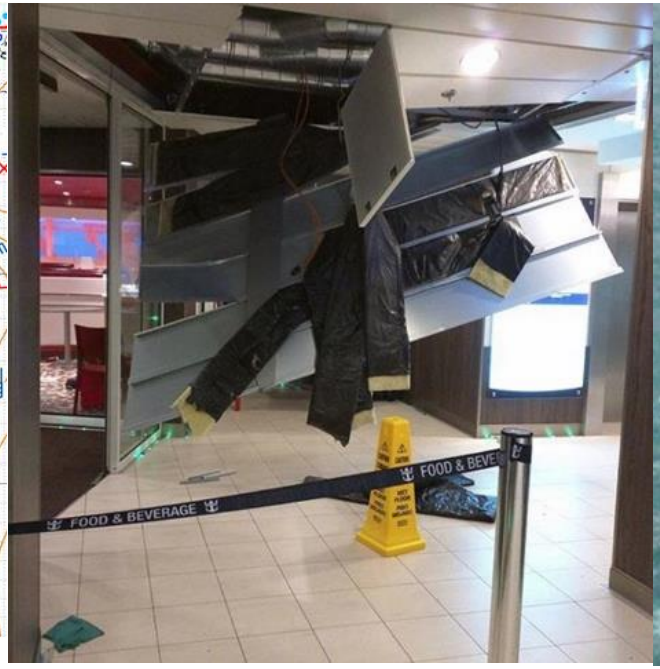
Graphics – HF Radiofax, FTPmail, web

Digital – Gridded winds and waves
FTPmail
Nomads

Ocean Prediction Center: Vision

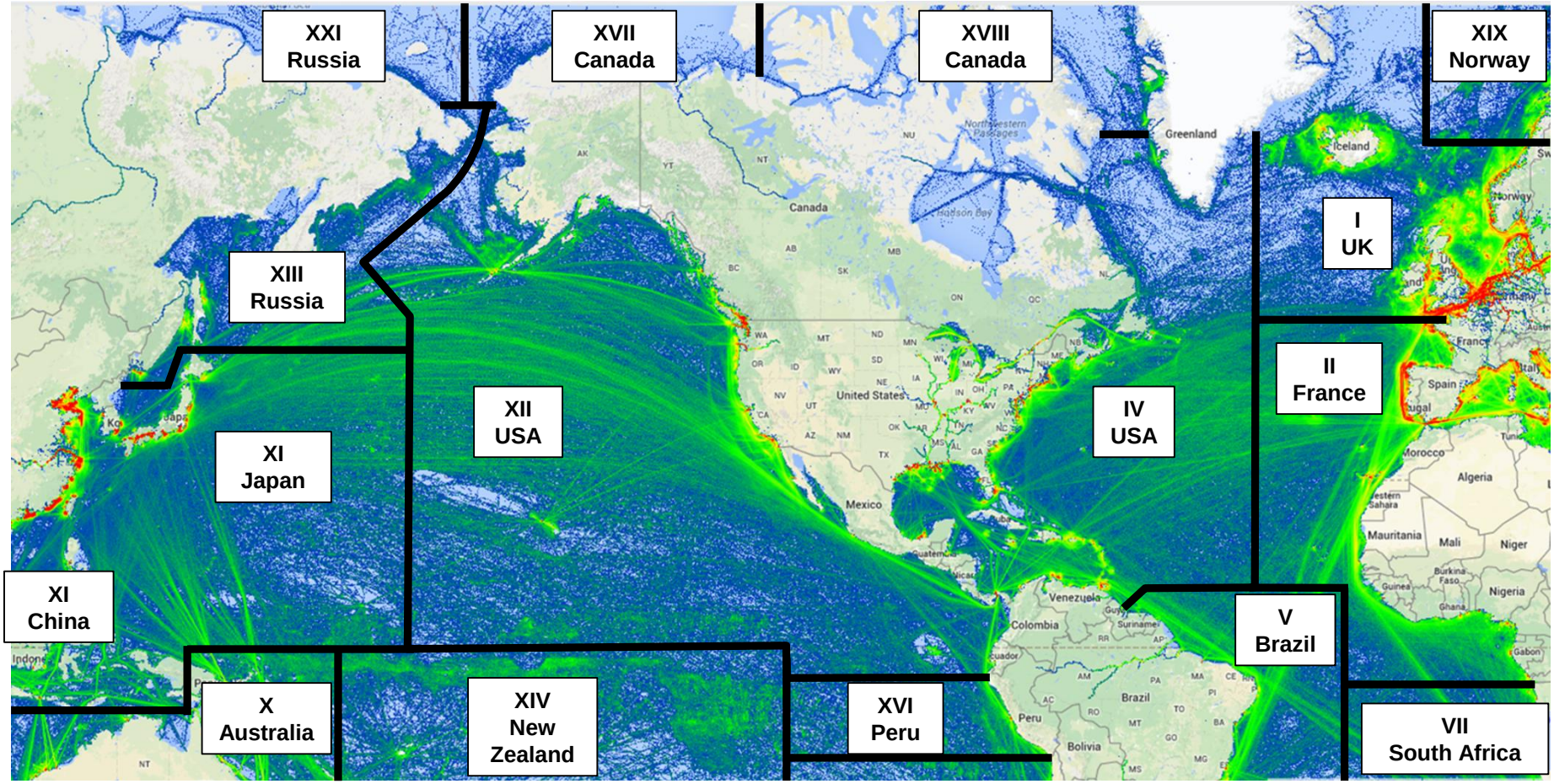
Provide the world's best
marine weather decision support services,
preventing loss of life and property at sea.





High Seas METAREAs

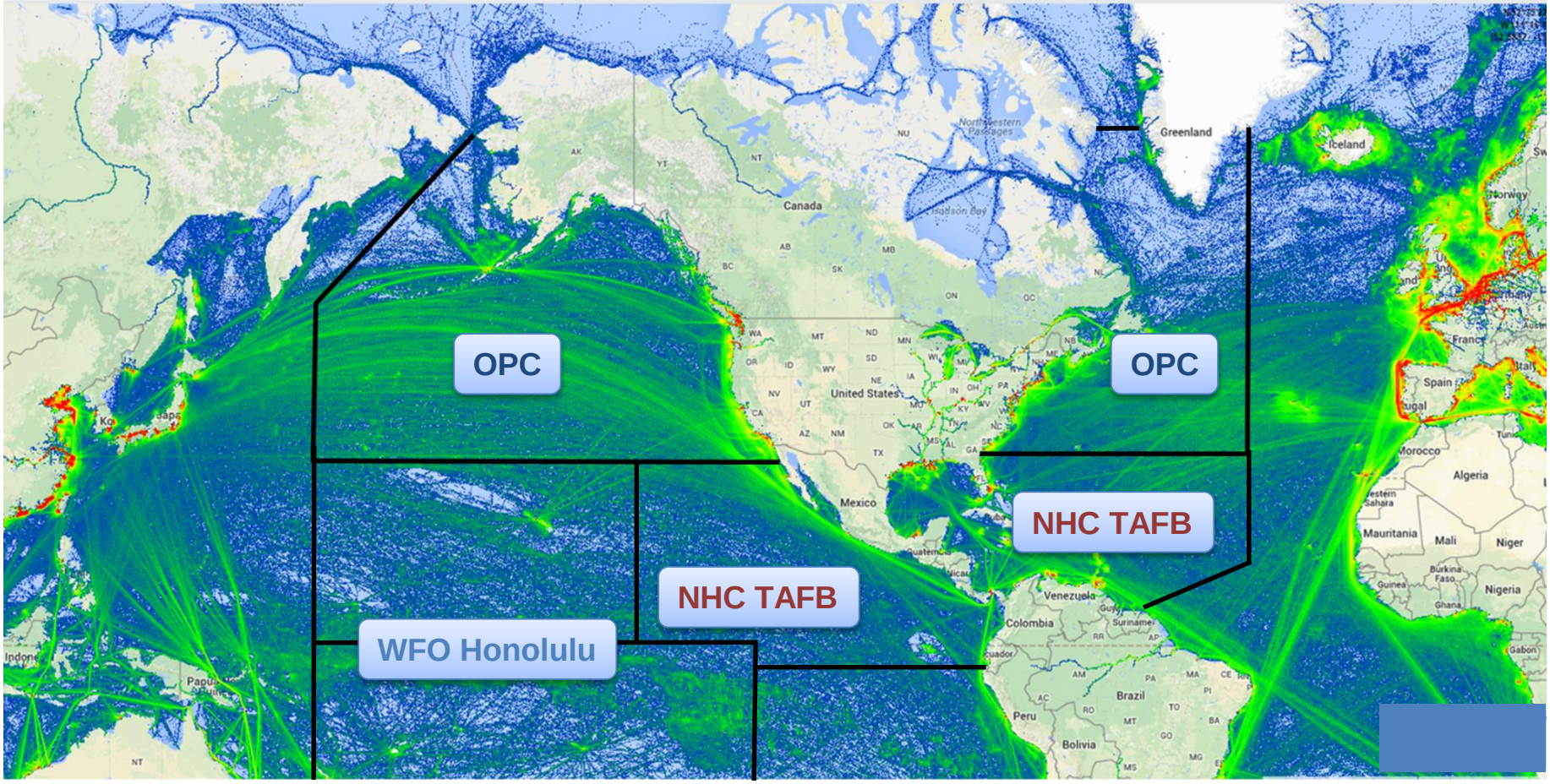
Globally, US$13 trillion in goods & 2 billion passengers per year travel at sea!



Source of 2016 total ship tracks and background: marinetraffic.com

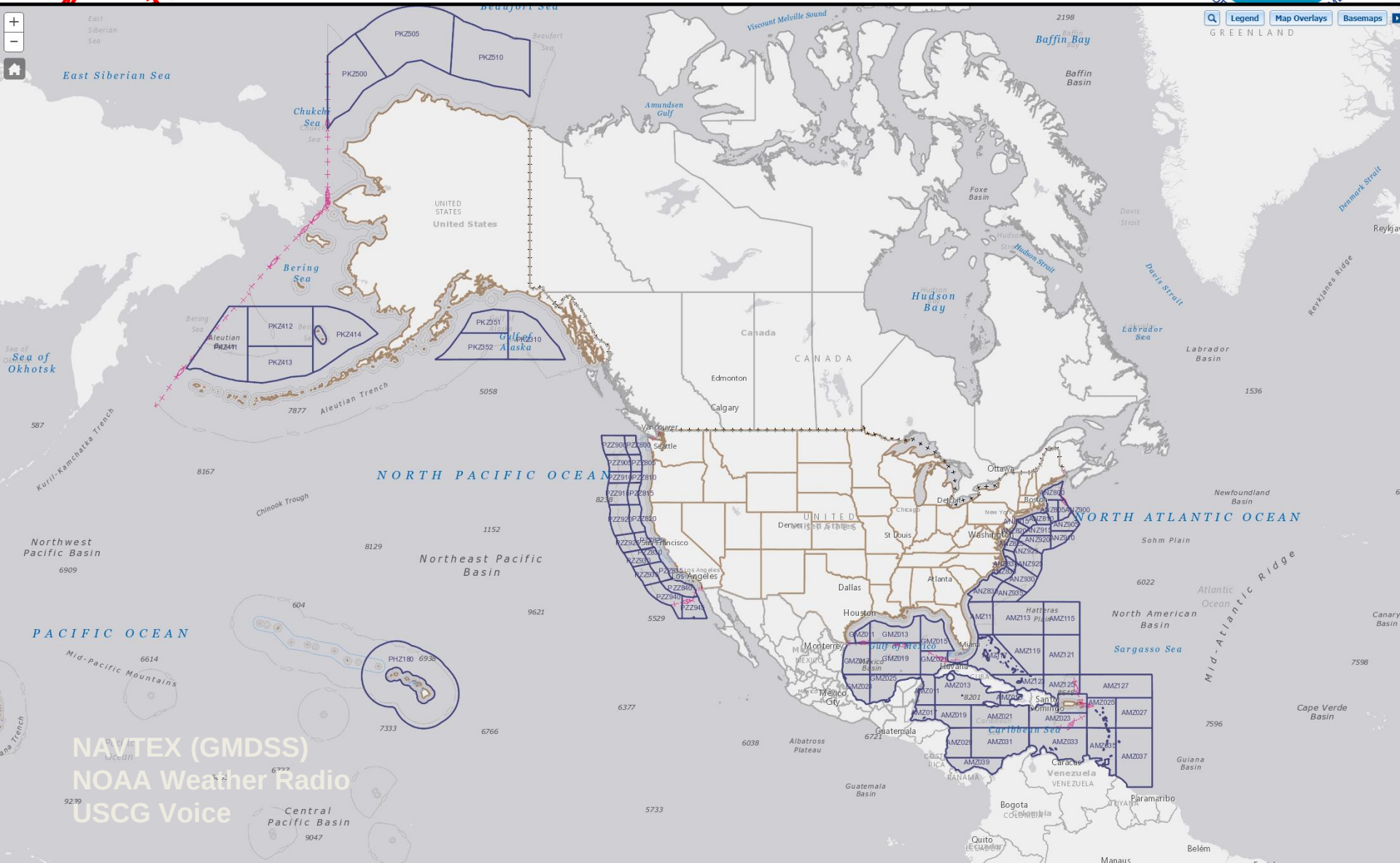
NWS High Seas Marine Zones

$2T in imports/exports & 11M passengers per year transit through US ports



Source of 2016 total ship tracks and background: marinetraffic.com

NWS Offshore Waters Responsibility

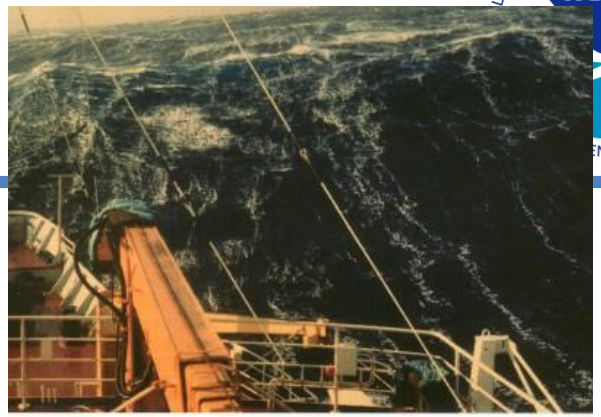


WARNINGS (non-TROPICAL)

GALE WARNING
Force 8,9

BEAUFORT FORCE 8
WIND SPEED: 34-40 KNOTS

SEA: WAVE HEIGHT 5.5-7.5M (18-25FT), MODERATELY HIGH WAVES OF GREATER LENGTH, EDGES OF CREST BEGIN TO BREAK INTO THE SPINDRIFT, FOAM BLOWN IN WELL MARKED STREAKS ALONG WIND DIRECTION.



BEAUFORT FORCE 9
WIND SPEED: 41-47 KNOTS

SEA: WAVE HEIGHT 7-10M (23-32FT), HIGH WAVES, DENSE STREAKS OF FOAM ALONG DIRECTION OF THE WIND, WAVE CRESTS BEGIN TO TOPPLE, TUMBLE, AND ROLL OVER. SPRAY MAY AFFECT VISIBILITY.

STORM WARNING
Force 10,11

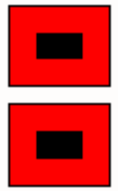
BEAUFORT FORCE 10
WIND SPEED: 48-55 KNOTS

SEA: WAVE HEIGHT 9-12.5M (29-41FT), VERY HIGH WAVES WITH LONG OVERHANGING CRESTS, THE RESULTING FOAM, IN GREAT PATCHES, IS BLOWN IN DENSE WHITE STREAKS ALONG WIND DIRECTION. ON THE WHOLE, SEA SURFACE TAKES A WHITE APPEARANCE, TUMBLING OF THE SEA IS HEAVY AND SHOCK-LIKE, VISIBILITY AFFECTED.

BEAUFORT FORCE 12
WIND SPEED: 64 KNOTS

SEA: SEA COMPLETELY WHITE WITH DRIVING SPRAY, VISIBILITY VERY SERIOUSLY AFFECTED. THE AIR IS FILLED WITH FOAM AND SPRAY

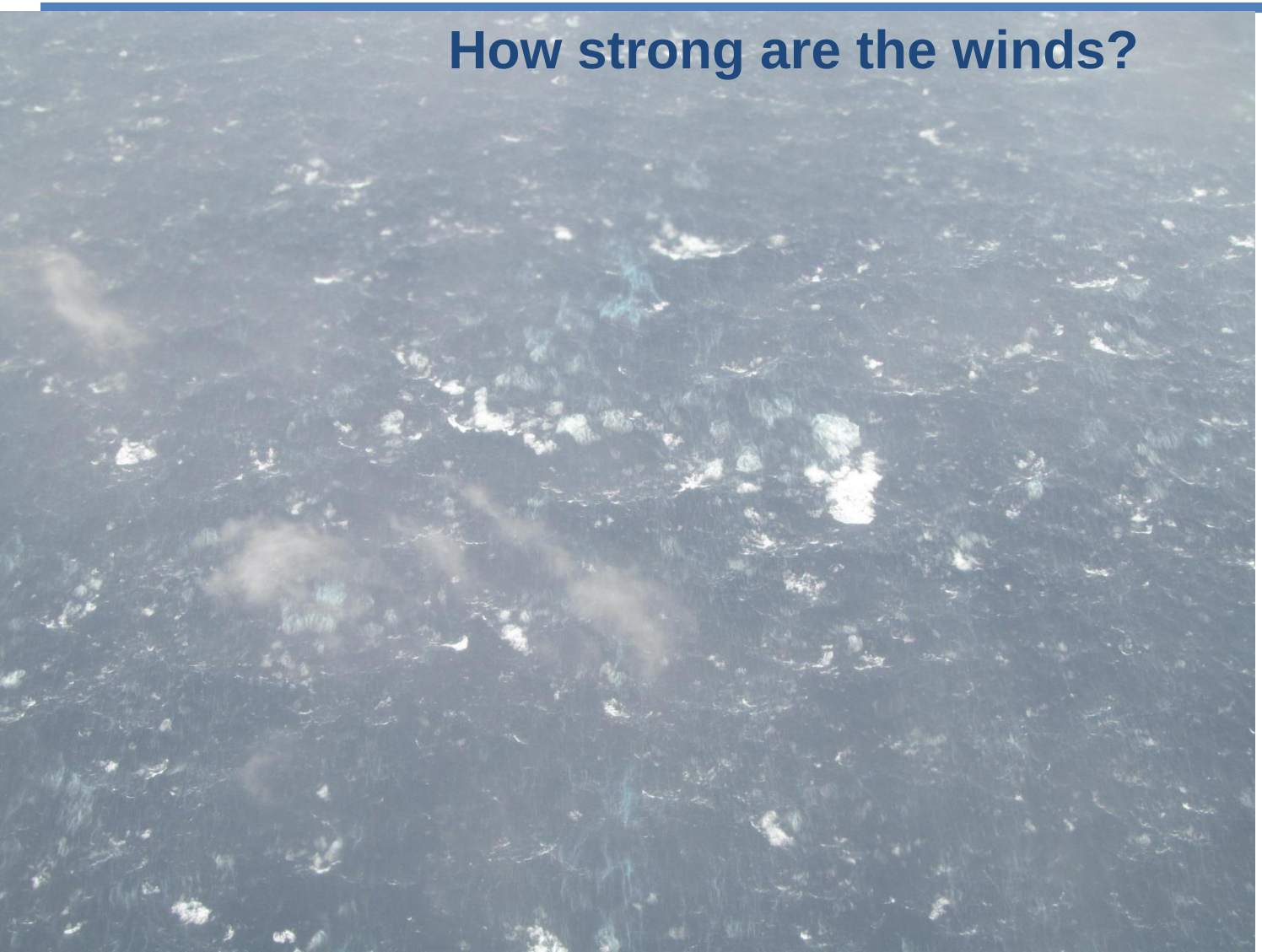
HURRICANE FORCE WARNING
Force 12



[Beaufort Wind Scale]

[NWS Marine Weather]

Ocean Weather



How strong are the winds?

Force 8

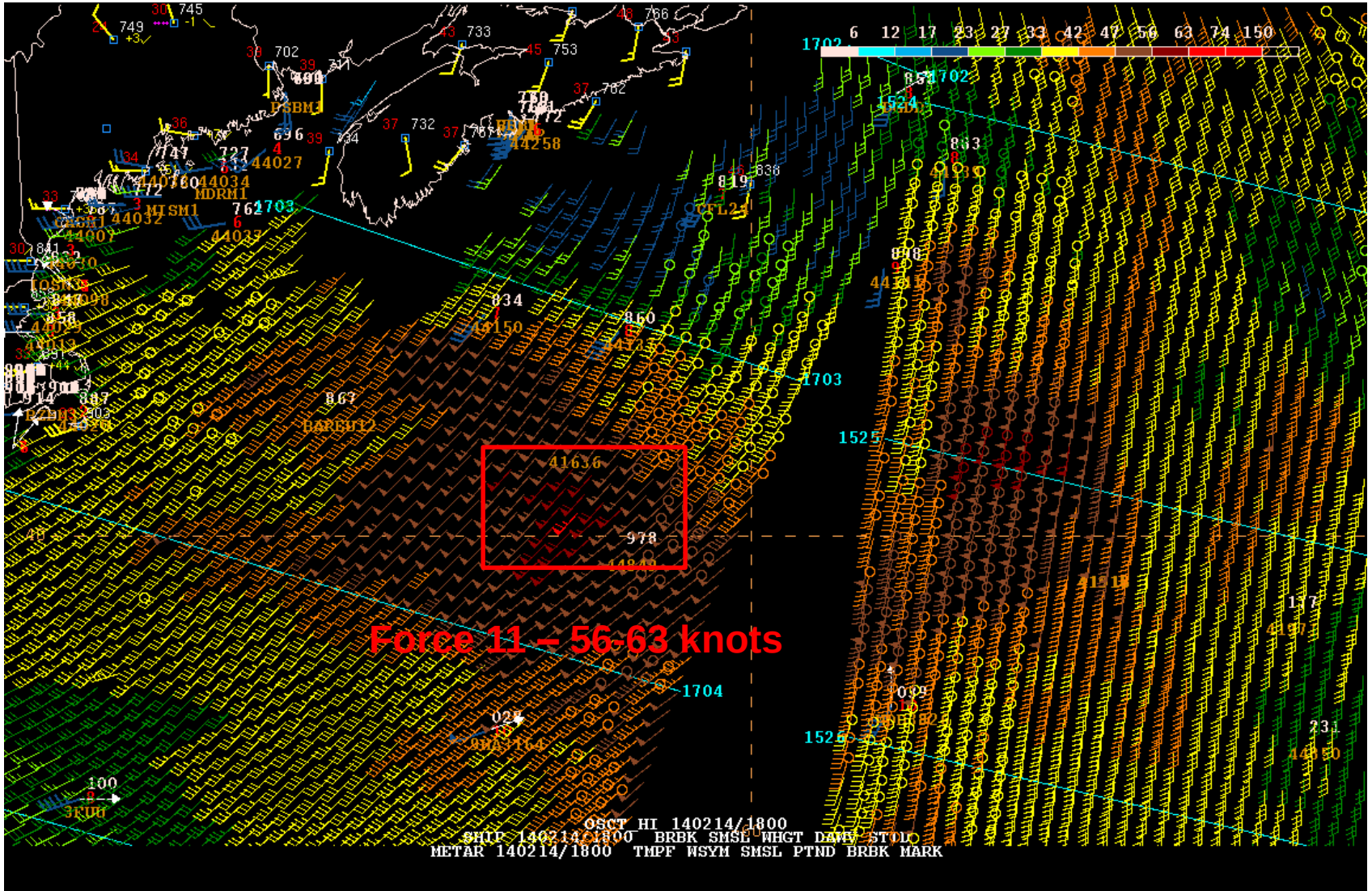
Force 9

Force 10

Force 11

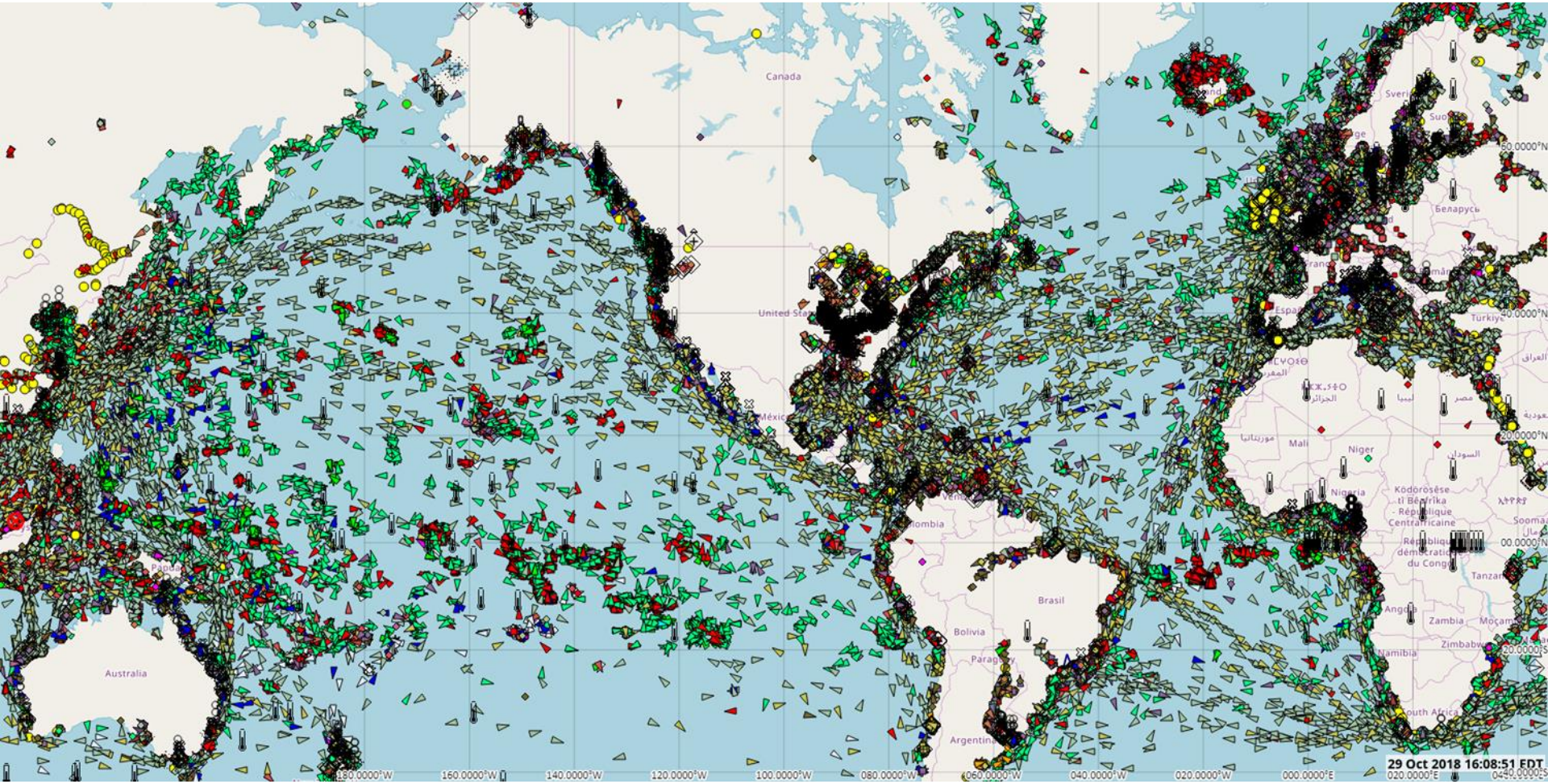
Force 12

Ocean Weather

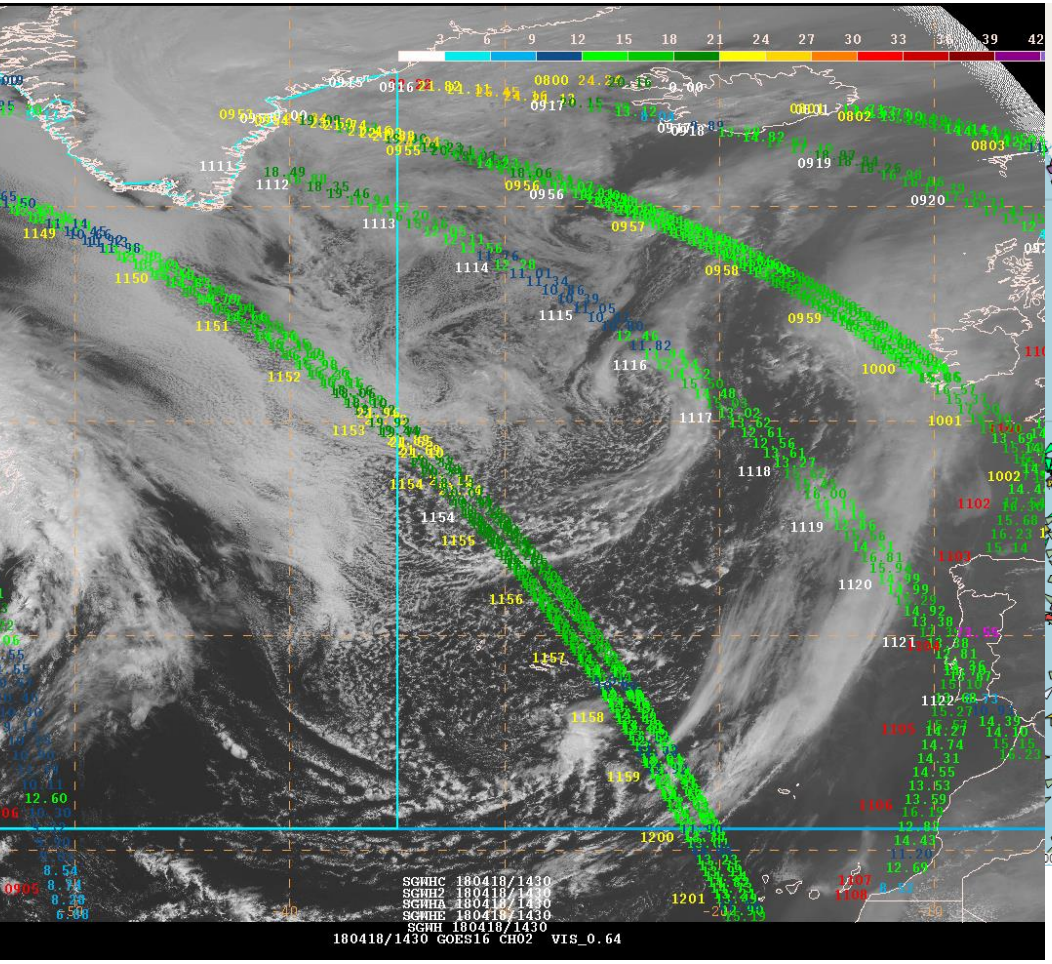


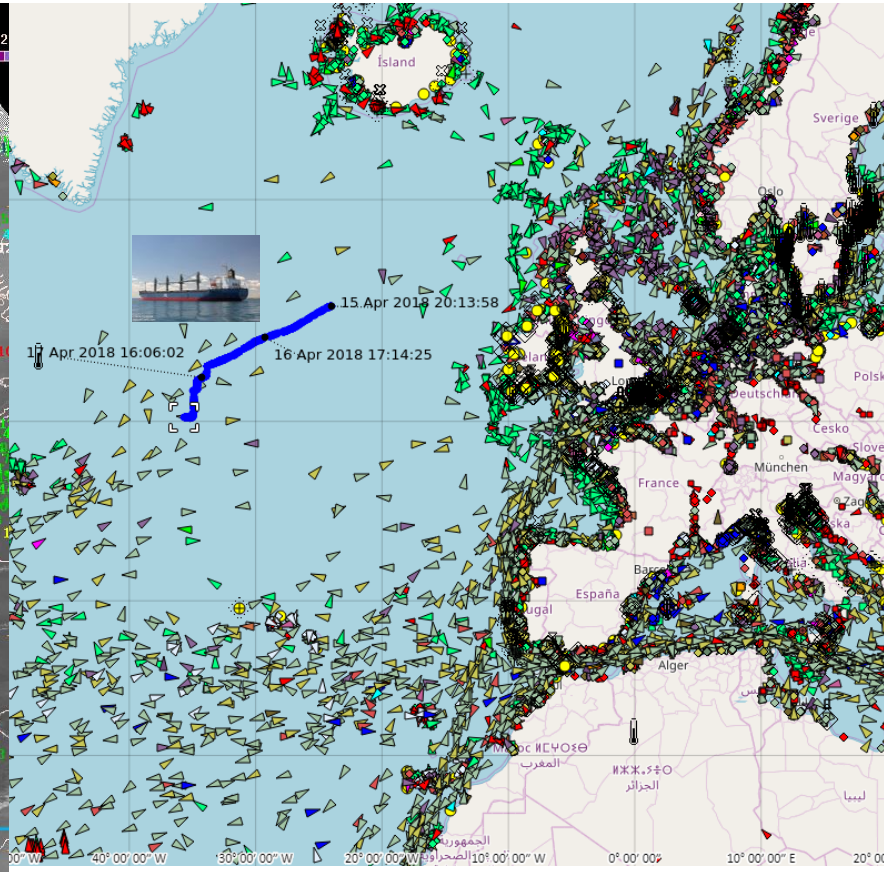
Global Vessel Traffic

Automatic Identification System – AIS

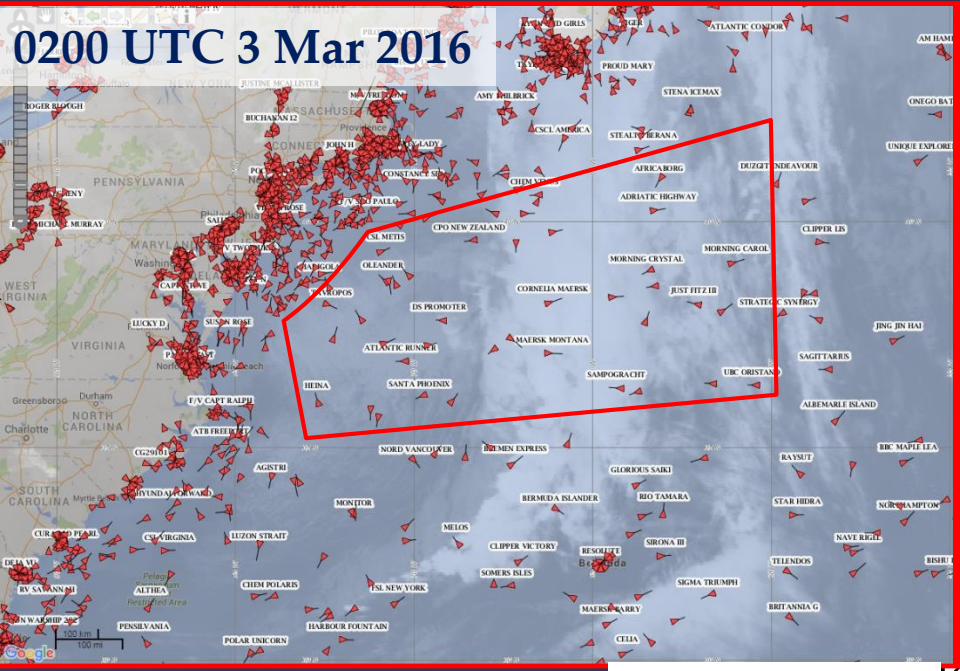


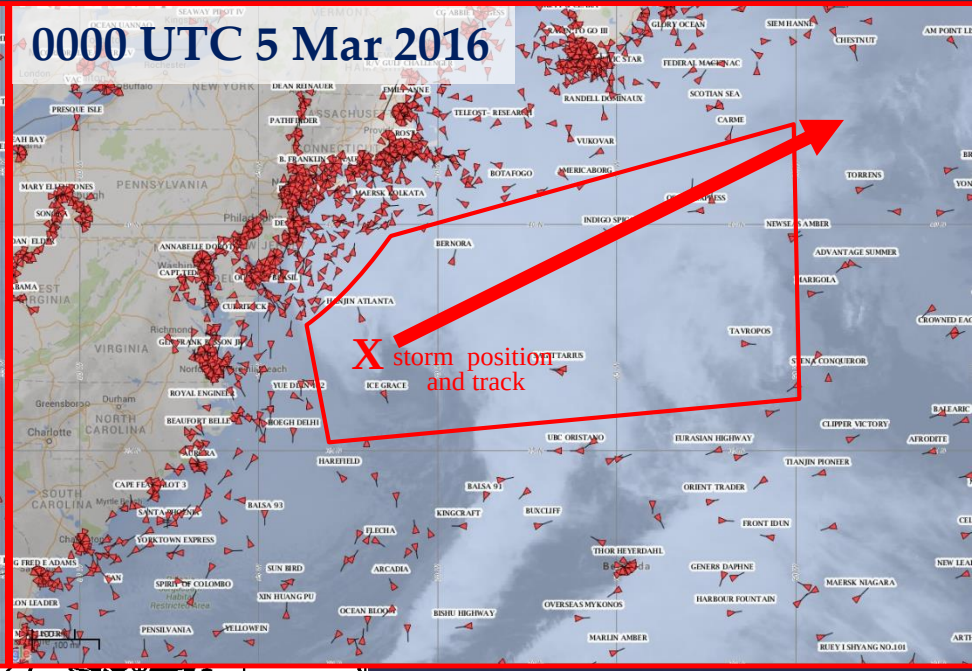
Application - Vessel Avoidance Practices





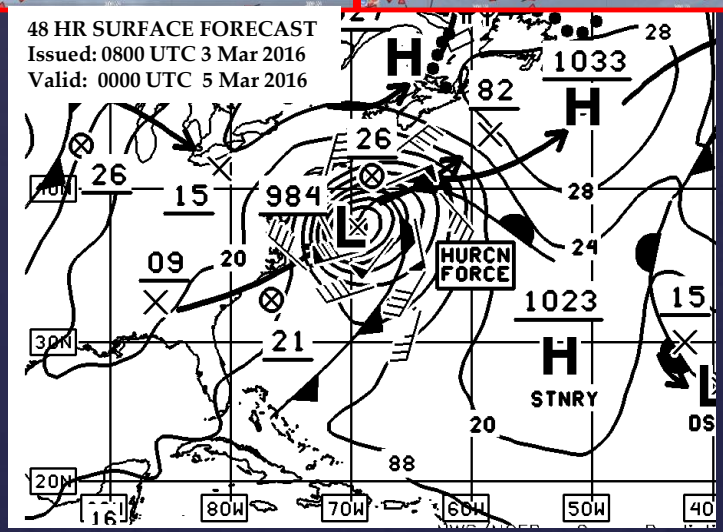
Heavy Weather Avoidance





2 Days Before the Storm

46 ships in the polygon



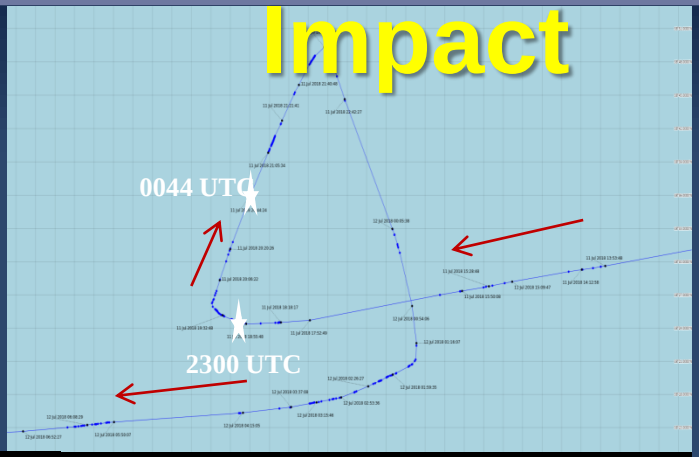
During the Storm

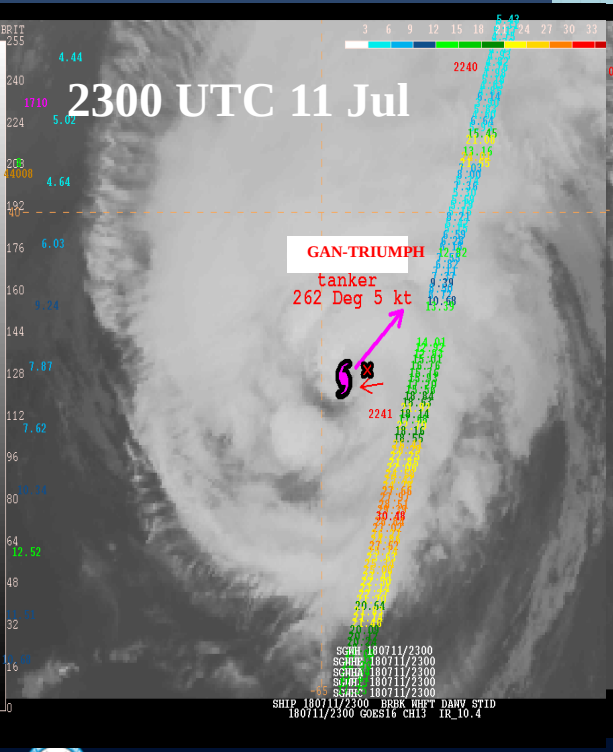
Ships heed hurricane force wind warnings:

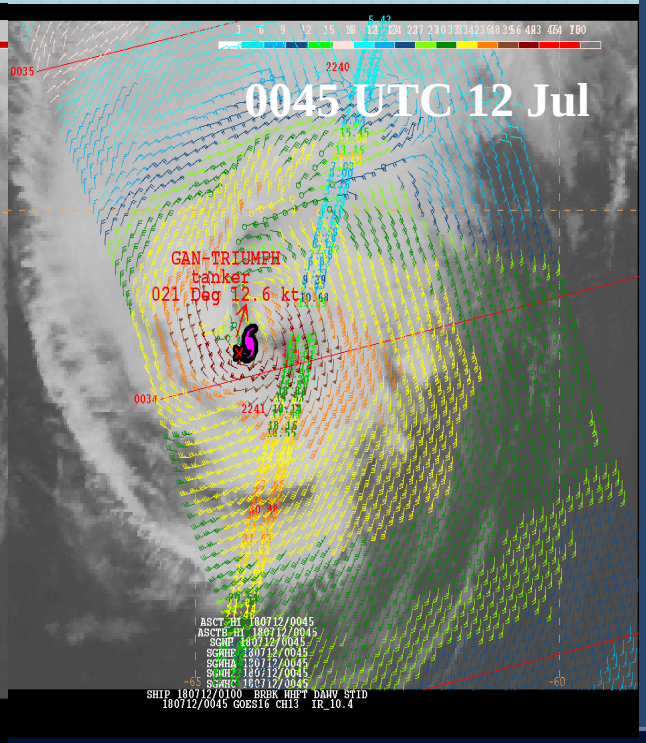
13 ships in the polygon

Hurricane Chris – Extreme Weather

Impact

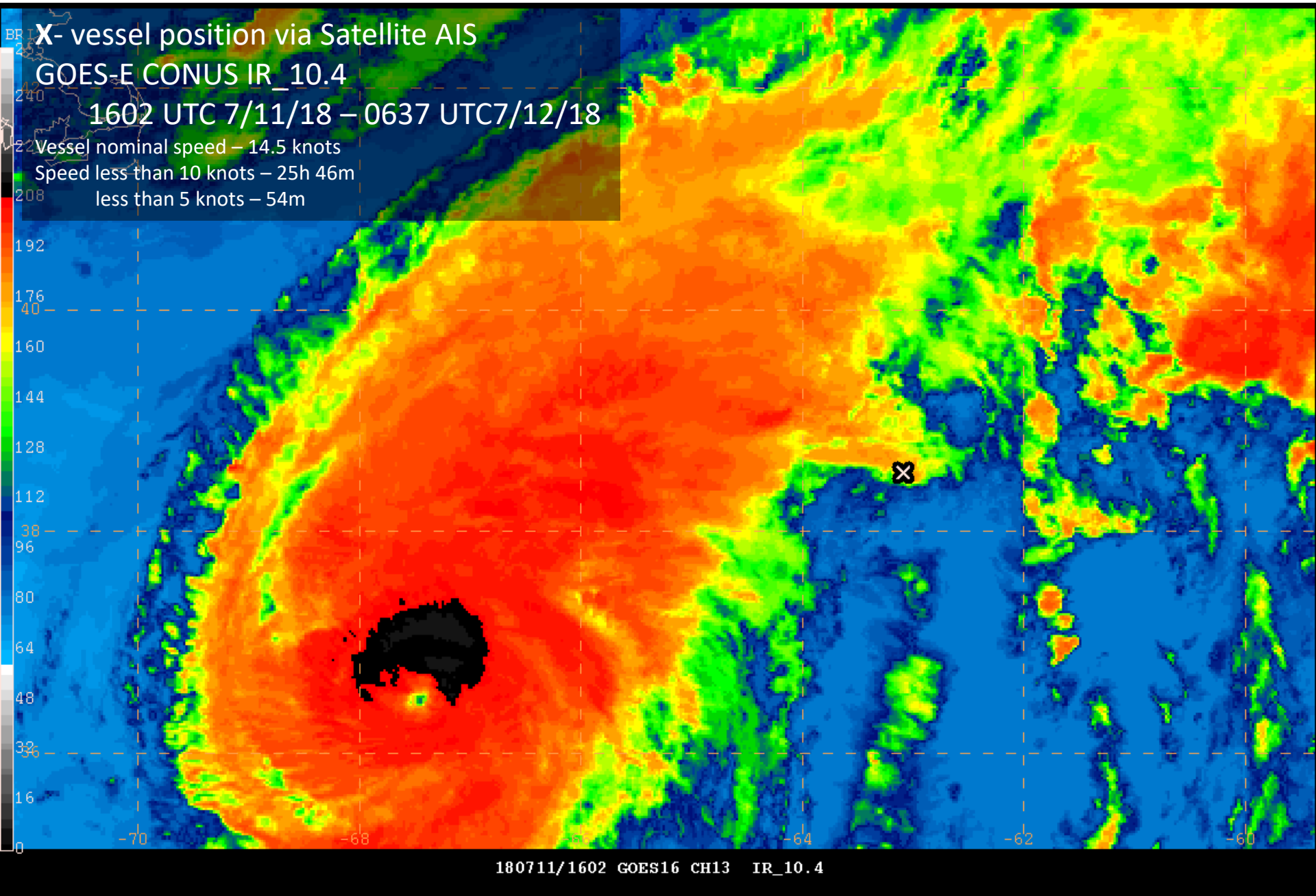




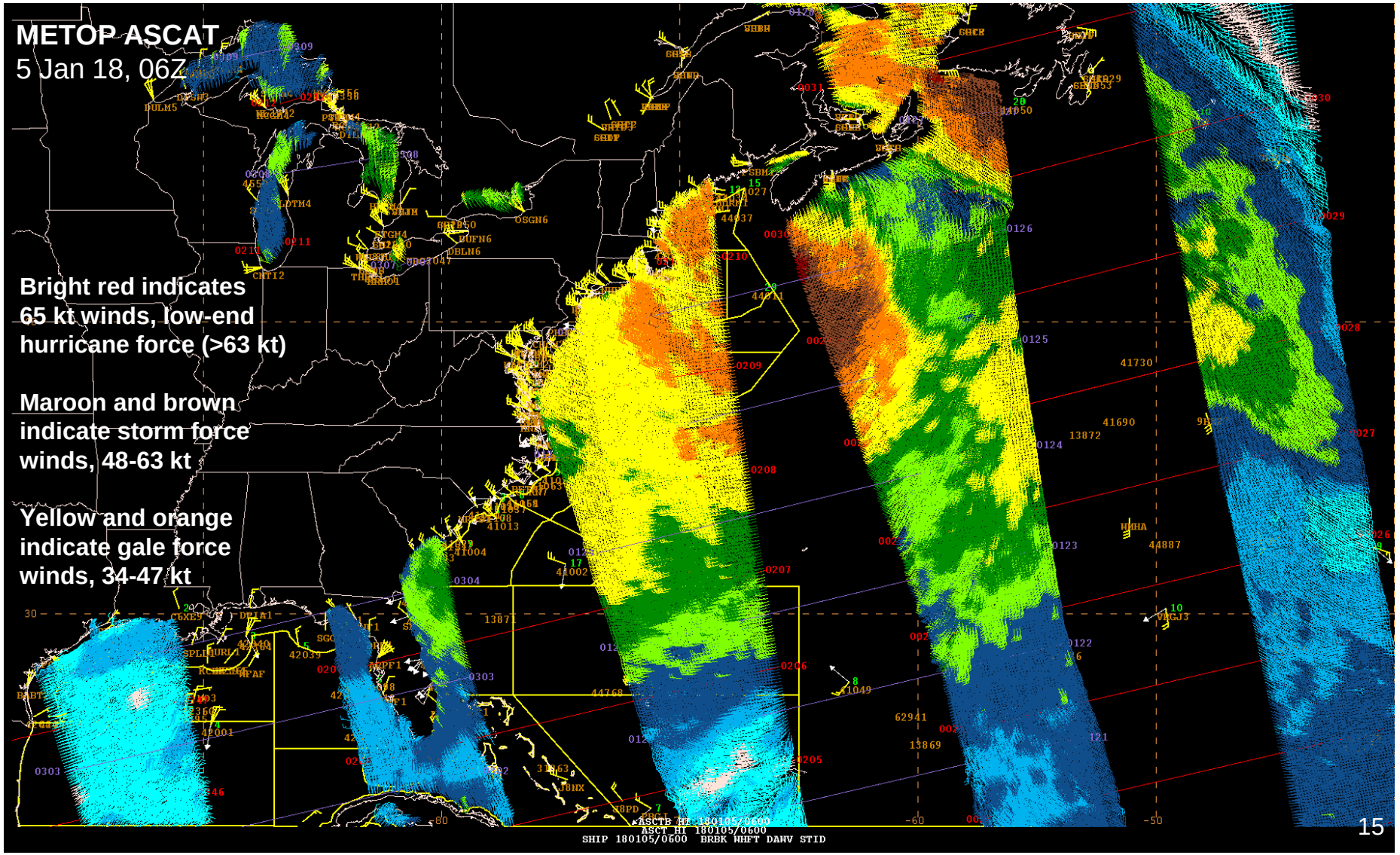


- Nearly all vessels avoided extreme winds and seas.
- Tanker GAN-TRIUMPH Enroute Spain to NYC
  - Encountered Hurricane Chri
  - 2300 ~15 nm ENE center
  - 0045 W of center
- AIS shows vessel slowed and did a loop of ~140 nm
- AltiKa – seas to 30 ft
- ASCAT-A – HF to E of center
  - Large area TS winds
- No observations received from ship
- No report of impact to vessel

Vessel Encounter with Hurricane Chris – July 11-12, 2018

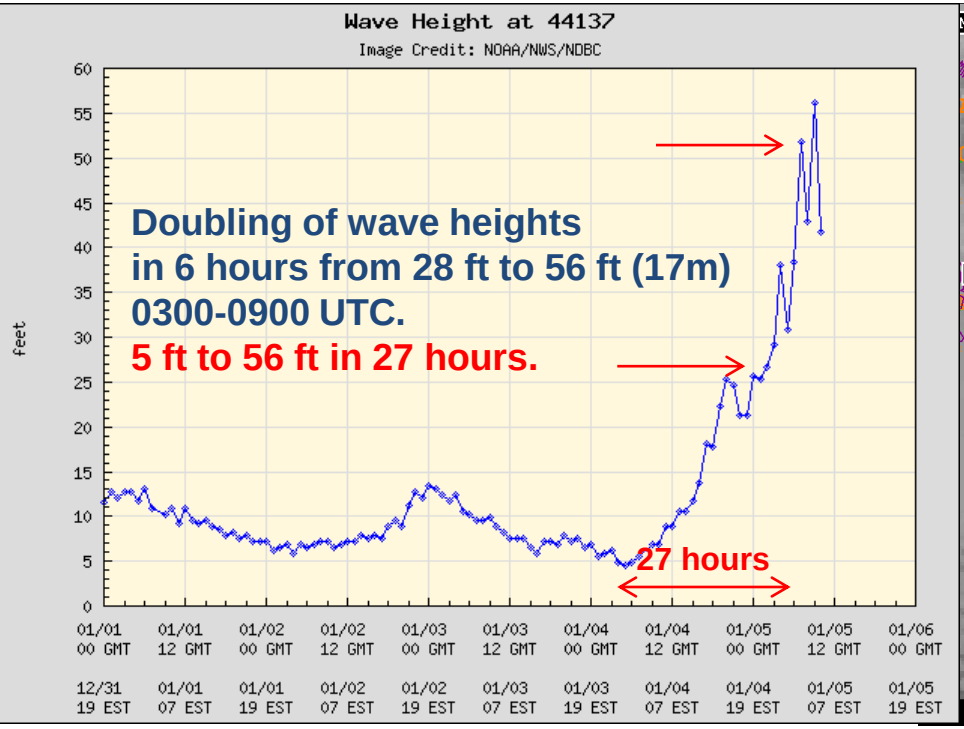


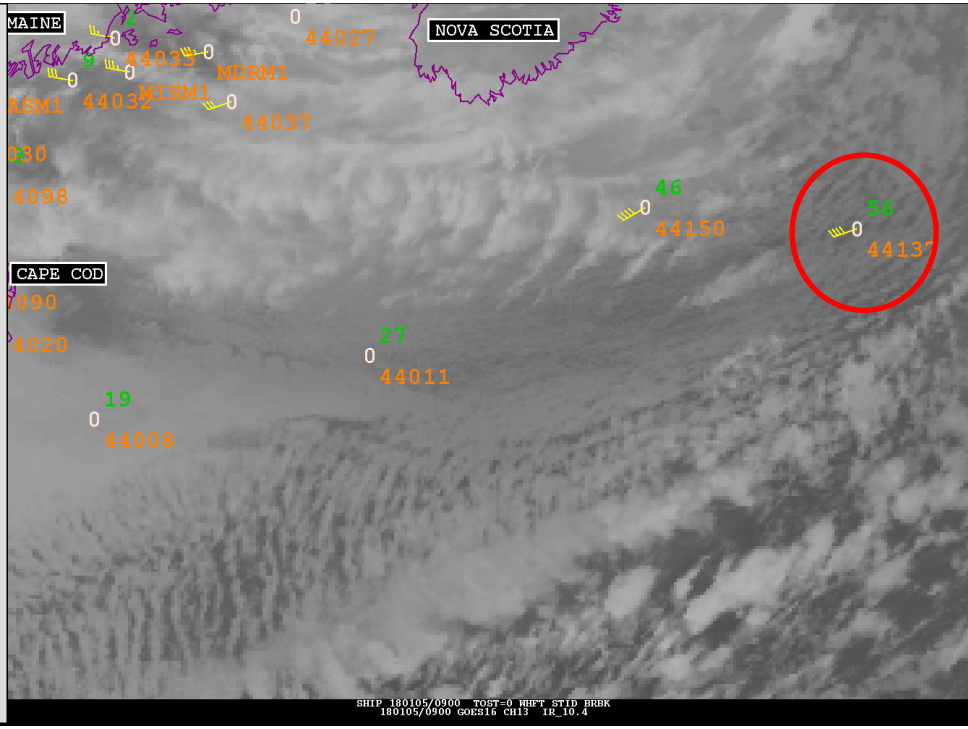
Observations:
Extreme Weather, 4-5 Jan 2018



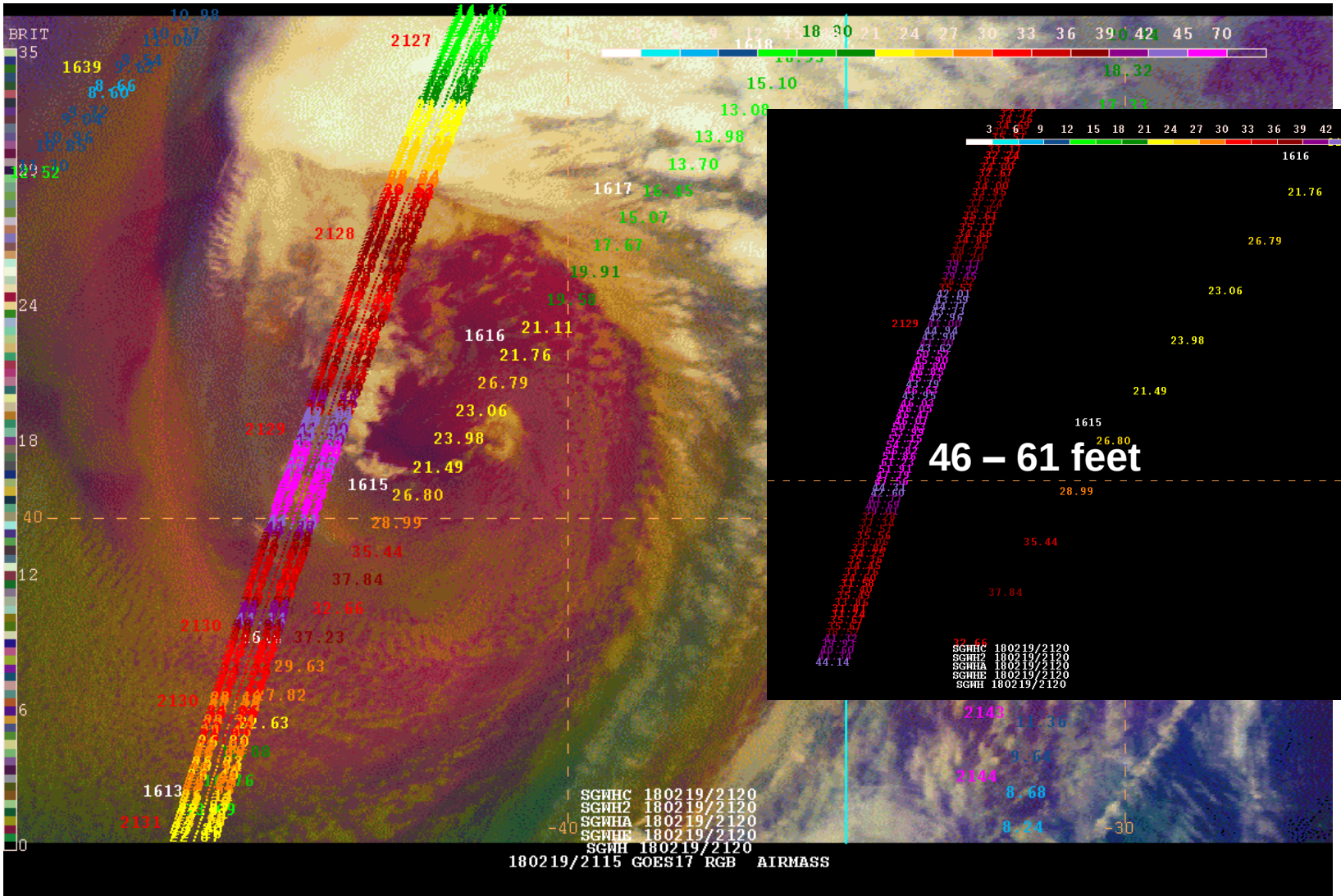
Wave Growth and Dynamic* Fetch
Jan 03-05, 2018 Ocean Storm

*also, Trapped or Contained Fetch



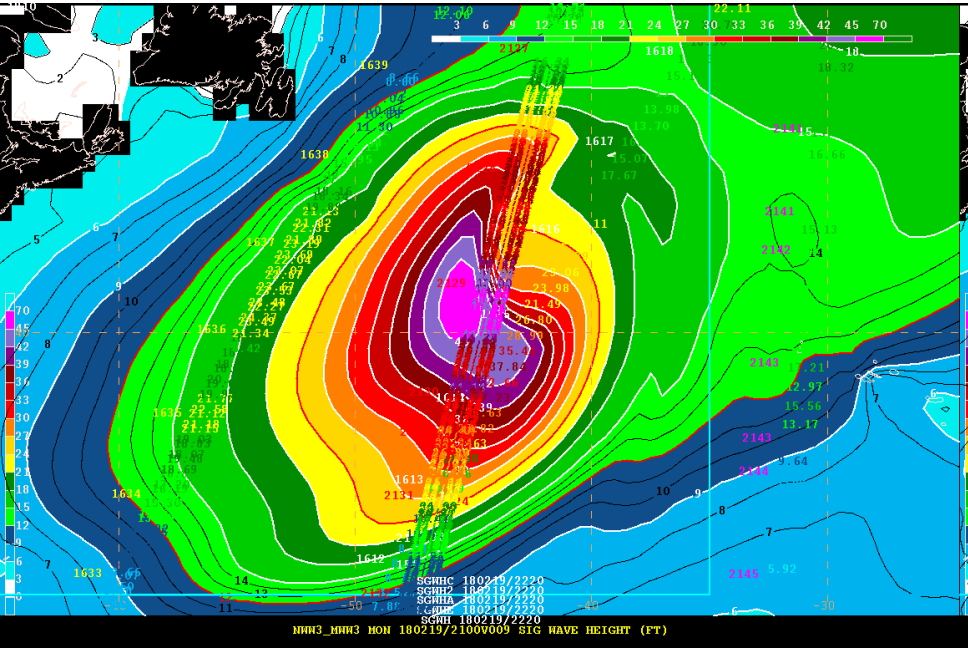


Extreme Waves

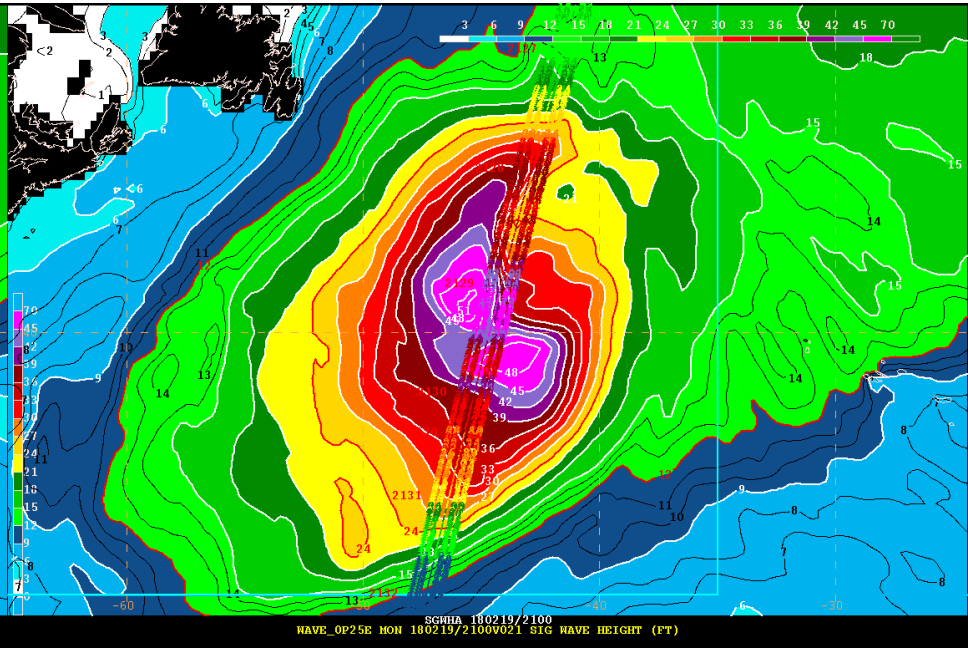


Wave Model Comparison

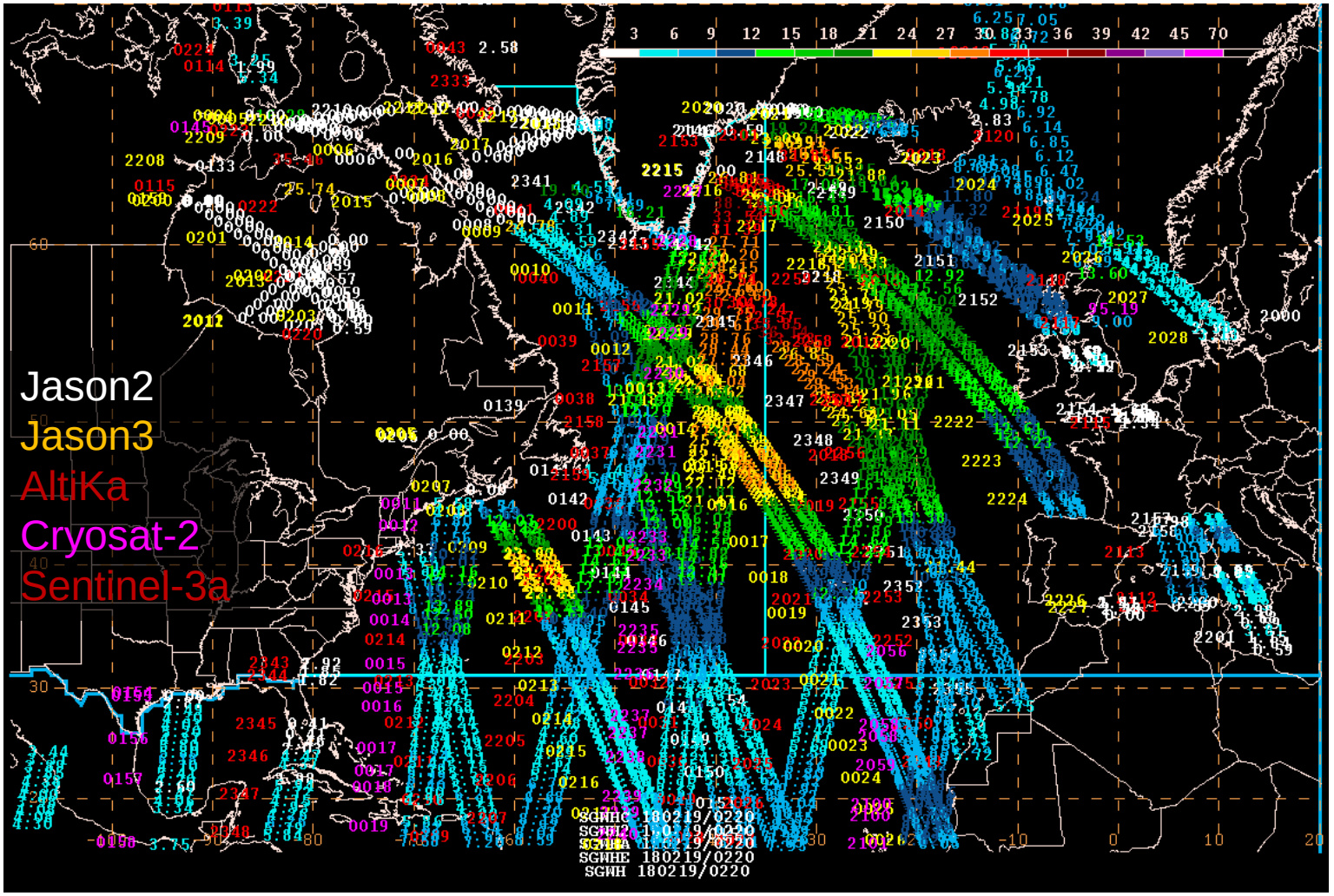
Operational Multi-grid Wave Model



Experimental Multi-grid Wave Model



Wave Heights – 5 Altimeters



Explosive Cyclogenesis

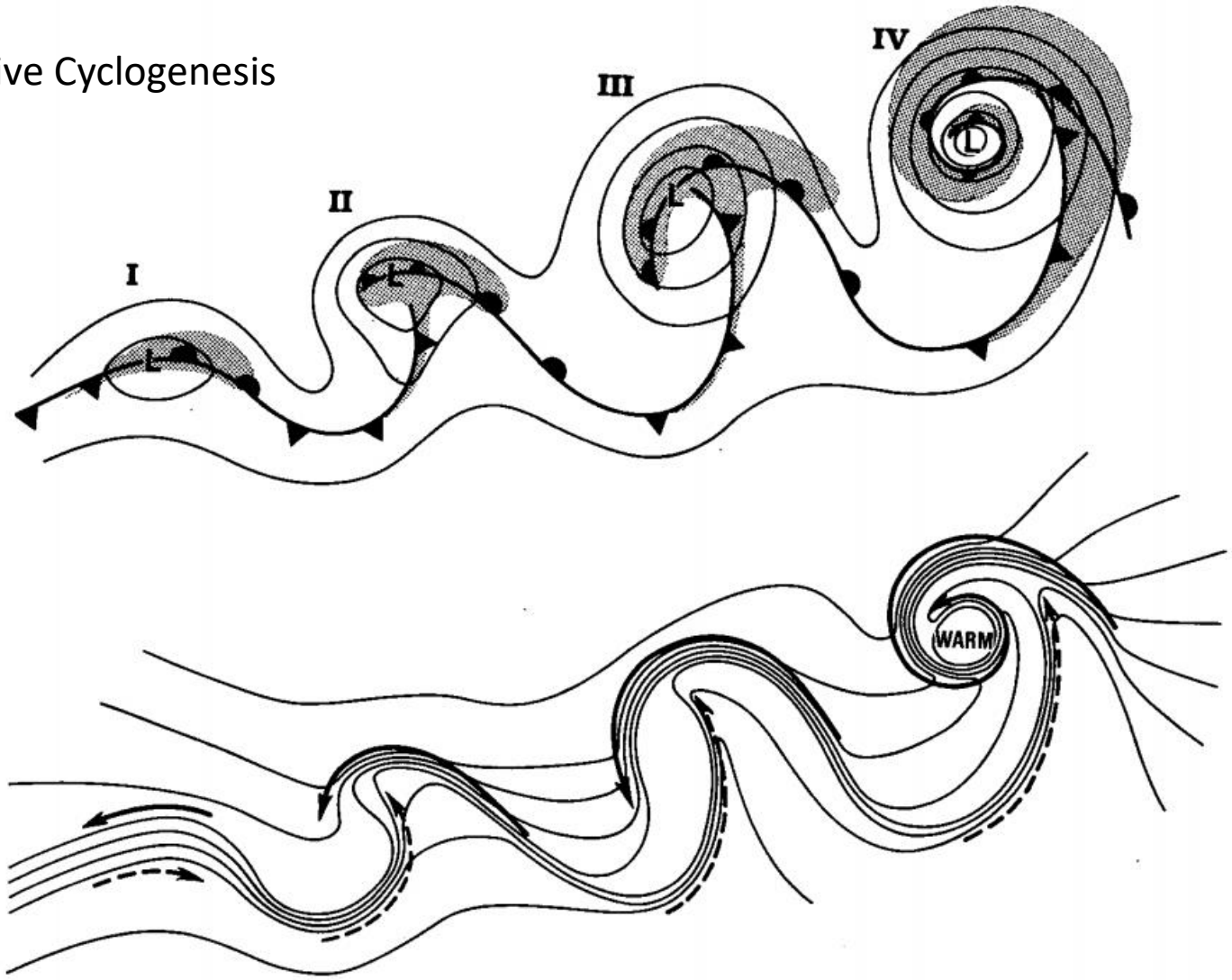
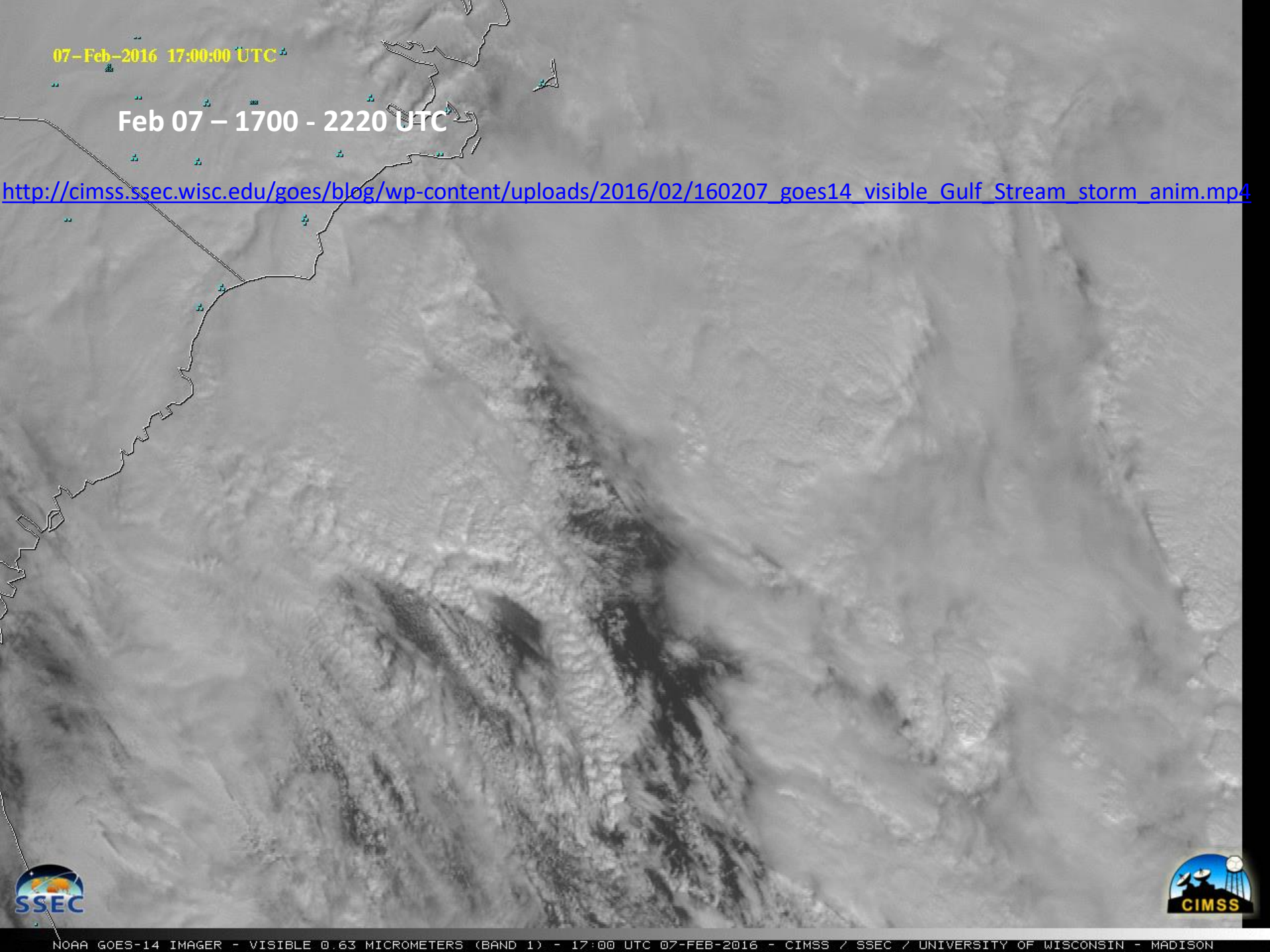
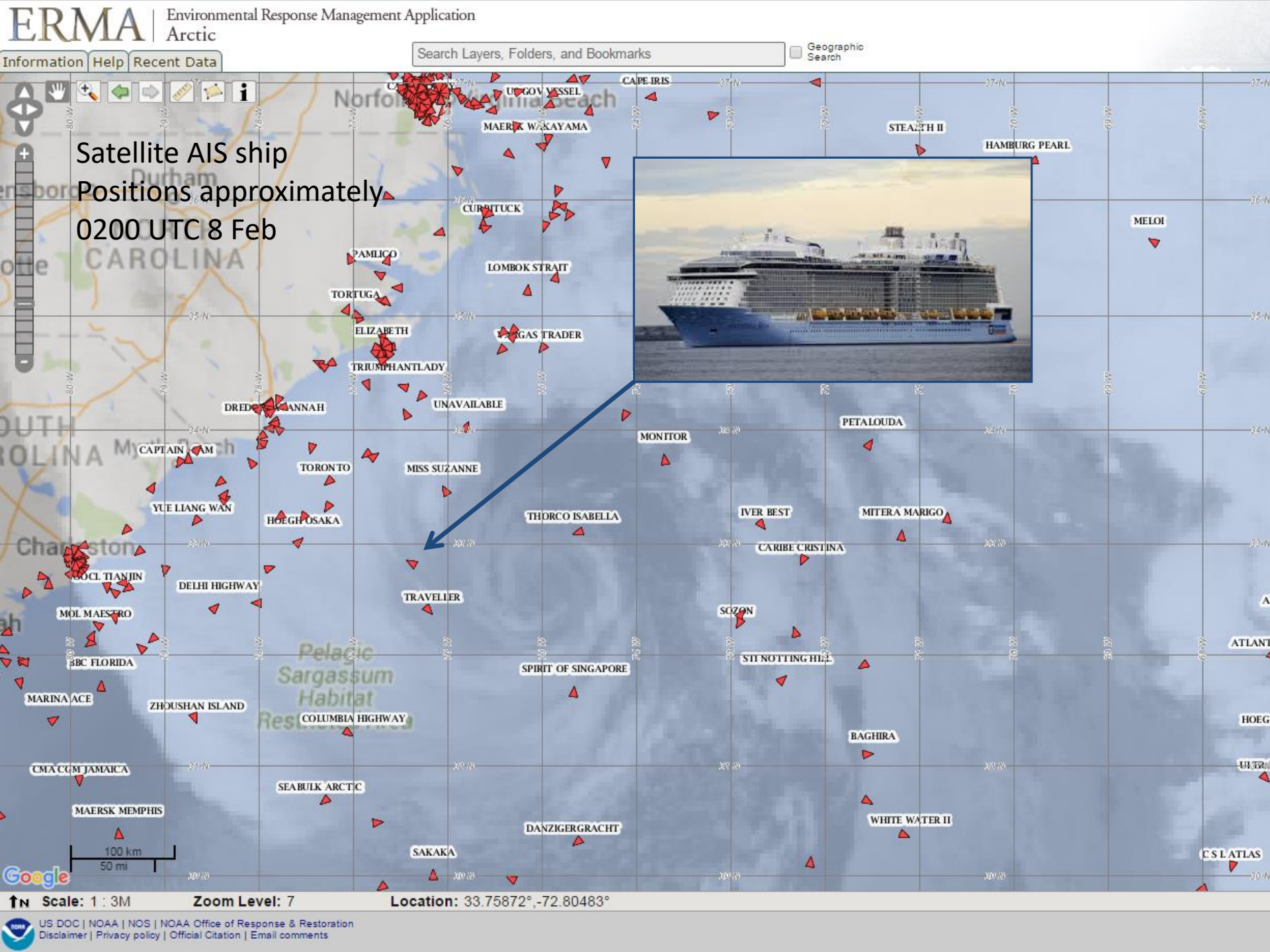
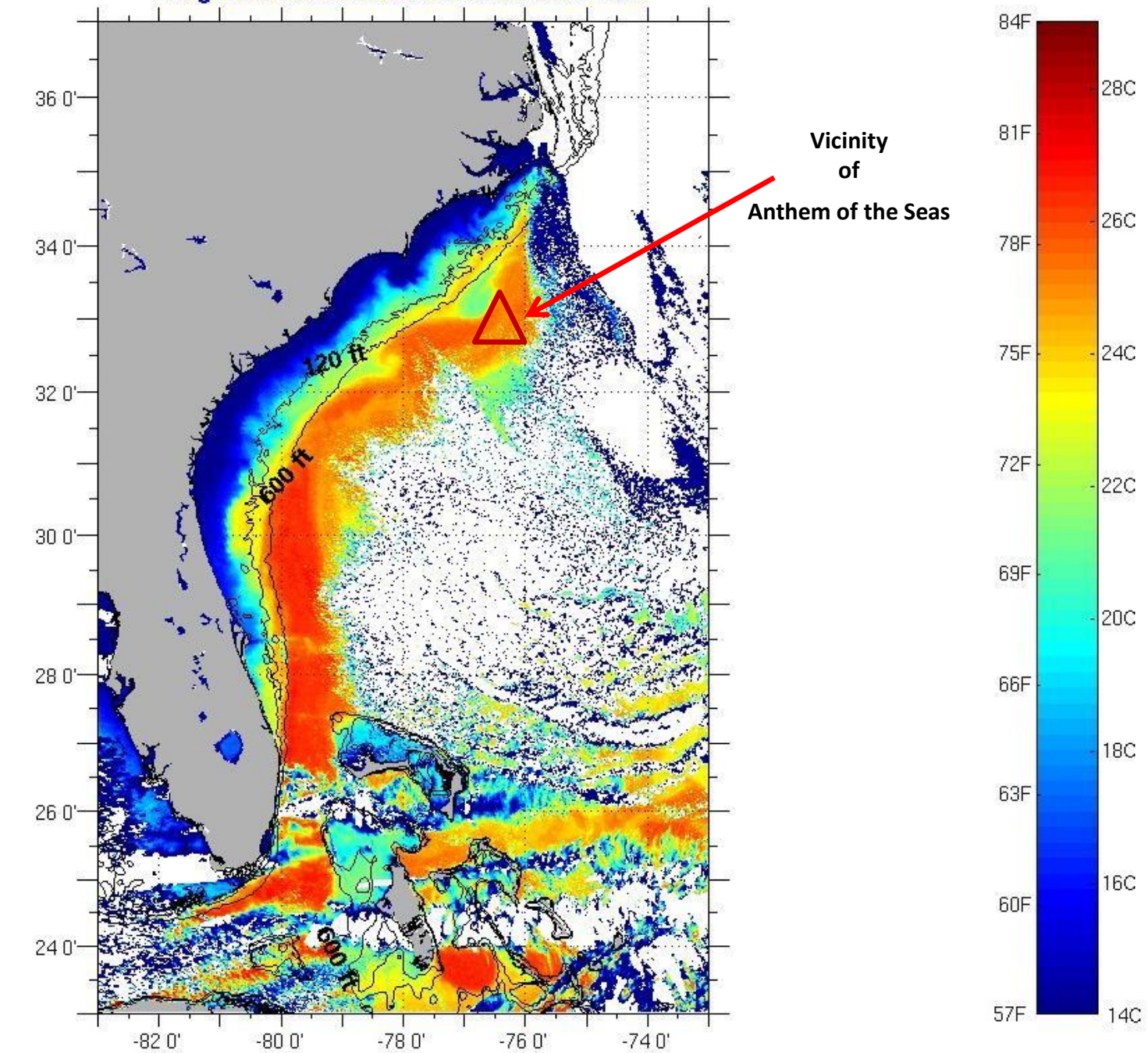


FIG. 21. An alternative model of frontal-cyclone evolution (Shapiro and Keyser 1990): incipient broad-baroclinic phase (I), frontal fracture (II), bent-back front and frontal T-bone (III), and warm-core frontal seclusion (IV). Upper: sea level pressure (solid), fronts (bold), and cloud signature (shaded). Lower: temperature (solid), and cold and warm air currents (solid and dashed arrows, respectively).

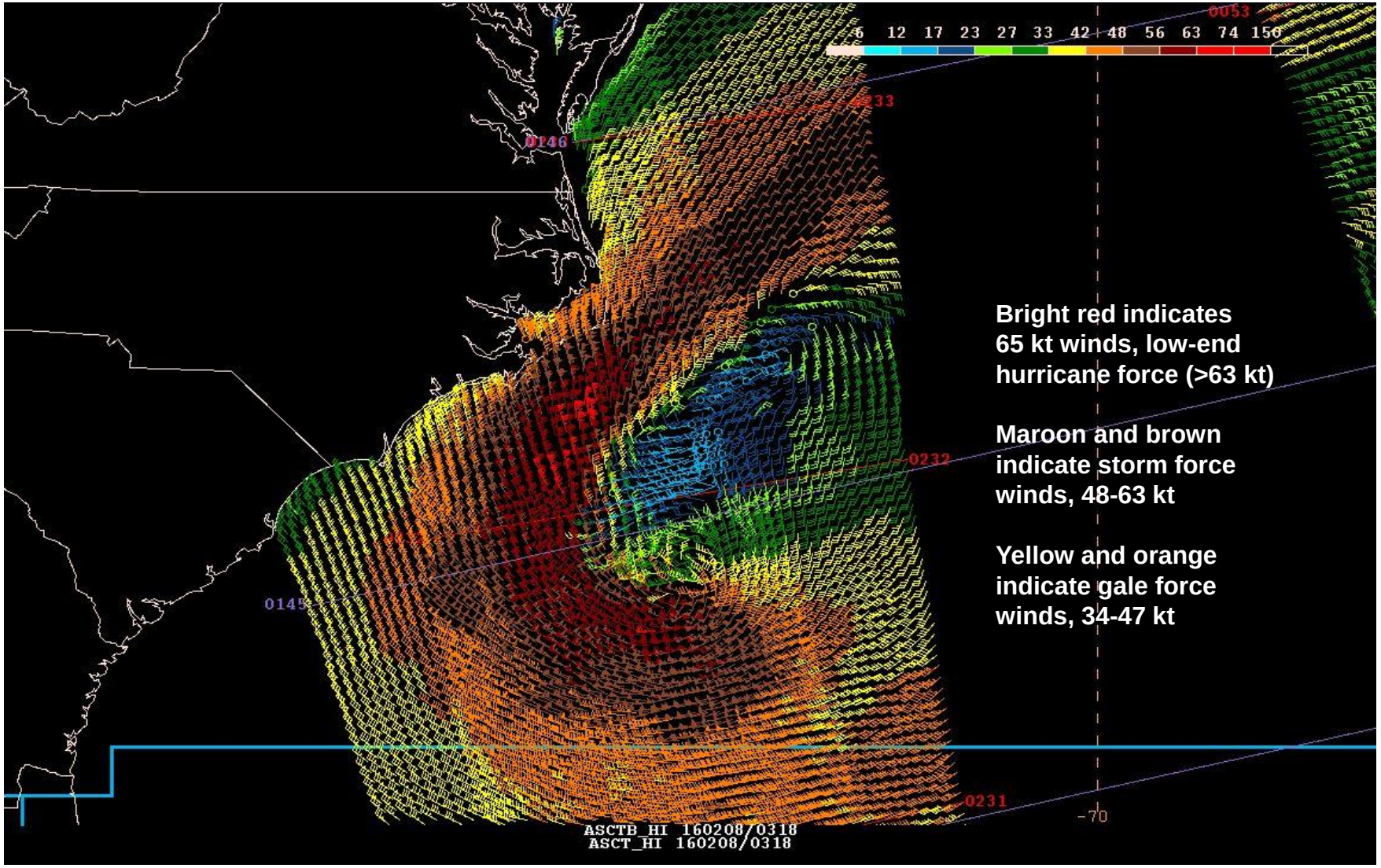

Where are the strongest winds?
DEG C
-110.1
-100
-90
-80
-70
-60
-50
-40
-30
-20
-10
0
10
20
30
40
50
56.9
40
30
-150
-140
-130
060104/0530 GOES10 IR4


07-Feb-2016 17:00:00 UTC
Feb 07 – 1700 - 2220 UTC
http://cimss.ssec.wisc.edu/goes/blog/wp-content/uploads/2016/02/160207_goes14_visible_Gulf_Stream_storm_anim.mp4
SSEC
CIMSS
NOAA GOES-14 IMAGER - VISIBLE 0.63 MICROMETERS (BAND 1) - 17:00 UTC 07-FEB-2016 - CIMSS / SSEC / UNIVERSITY OF WISCONSIN - MADISON


ERMA
Environmental Response Management Application
Arctic
Information
Help
Recent Data
Search Layers, Folders, and Bookmarks
Geographic Search
Satellite AIS ship
Positions approximately
0200 UTC 8 Feb
CAPE IRIS
MAERSK WAKAYAMA
HAMBURG PEARL
CURRITUCK
MELOI
PAMLICO
LOMBOK STRAIT
TORTUGA
ELIZABETH
TRIUMPHANTLADY
UNAVAILABLE
PETALOUDA
MONITOR
CAPTAIN SAM
TORONTO
MISS SUZANNE
YUE LIANG WAN
HOEGH OSAKA
THORCO ISABELLA
IVER BEST
MITERA MARIGO
CARIBE CRISTINA
SOCL TIANJIN
DELHI HIGHWAY
TRAVELLER
MOL MAESTRO
SOZON
SPIRIT OF SINGAPORE
MARINA ACE
ZHOUSHAN ISLAND
COLUMBIA HIGHWAY
BAGHIRA
CMA CGM JAMAICA
SEABULK ARCTIC
MAERSK MEMPHIS
DANZIGERGRACHT
WHITE WATER II
SAKAKA
C S L ATLAS
Pelagic Sargassum Habitat
100 km
50 mi
Google
Scale: 1 : 3M
Zoom Level: 7
Location: 33.75872°,-72.80483°
US DOC | NOAA | NOS | NOAA Office of Response & Restoration
Disclaimer | Privacy policy | Official Citation | Email comments


NOAA-18 Sea Surface Temperature: February 08, 2016 1037 GMT
Rutgers Coastal Ocean Observation Lab
36 0'
34 0'
32 0'
30 0'
28 0'
26 0'
24 0'
-82 0'
-80 0'
-78 0'
-76 0'
-74 0'
120 ft
600 ft
600 ft
Vicinity
of
Anthem of the Seas
84F
81F
78F
75F
72F
69F
66F
63F
60F
57F
28C
26C
24C
22C
20C
18C
16C
14C

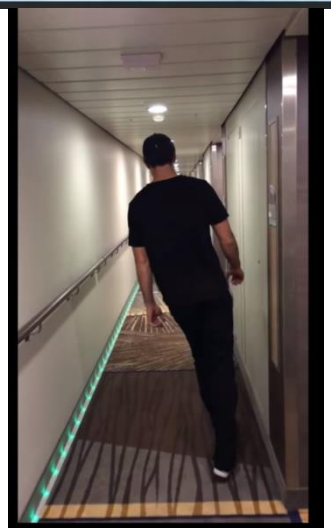
Wind Speed (knots)
METOP ASCAT: Feb **7, 2016**



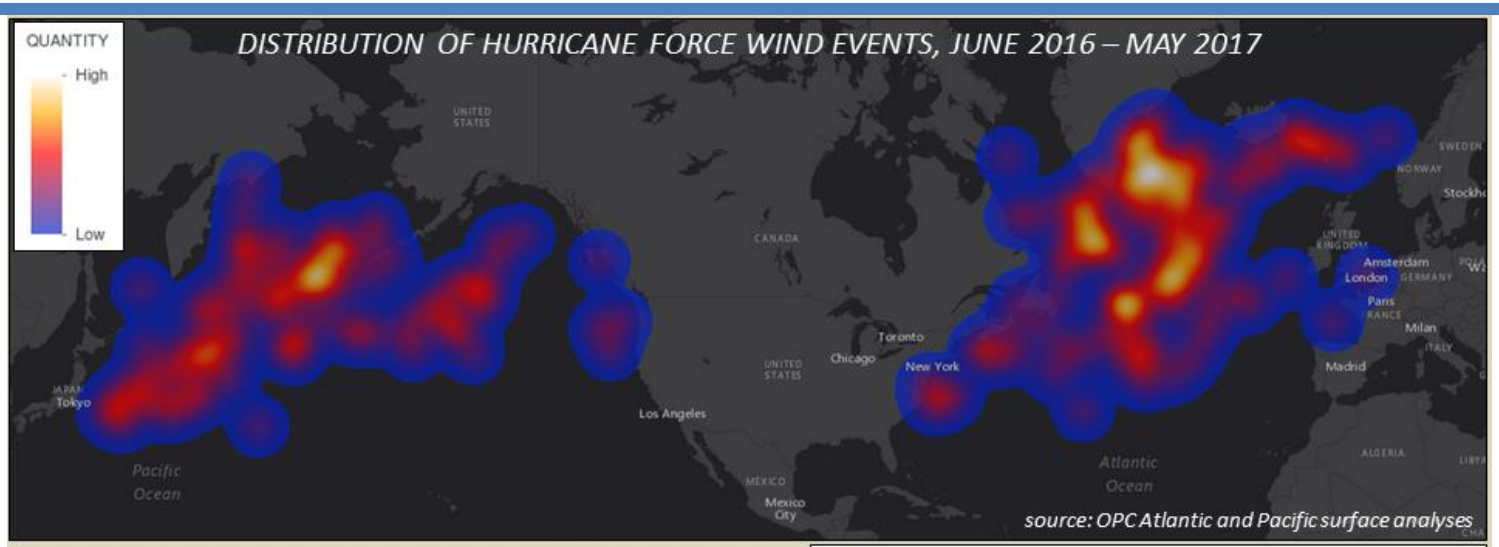
Anthem Of The Seas Vs Huge Waves And 120 MPH Winds. Viewed From My Room On The Third Deck. NO MUSIC!

Watch later Share

http://www.metaspoon.com/waves-pummel-ship?cat=news

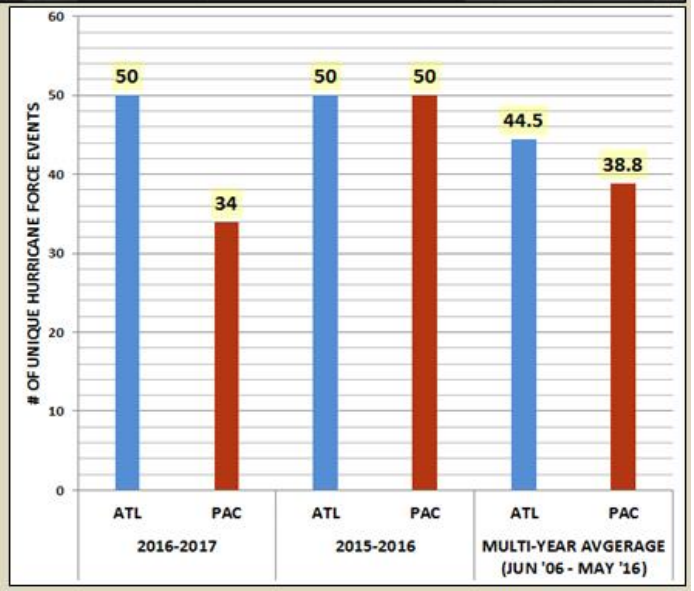


Ocean Prediction Center:
Heavy Weather Avoidance



TOP: heat map of total distribution of hurricane force low centers and hurricane force wind events (i.e., Greenland tip jets with no associated low center) for the winter season 2016/17.

RIGHT: bar chart comparison of hurricane force wind events between each ocean basin for the previous two winter seasons and multi-year average.



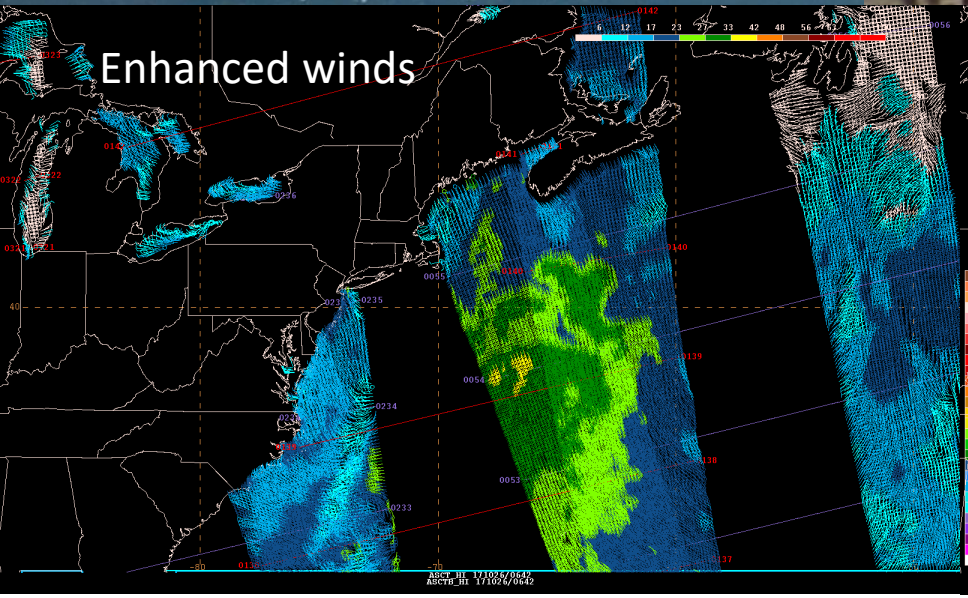
WWW.OPC.NCEP.NOAA.GOV

TWITTER.COM/NWSOPC
FACEBOOK.COM/NWSOPC

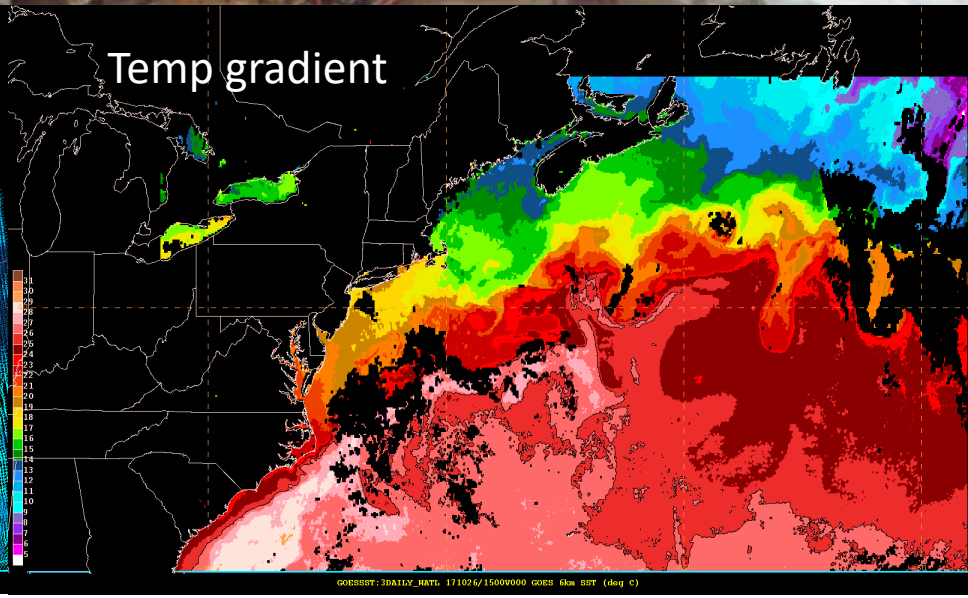
Gulf Stream Effects

Wind vs. Current

Trapped Swell



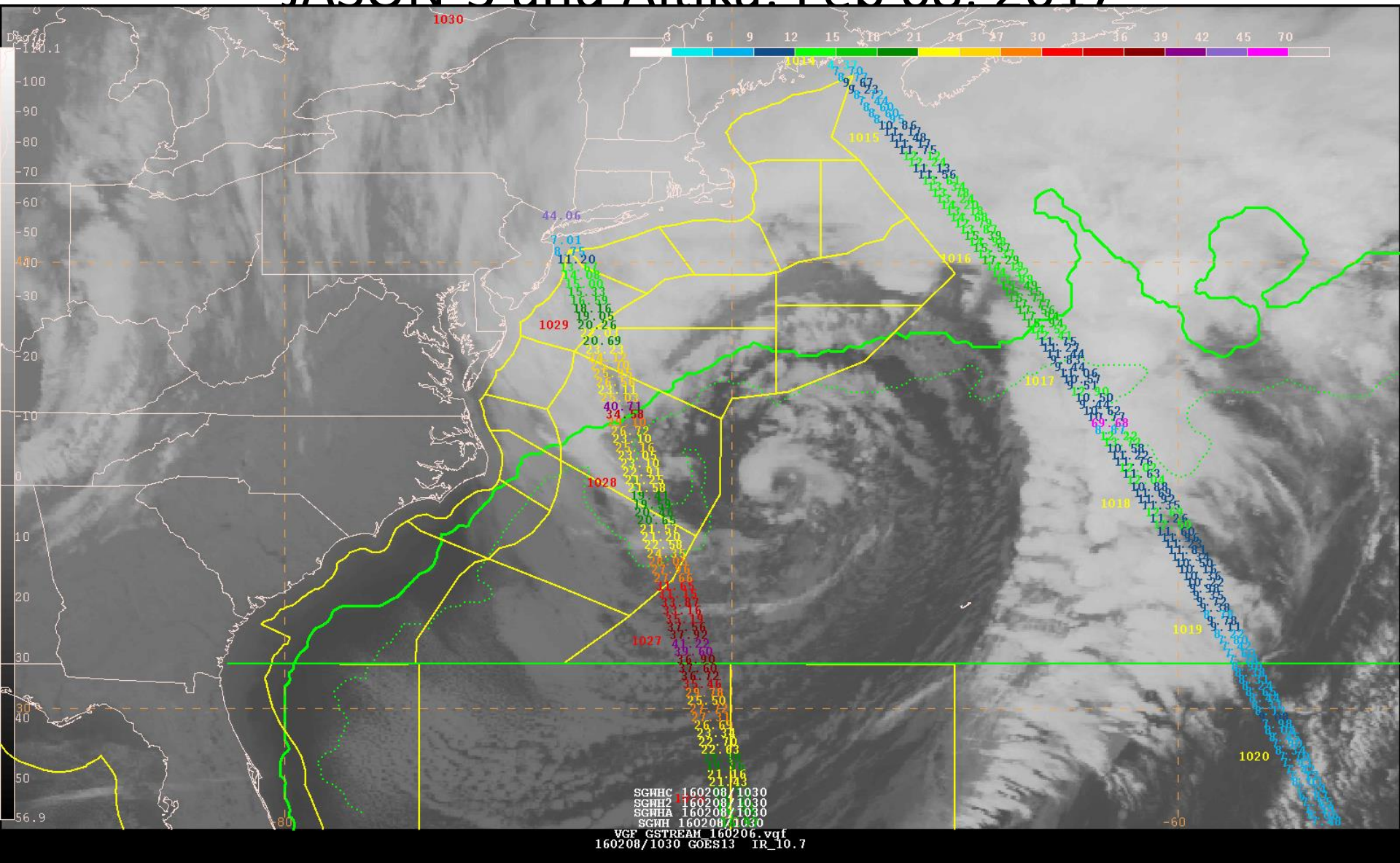
Enhanced winds



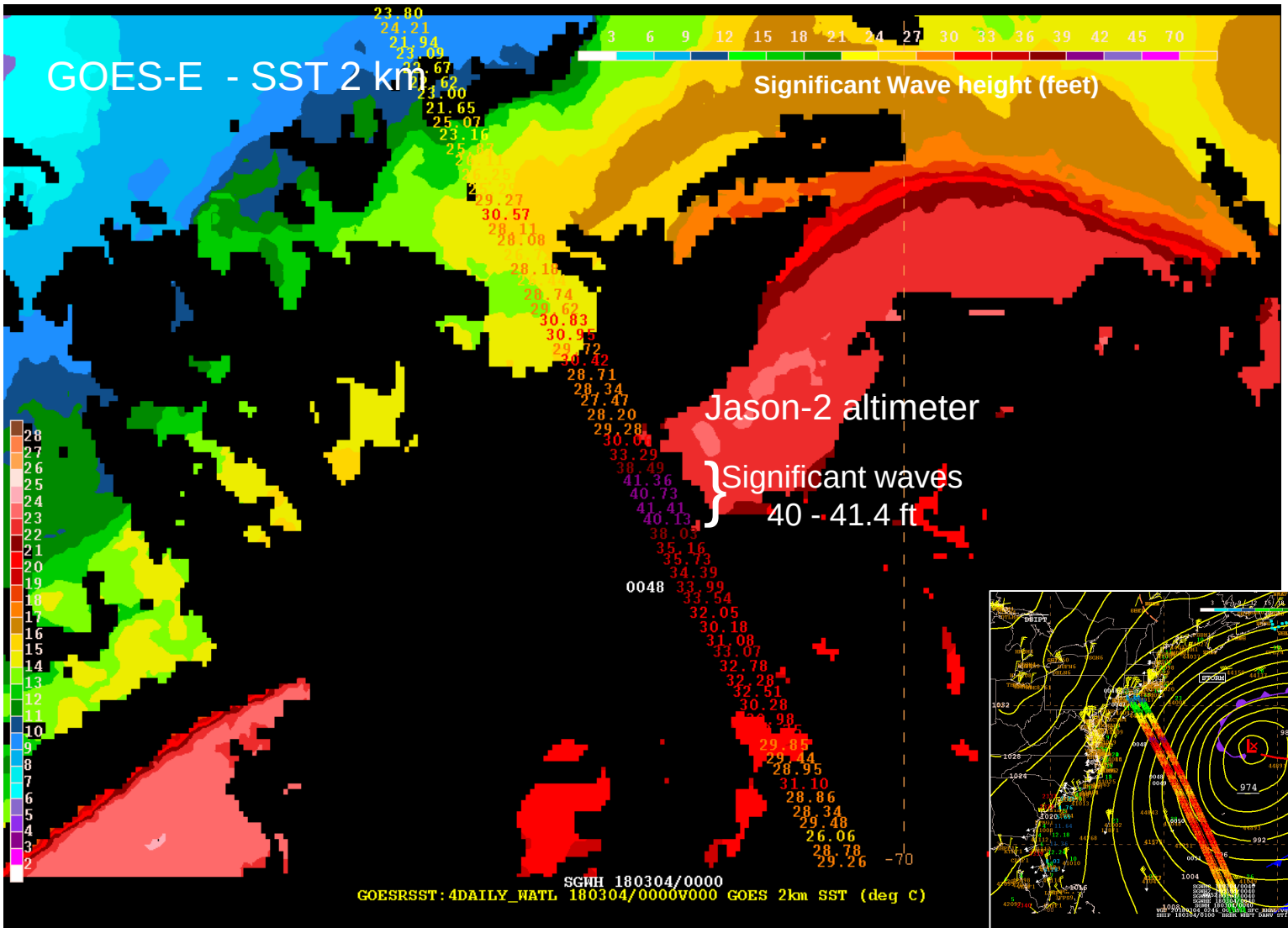
Temp gradient

Significant Wave Height (feet)

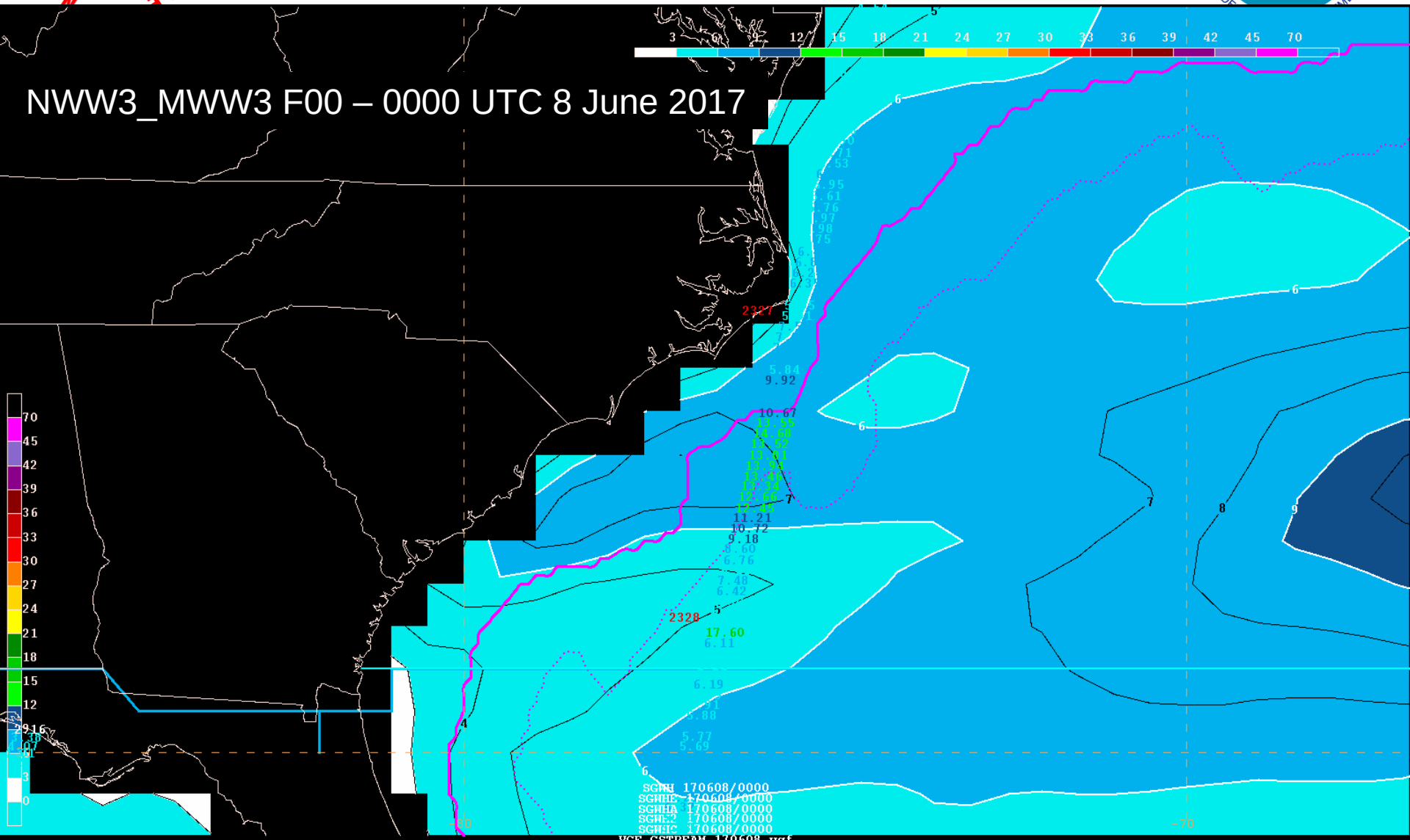
JASON-3 and Altika: Feb 08, 2017

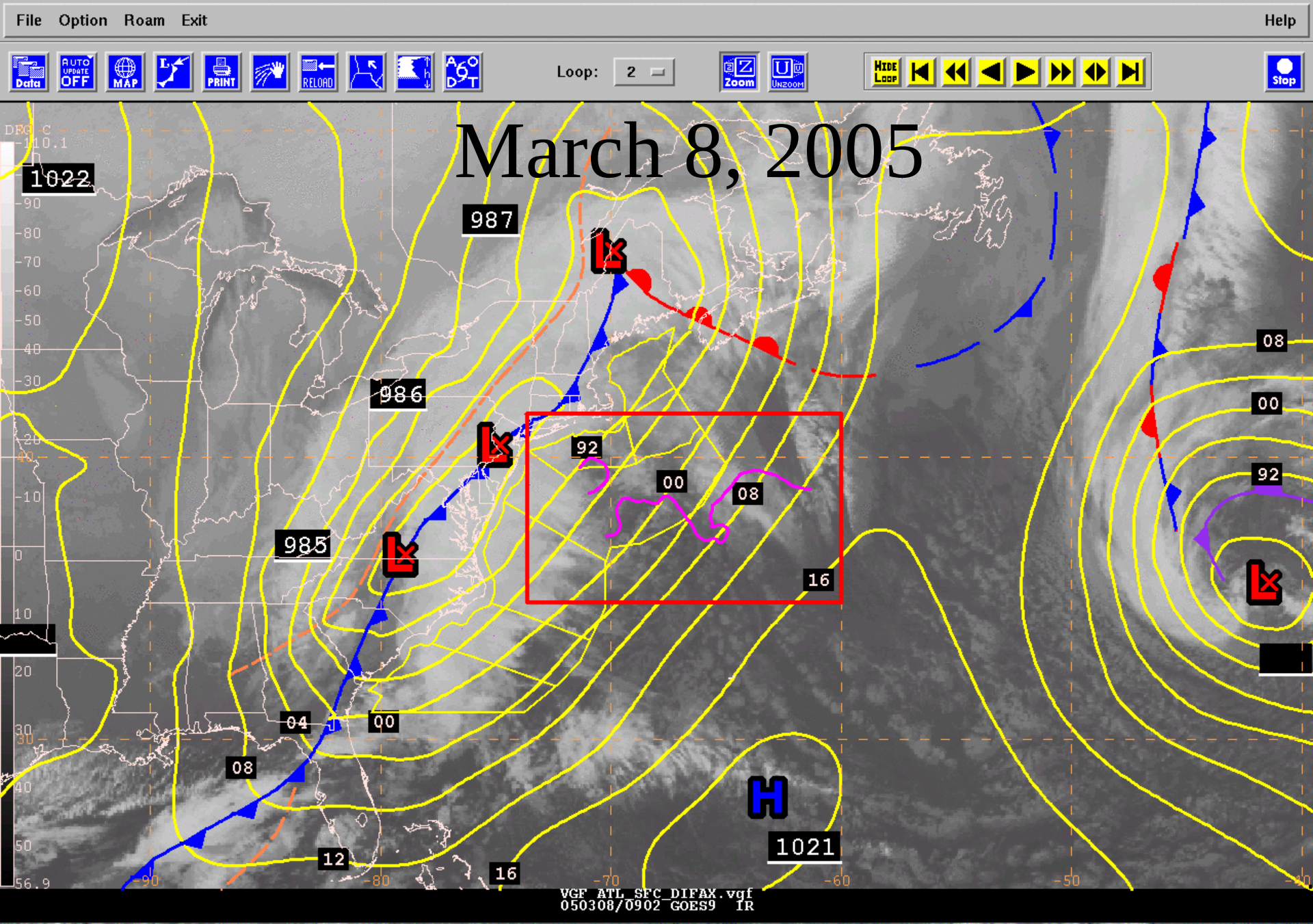


Waves in the Gulf Stream
Wind against current - Mar 4, 2018



Model Comparison

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Help
Data
AUTO UPDATE OFF
MAP
PRINT
RELOAD
Loop: 2
Zoom
UnZoom
HIDE Loop
Stop
March 8, 2005
1022
987
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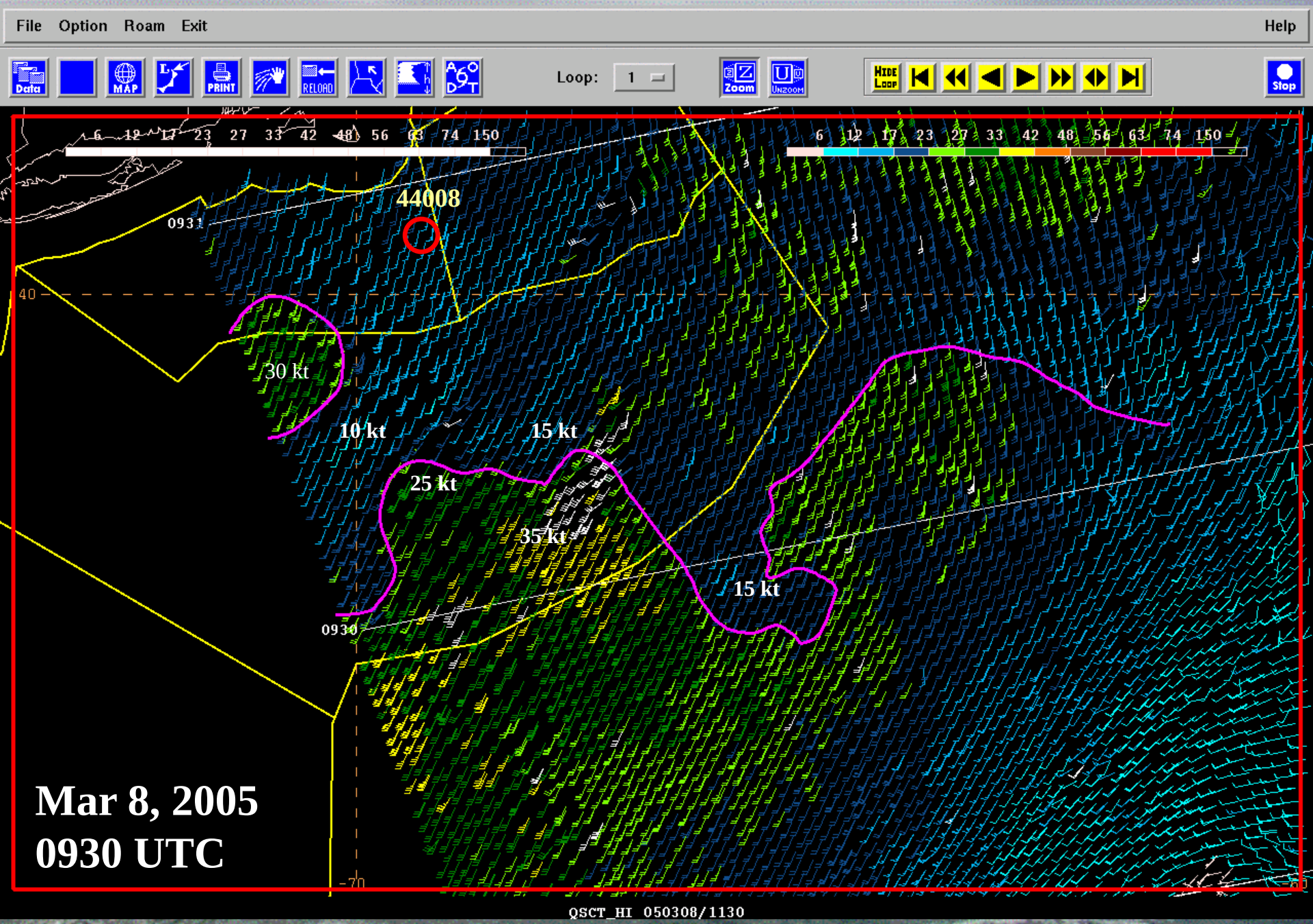
VGF ATL SFC DIFAX.vgf
050308/0902 GOES9 IR


File Option Roam Exit
Help
Data
MAP
PRINT
RELOAD
Loop: 1
Zoom
Unzoom
Hide Loop
Stop
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Mar 8, 2005
0930 UTC
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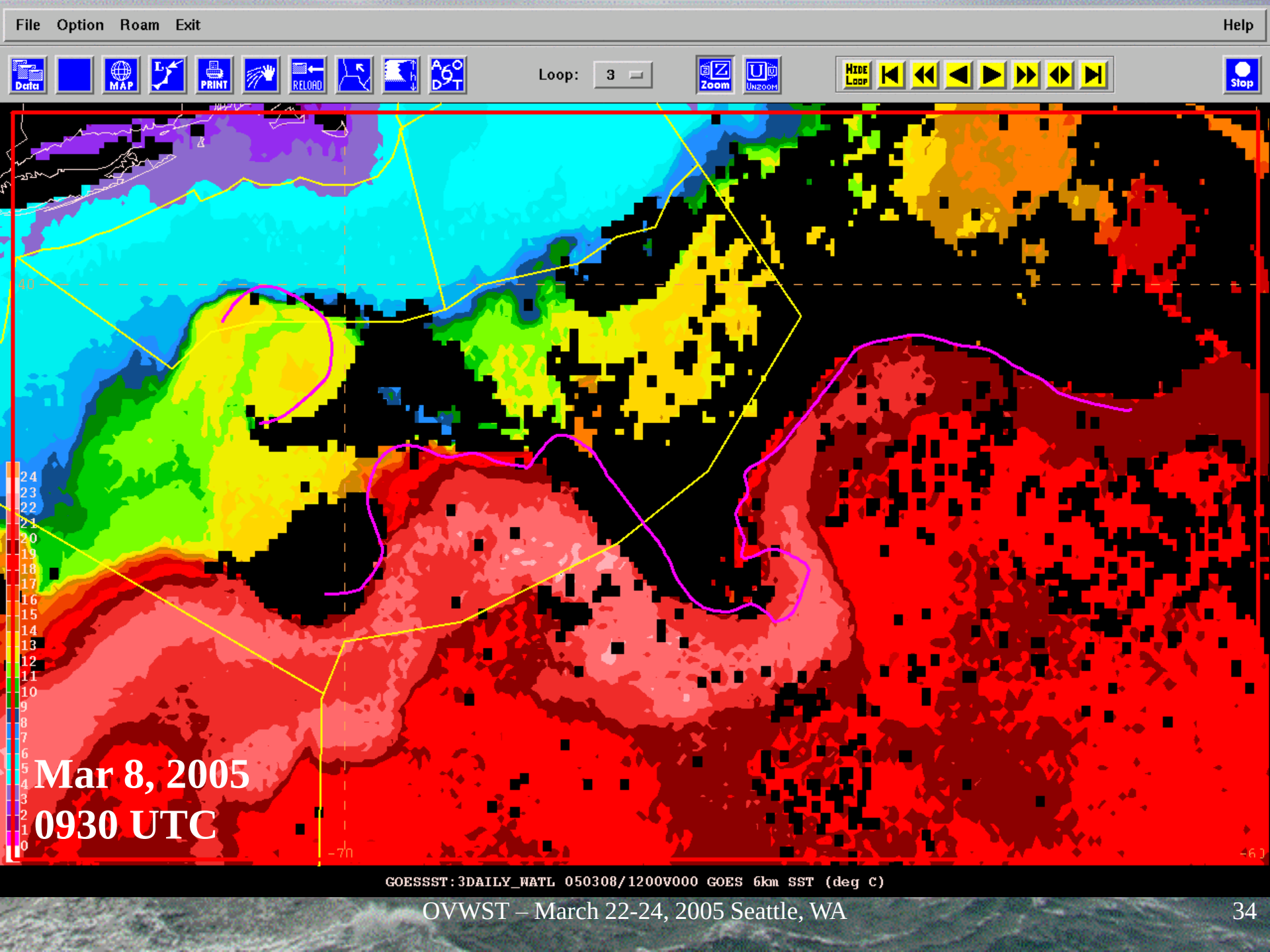
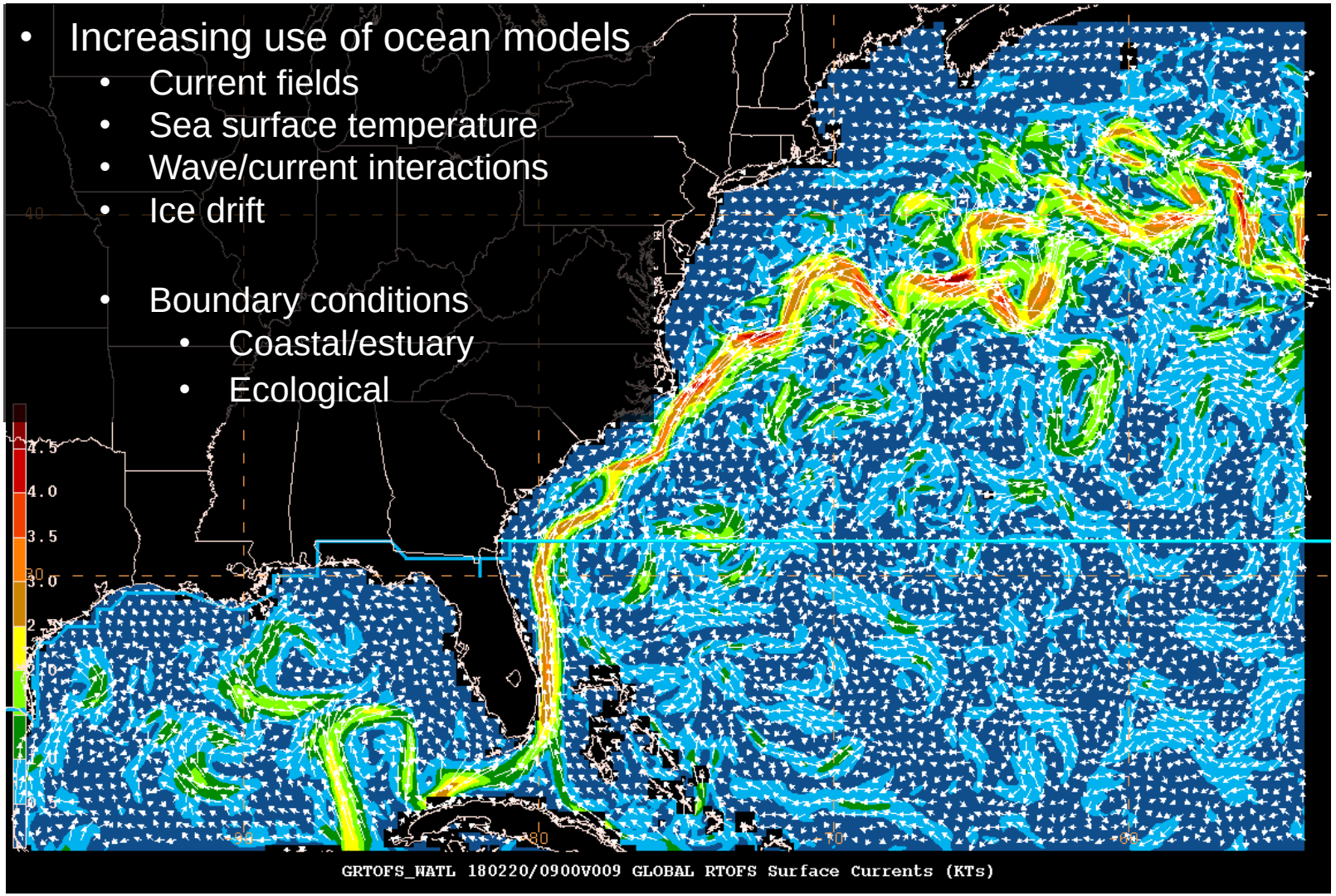
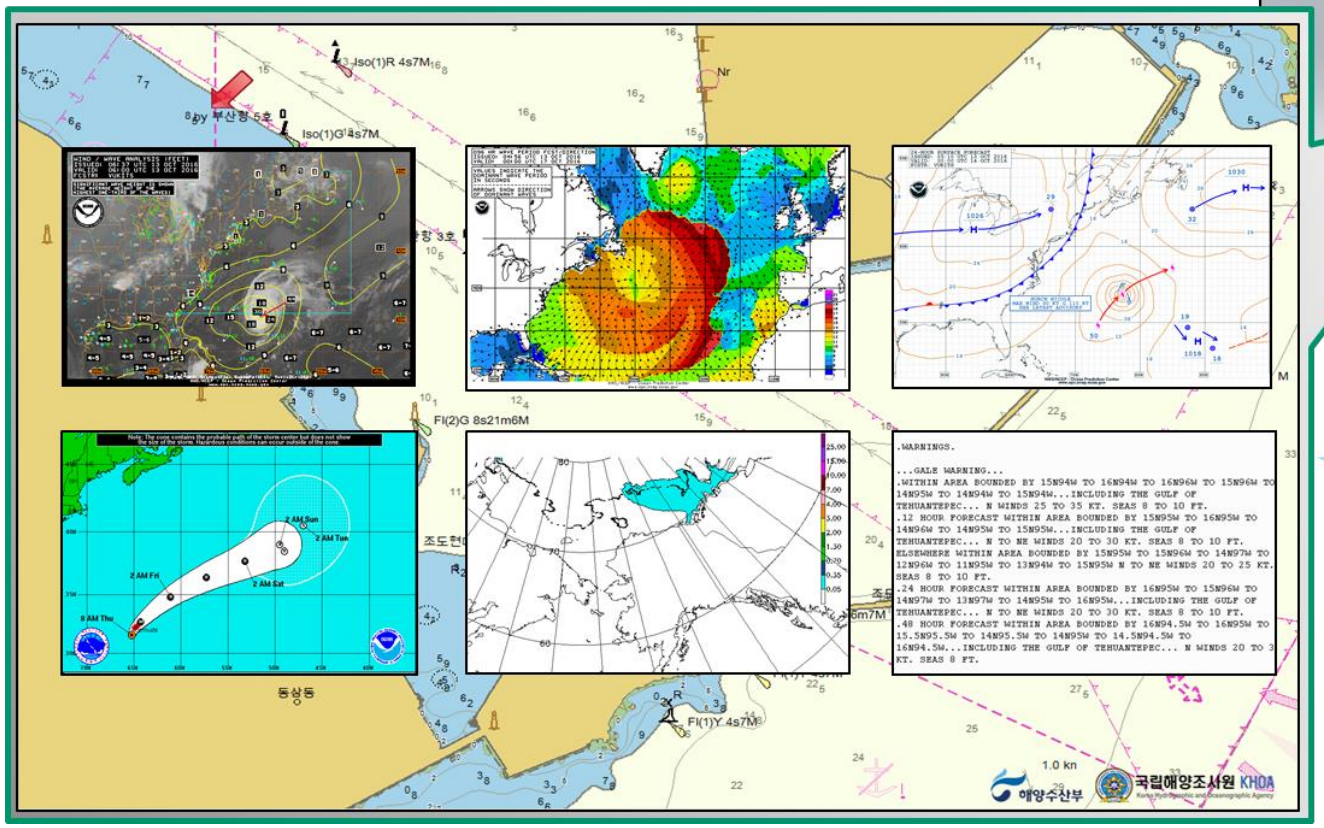

File Option Roam Exit
Help
Data
MAP
PRINT
RELOAD
Loop: 3
Zoom
Unzoom
Hide Loop
Stop
Mar 8, 2005
0930 UTC
GOESSST:3DAILY_WATL 050308/1200V000 GOES 6km SST (deg C)

Not Just Waves



S-412 ECDIS*
Weather Overlay



* ECDIS: Electronic Chart Display and Information System

Summary – satellite winds and wave

- Operational use - support of Safety of Life at Sea
  - Similar use as buoys, ships – warnings
- Verification
  - Models (real-time)
  - Models (biases)
  - Forecasts
- To determine challenges
  - Waves in the Gulf Stream, explosive deepening storms
- Growing use of Ocean Models (SSHA)
- Vessel avoidance practices