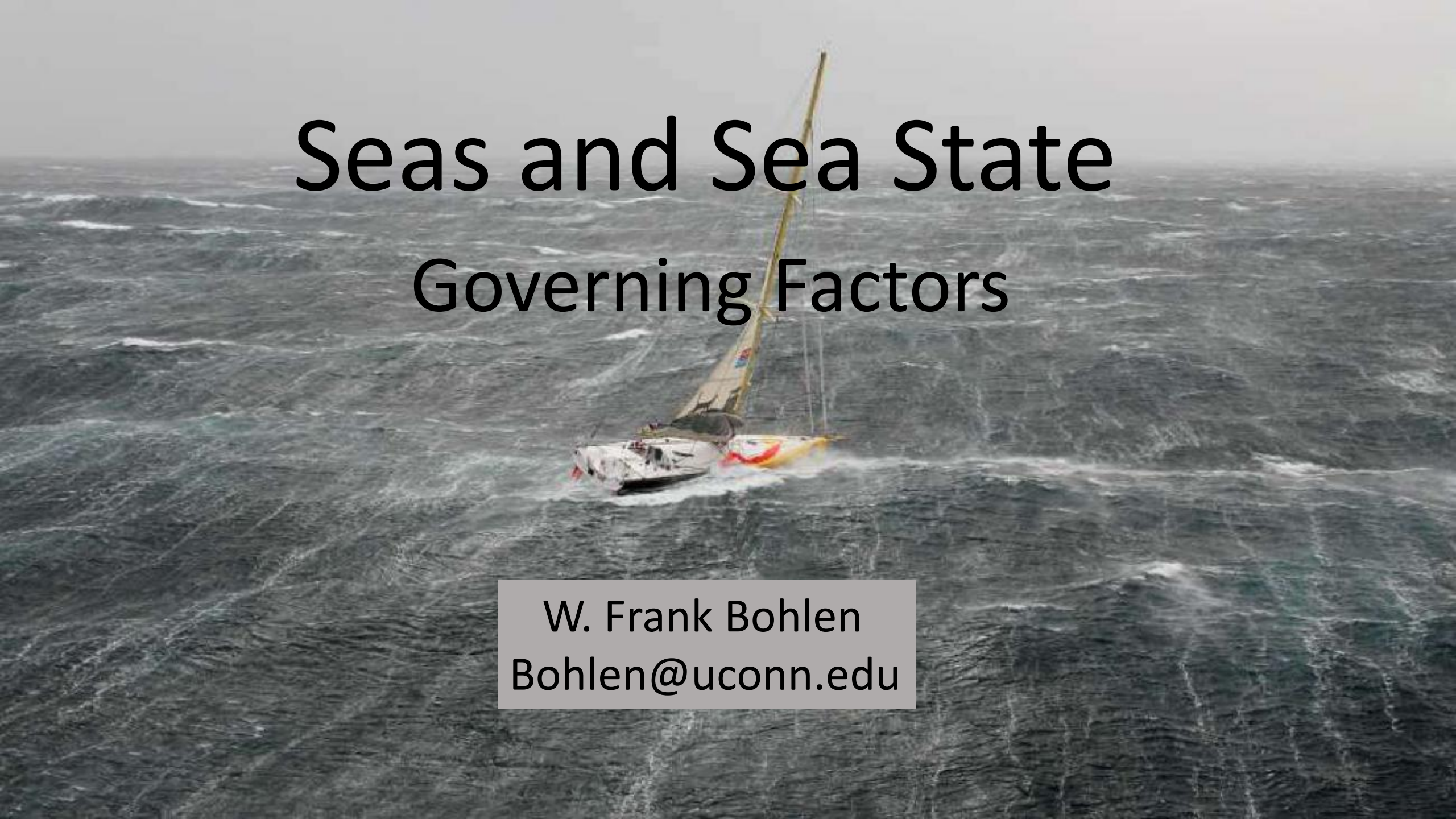
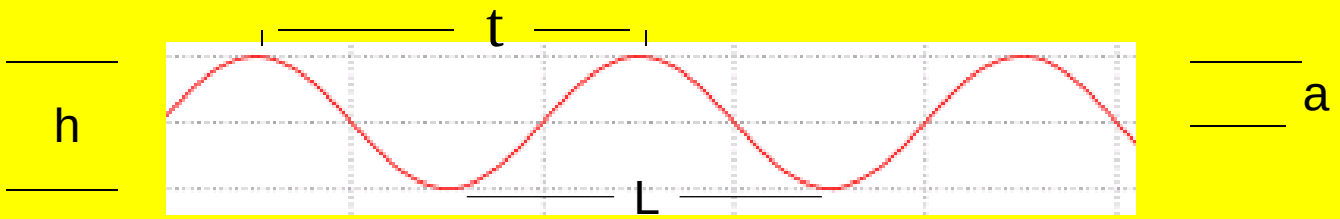


Seas and Sea State

Governing Factors

W. Frank Bohlen
Bohlen@uconn.edu

Winds produce Waves !



The size (heights and lengths) of wind waves depends on

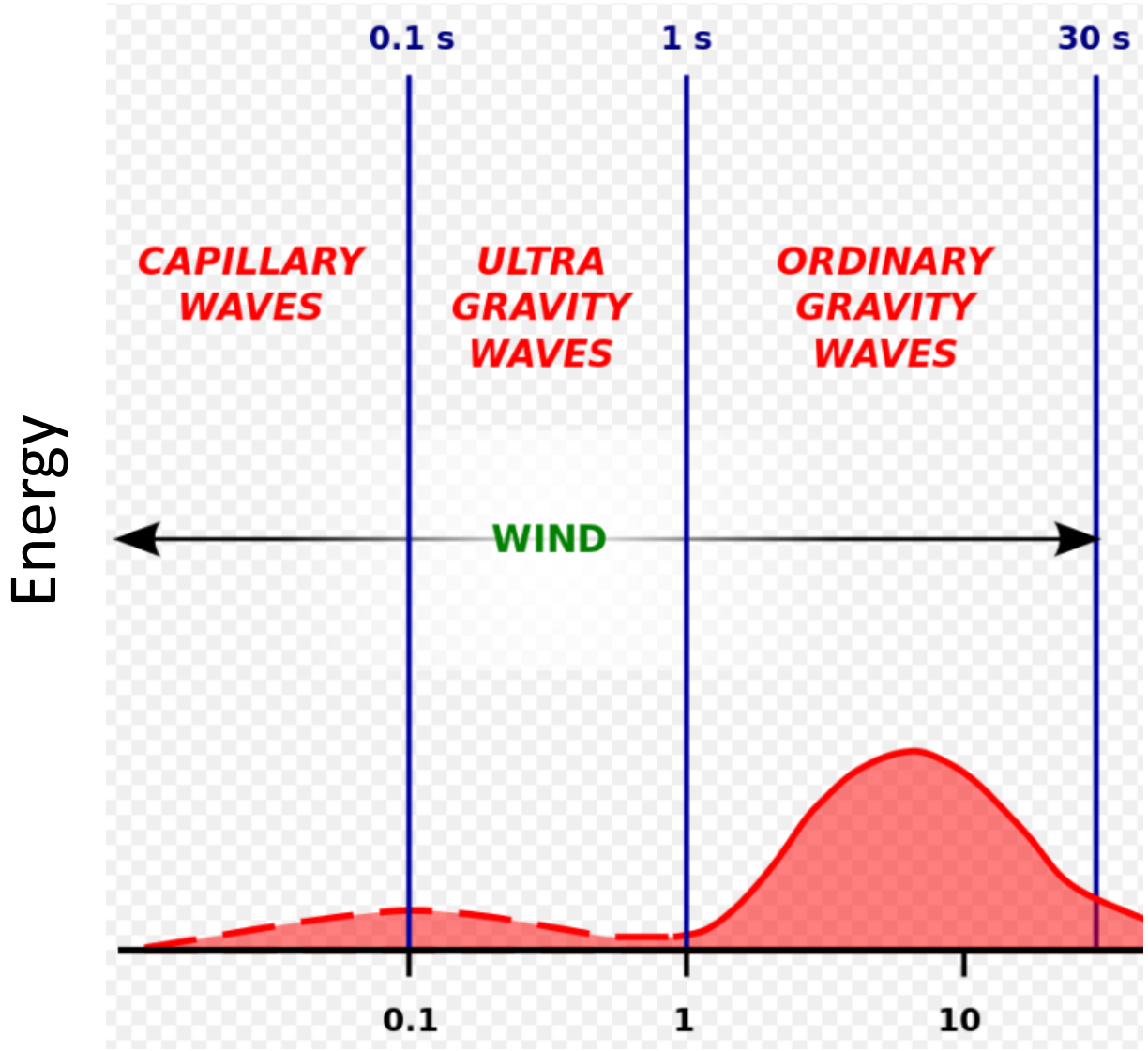
- *Wind Speed* and direction

- *Duration*

- *Fetch* – overwater distance on which wind acts

The result is a variety of waves of differing lengths and heights !

Ocean Wind Wave Spectrum



C = Speed of Advance = Celerity

$$C = \sqrt{gL/2\pi}$$

where g = acceleration of gravity

L = wavelength

$$L = 5.12\ T^2$$

T= Period in sec

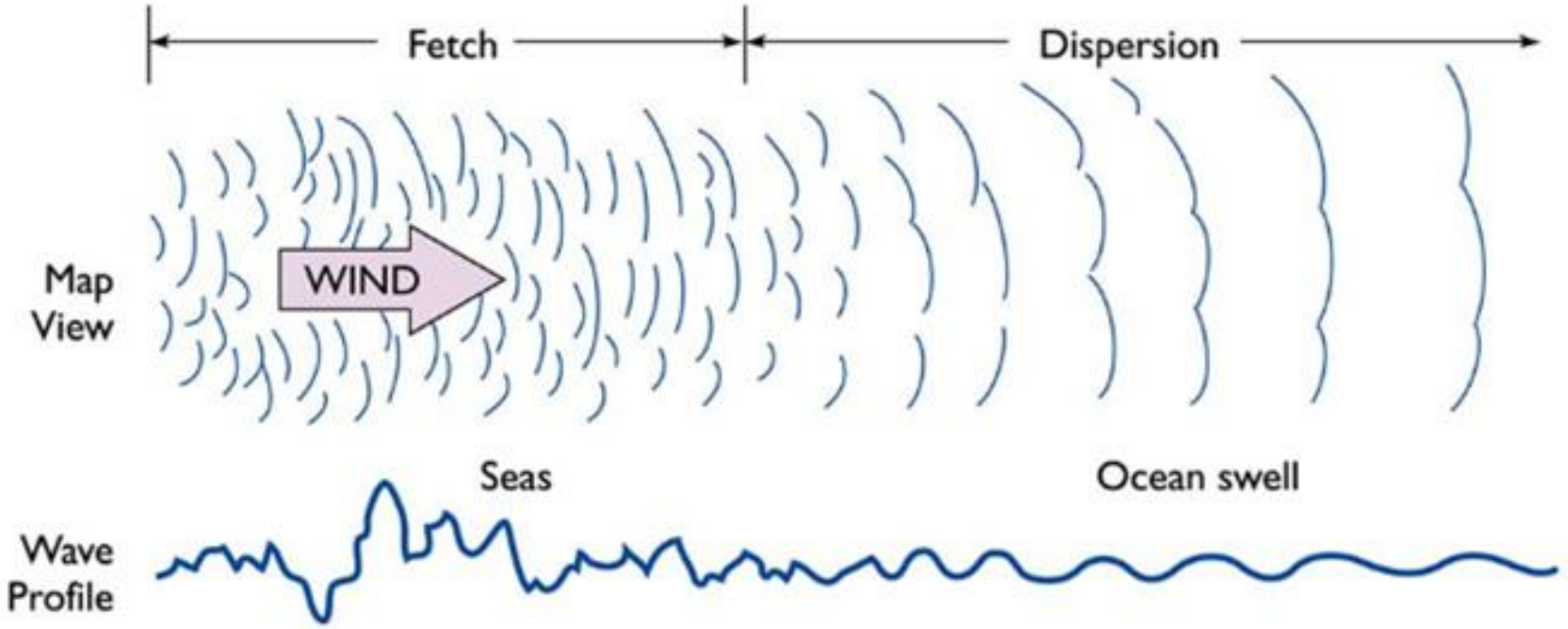
e.g. Period T = 9 sec

L = 5.12 x 81 = 421 ft

= 46 ft/sec = ~ 27 kts

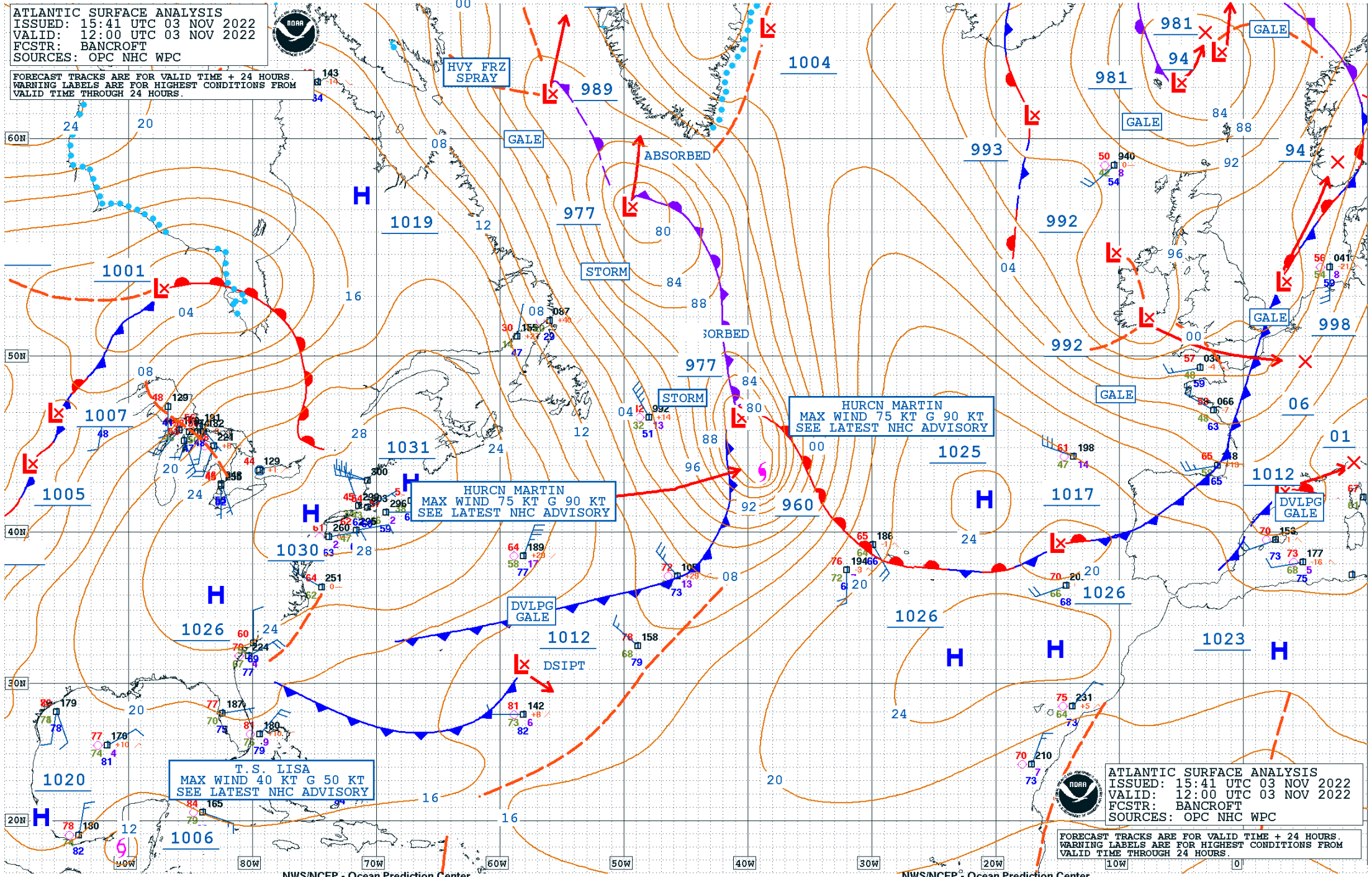
T = 6 sec => ~ 17 kts

Deep Water Transformations

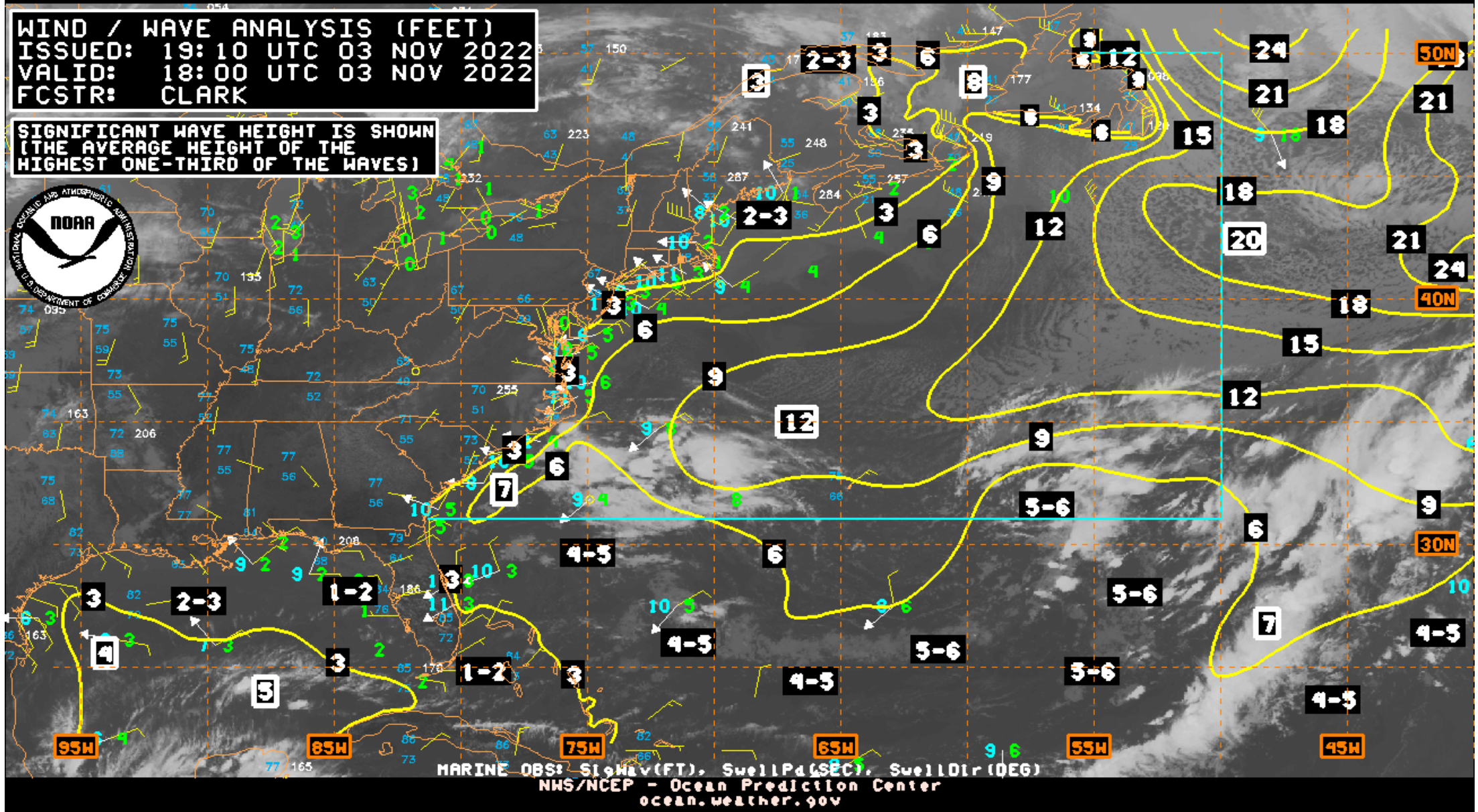


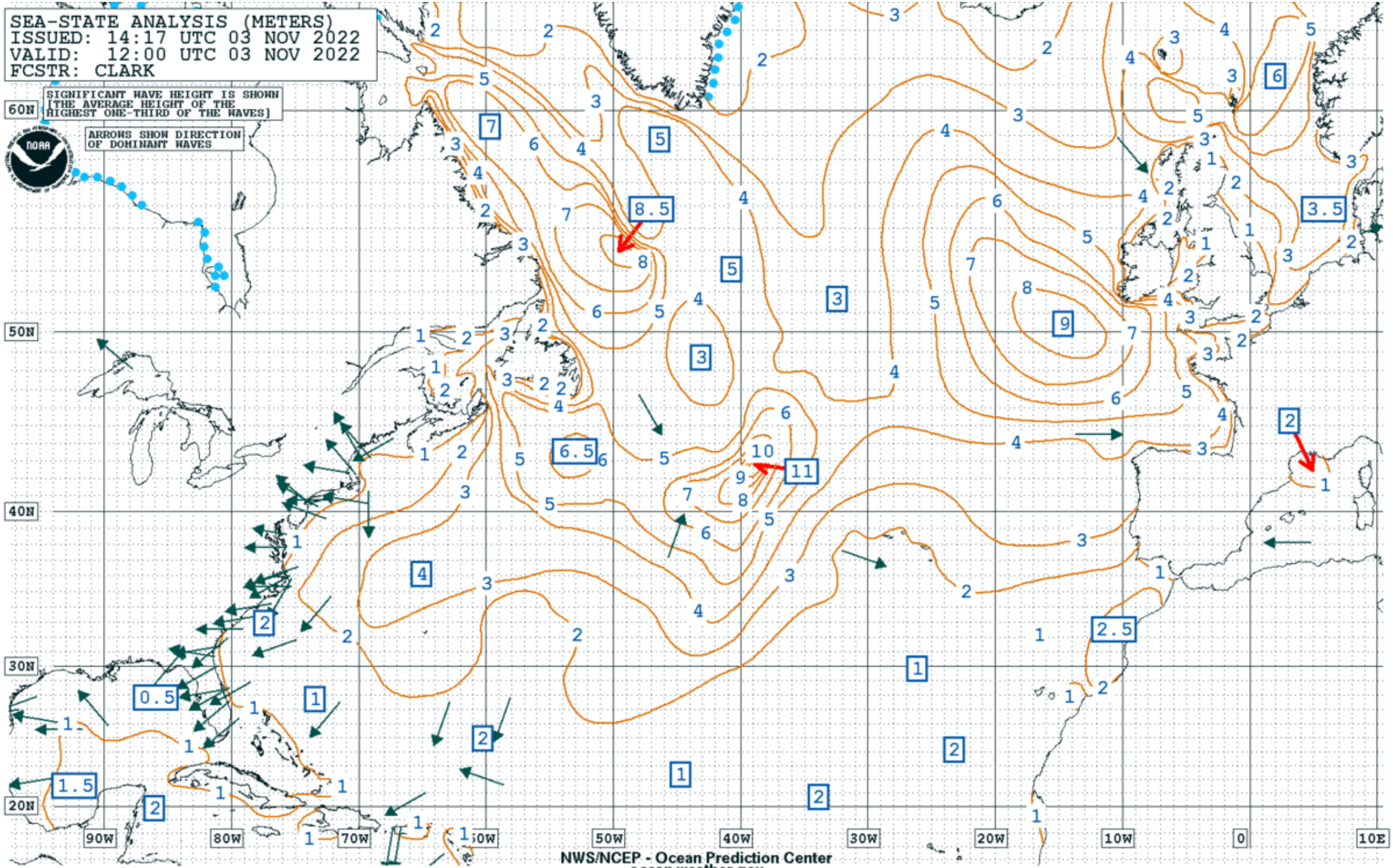
Chaotic seas
inside fetch area.

Swells: wave
type found
outside the fetch.



ATLANTIC SURFACE ANALYSIS
ISSUED: 15:41 UTC 03 NOV 2022
VALID: 12:00 UTC 03 NOV 2022
FCSTR: BANCROFT
SOURCES: OPC NHC WPC
FORECAST TRACKS ARE FOR VALID TIME + 24 HOURS.
WARNING LABELS ARE FOR HIGHEST CONDITIONS FROM VALID TIME THROUGH 24 HOURS.
NWS/NCEP - Ocean Prediction Center
ocean.weather.gov


WIND / WAVE ANALYSIS (FEET)
ISSUED: 19:10 UTC 03 NOV 2022
VALID: 18:00 UTC 03 NOV 2022
FCSTR: CLARK
SIGNIFICANT WAVE HEIGHT IS SHOWN
(THE AVERAGE HEIGHT OF THE
HIGHEST ONE-THIRD OF THE WAVES)
NOAA
50N
40N
30N
95W
85W
75W
65W
55W
45W
MARINE OBS: SigHgt(FT), SwellPd(SEC), SwellDir(DEG)
NWS/NCEP - Ocean Prediction Center
ocean.weather.gov


SEA-STATE ANALYSIS (METERS)
ISSUED: 14:17 UTC 03 NOV 2022
VALID: 12:00 UTC 03 NOV 2022
FCSTR: CLARK
SIGNIFICANT WAVE HEIGHT IS SHOWN
(THE AVERAGE HEIGHT OF THE
HIGHEST ONE-THIRD OF THE WAVES)
ARROWS SHOW DIRECTION
OF DOMINANT WAVES
60N
50N
40N
30N
20N
90W
80W
70W
50W
40W
30W
20W
10W
0
10E
NWS/NCEP - Ocean Prediction Center
ocean.weather.gov

GFS WAVE PRODUCT VIEWER

Viewer | Table | Descriptions | Description | Validation | Access

Choose a Model
Choose a Region
Choose a Run Time
Need help?

Significant Wave Height
Wind Sea Wave Height
Primary Swell Wave Height
Secondary Swell Wave Height
Tertiary Swell Wave Height
Wind Speed and Direction

Peak Wave Period
Wind Sea Period
Primary Swell Period
Secondary Swell Period
Tertiary Swell Period

NW Atlantic (GFS) (Latest run) 2022/11/05 06z

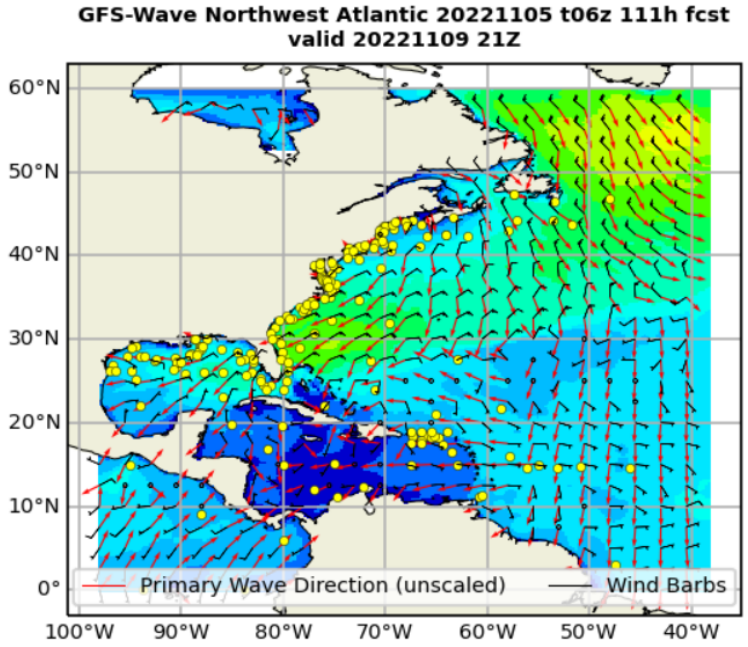
Significant Wave Height and Peak Direction forecast for 111 Hours

Buoy Info: Bulletin Spectra Sources

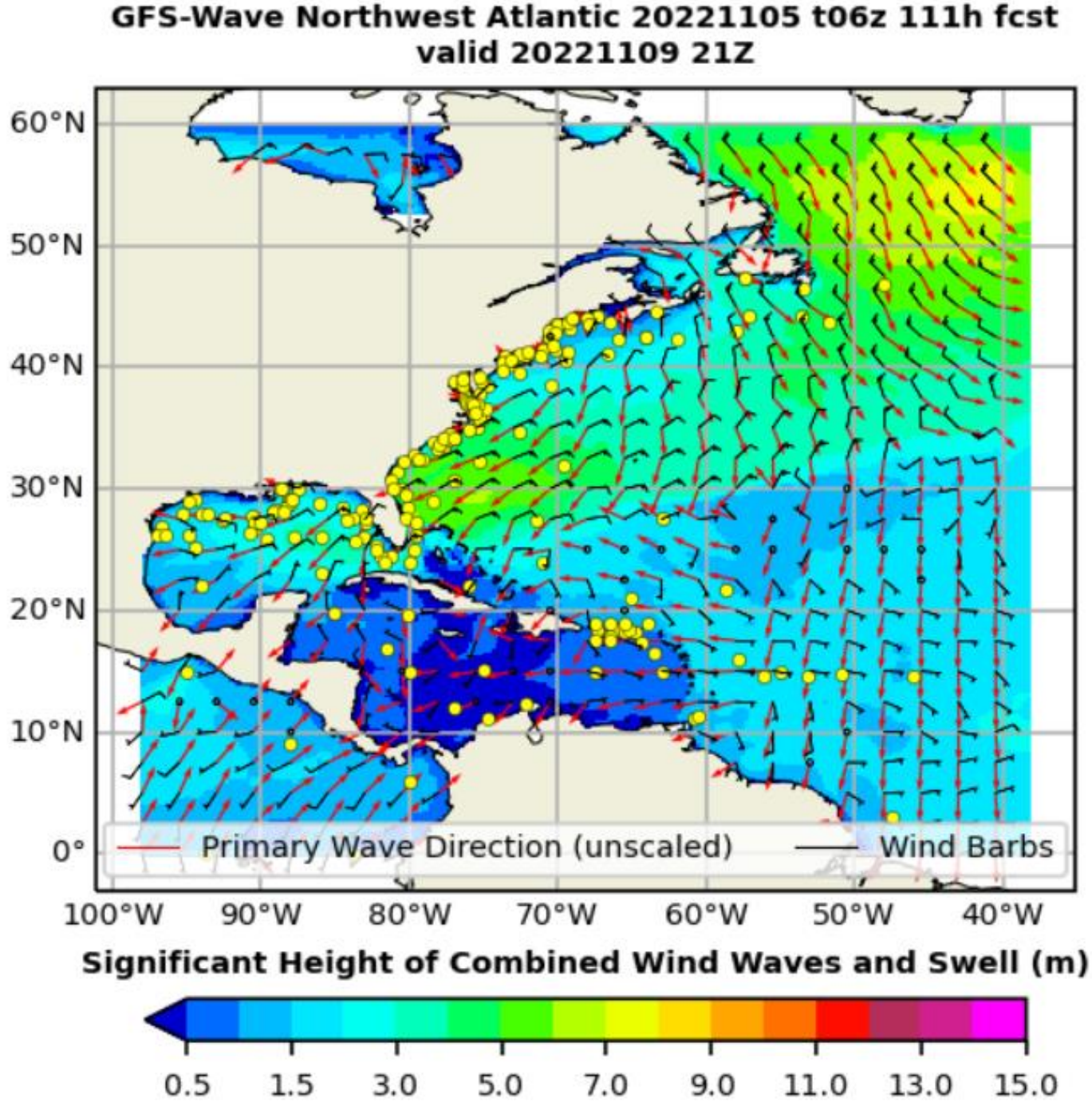
Loop Images: << Stop >>

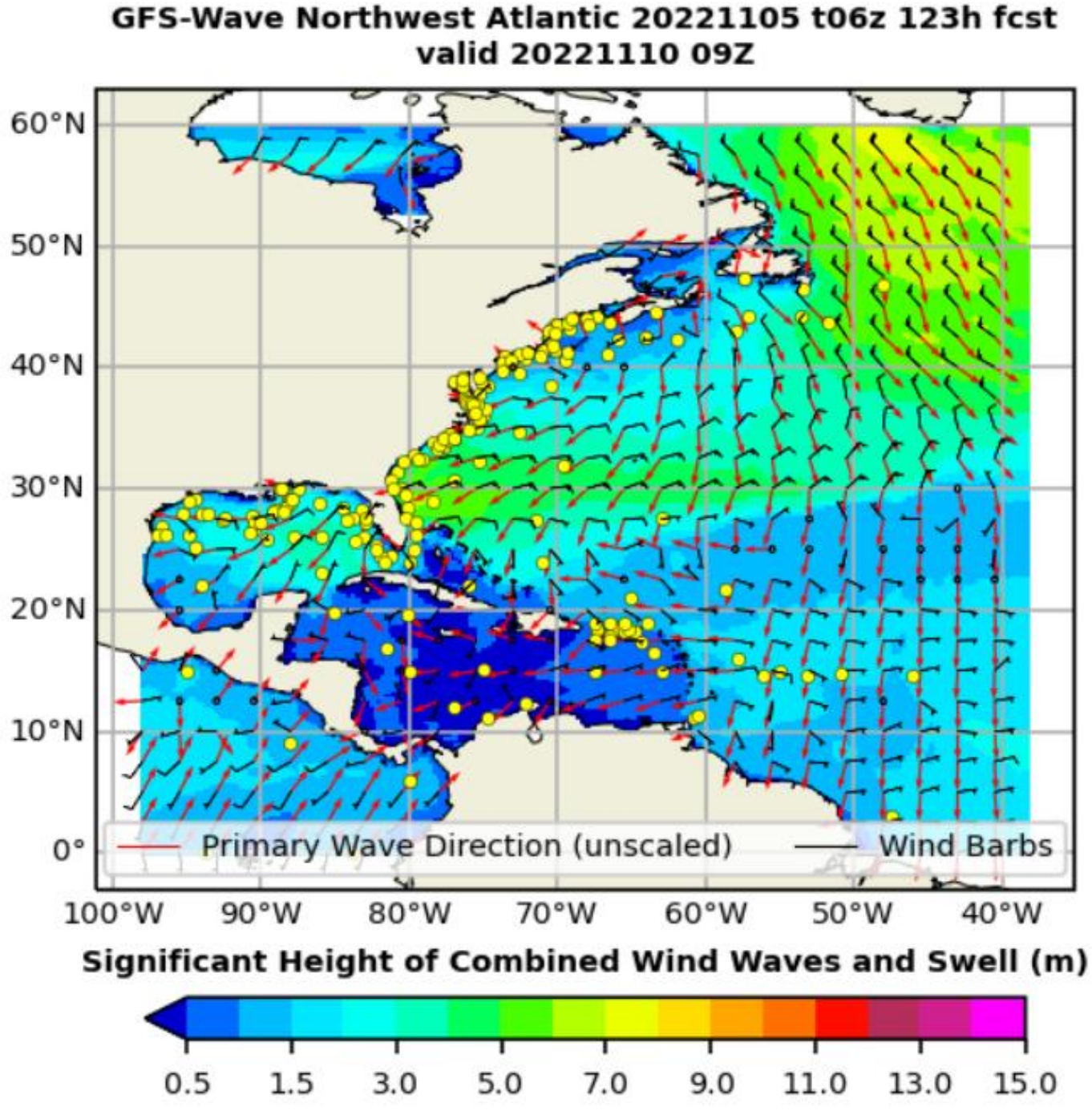
Adjust Speed: Slower Faster

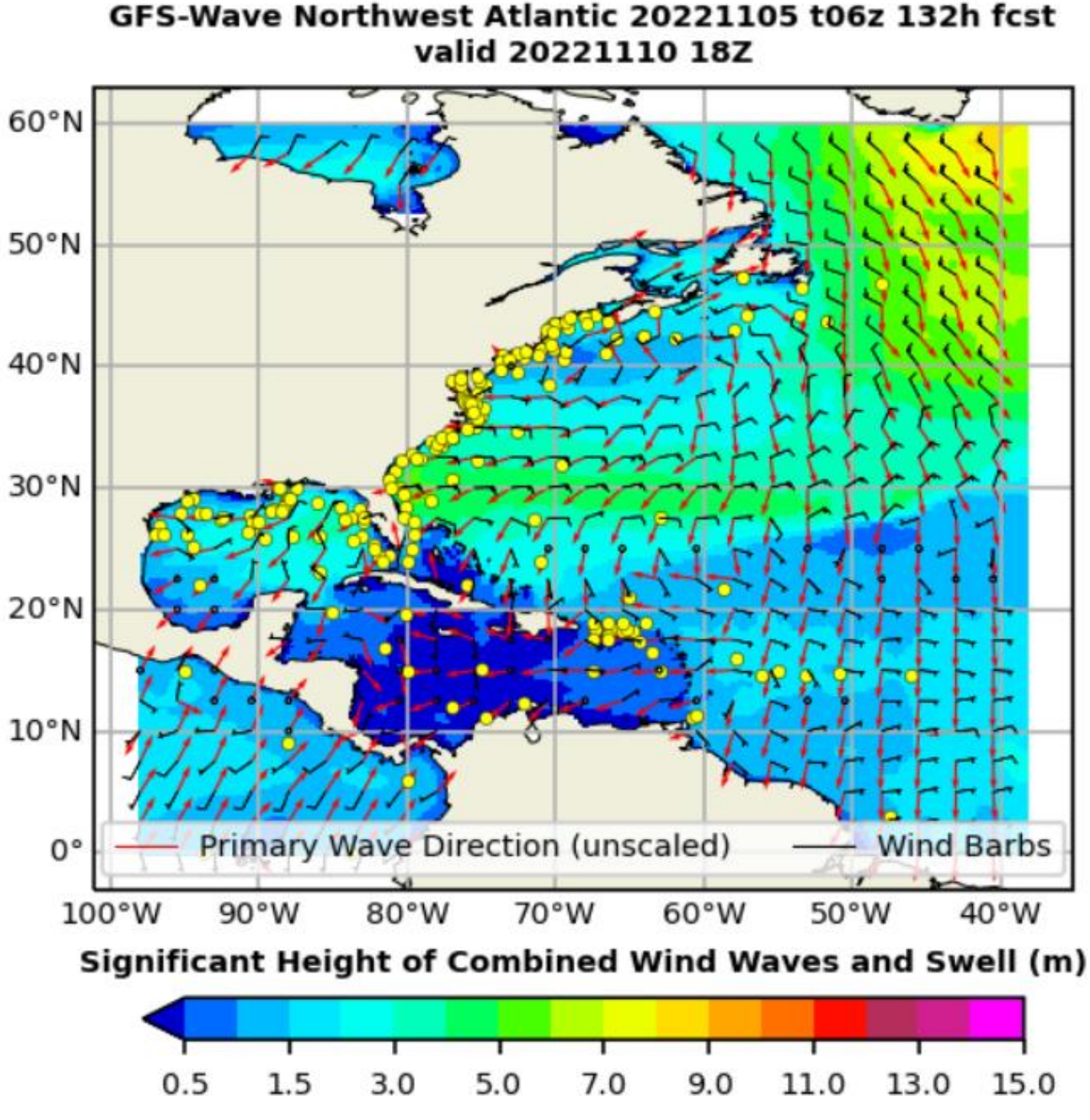
Advance One: |< < > >|

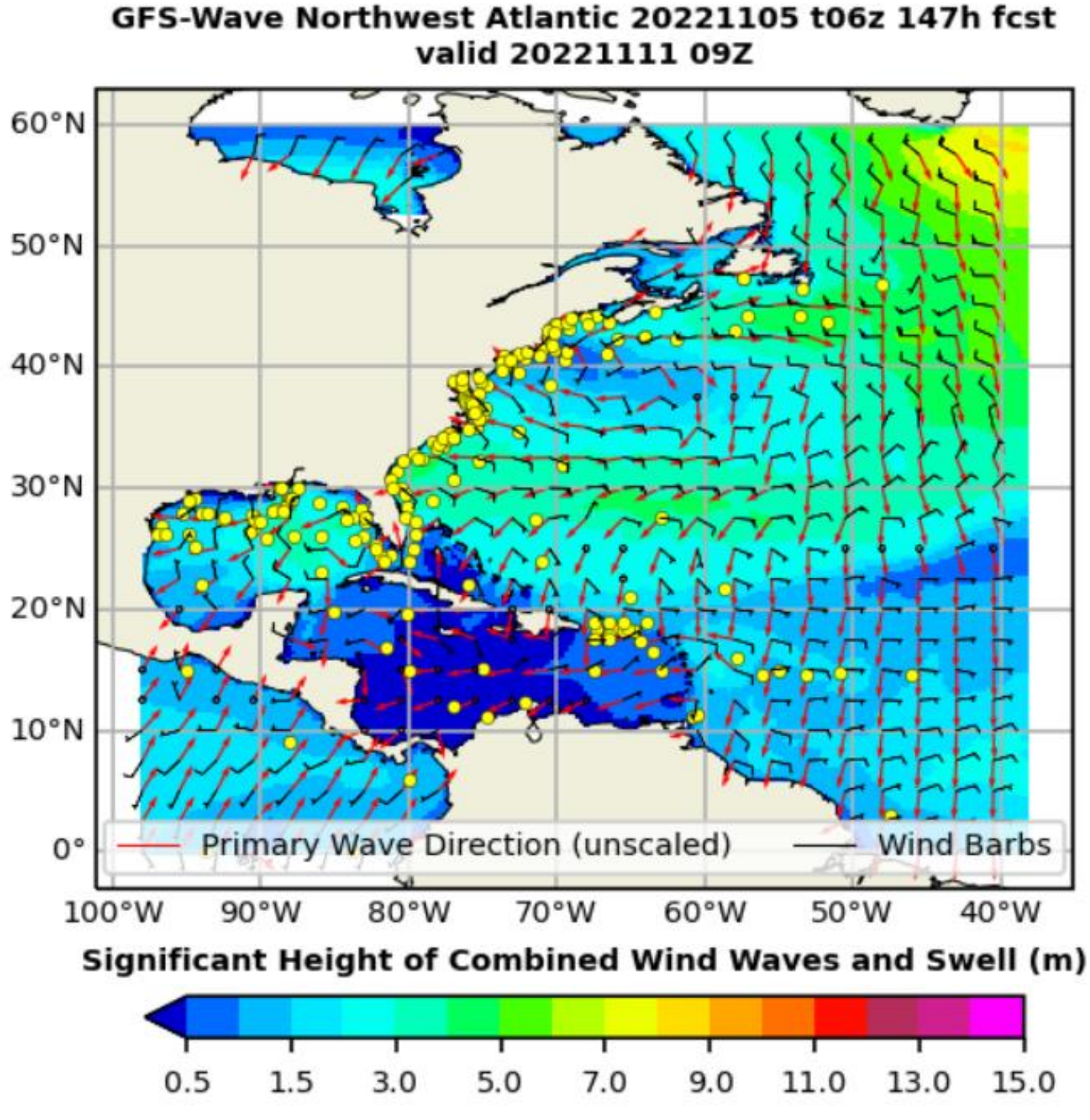


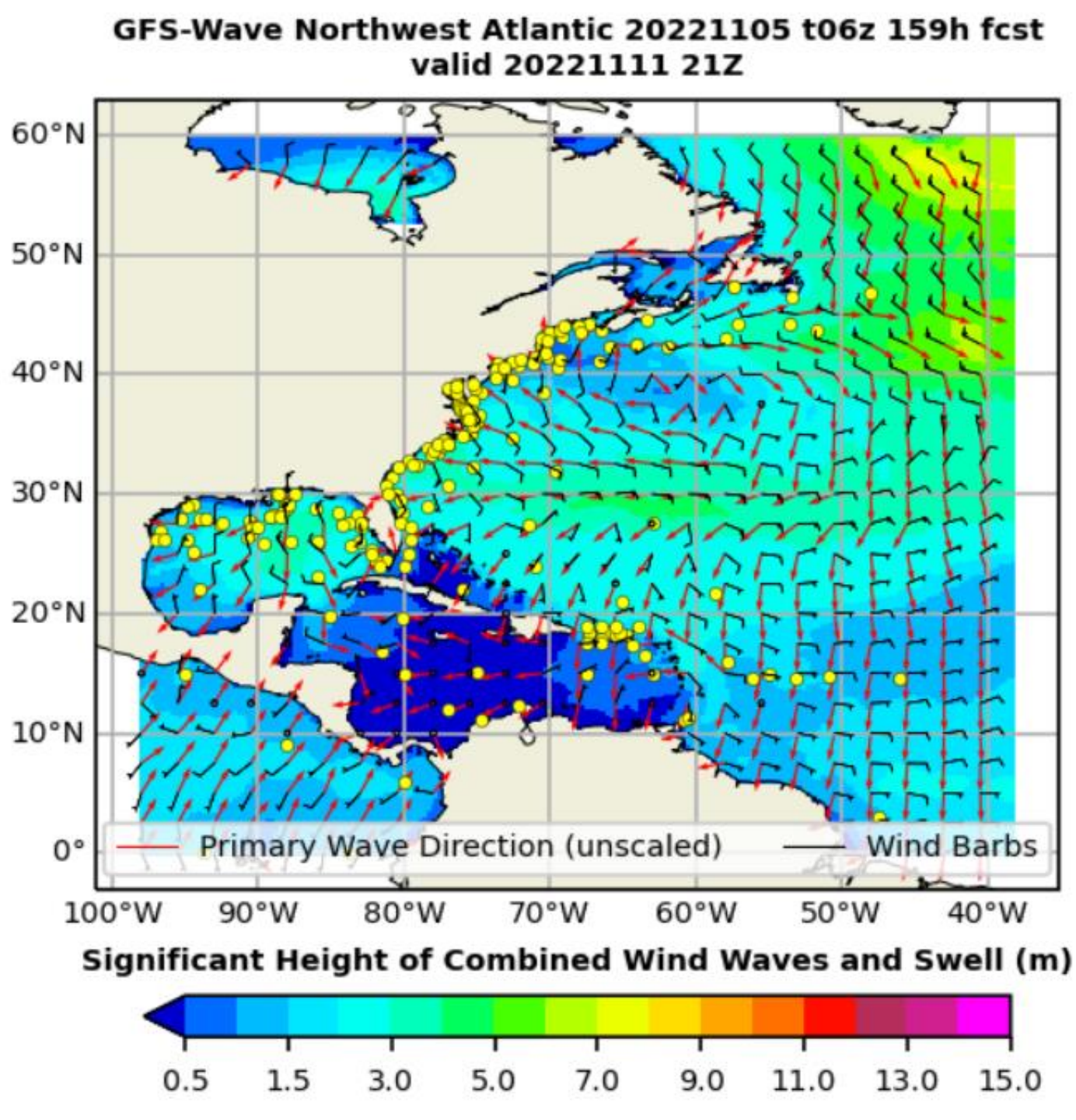
https://polar.ncep.noaa.gov/waves/viewer.shtml?-gfswave-latest-hs-NW_atlantic-


GFS-Wave Northwest Atlantic 20221105 t06z 111h fcst
valid 20221109 21Z
60°N
50°N
40°N
30°N
20°N
10°N
0°
100°W
90°W
80°W
70°W
60°W
50°W
40°W
Primary Wave Direction (unscaled)
Wind Barbs
Significant Height of Combined Wind Waves and Swell (m)
0.5
1.5
3.0
5.0
7.0
9.0
11.0
13.0
15.0

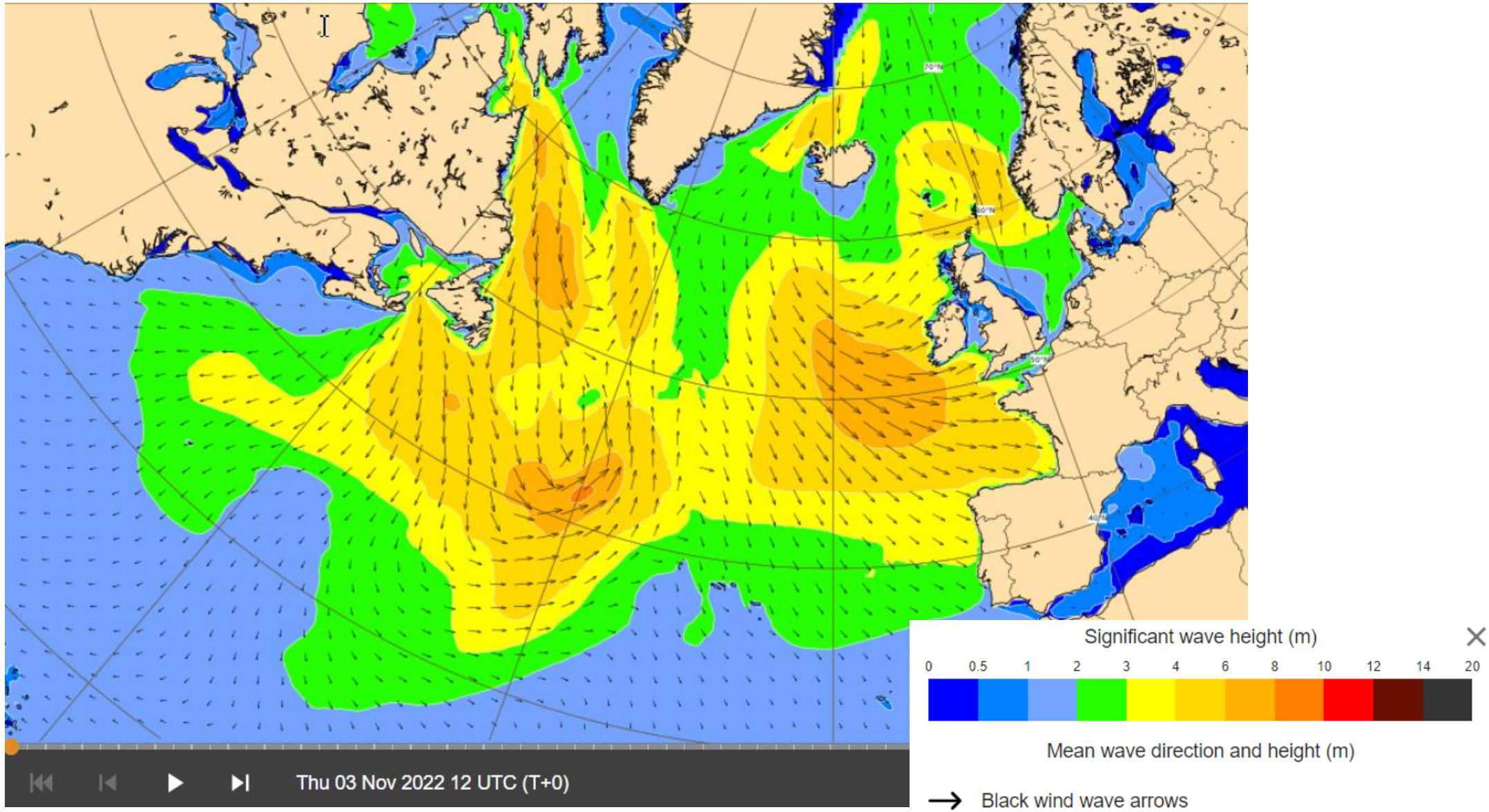

GFS-Wave Northwest Atlantic 20221105 t06z 123h fcst
valid 20221110 09Z
60°N
50°N
40°N
30°N
20°N
10°N
0°
100°W
90°W
80°W
70°W
60°W
50°W
40°W
Primary Wave Direction (unscaled)
Wind Barbs
Significant Height of Combined Wind Waves and Swell (m)
0.5
1.5
3.0
5.0
7.0
9.0
11.0
13.0
15.0


GFS-Wave Northwest Atlantic 20221105 t06z 132h fcst
valid 20221110 18Z
60°N
50°N
40°N
30°N
20°N
10°N
0°
100°W
90°W
80°W
70°W
60°W
50°W
40°W
Primary Wave Direction (unscaled)
Wind Barbs
Significant Height of Combined Wind Waves and Swell (m)
0.5
1.5
3.0
5.0
7.0
9.0
11.0
13.0
15.0


GFS-Wave Northwest Atlantic 20221105 t06z 147h fcst
valid 20221111 09Z
60°N
50°N
40°N
30°N
20°N
10°N
0°
100°W
90°W
80°W
70°W
60°W
50°W
40°W
Primary Wave Direction (unscaled)
Wind Barbs
Significant Height of Combined Wind Waves and Swell (m)
0.5
1.5
3.0
5.0
7.0
9.0
11.0
13.0
15.0

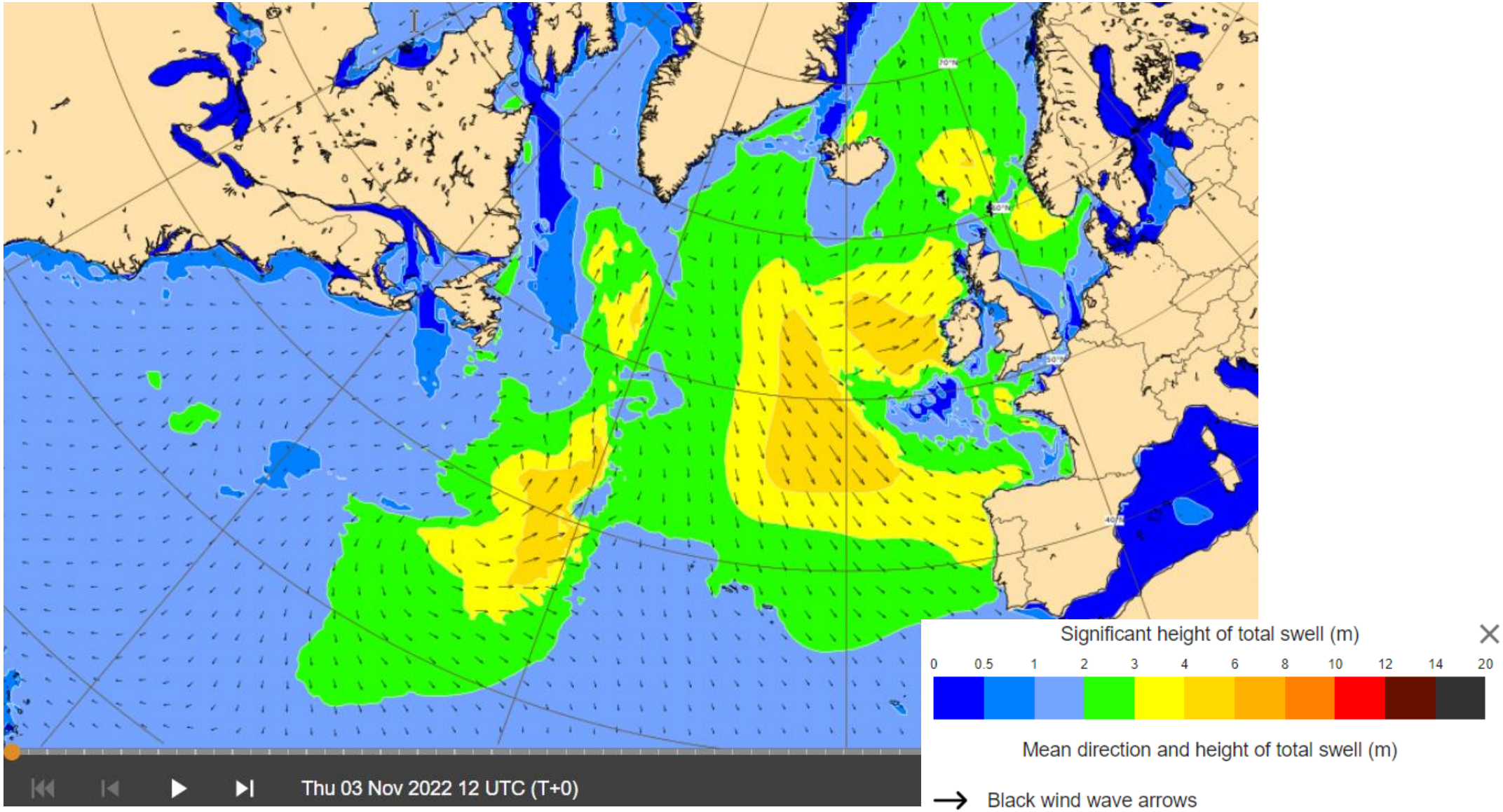

GFS-Wave Northwest Atlantic 20221105 t06z 159h fcst
valid 20221111 21Z
60°N
50°N
40°N
30°N
20°N
10°N
0°
100°W
90°W
80°W
70°W
60°W
50°W
40°W
Primary Wave Direction (unscaled)
Wind Barbs
Significant Height of Combined Wind Waves and Swell (m)
0.5
1.5
3.0
5.0
7.0
9.0
11.0
13.0
15.0

Significant wave height and mean direction



[ECMWF | Advancing global NWP through international collaboration]

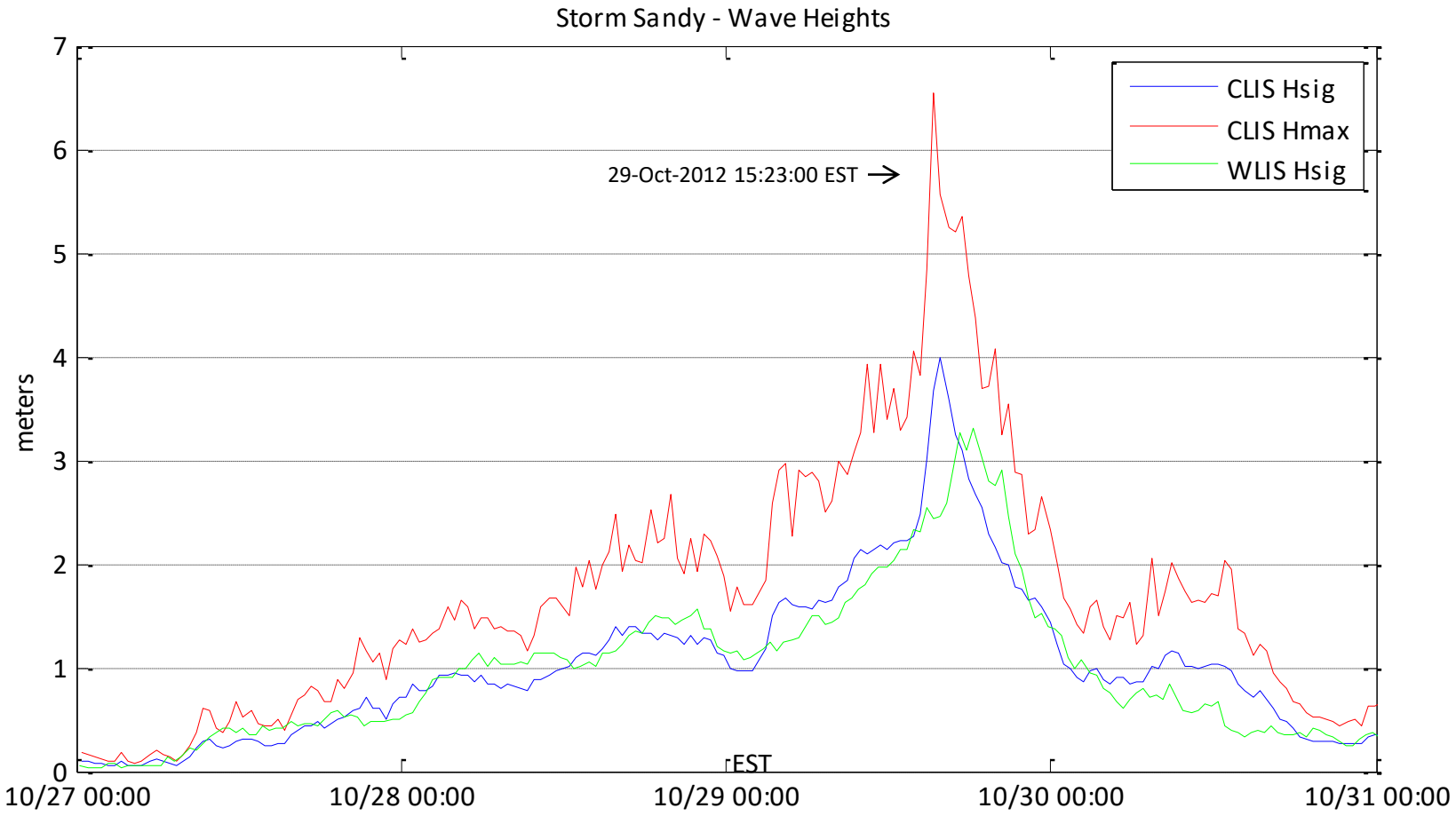
Total swell: significant wave height and mean direction



ECMWF | Advancing global NWP through international collaboration

University of Connecticut

Department of Marine Sciences



Long Island Sound Integrated Coastal Observing System – lisicos.uconn.edu
A component of NERACOOS – neracoos.org
Warning : data is considered provisional and subject to change.

Hsig = significant wave height
Hmax = maximum wave height

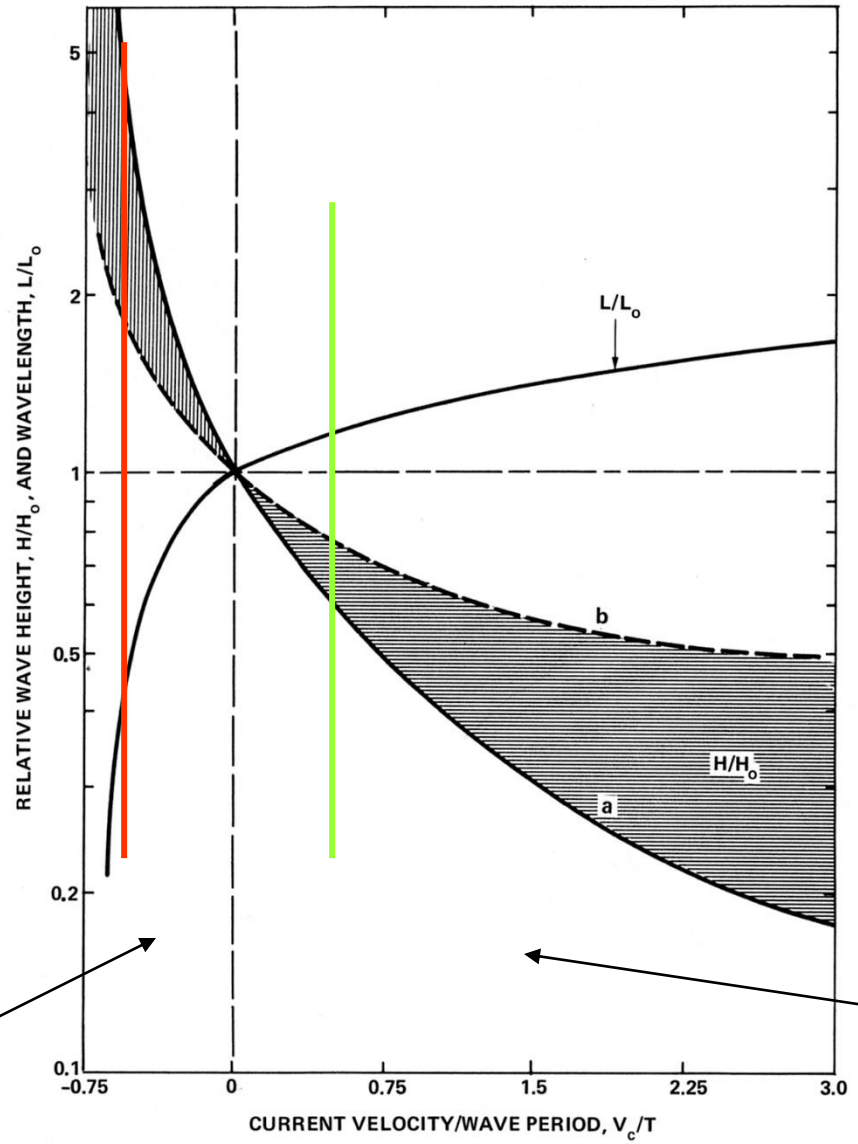


Fig. 87. Influence of contrary (negative) and following (positive) currents of velocity V_c on relative wave height and wavelength, for waves of period T seconds. The shaded band gives the range of variation from pure, periodic swell *(a)* to a random sea *(b)*. No swell can propagate against a current $V_c > 0.75T$ knots.

Ocean Wave Periods

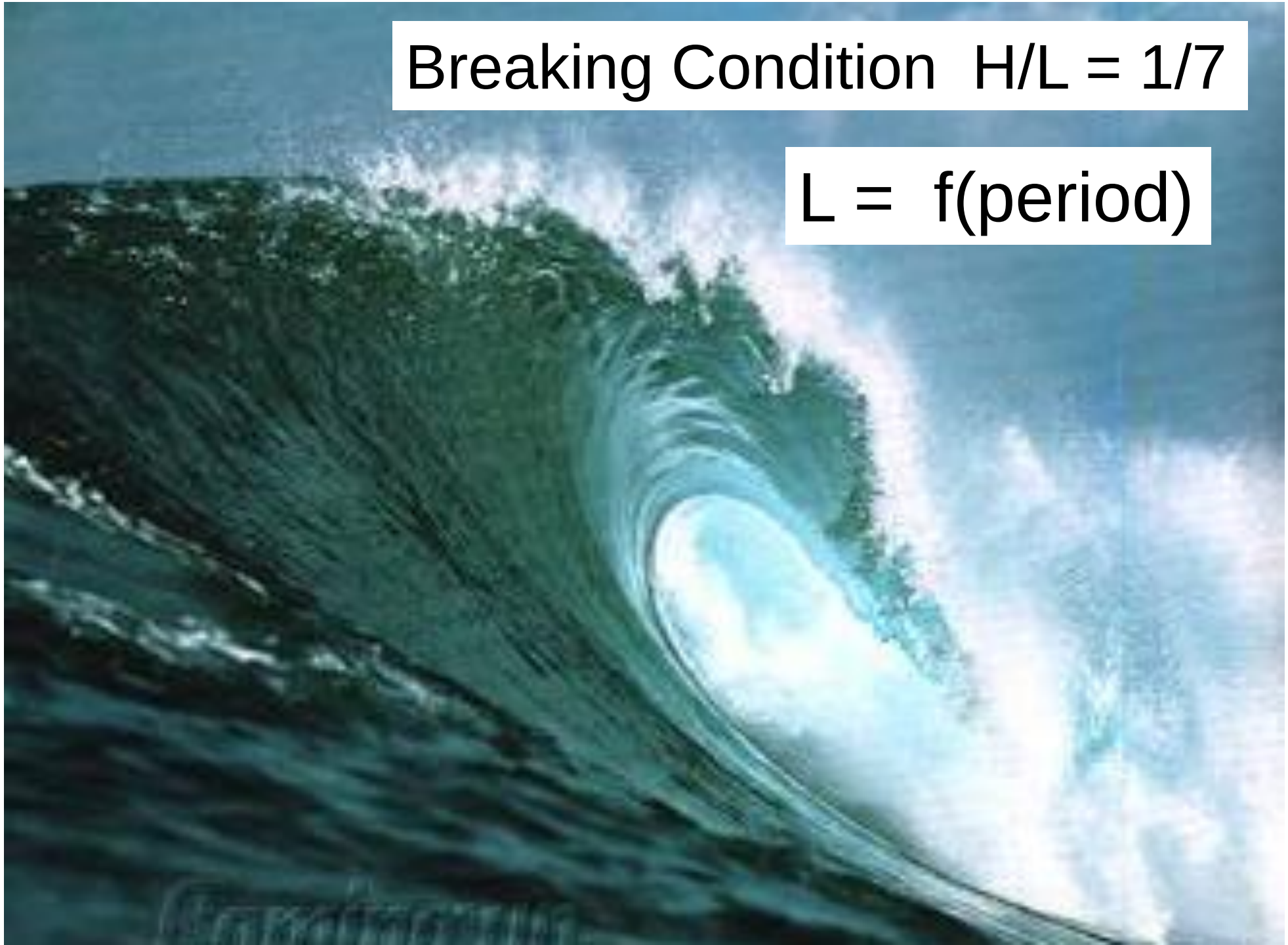
T typical = 10 sec

$V_c = \sim 5kts$

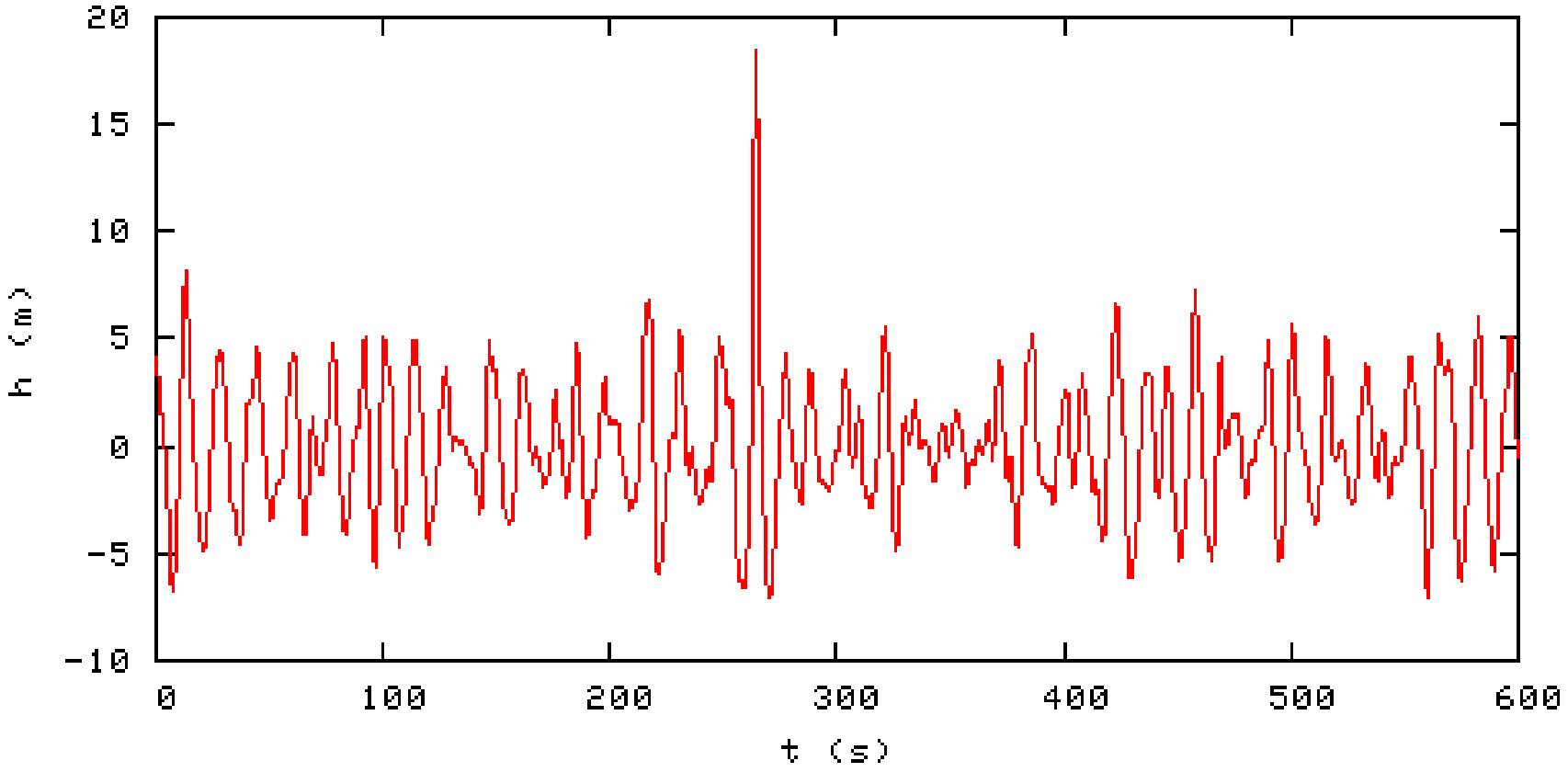
Winds against the current

Winds with the current

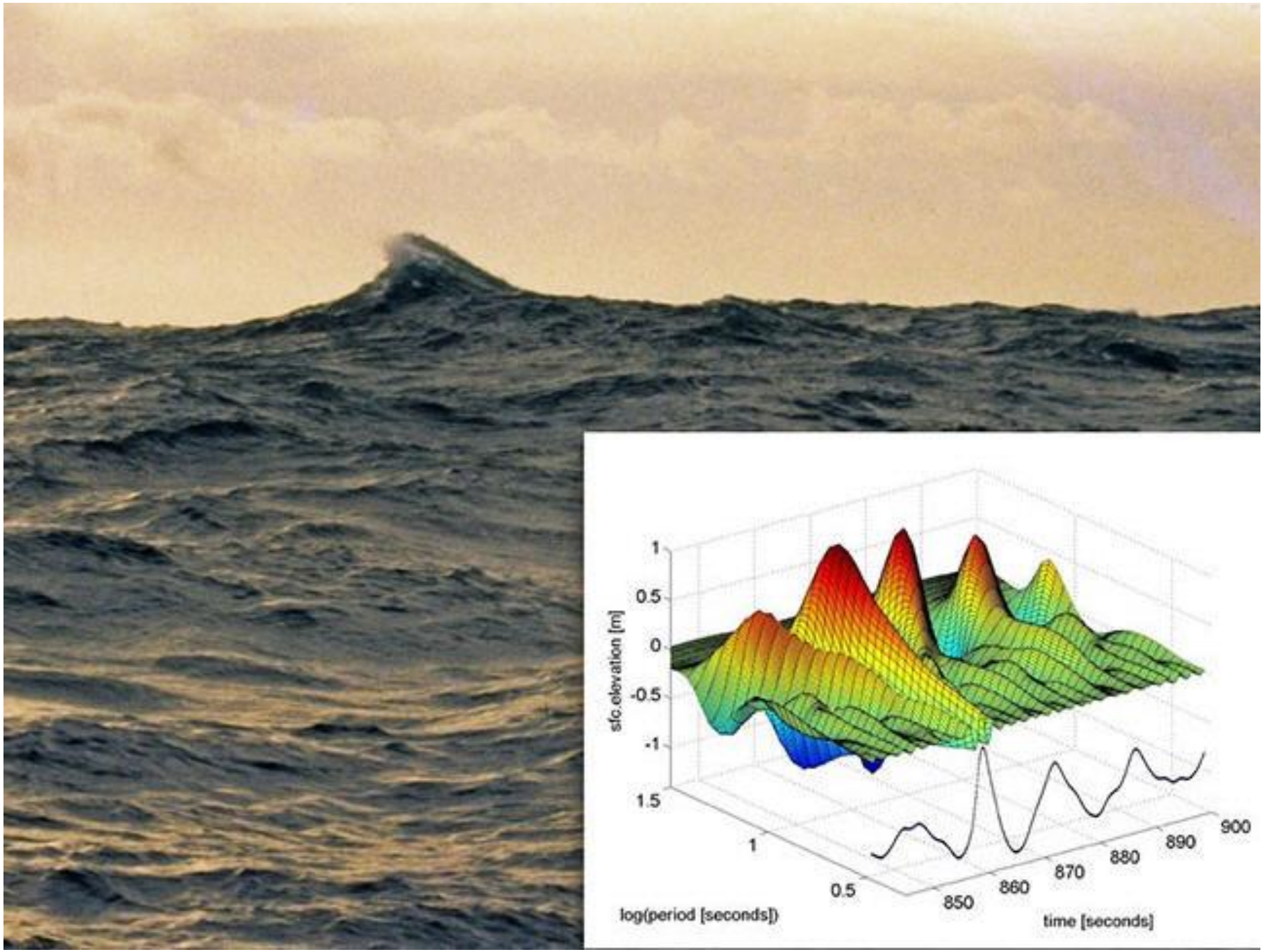
Source: van Dorn 1993 Oceanography and Seamanship 2nd ed.

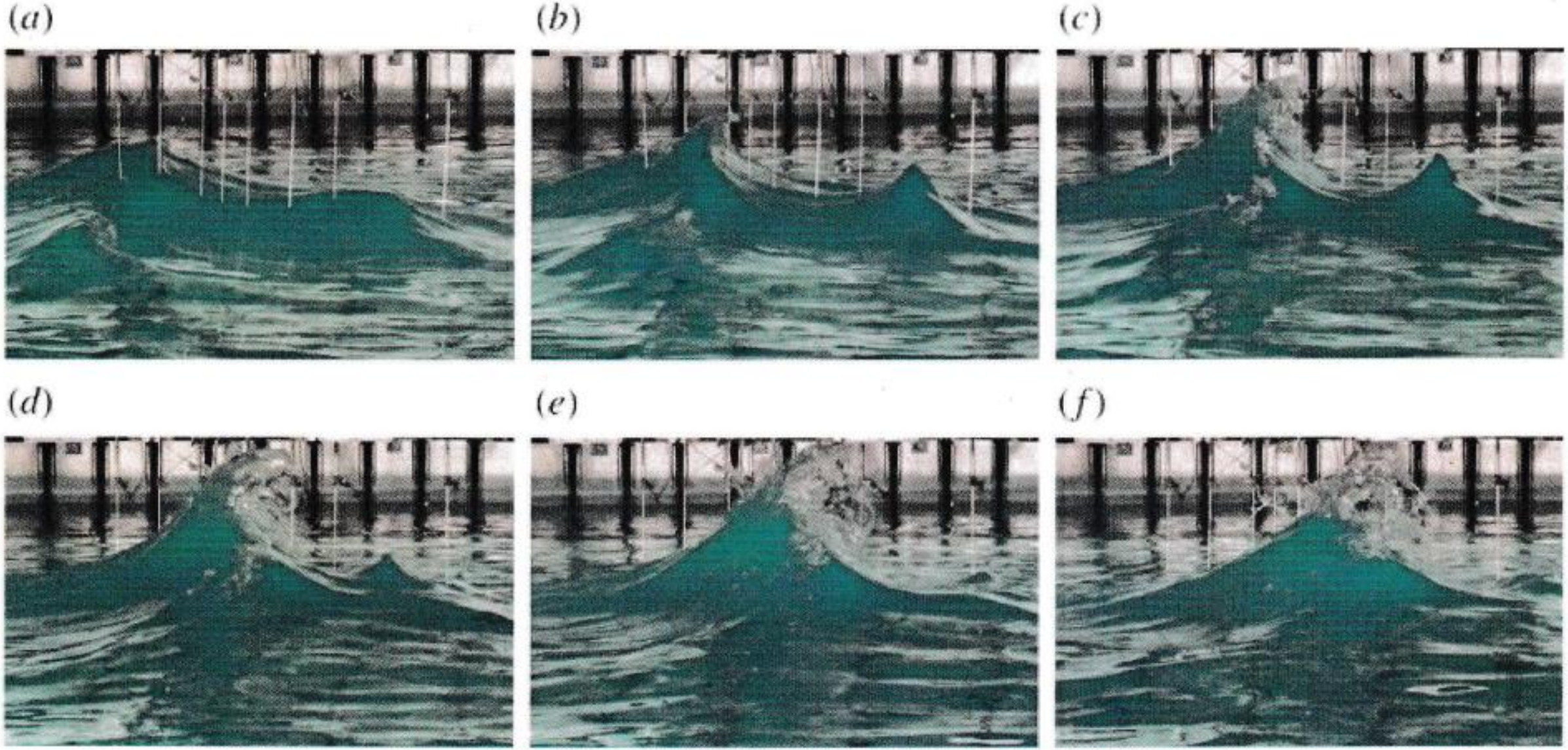

Breaking Condition H/L = 1/7
L = f(period)

Rogue Wave - Draupner Platform - January 1, 1995



Rogue Wave ….waves whose height is more than twice the significant wave height (SWH) ! ?


1
0.5
0
-0.5
-1
1.5
sfc.elevation [m]
1
0.5
log(period [seconds])
850
860
870
880
890
900
time [seconds]



Still images showing the most successful reconstruction of the Draupner wave.

Seeking to understand how freak waves form, the team of researchers set out to reproduce the Draupner wave under laboratory conditions at the FloWave Ocean Energy Research facility at the University Of Edinburgh. What they discovered was that that they could recreate the wave using two smaller wave groups that crossed at a specific angle – approximately 120 degrees.

"When waves are not crossing, wave breaking limits the height that a wave can achieve. However, when waves cross at large angles, wave breaking behavior changes and no longer limits the height a wave can achieve in the same manner," the researchers noted.

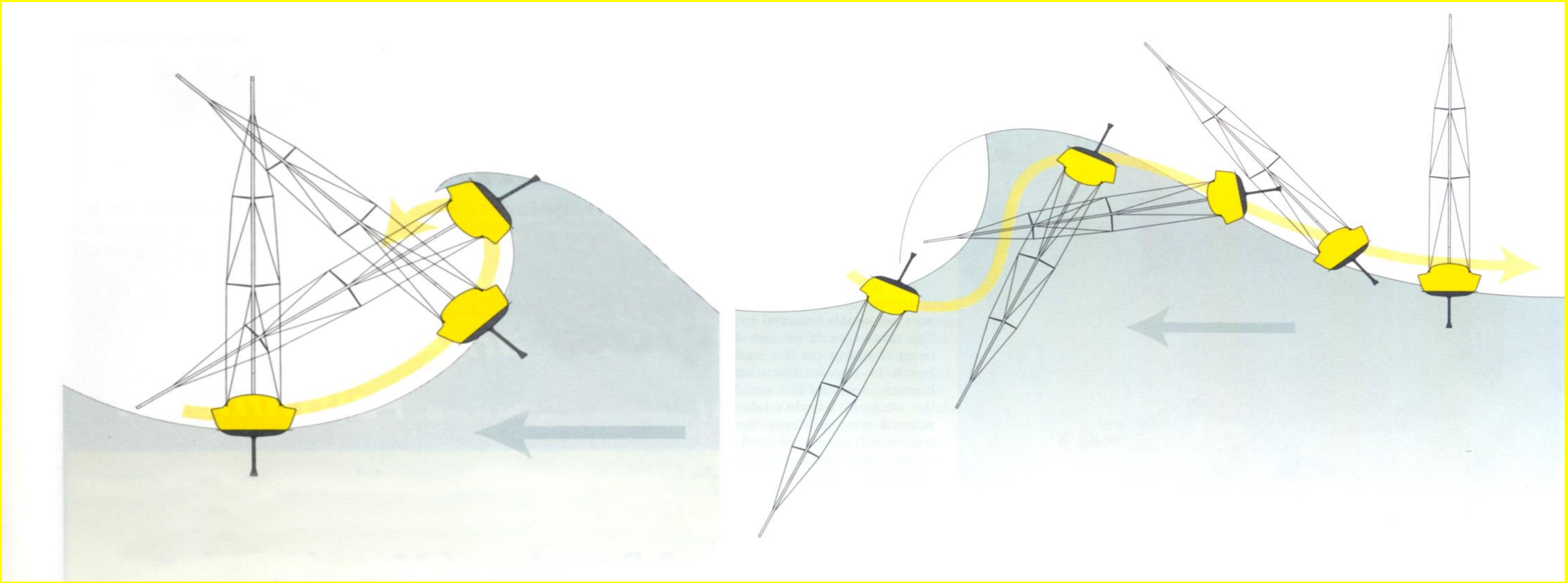
The Coffin Corner

Hypothesis

When a yacht is on a broad reach at a narrow range of headings, there may be a considerable time when the yacht wake and ocean wave are interacting. The result is the energy of the yacht wave, represented by its height, is slowly added to the ocean wave. This can happen for many seconds. If the ocean wave is near a breaking height, eventually, the wave will break at the yacht's stern and could come crashing aboard with even greater energy than usual, since it has been supercharged by the yacht wake. By only altering the yacht heading slightly, she can be kept out of this dangerous operating area. This particular range of headings in which the boat wake interacts with the wind waves producing unusually steep and breaking waves has been termed the Coffin Corner.

Ted Brainard II

- Deepwater Wavelength = 5.12 T^2 (L in feet)
- Waves break when Height/Length ~ 1:7
- Shoaling causes Length to decrease and Height to increase
- Shoaling" can be caused by <u>decreasing depth</u> **or** <u>wind against current</u>



Also see: Desirable and Undesirable Characteristics of Offshore Yachts , 1987

“Races are lost on the water”
Anon..

Preparation is Everything

https://sas.cruisingclub.org/weather/online