Waves: The Rainbow in the Ocean.

Kevin R. Bodge, Ph.D., P.E.

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jacksonville, florida.

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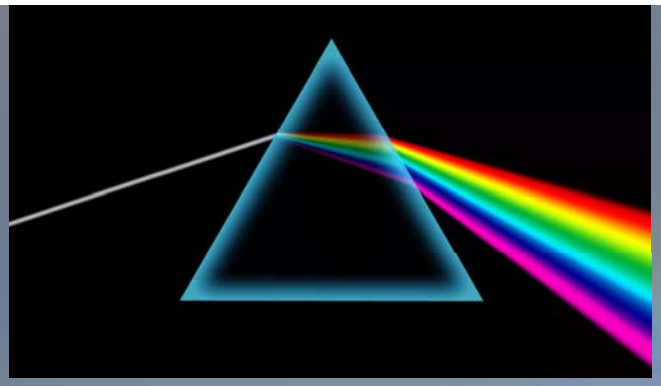
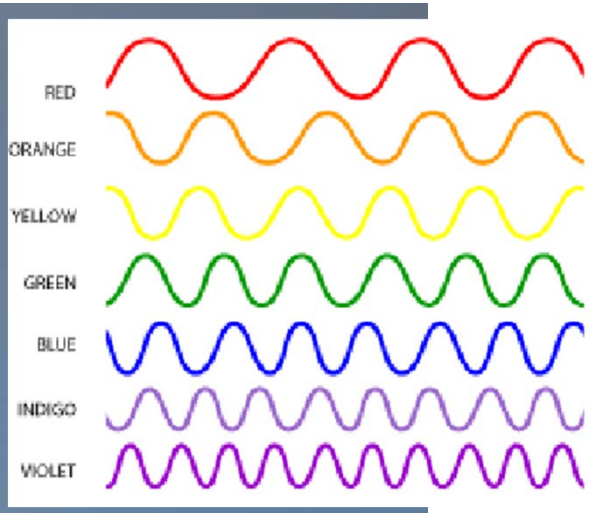


Each color is a different wavelength of the electromagnetic spectrum.



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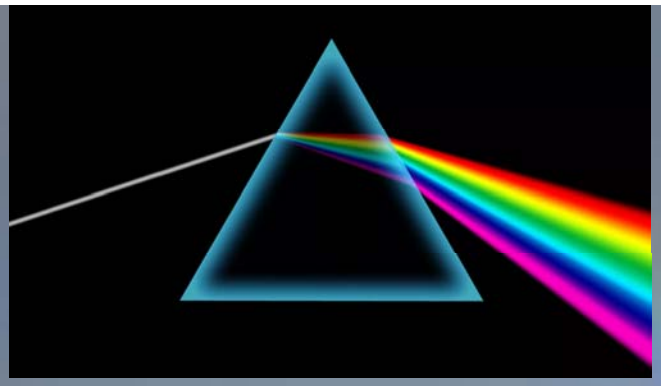

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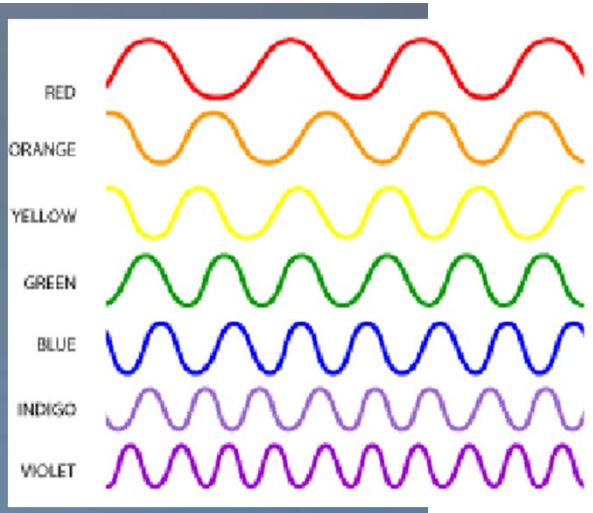
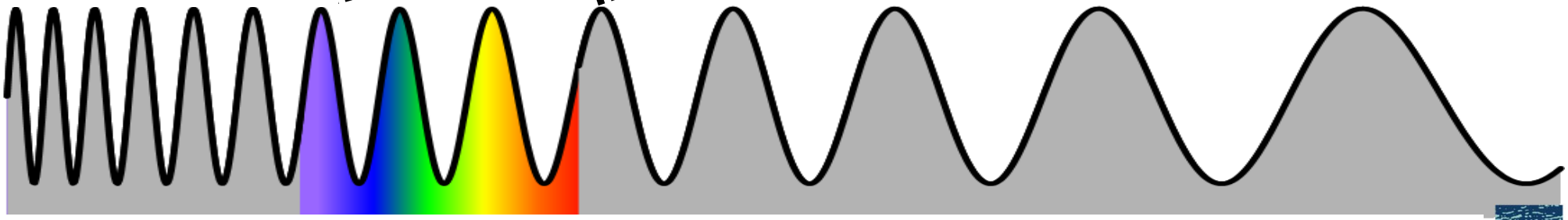


Electromagnetic Waves

Gamma X-Rays UV Visible Light Infrared Microwaves Radio Waves



Increasing Wavelength

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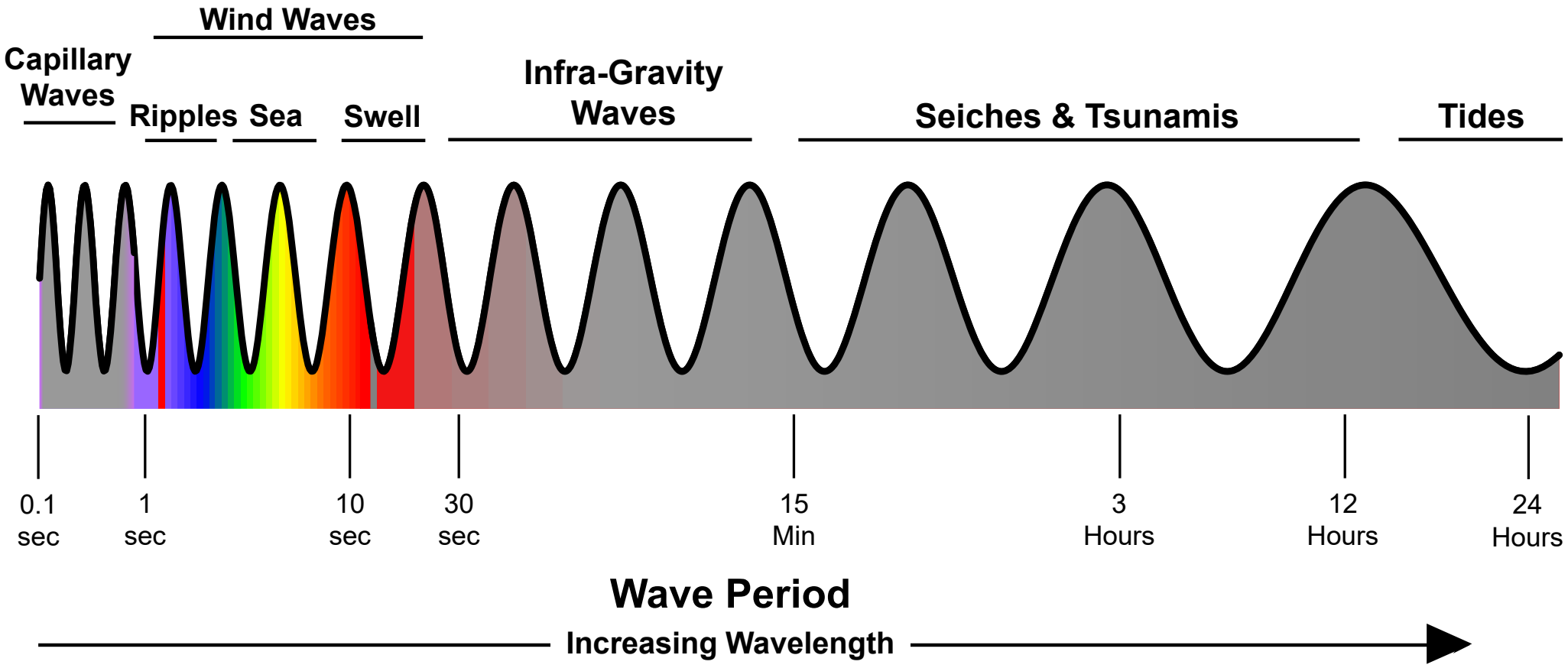
OCEAN WAVES



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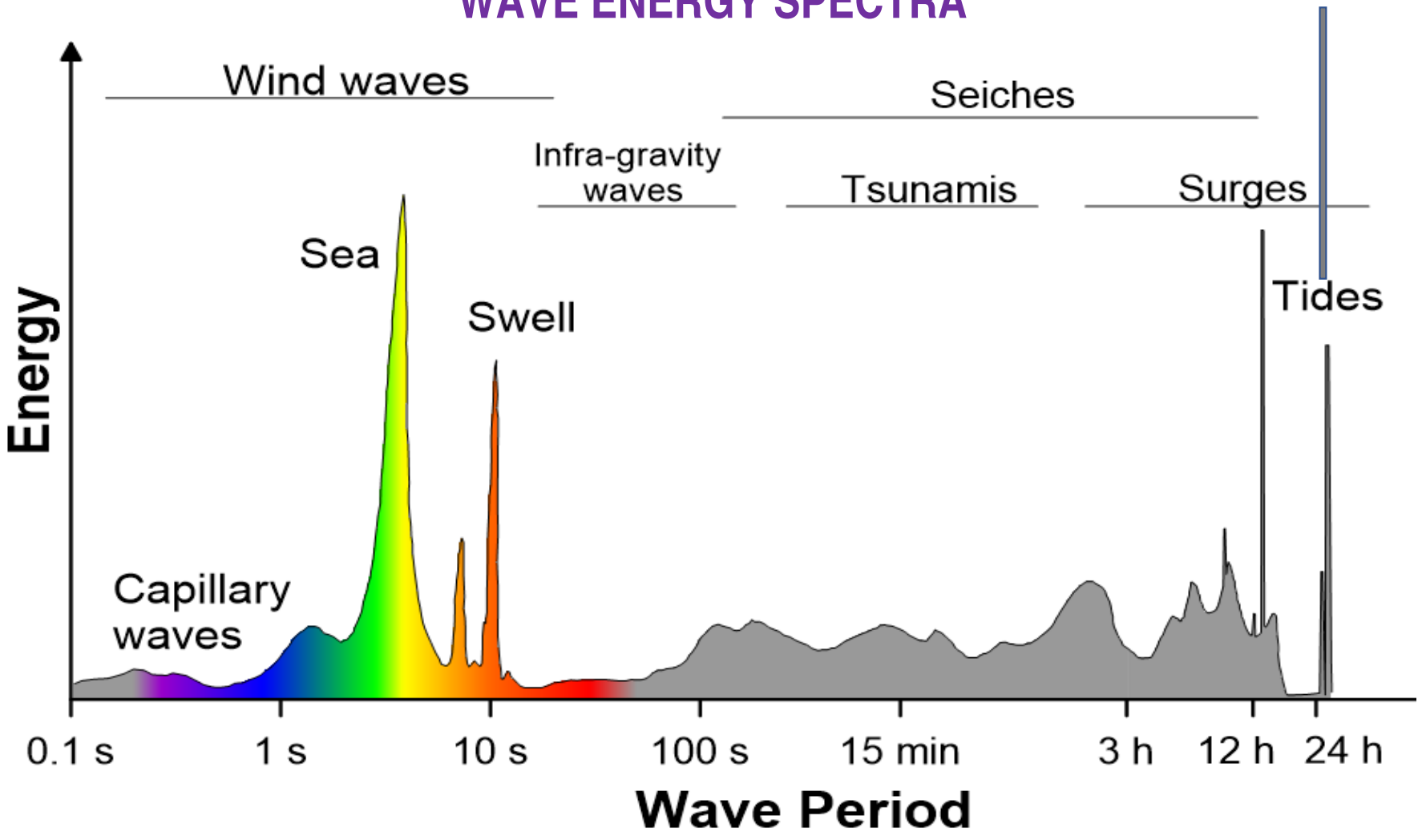
WAVE ENERGY SPECTRA



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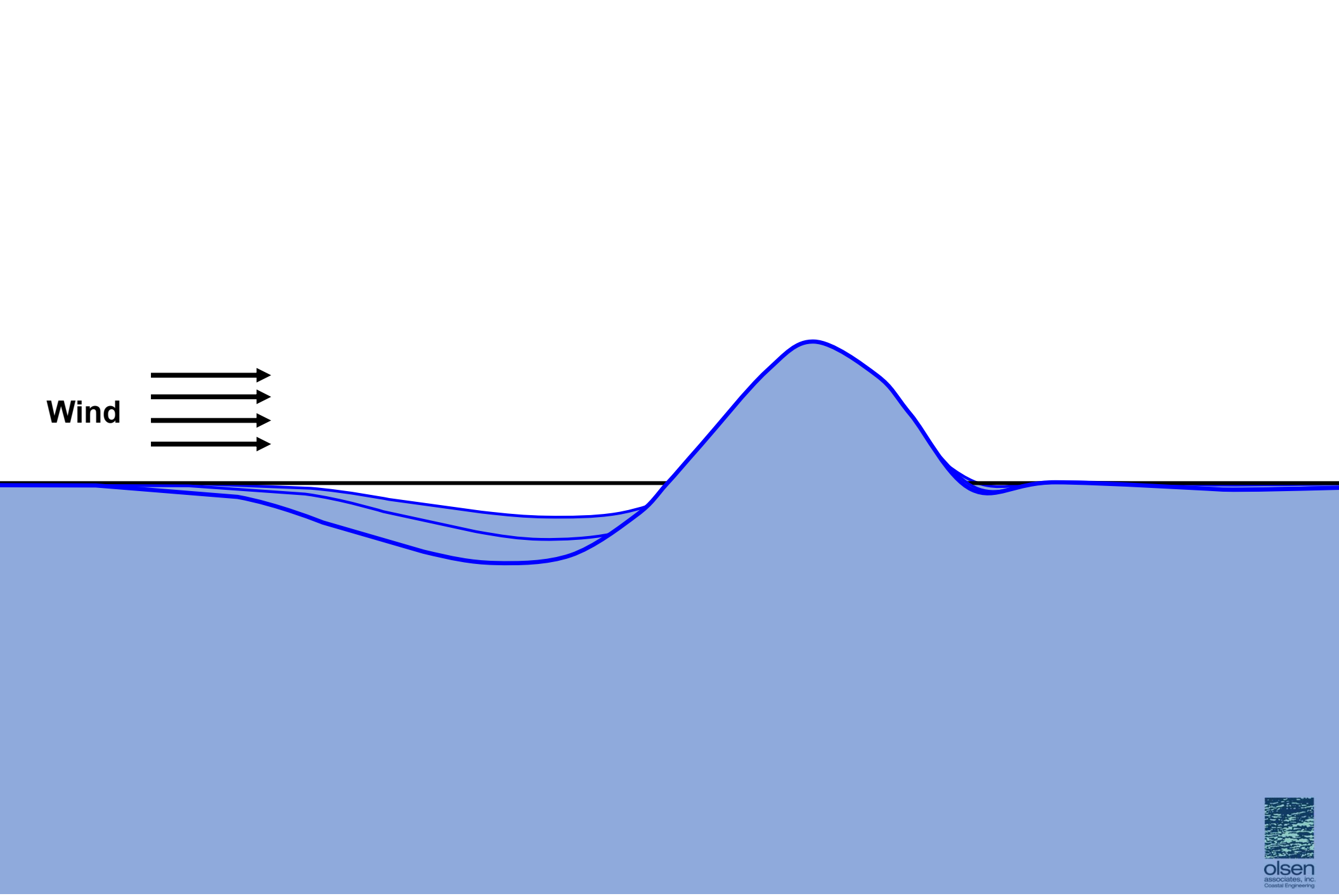
ORIGIN OF WIND WAVES

Wind

Surface Tension of Water


Wind
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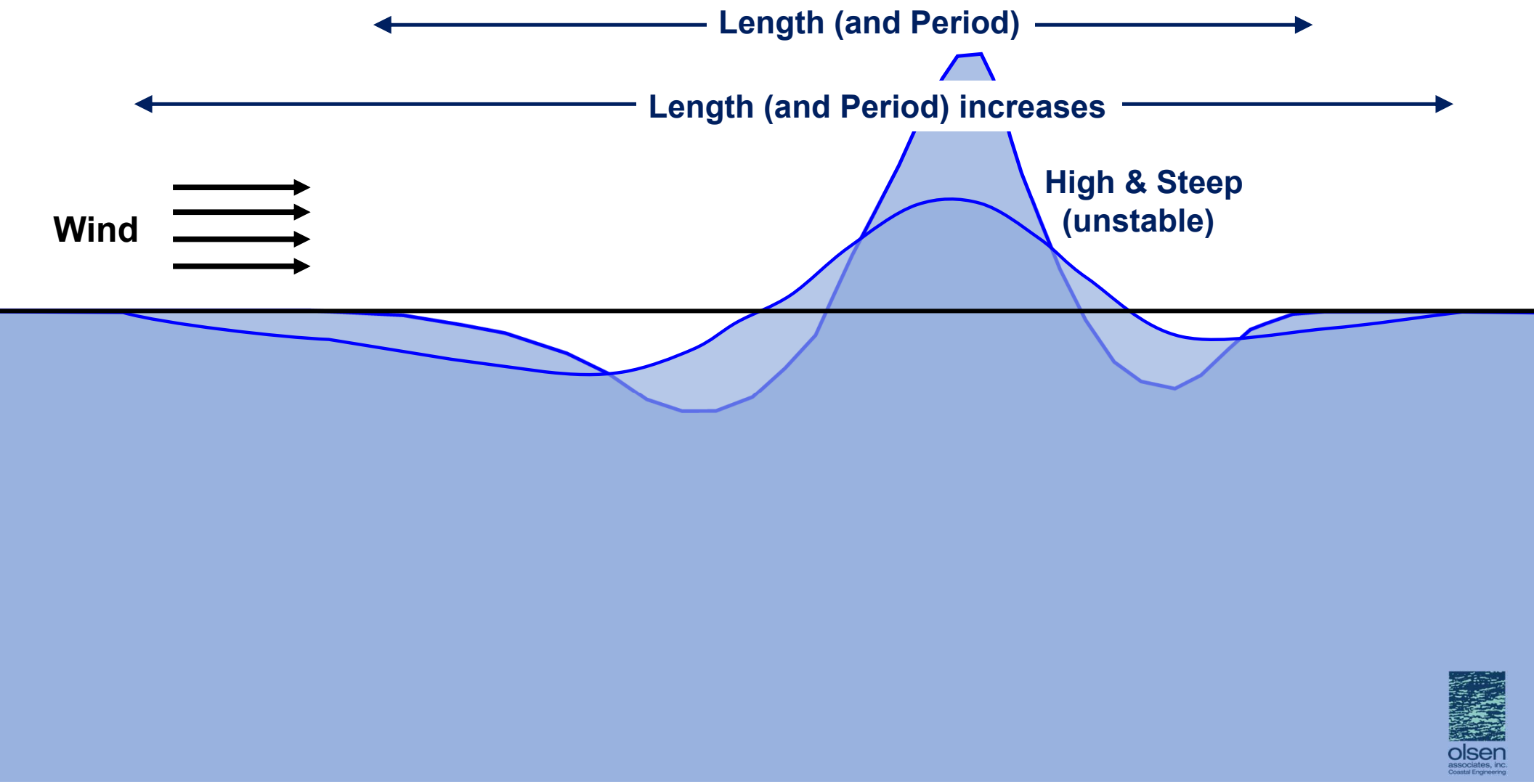
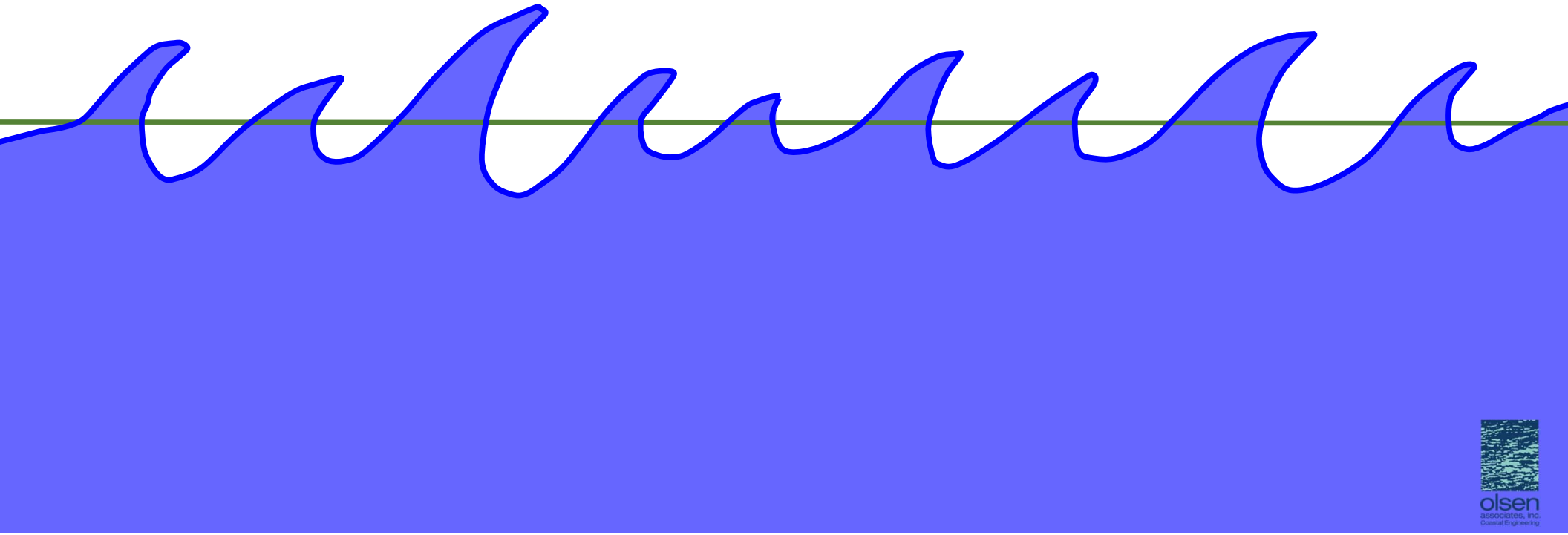
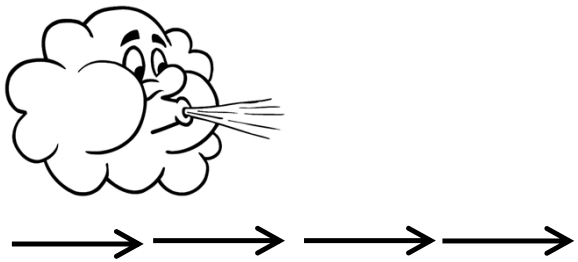
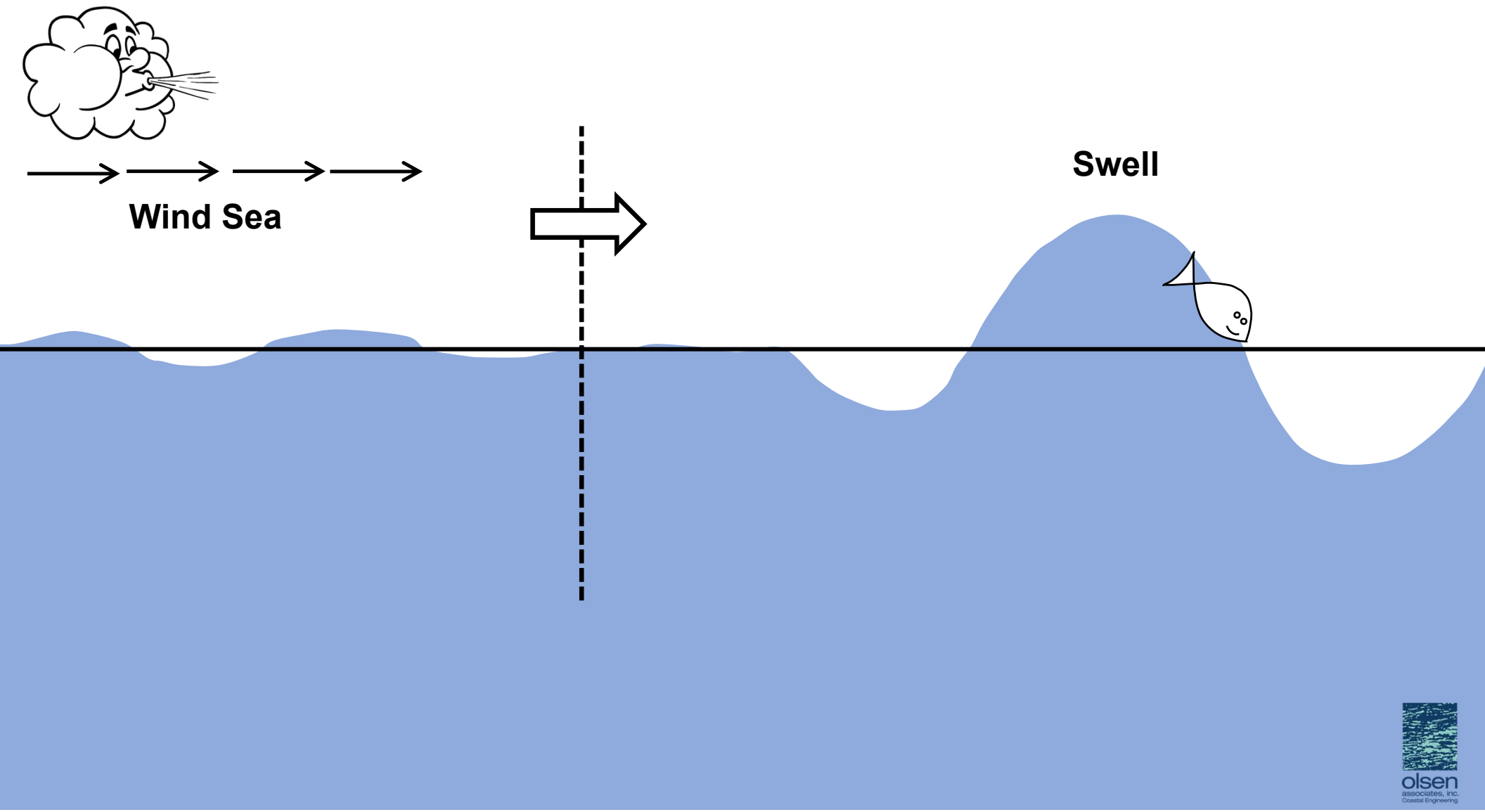

Length (and Period)
Length (and Period) increases
High & Steep
(unstable)
Wind

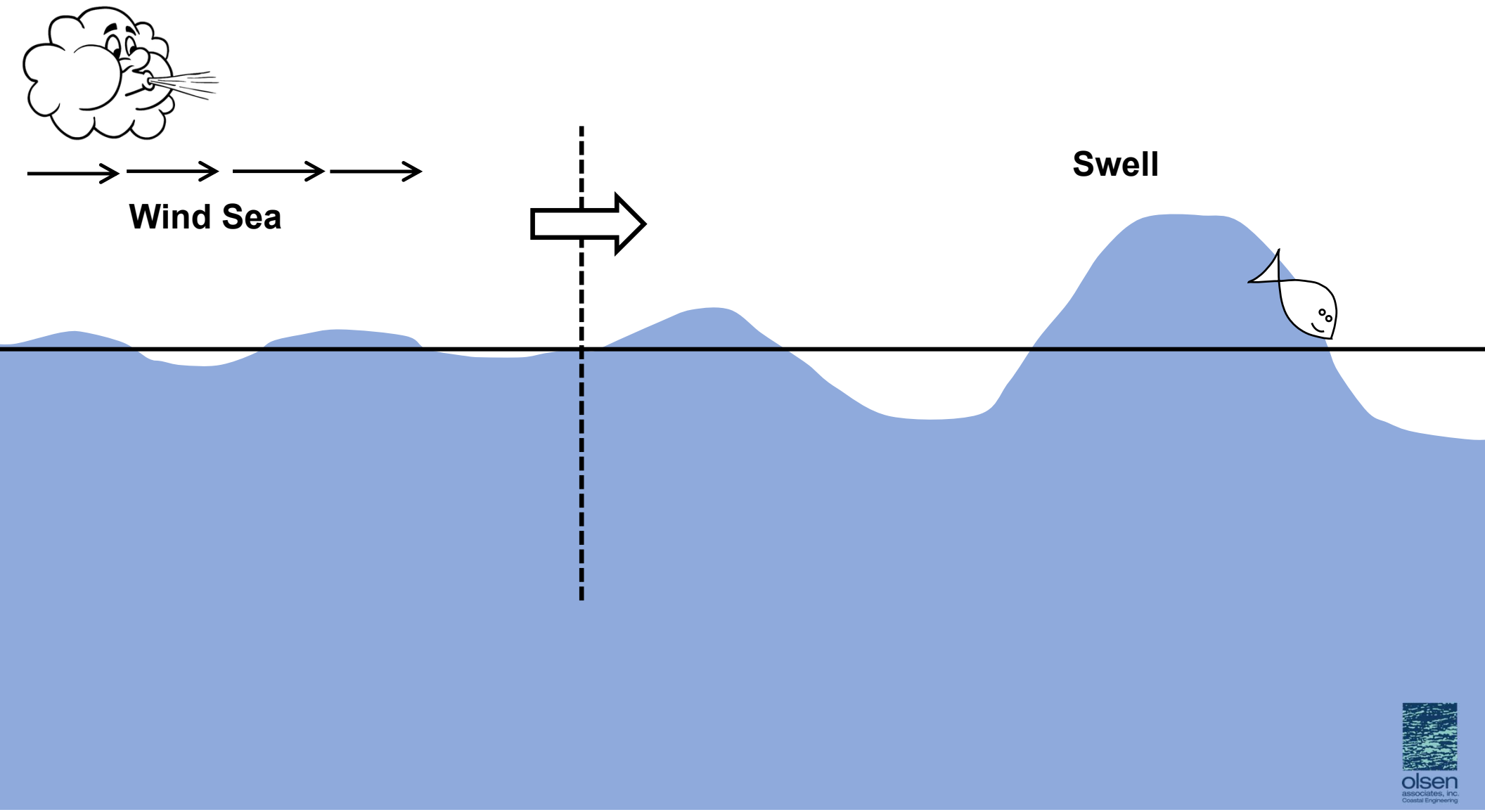
Wind Wave Generation

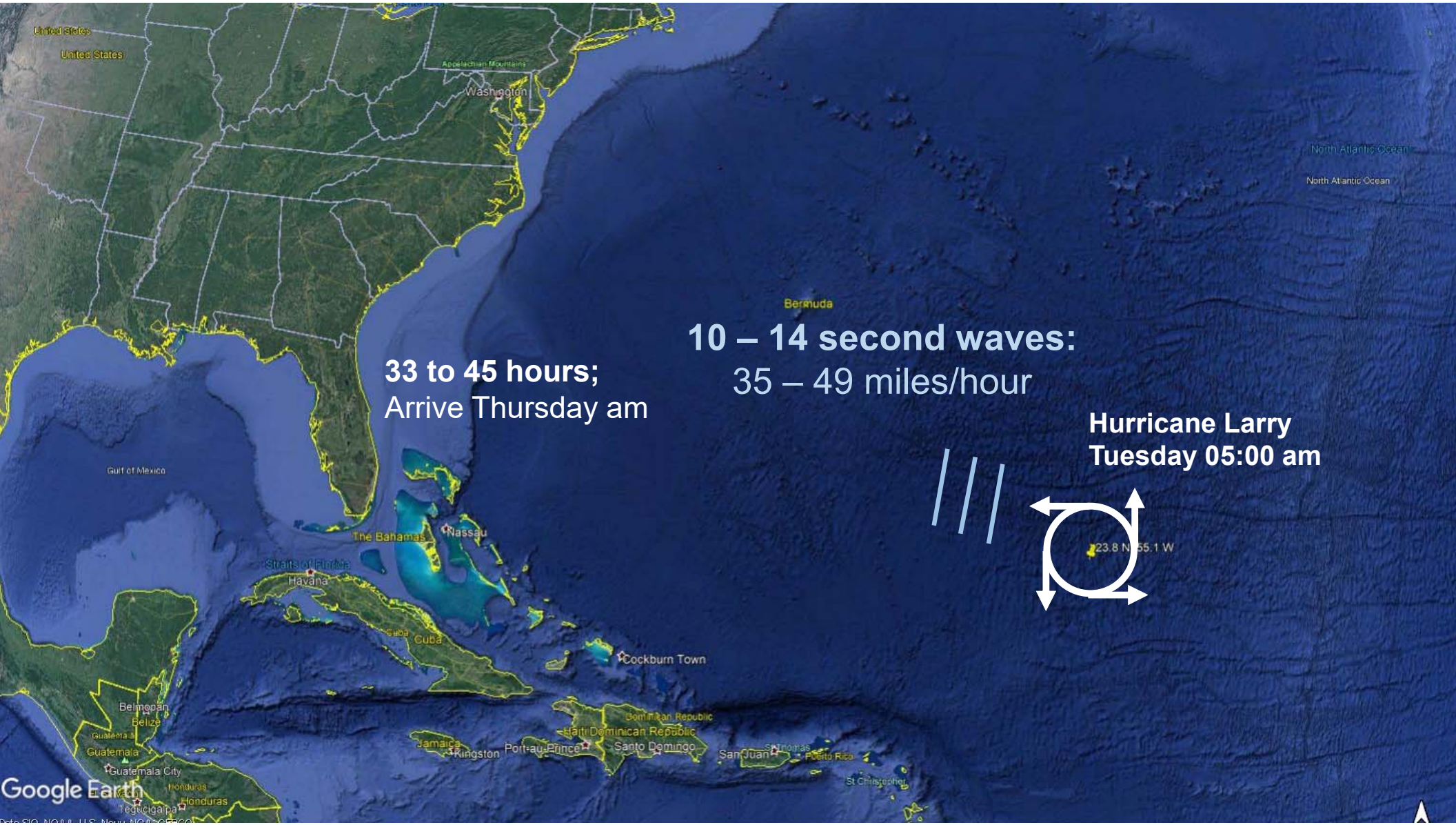


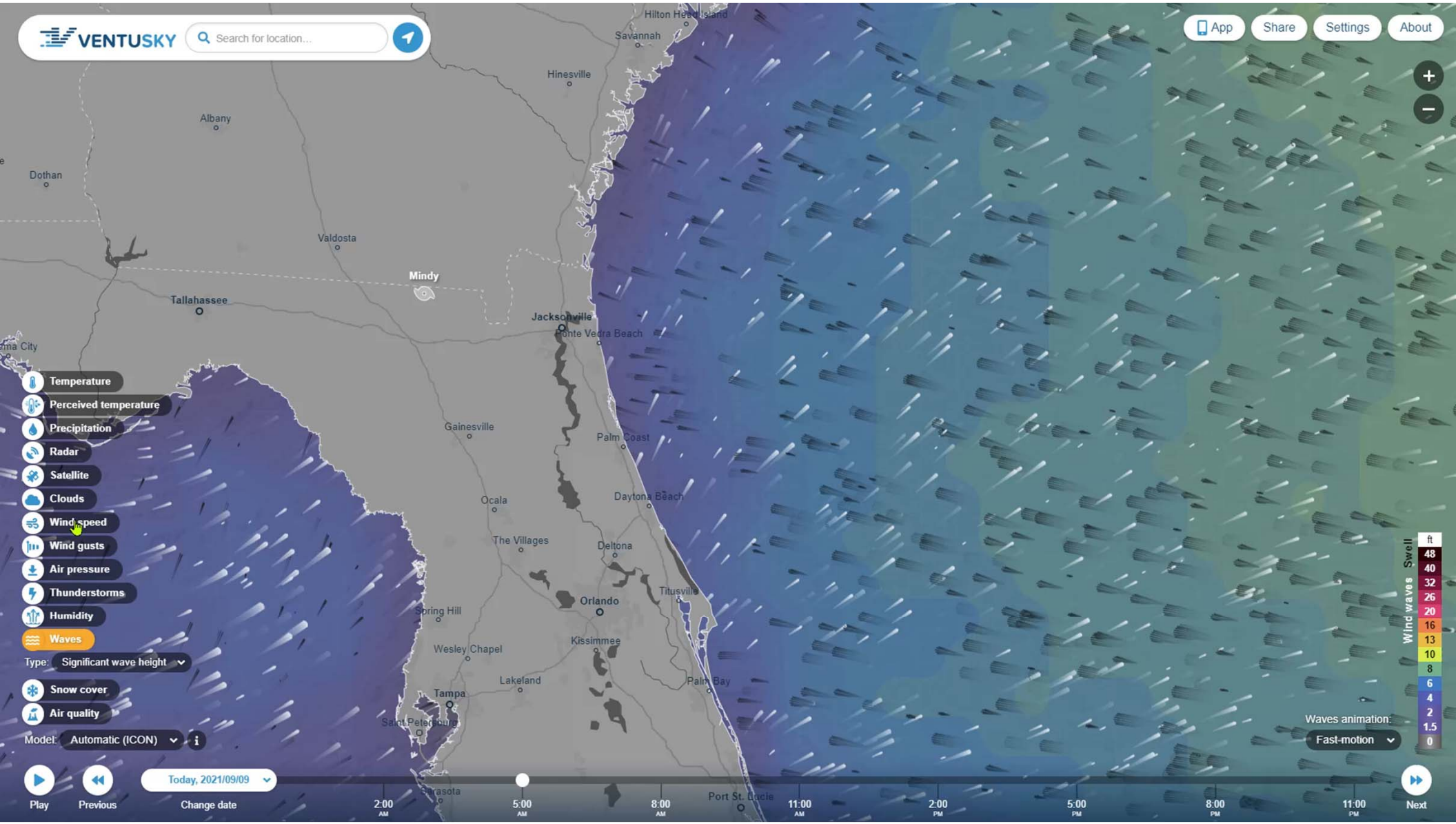


Wind Sea

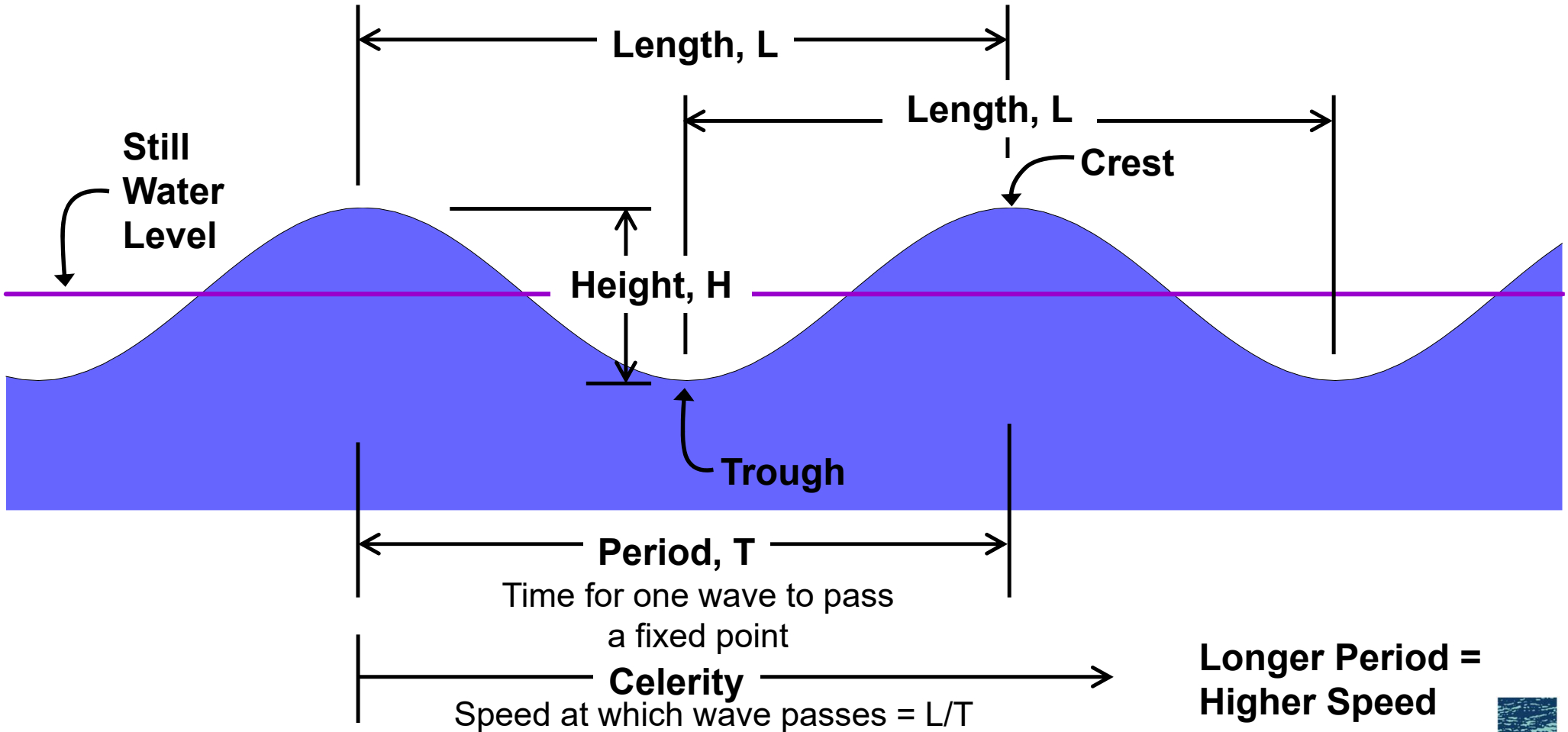

Wind Sea
Swell


Wind Sea
Swell


United States
United States
Appalachian Mountains
Washington
North Atlantic Ocean
North Atlantic Ocean
Bermuda
10 – 14 second waves:
35 – 49 miles/hour
33 to 45 hours;
Arrive Thursday am
Hurricane Larry
Tuesday 05:00 am
Gulf of Mexico
The Bahamas
Nassau
Straits of Florida
Havana
Cuba
Cuba
Cockburn Town
Belmopan
Belize
Guatemala
Guatemala City
Honduras
Tegucigalpa
Honduras
Haiti Dominican Republic
Dominican Republic
Jamaica
Kingston
Port-au-Prince
Santo Domingo
San Juan
Puerto Rico
St Christopher
Google Earth


VENTUSKY
Search for location...
App
Share
Settings
About
Hilton Head Island
Savannah
Hinesville
Albany
Dothan
Valdosta
Mindy
Tallahassee
Jacksonville
Ponte Vedra Beach
Gainesville
Palm Coast
Ocala
Daytona Beach
The Villages
Deltona
Orlando
Titusville
Spring Hill
Kissimmee
Wesley Chapel
Lakeland
Palm Bay
Tampa
Saint Petersburg
Sarasota
Port St. Lucie
Temperature
Perceived temperature
Precipitation
Radar
Satellite
Clouds
Wind speed
Wind gusts
Air pressure
Thunderstorms
Humidity
Waves
Type: Significant wave height
Snow cover
Air quality
Model: Automatic (ICON)
Wind waves Swell
ft
48
40
32
26
20
16
13
10
8
6
4
2
1.5
0
Waves animation:
Fast-motion
Play
Previous
Today, 2021/09/09
Change date
2:00 AM
5:00 AM
8:00 AM
11:00 AM
2:00 PM
5:00 PM
8:00 PM
11:00 PM
Next

WAVE MEASUREMENT



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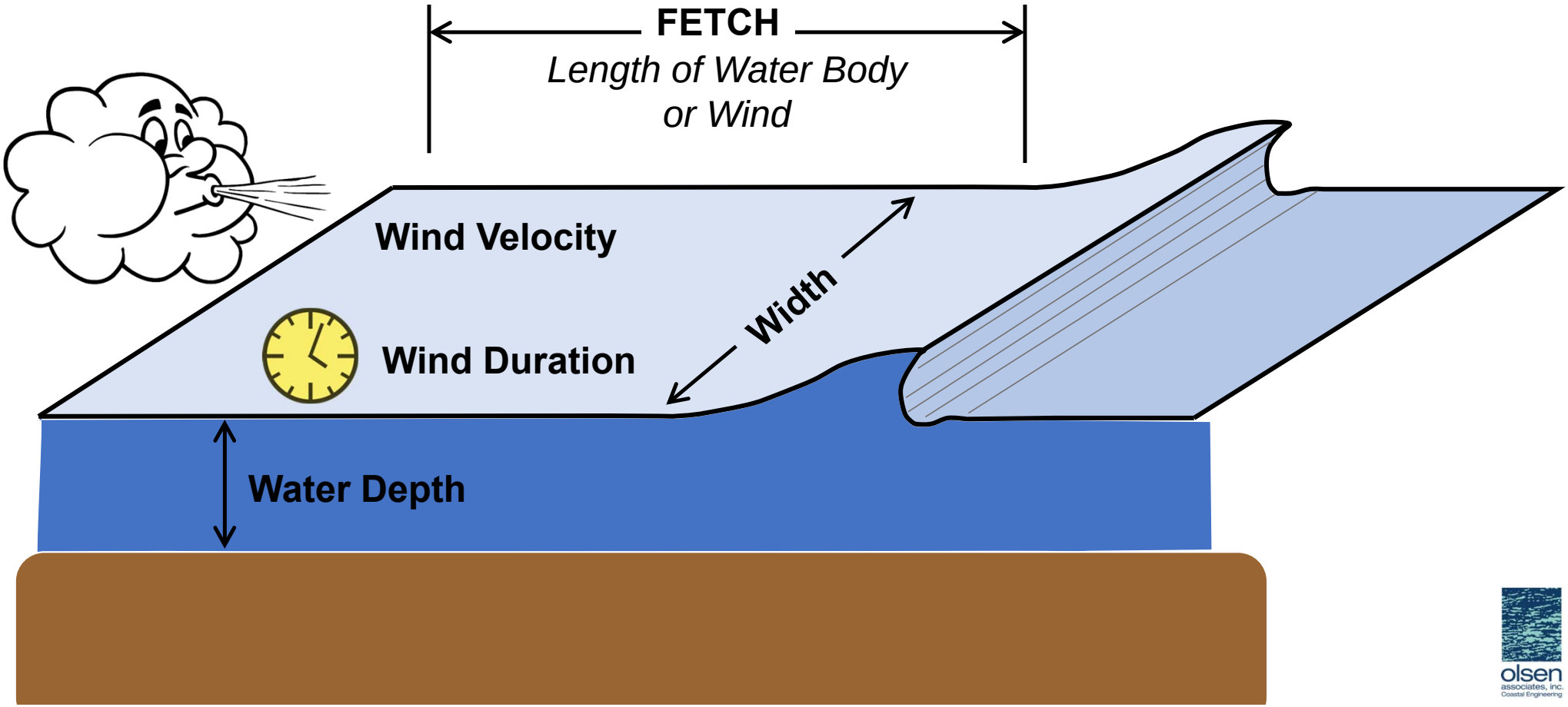
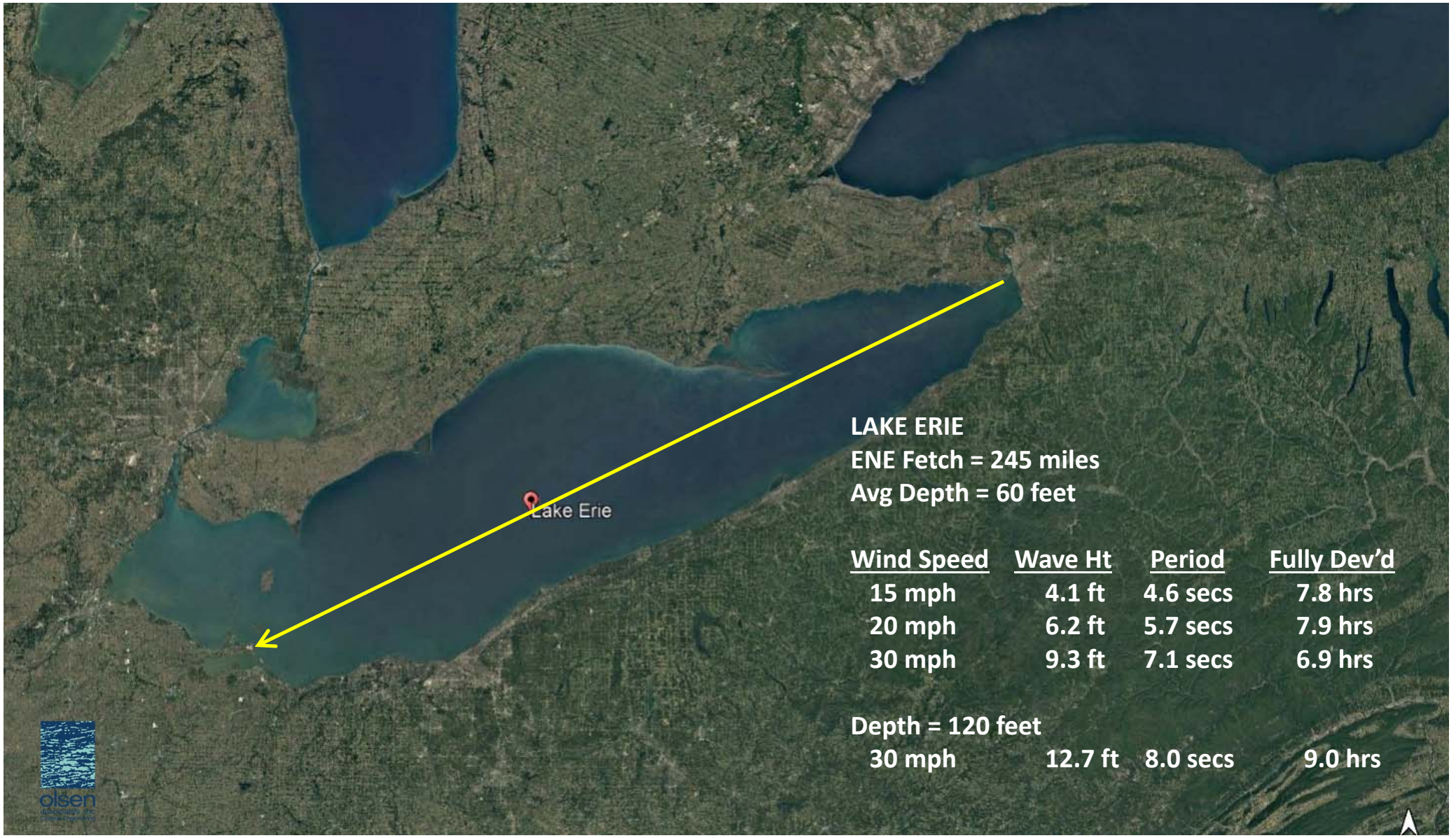
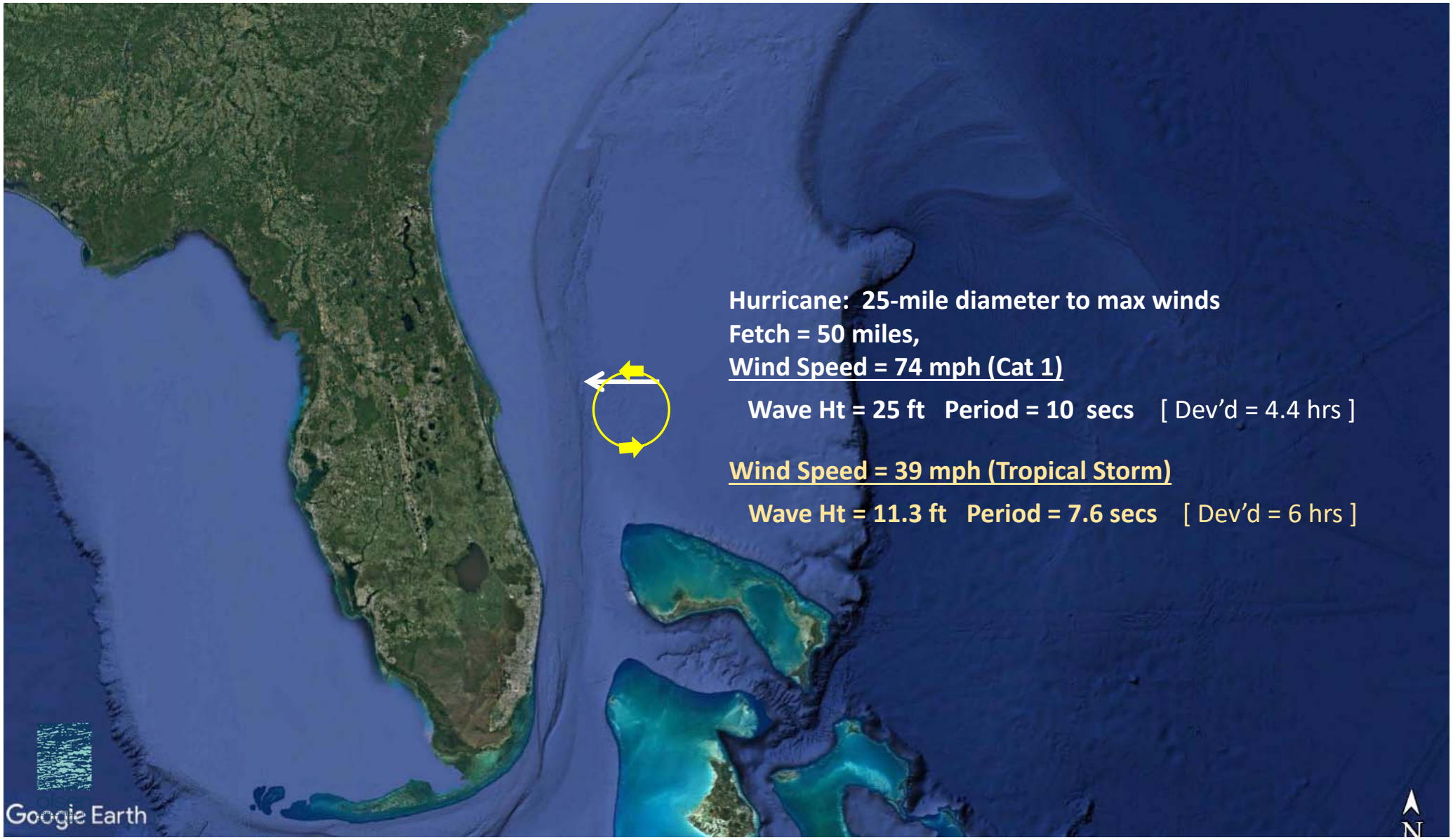
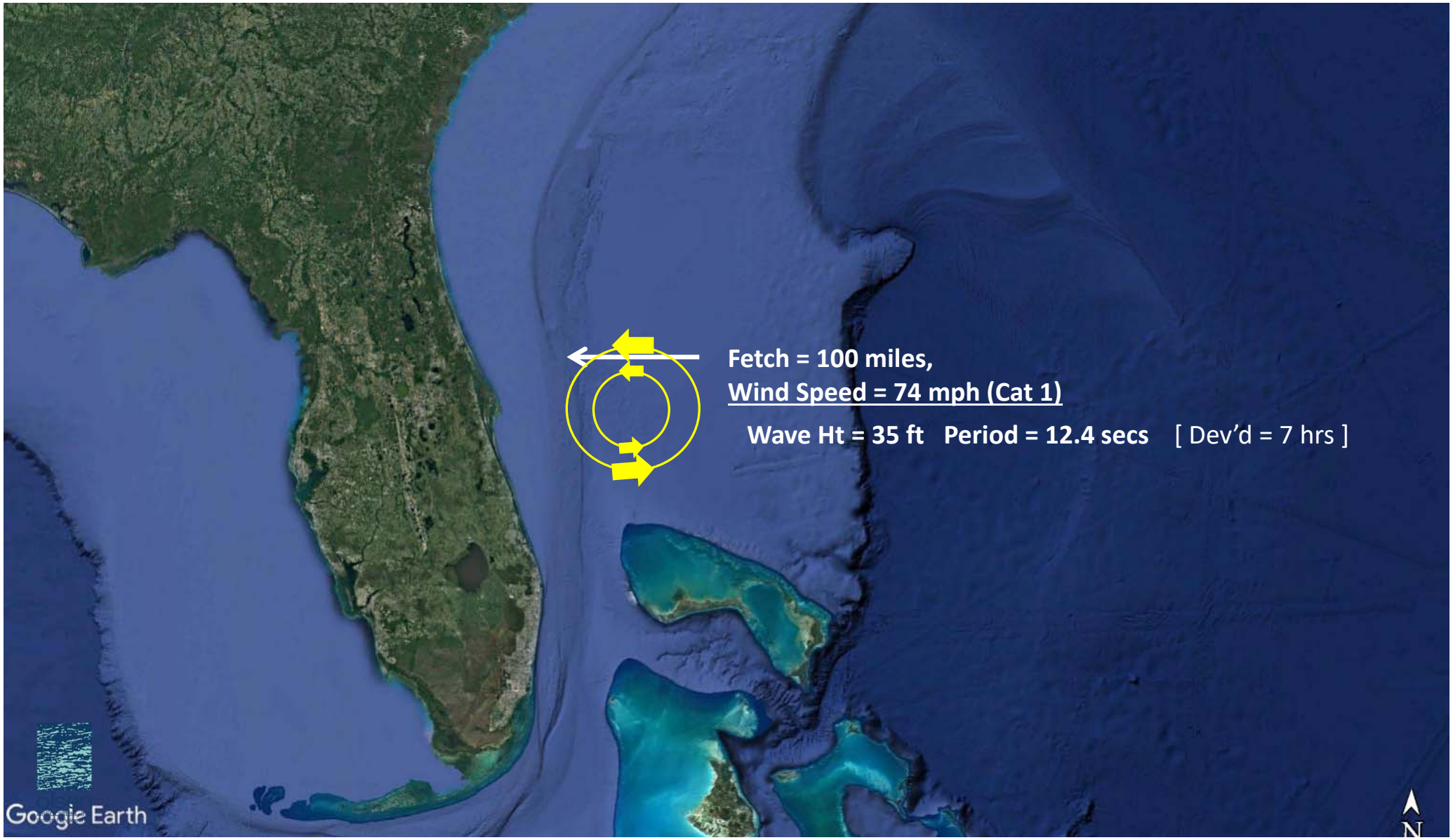
WAVE GENERATION

Wave Height & Period increases with: *Wind Velocity, Duration, Fetch, Depth, Width*

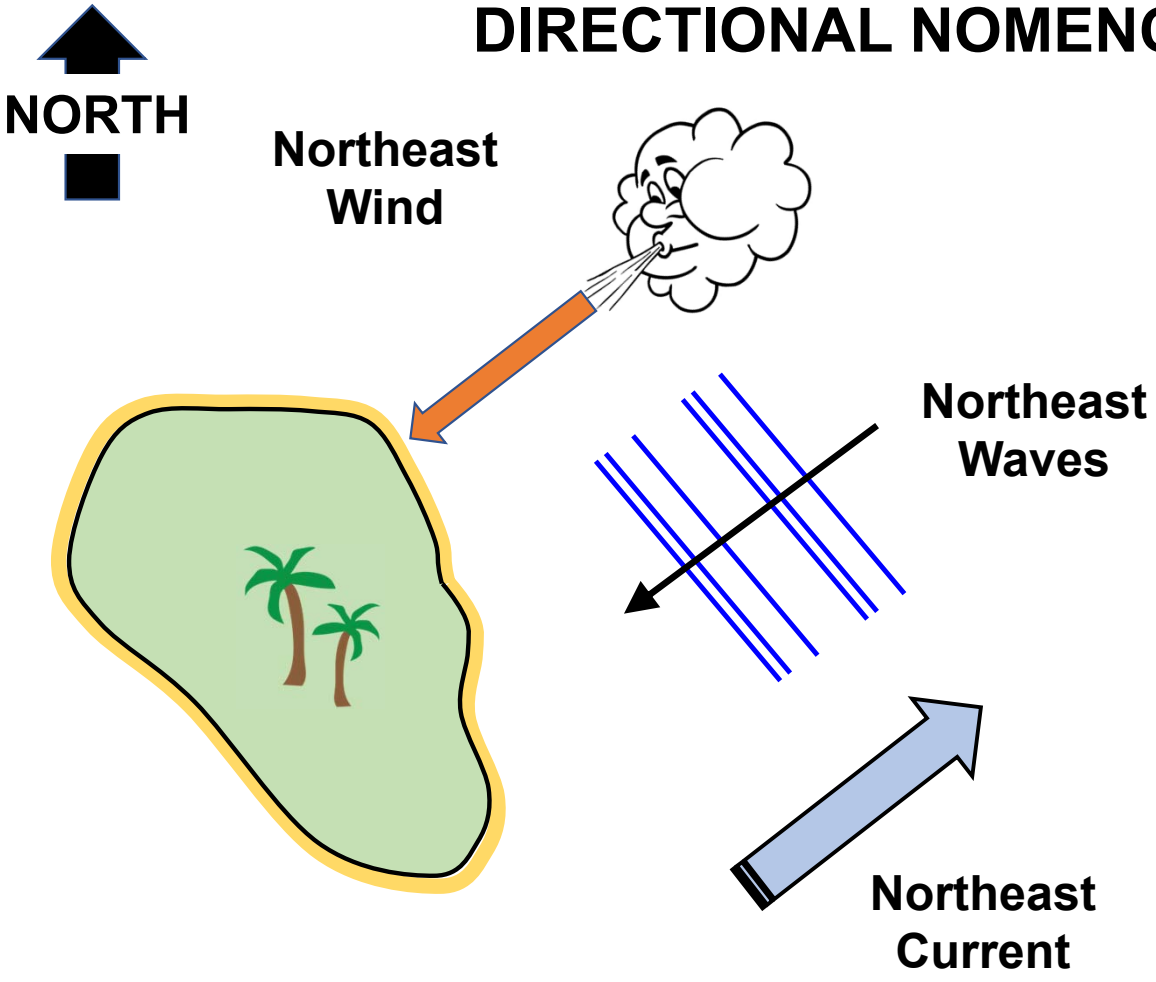



Lake Erie
LAKE ERIE
ENE Fetch = 245 miles
Avg Depth = 60 feet
Wind Speed Wave Ht Period Fully Dev'd
15 mph 4.1 ft 4.6 secs 7.8 hrs
20 mph 6.2 ft 5.7 secs 7.9 hrs
30 mph 9.3 ft 7.1 secs 6.9 hrs
Depth = 120 feet
30 mph 12.7 ft 8.0 secs 9.0 hrs
olsen


Hurricane: 25-mile diameter to max winds
Fetch = 50 miles,
Wind Speed = 74 mph (Cat 1)
Wave Ht = 25 ft Period = 10 secs [Dev'd = 4.4 hrs]
Wind Speed = 39 mph (Tropical Storm)
Wave Ht = 11.3 ft Period = 7.6 secs [Dev'd = 6 hrs]
Google Earth
N


Fetch = 100 miles,
Wind Speed = 74 mph (Cat 1)
Wave Ht = 35 ft Period = 12.4 secs [Dev'd = 7 hrs]
Google Earth
N

DIRECTIONAL NOMENCLATURE



Wind:
Direction From

Waves:
Direction From

Currents:
Direction To

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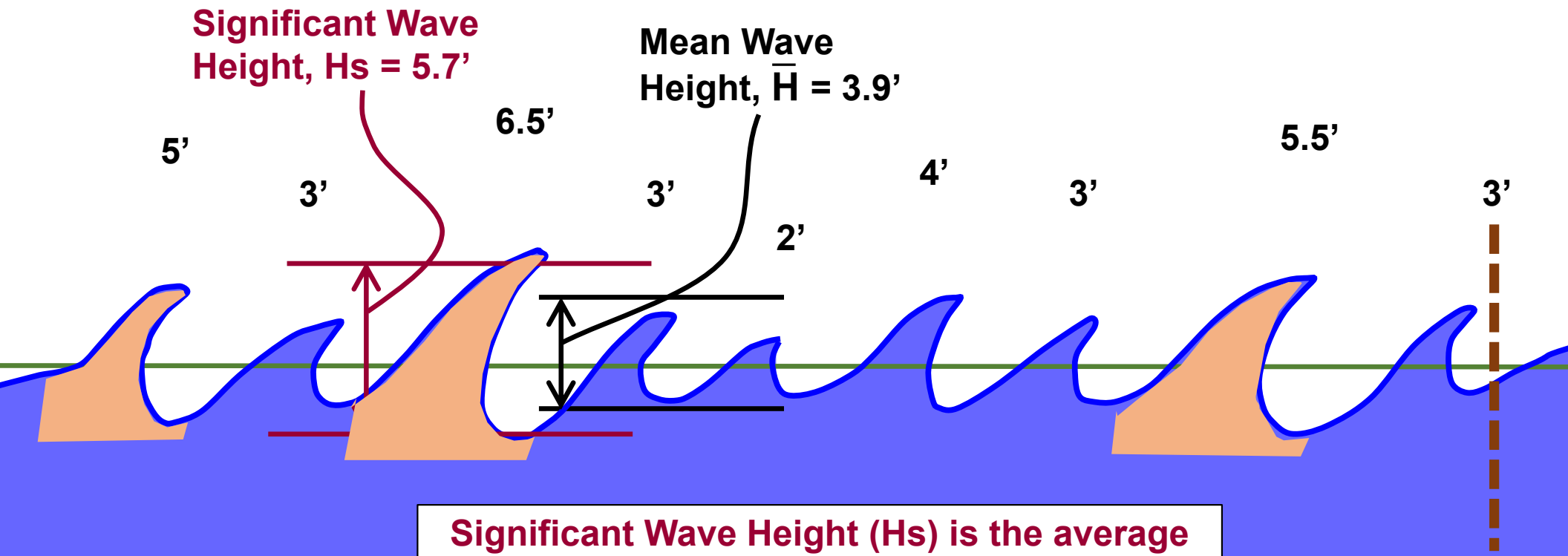
WAVE HEIGHT



Significant Wave Height (Hs) is the average height of the largest 1/3rd of the waves.

$$Hs \simeq 1.4 \times \overline{H}$$

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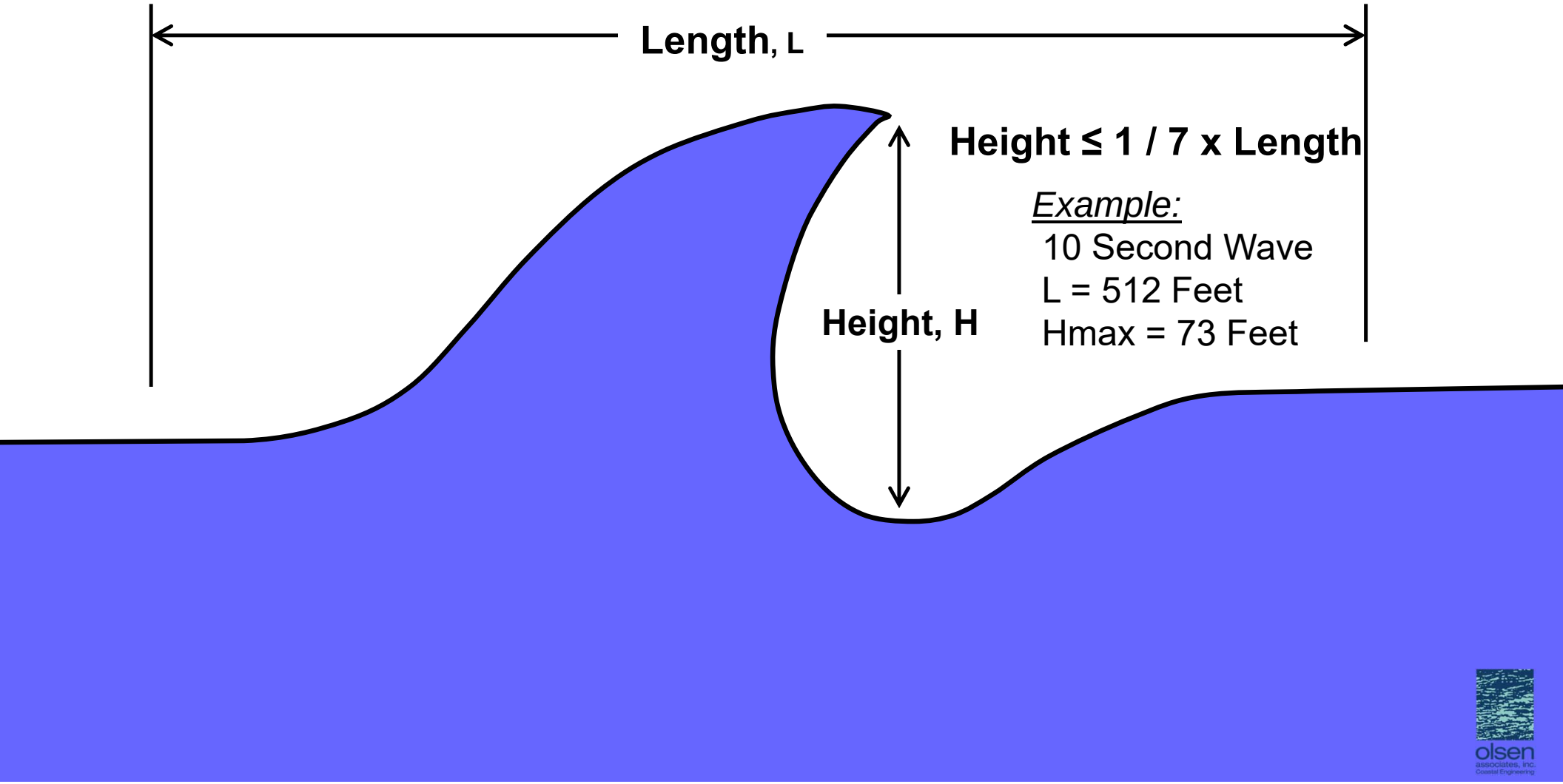
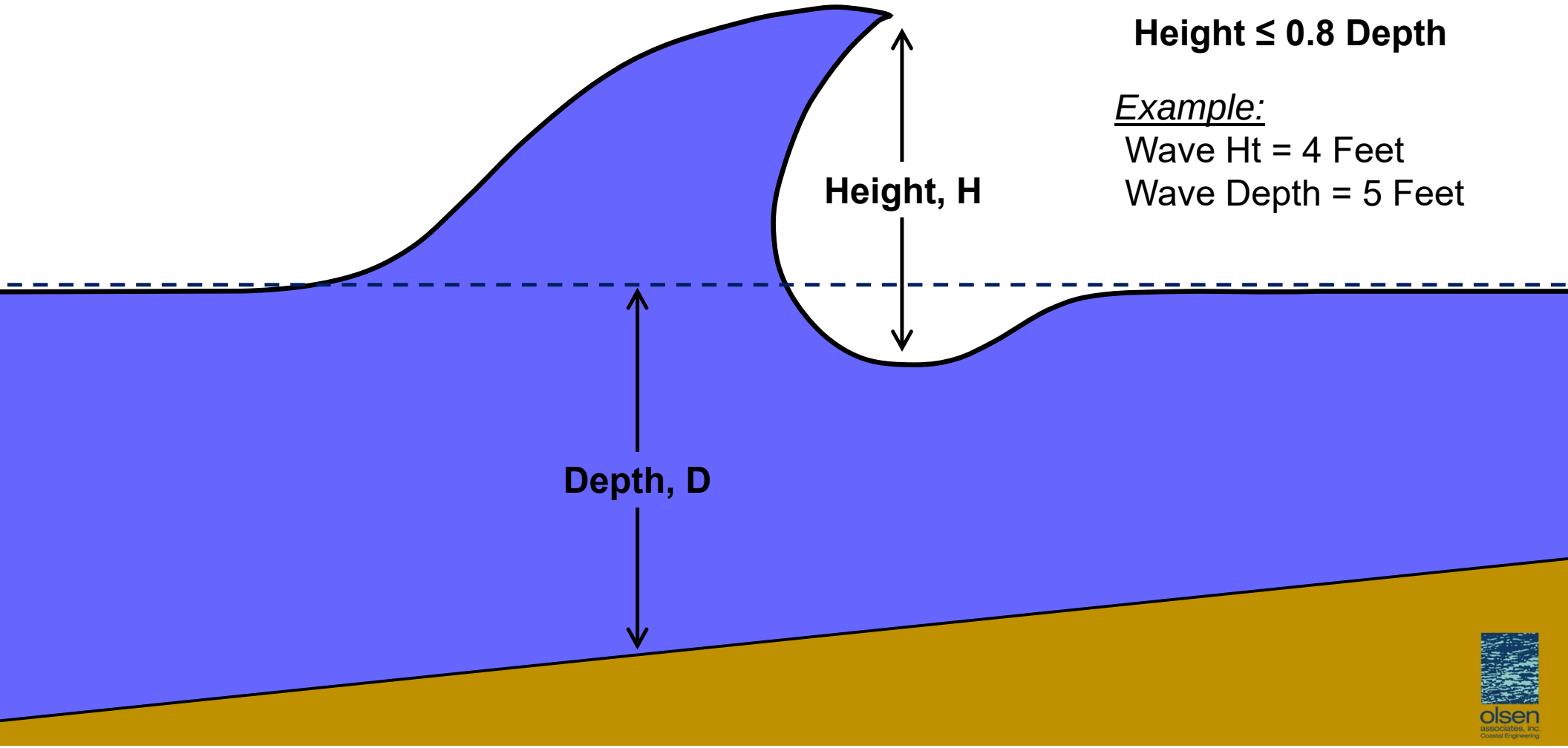
WAVE BREAKING – DEEP WATER



WAVE BREAKING – SHALLOW WATER



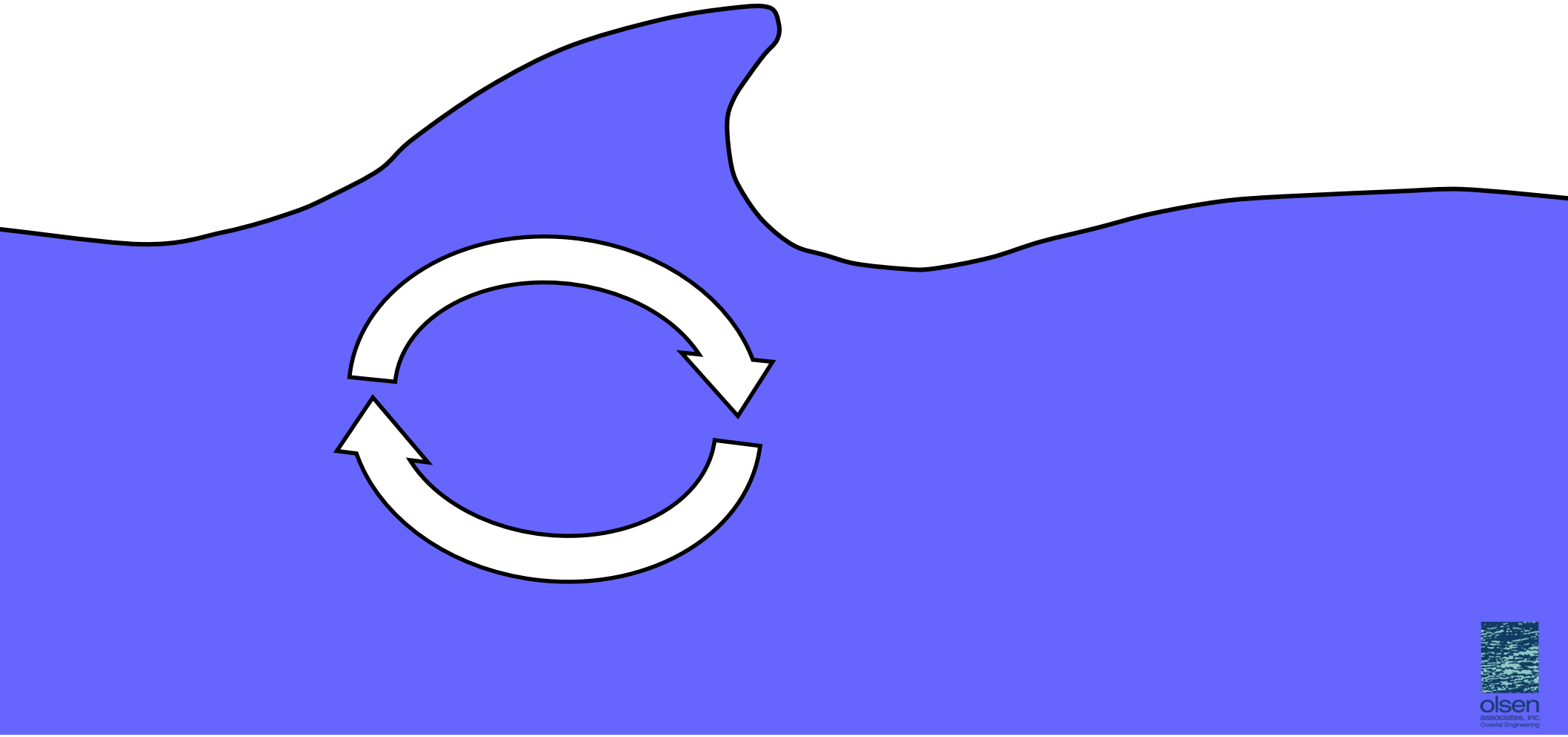
Height ≤ 0.8 Depth

Example:

Wave Ht = 4 Feet

Wave Depth = 5 Feet

WATER MOTION UNDER A WAVE



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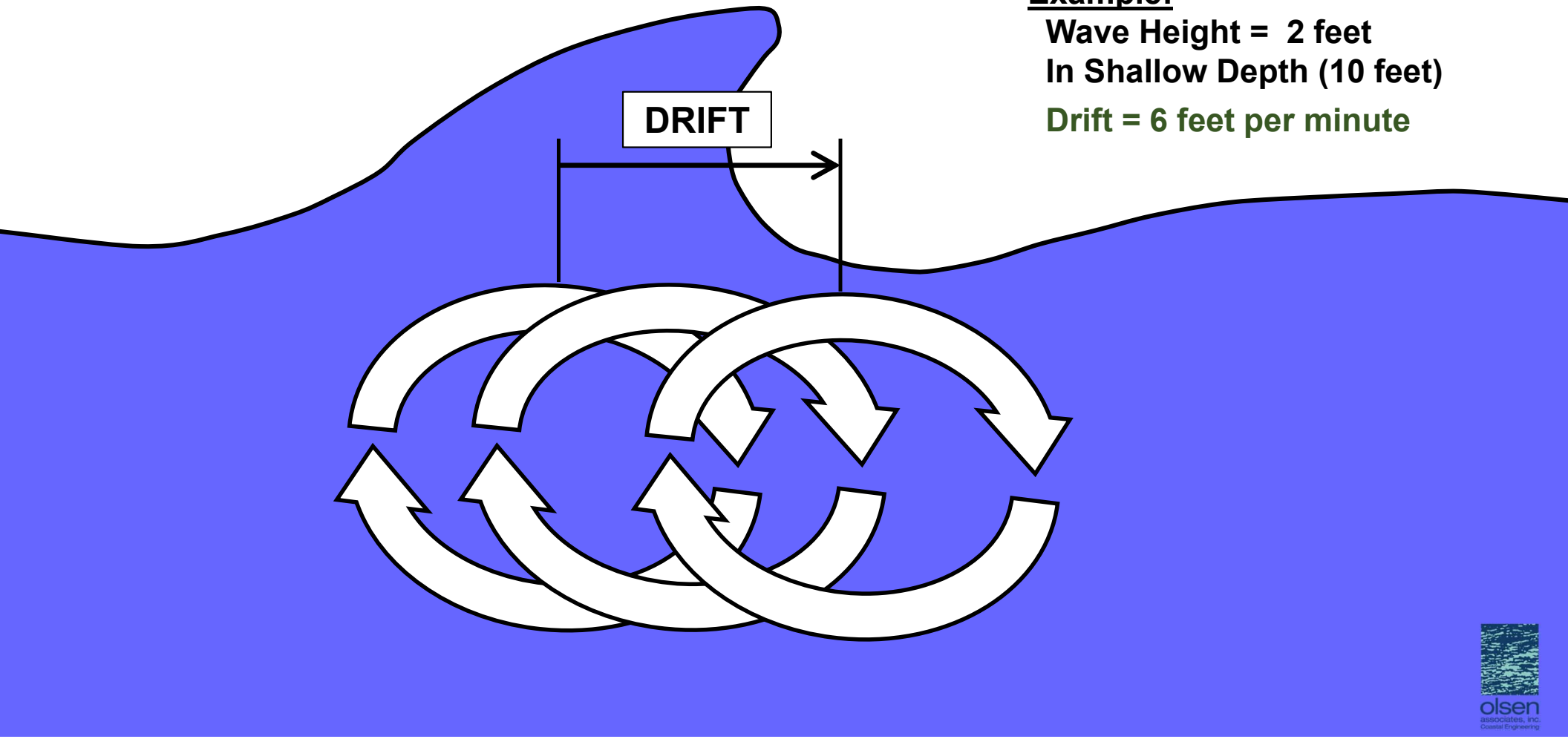
WAVE MASS TRANSPORT (DRIFT)

Example:

Wave Height = 2 feet
In Shallow Depth (10 feet)

Drift = 6 feet per minute



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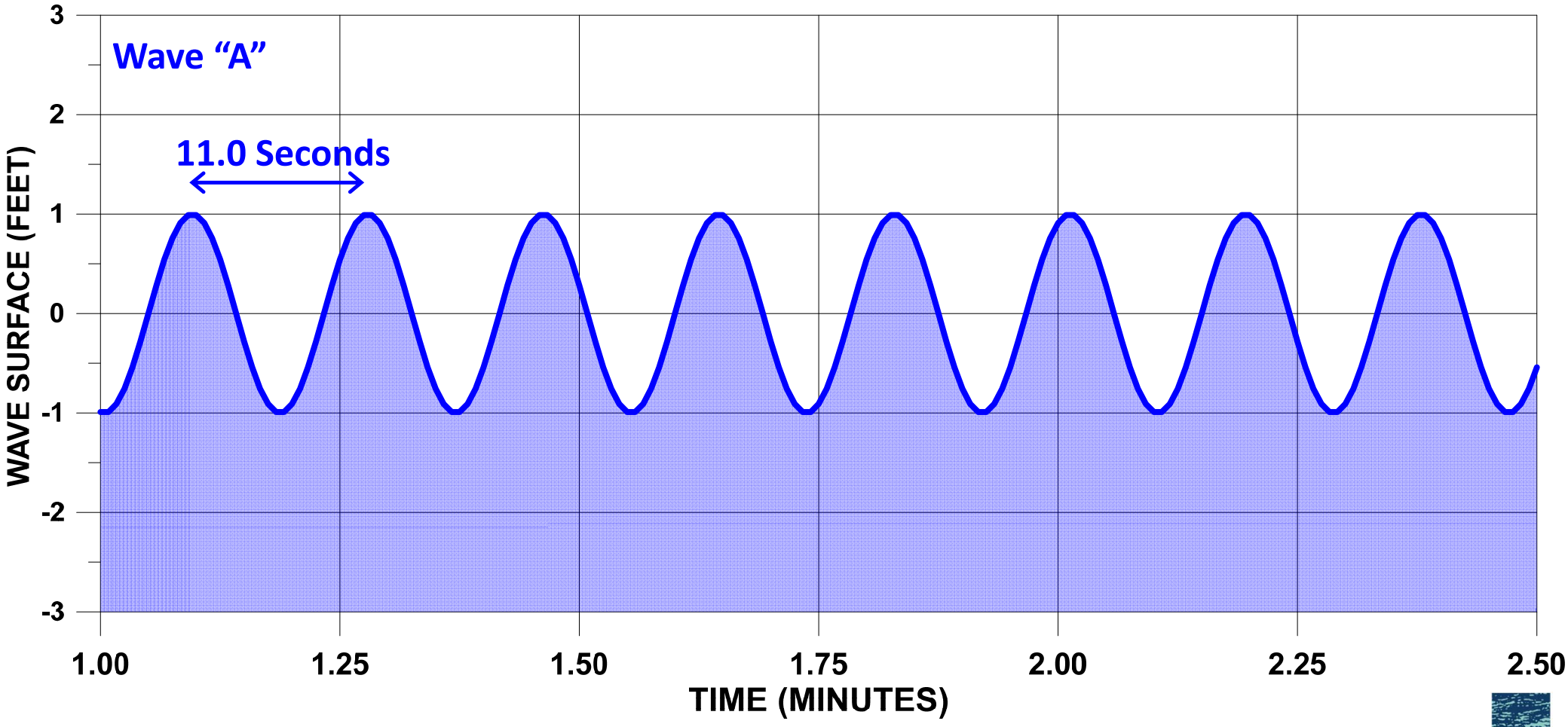
Wave “Sets”



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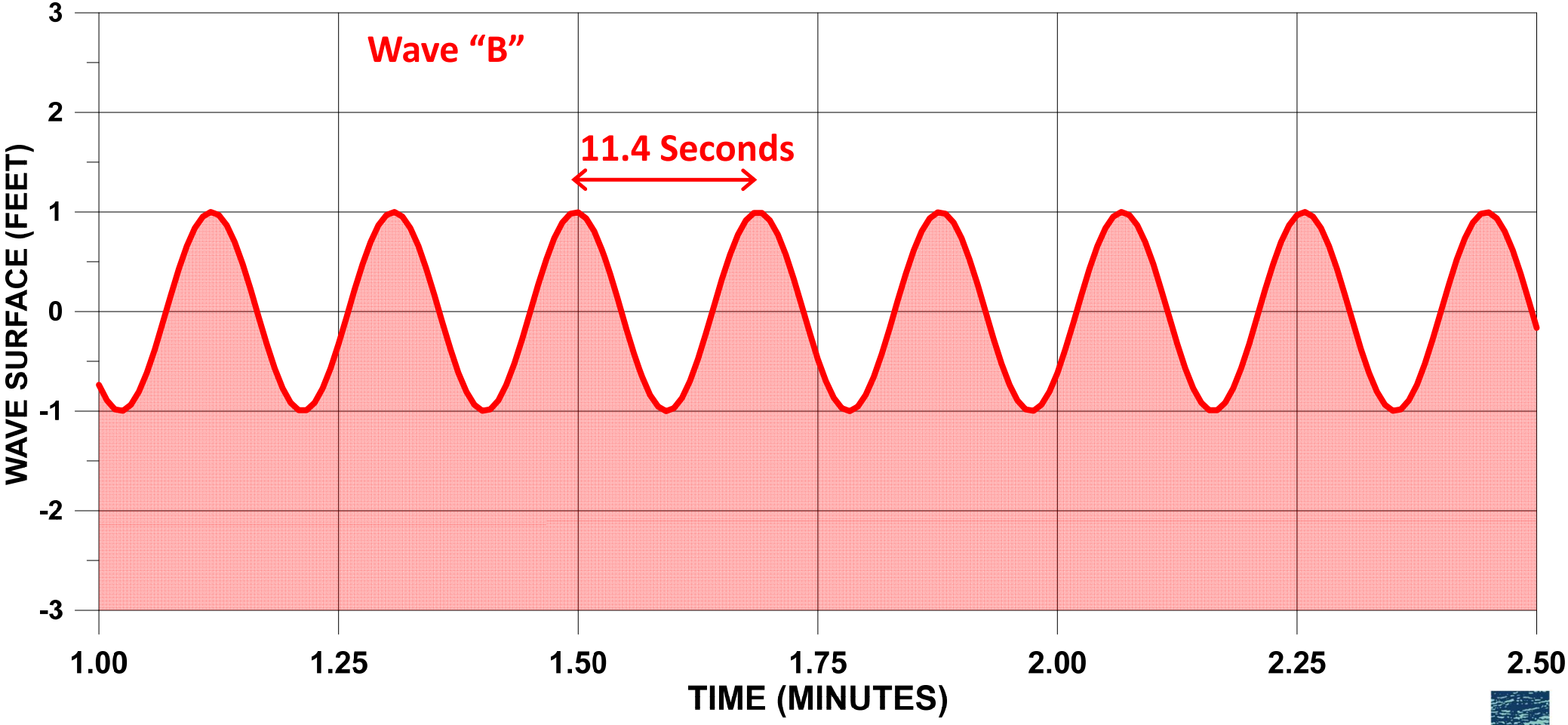
Wave “Sets”



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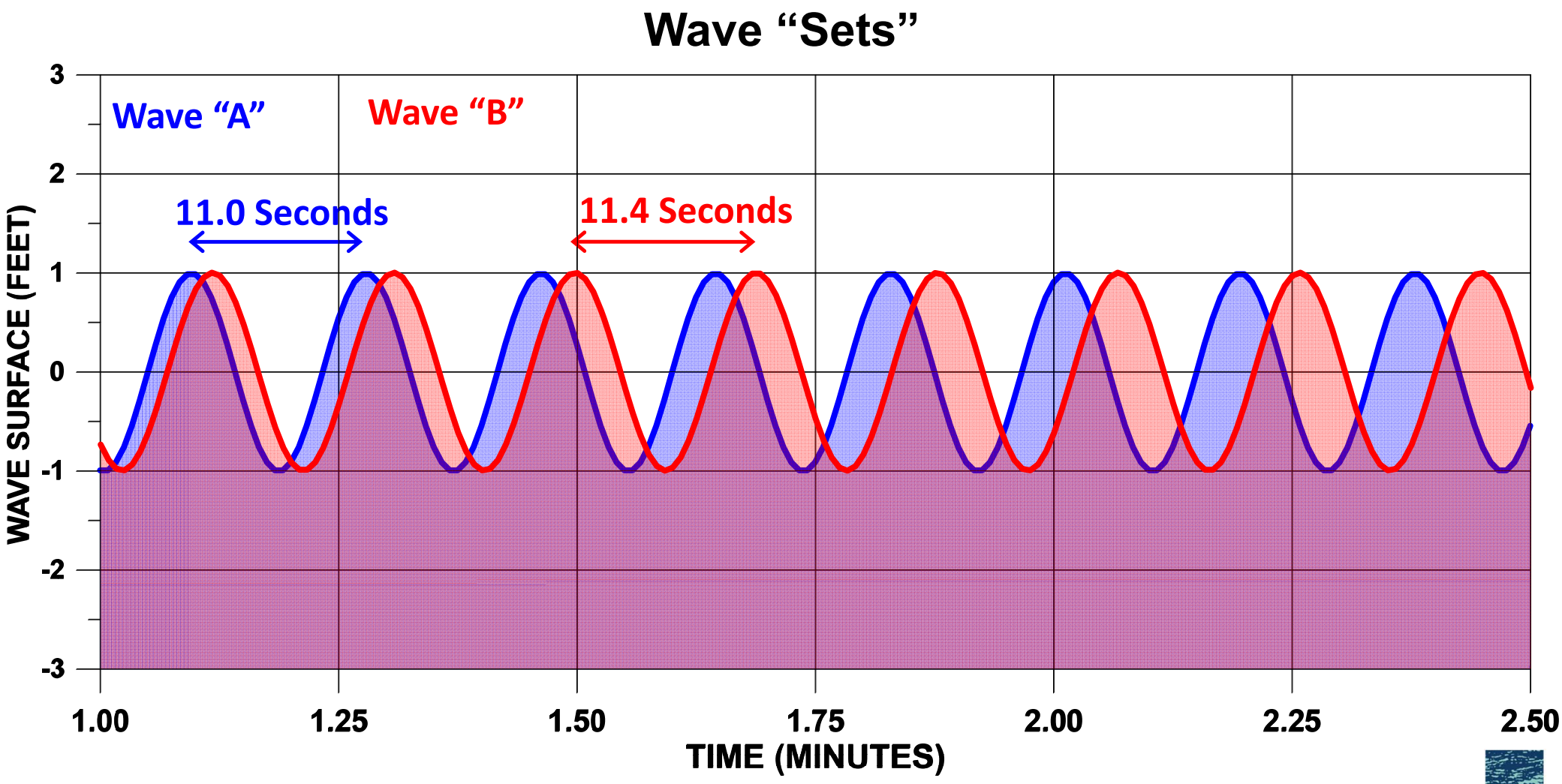
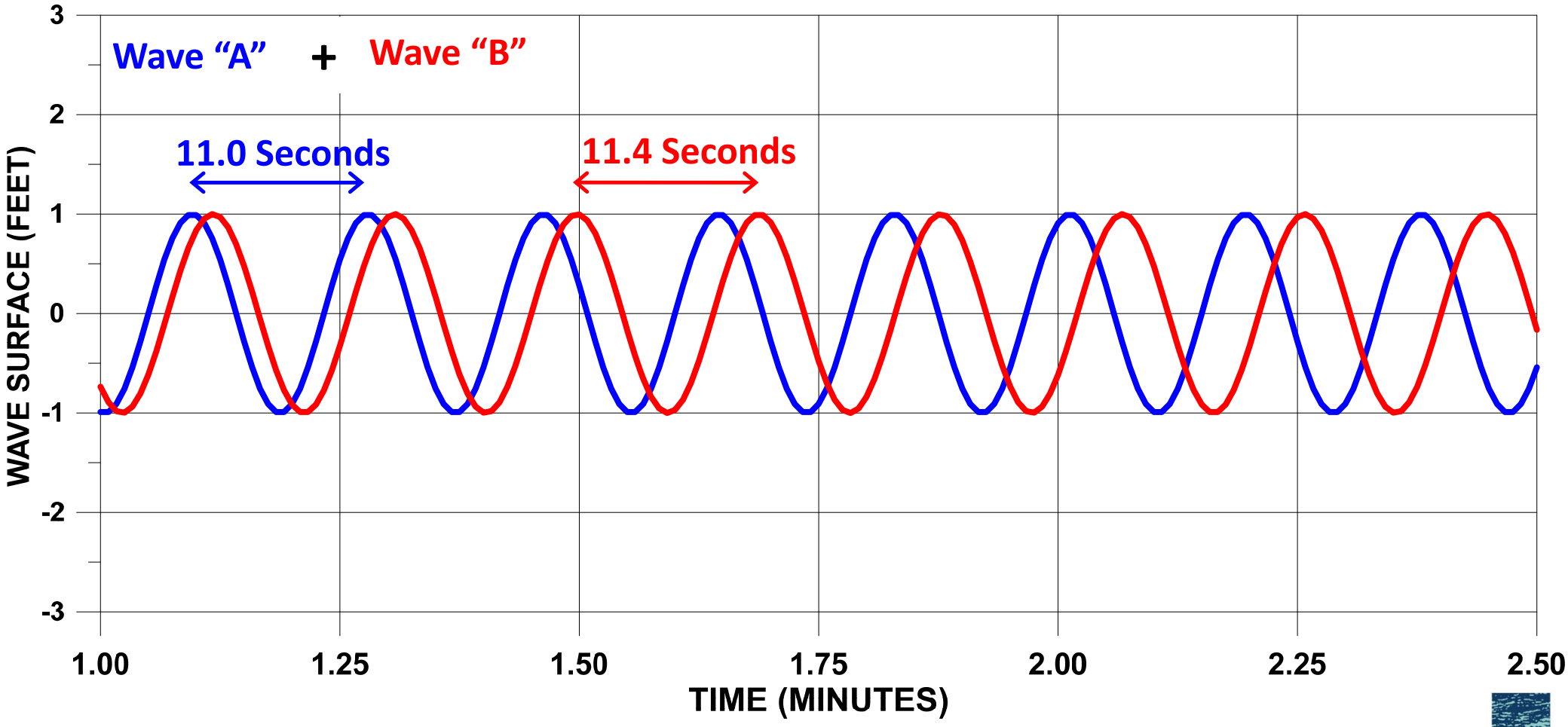

Wave "Sets"
Wave "A"
Wave "B"
11.0 Seconds
11.4 Seconds
WAVE SURFACE (FEET)
3
2
1
0
-1
-2
-3
1.00
1.25
1.50
1.75
2.00
2.25
2.50
TIME (MINUTES)

Wave "Sets"



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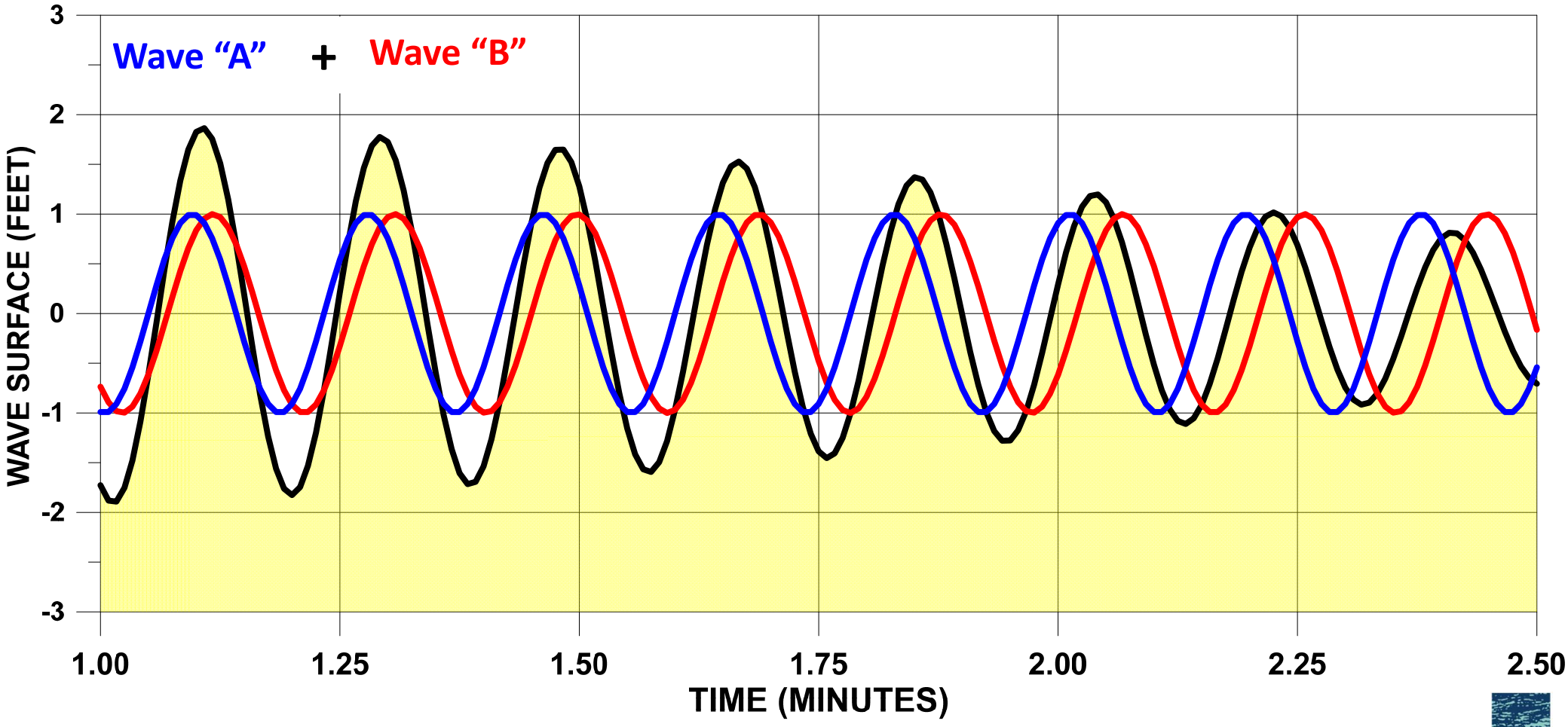
Wave “Sets”



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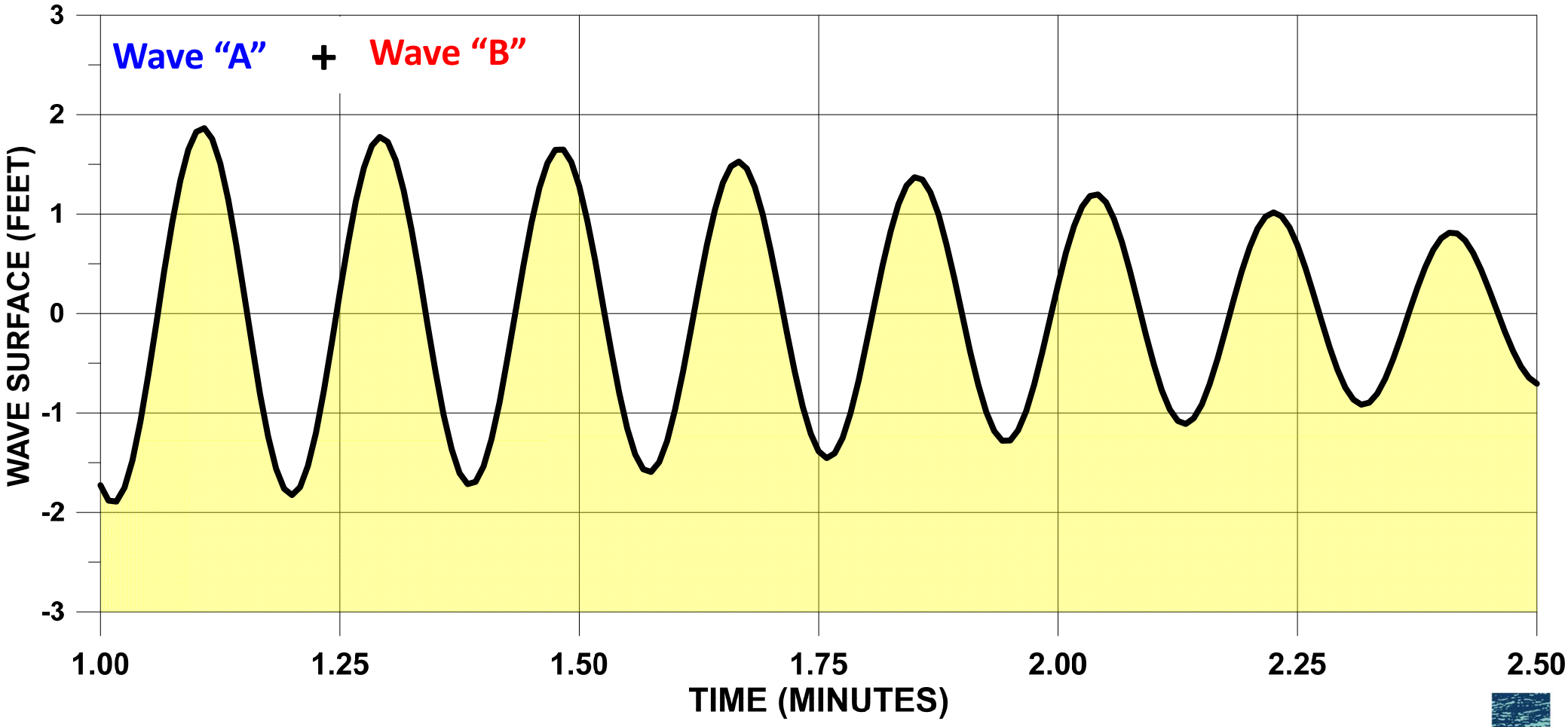
Wave “Sets”



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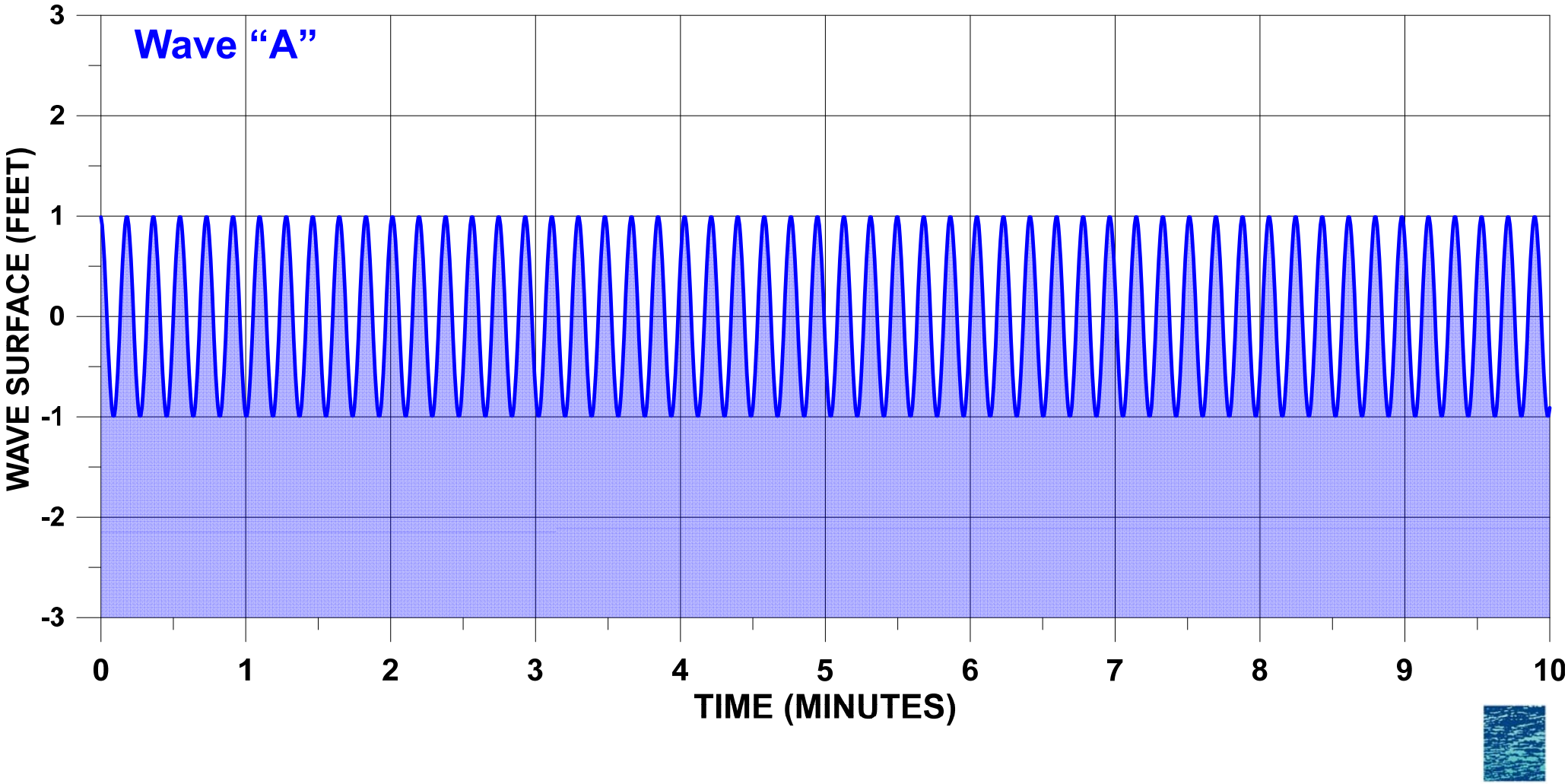
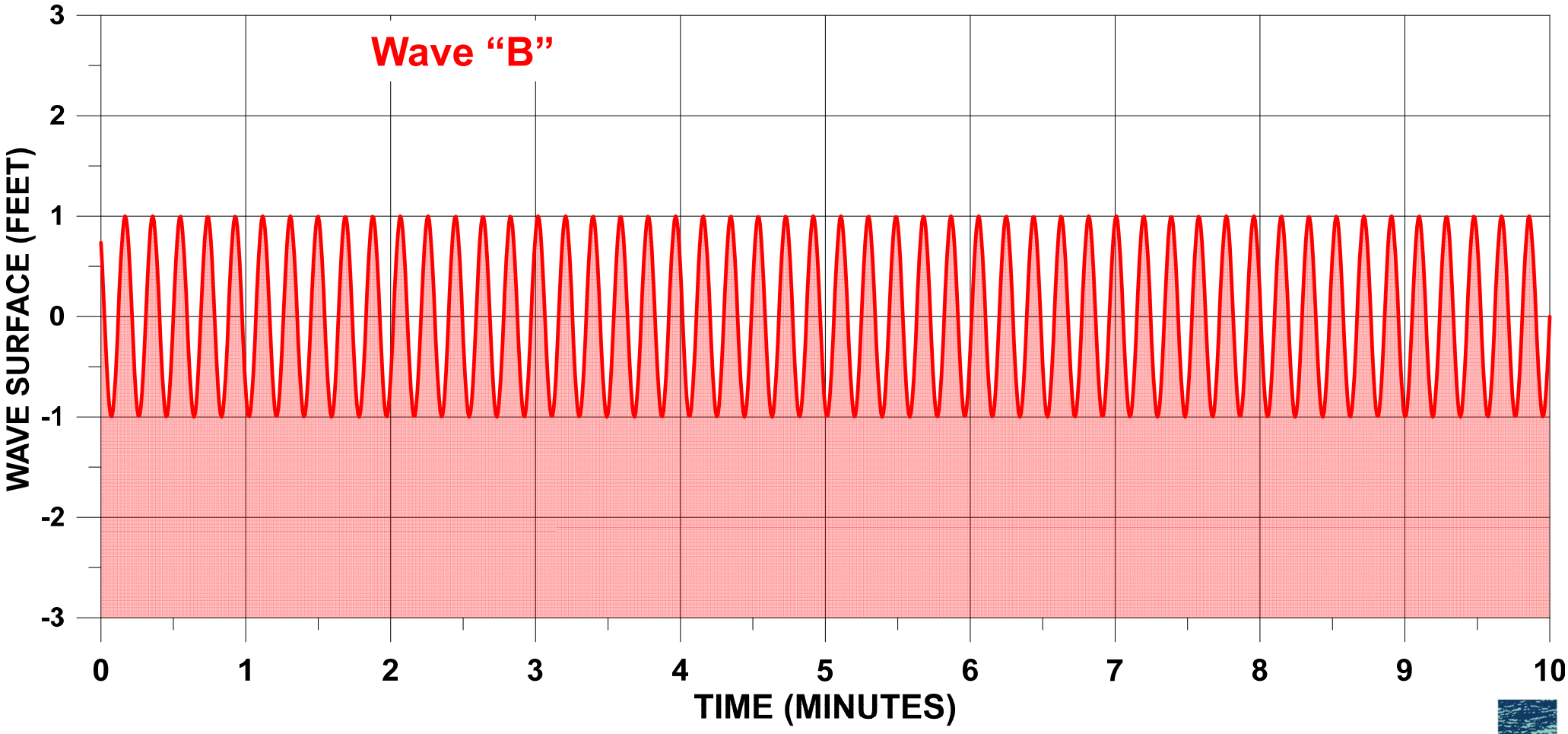

Wave "A"
WAVE SURFACE (FEET)
3
2
1
0
-1
-2
-3
0
1
2
3
4
5
6
7
8
9
10
TIME (MINUTES)

Wave “Sets”



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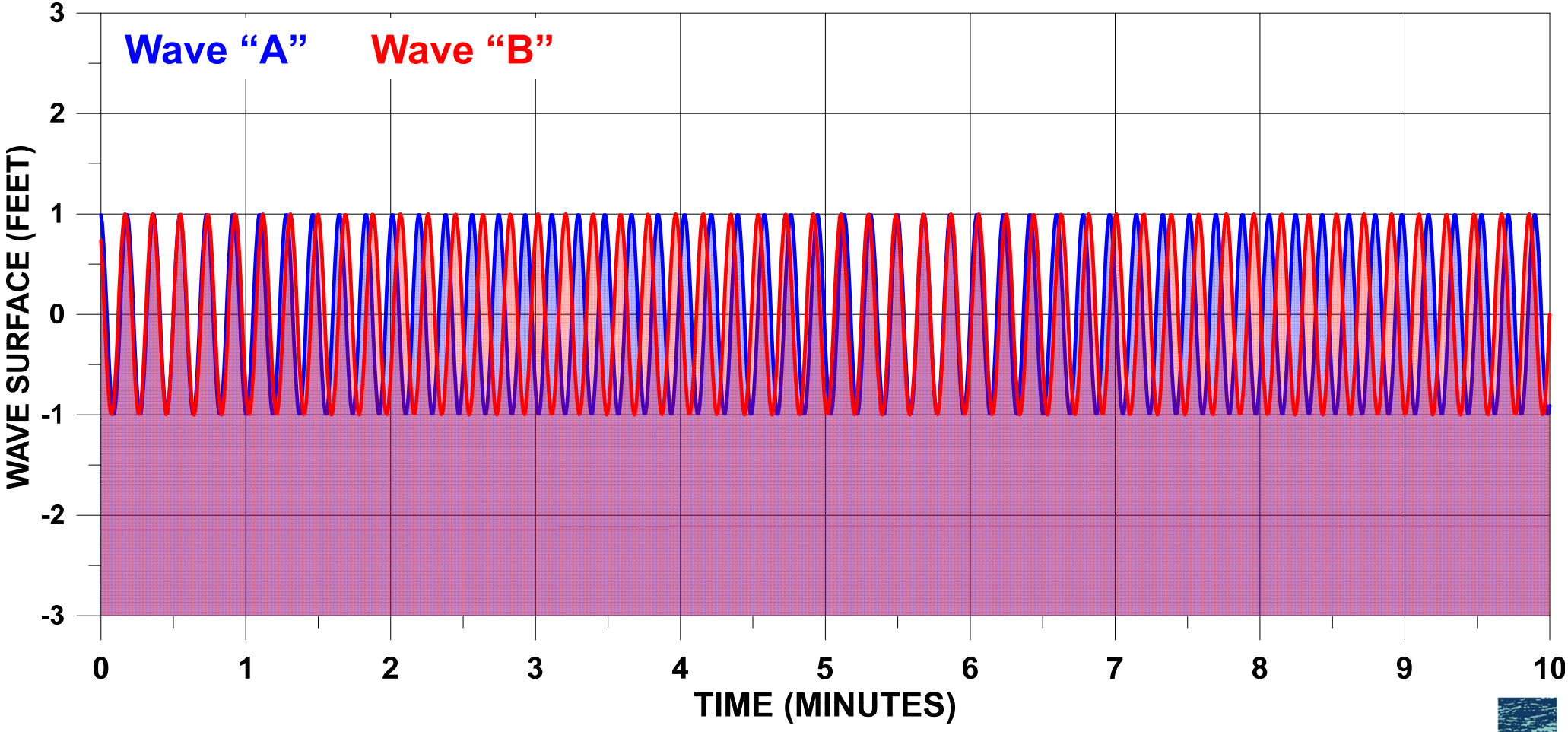
Wave “Sets”



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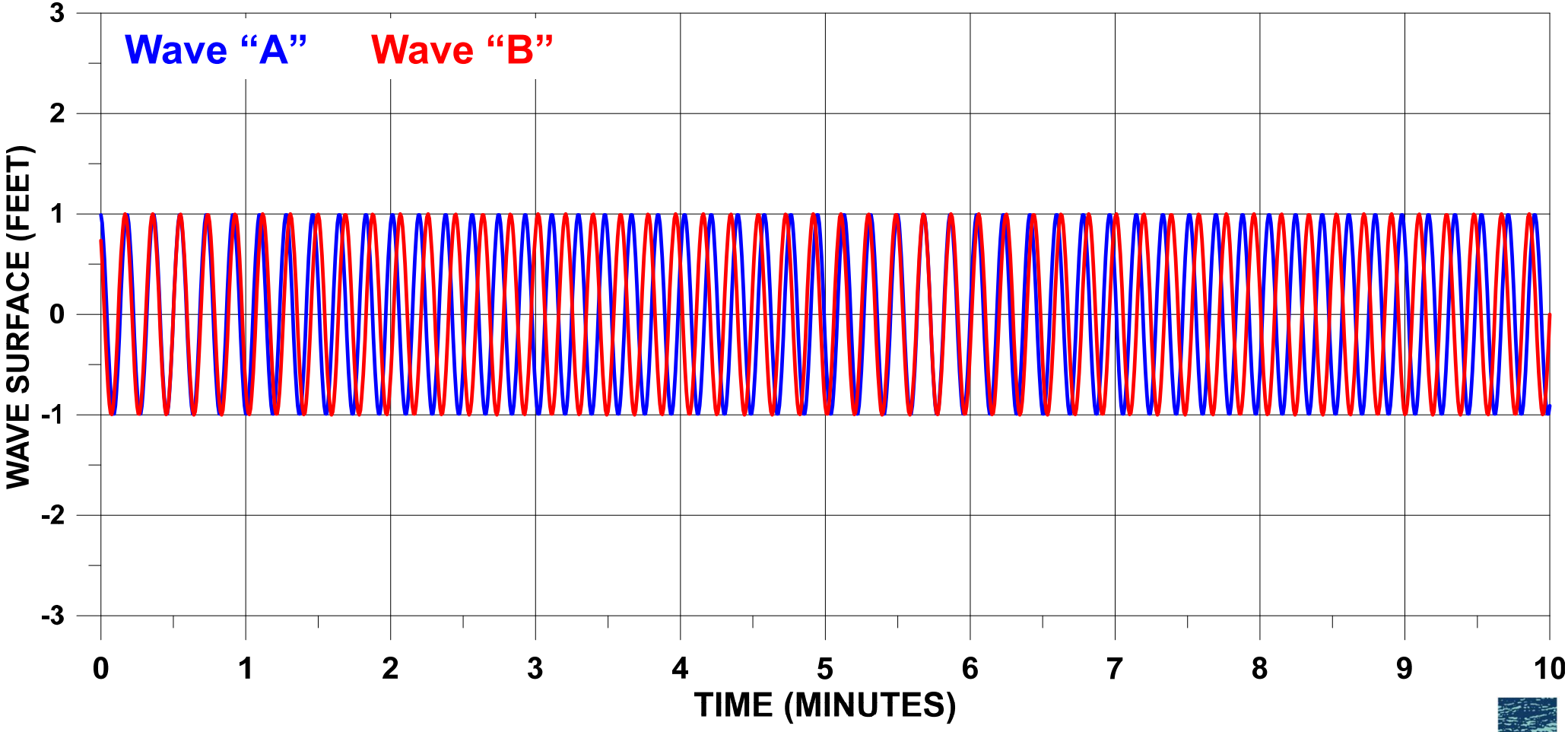
Wave “Sets”



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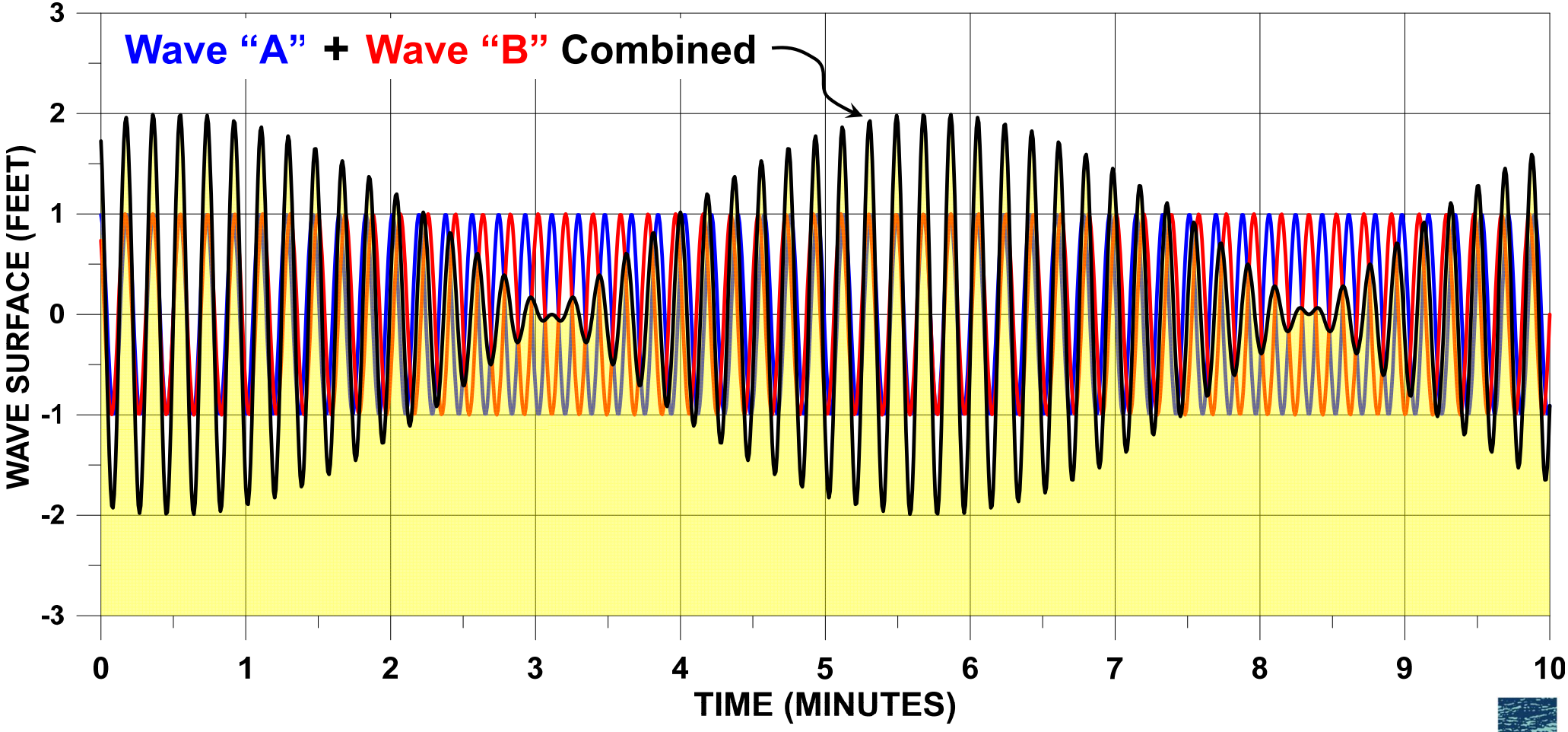
Wave “Sets”



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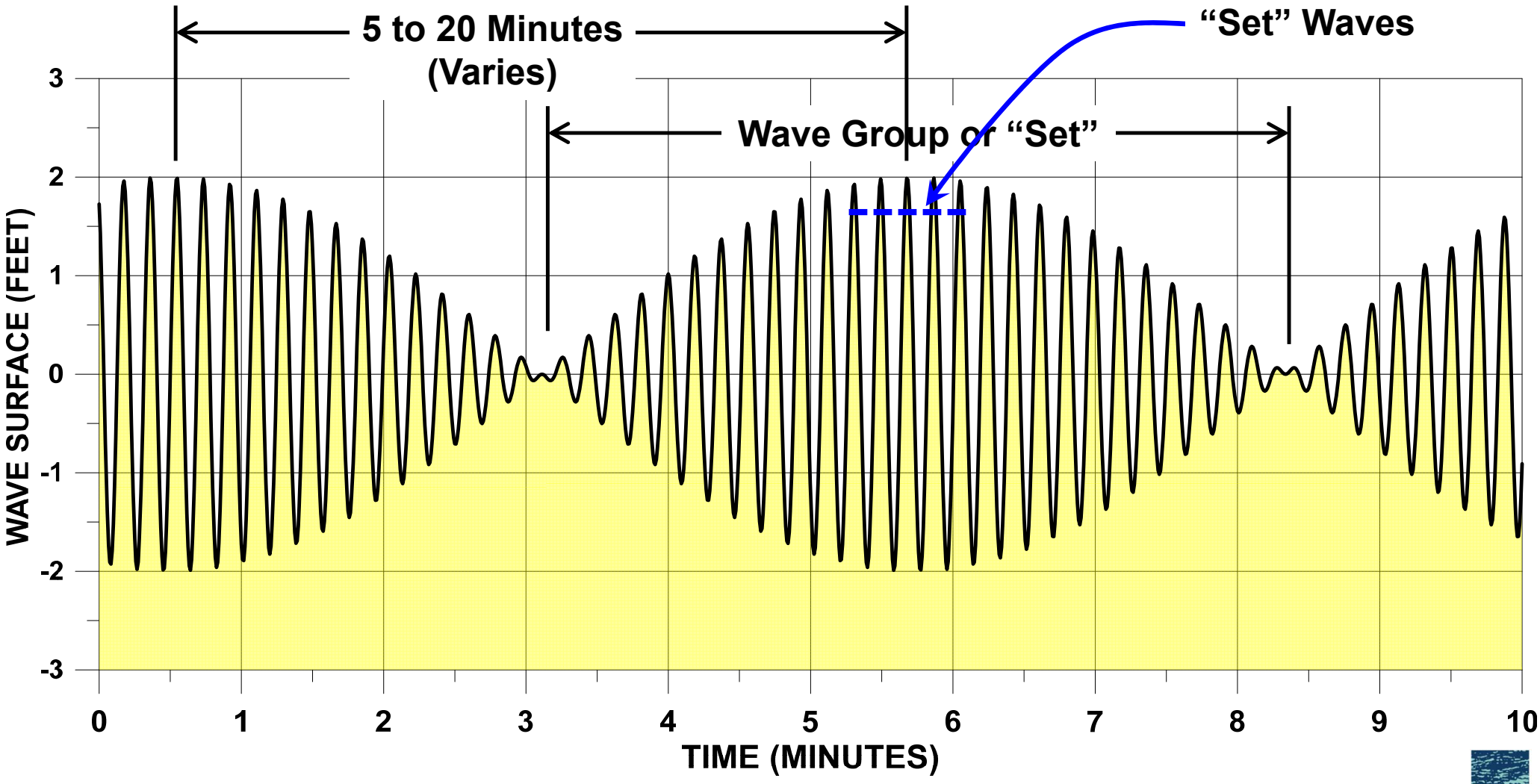
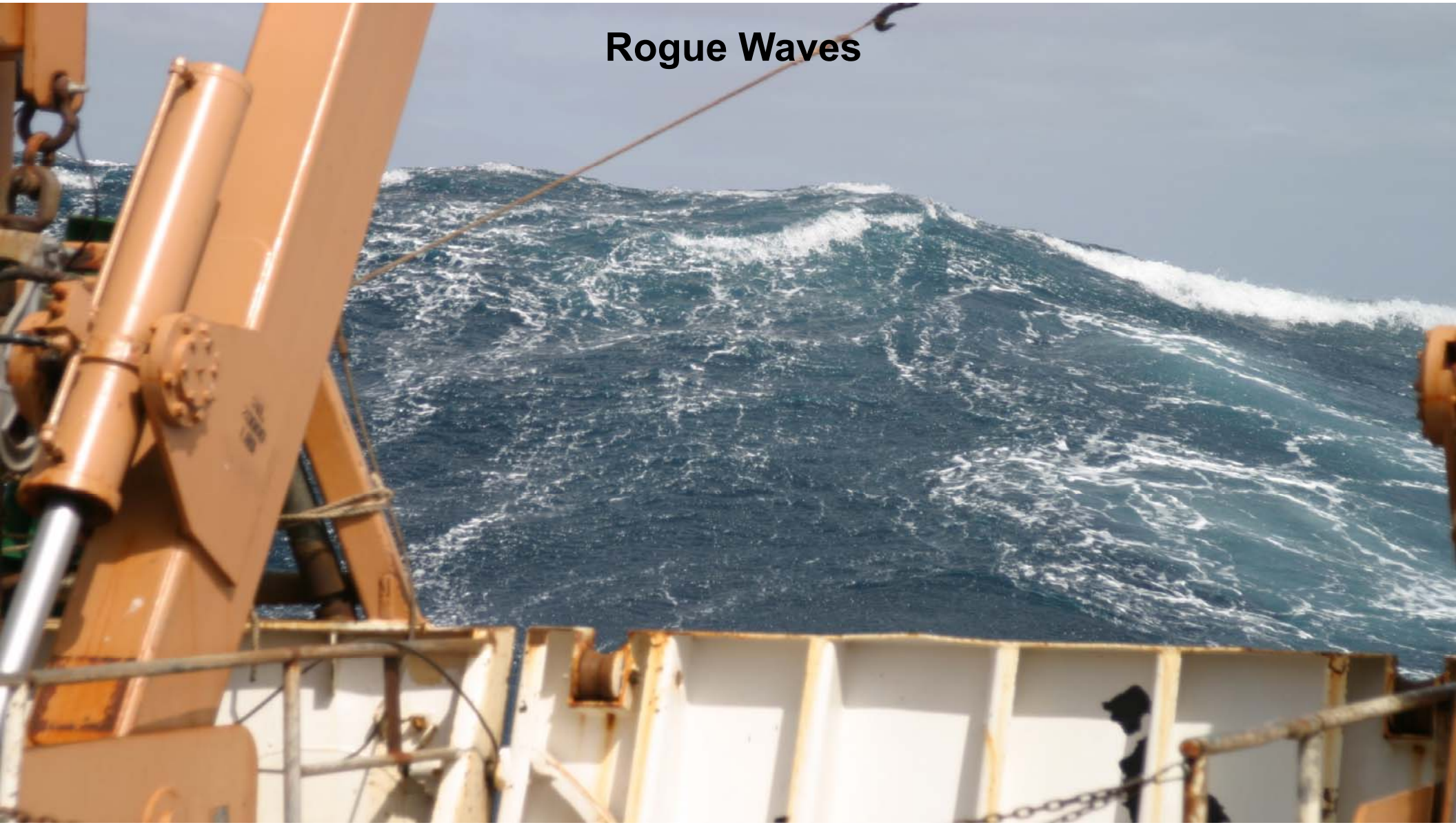
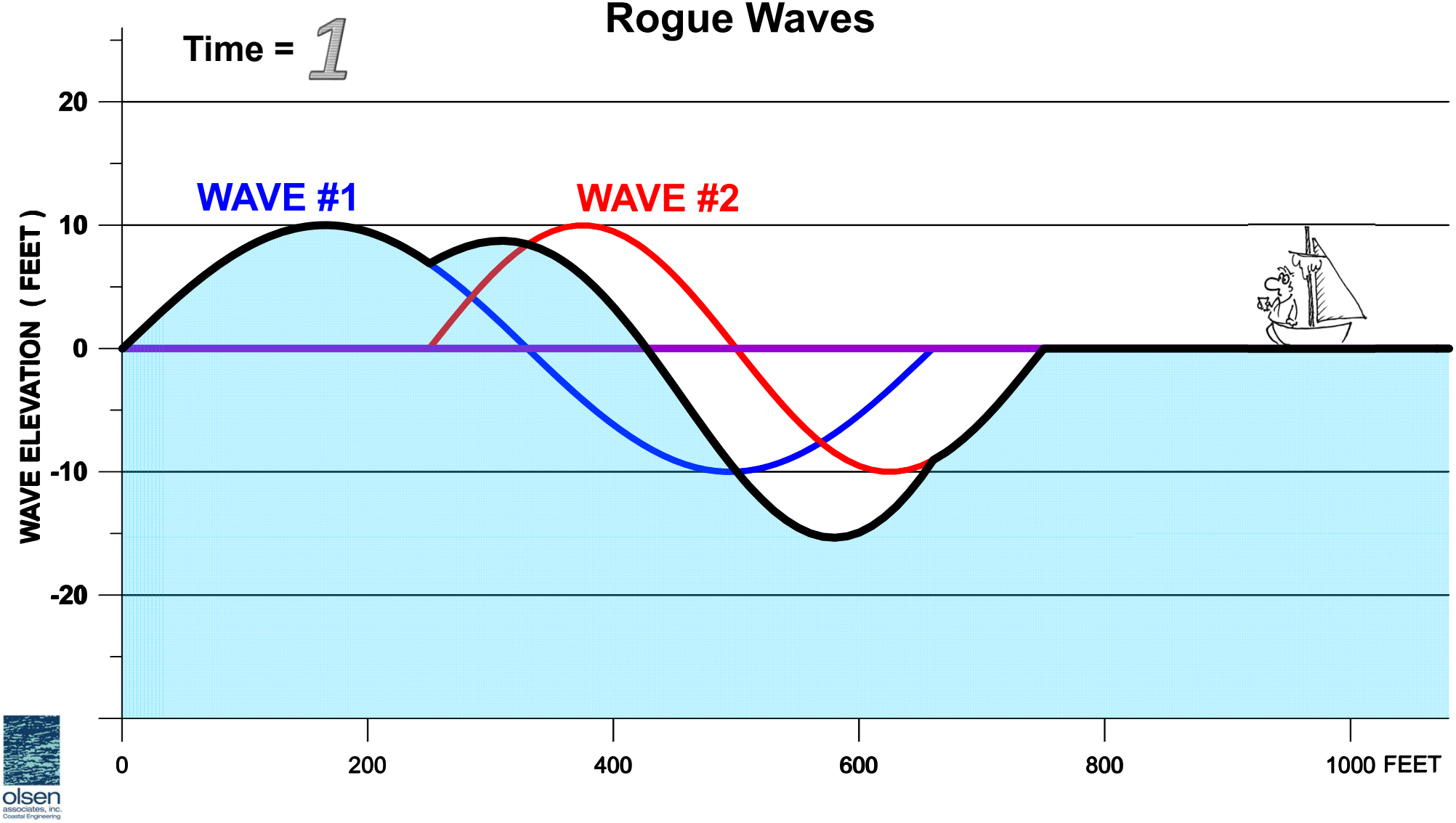

5 to 20 Minutes
(Varies)
"Set" Waves
Wave Group or "Set"
WAVE SURFACE (FEET)
3
2
1
0
-1
-2
-3
0
1
2
3
4
5
6
7
8
9
10
TIME (MINUTES)

Rogue Waves



Rogue Waves



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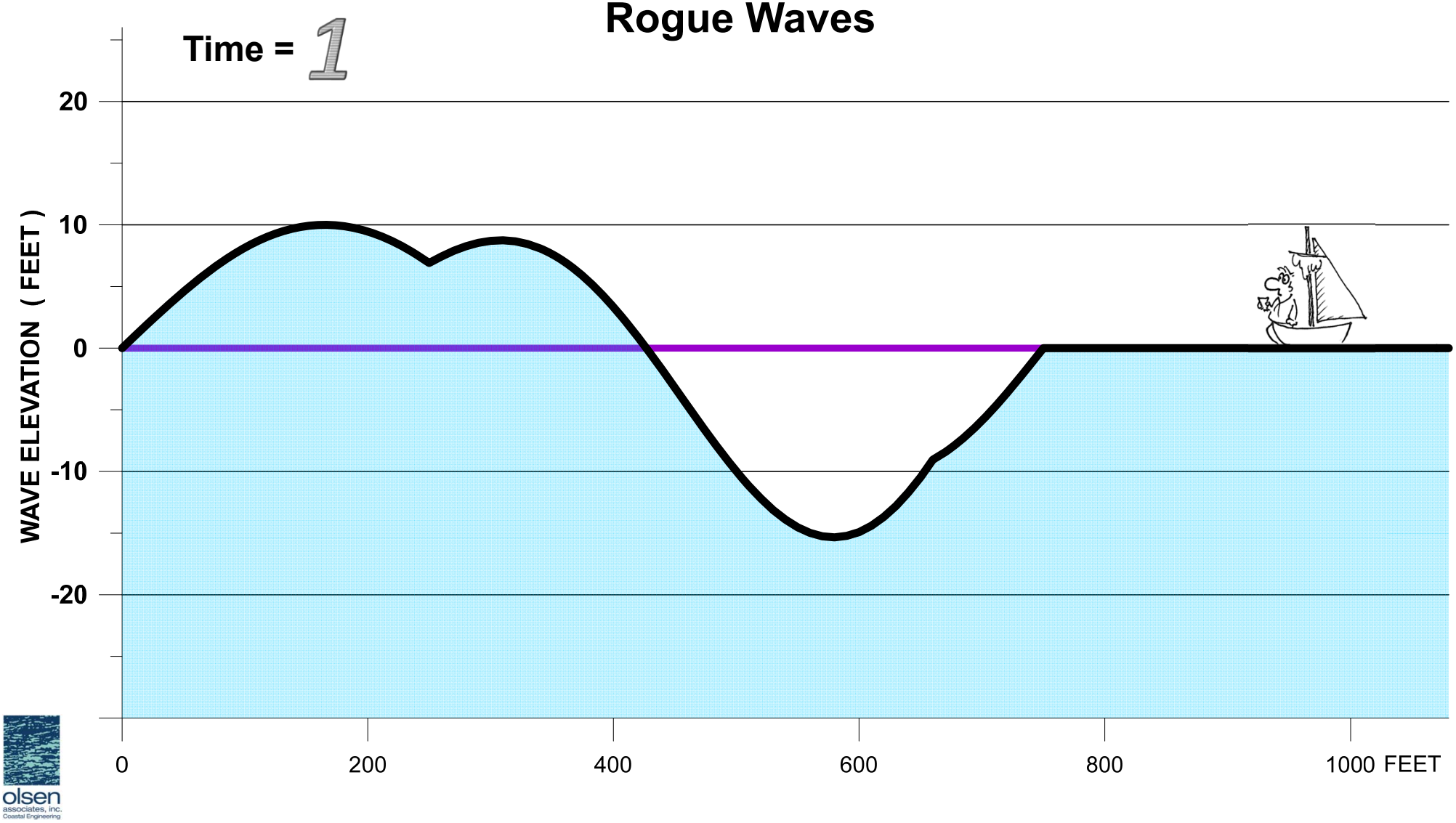
Rogue Waves



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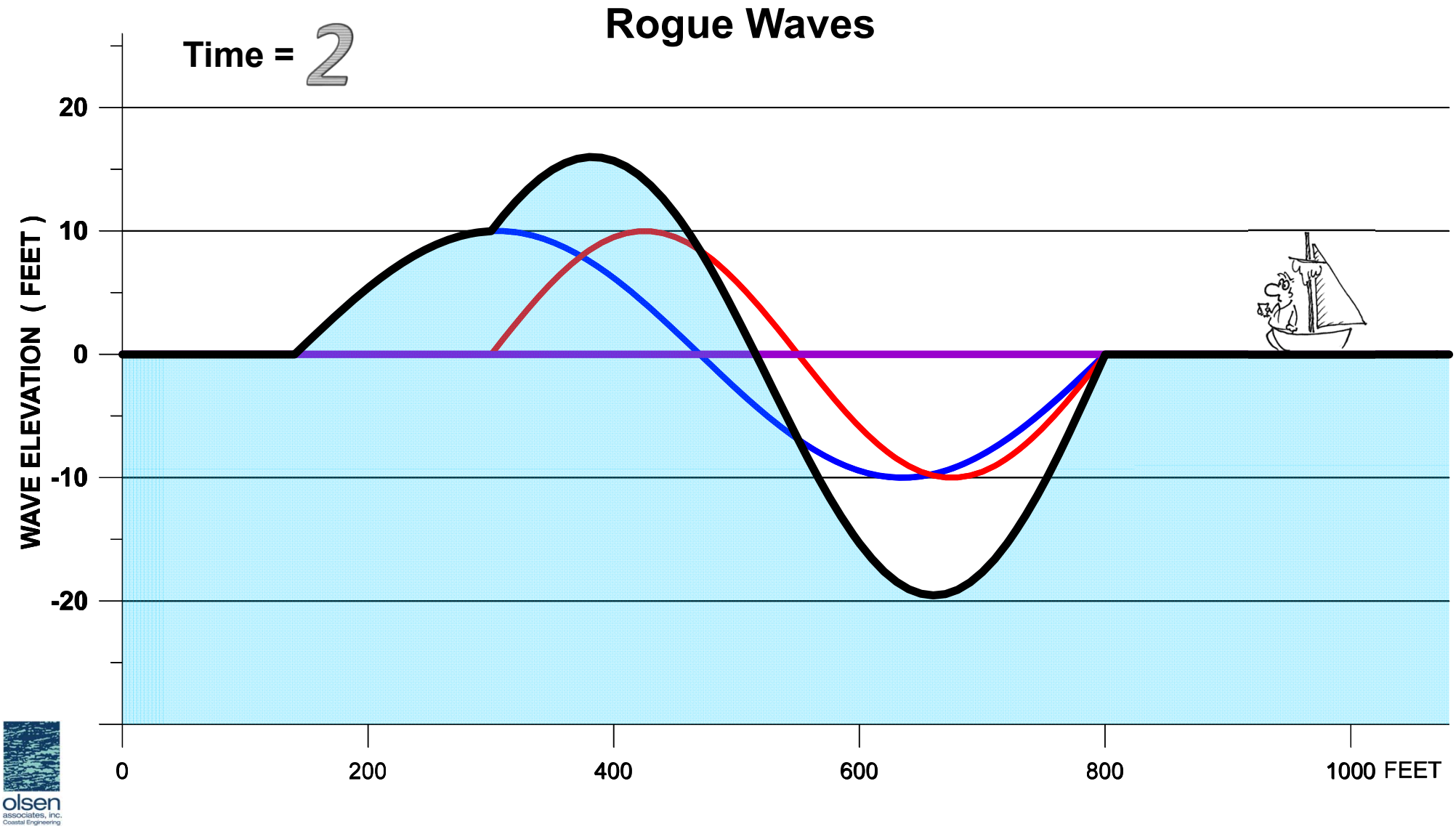
Rogue Waves



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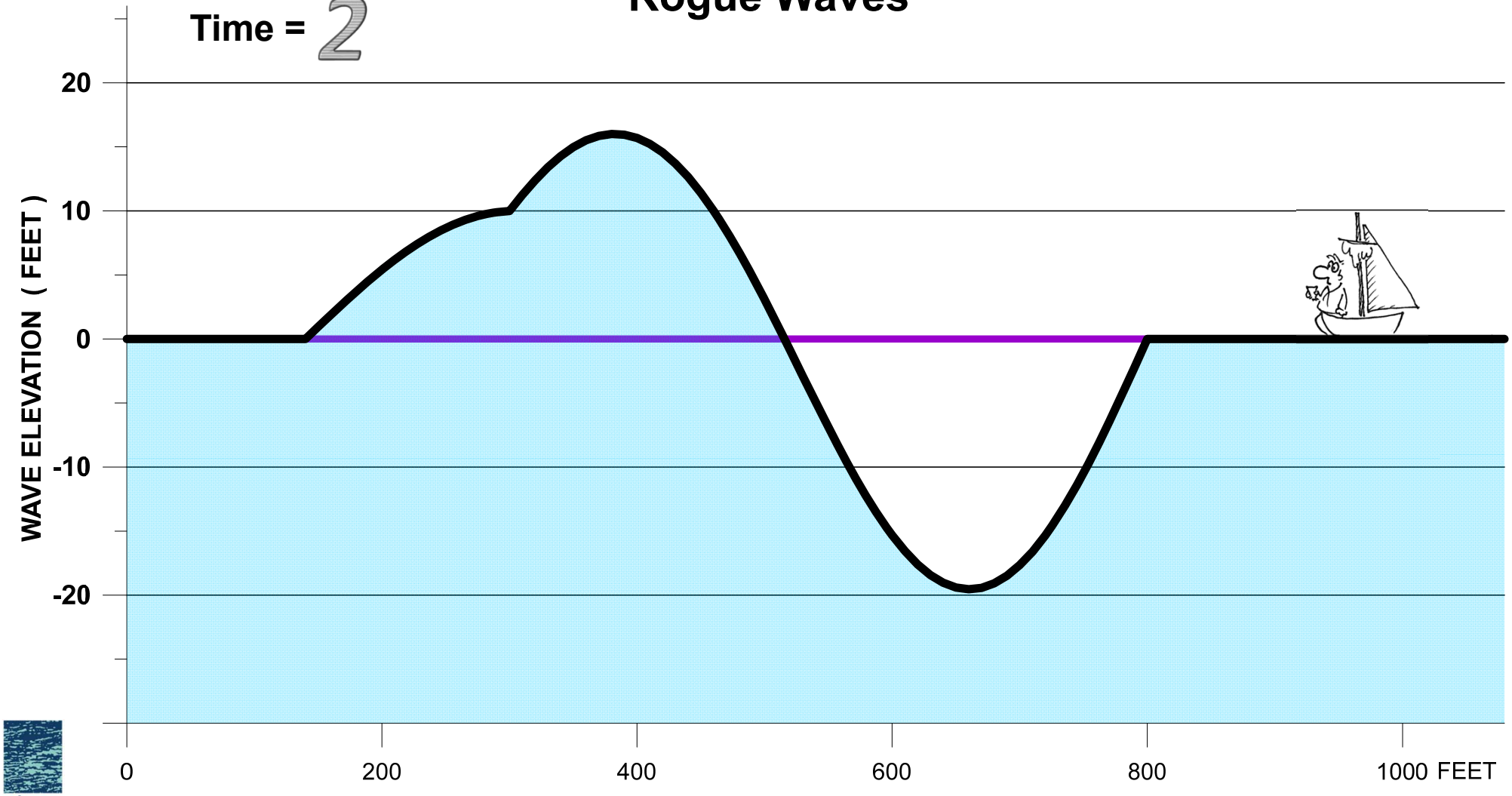
Rogue Waves

Time = 2



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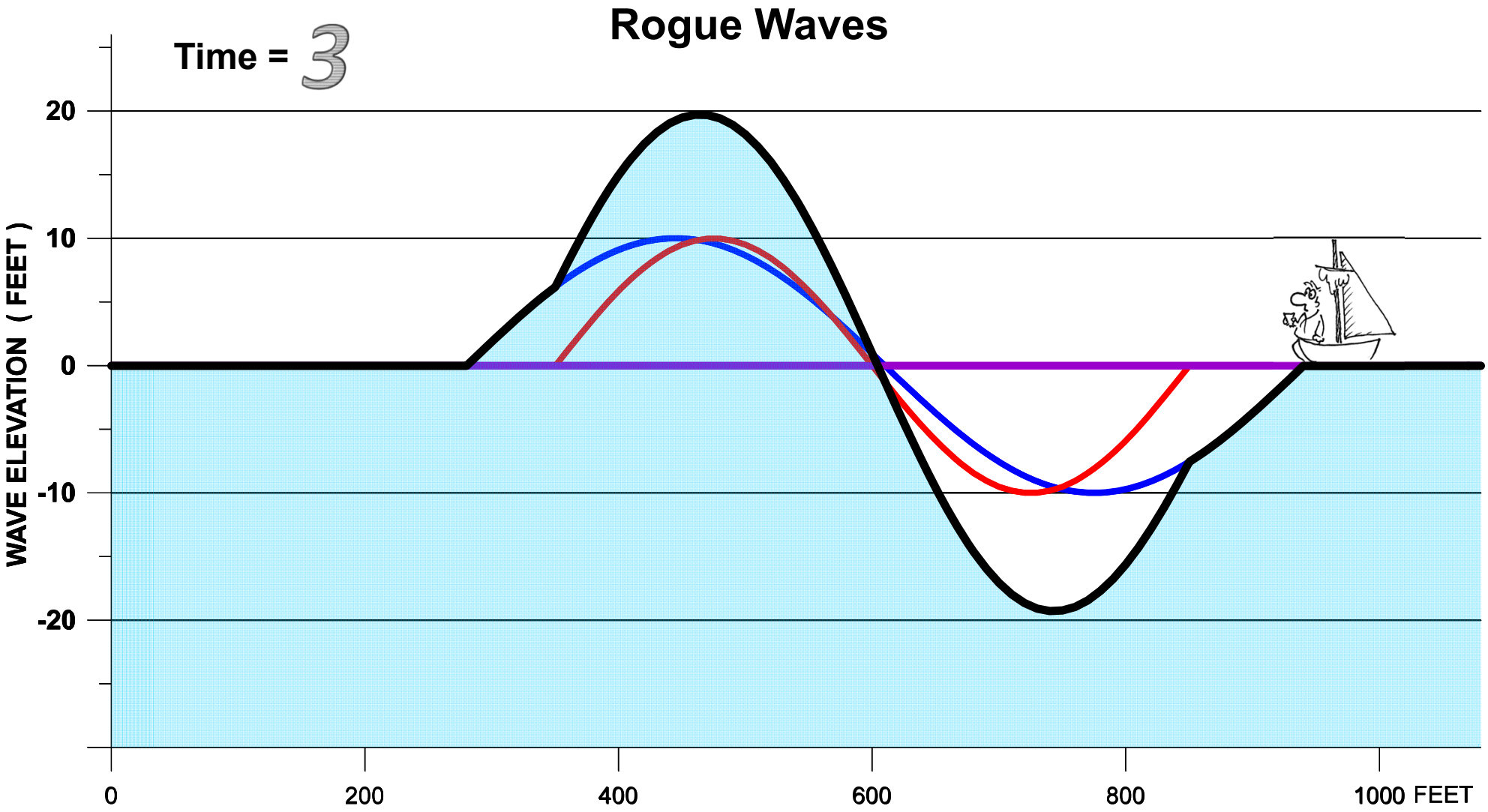
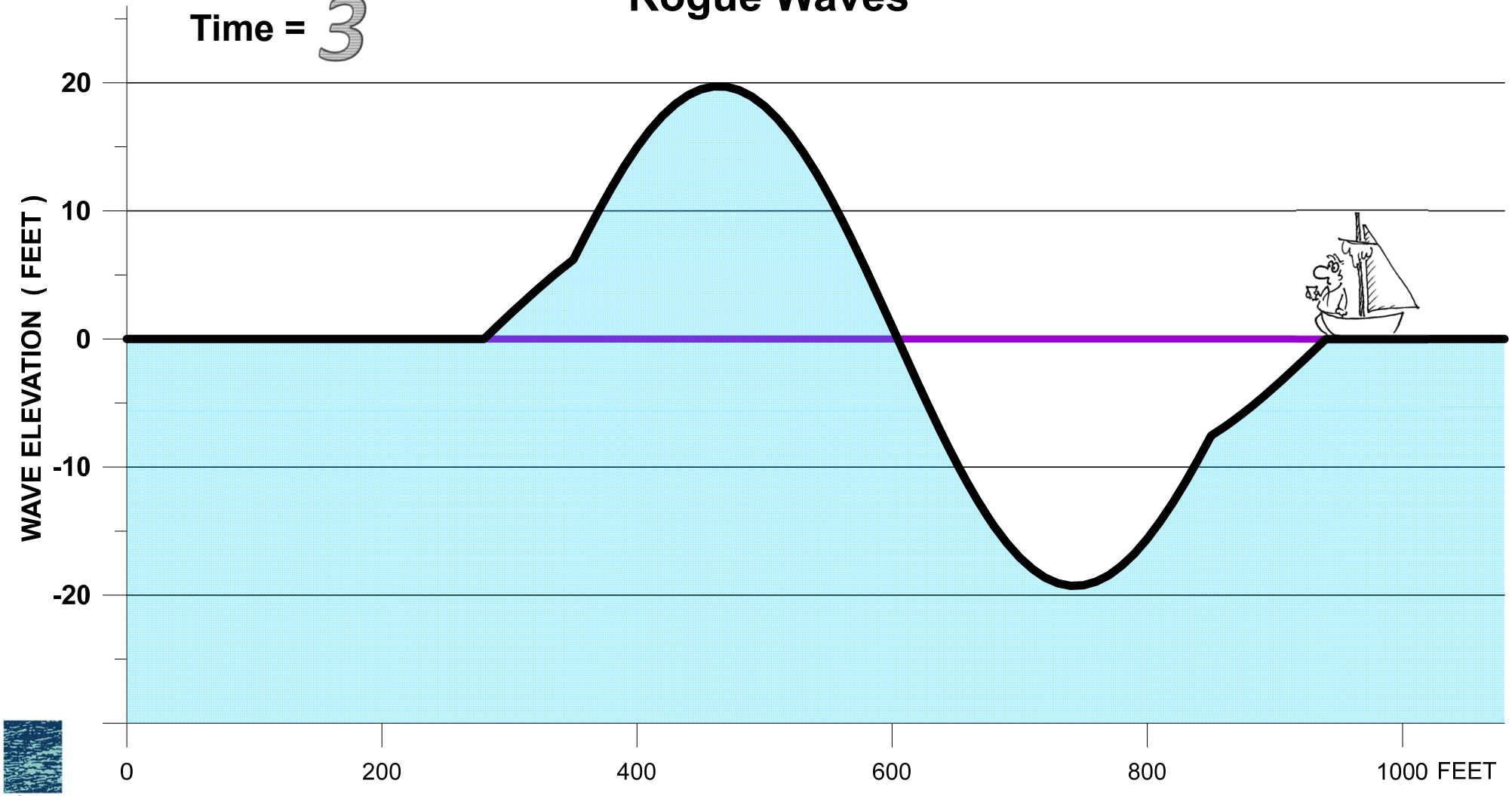

Rogue Waves
Time = 3
20
10
0
-10
-20
WAVE ELEVATION (FEET)
0
200
400
600
800
1000 FEET

Rogue Waves

Time = 3



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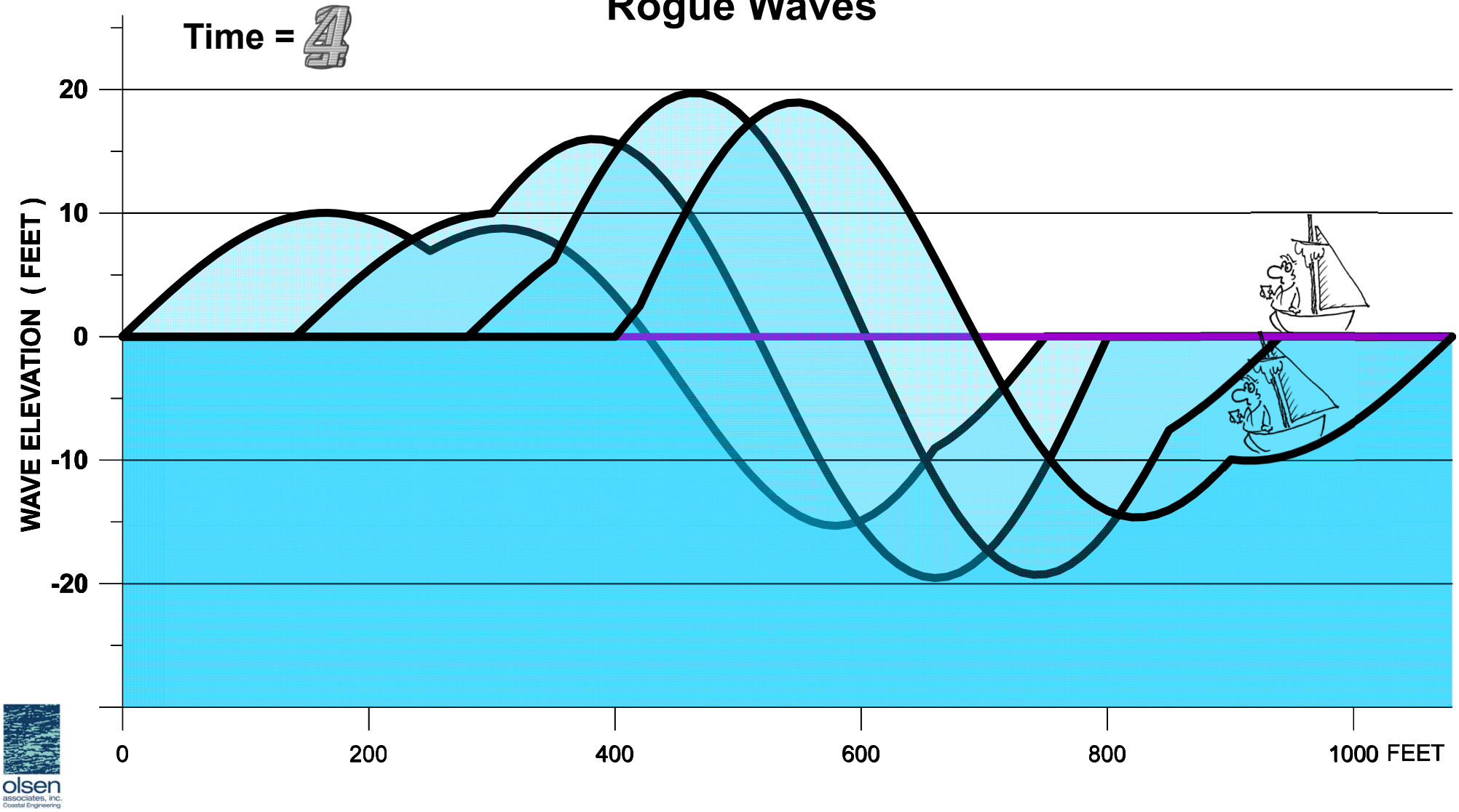
Rogue Waves



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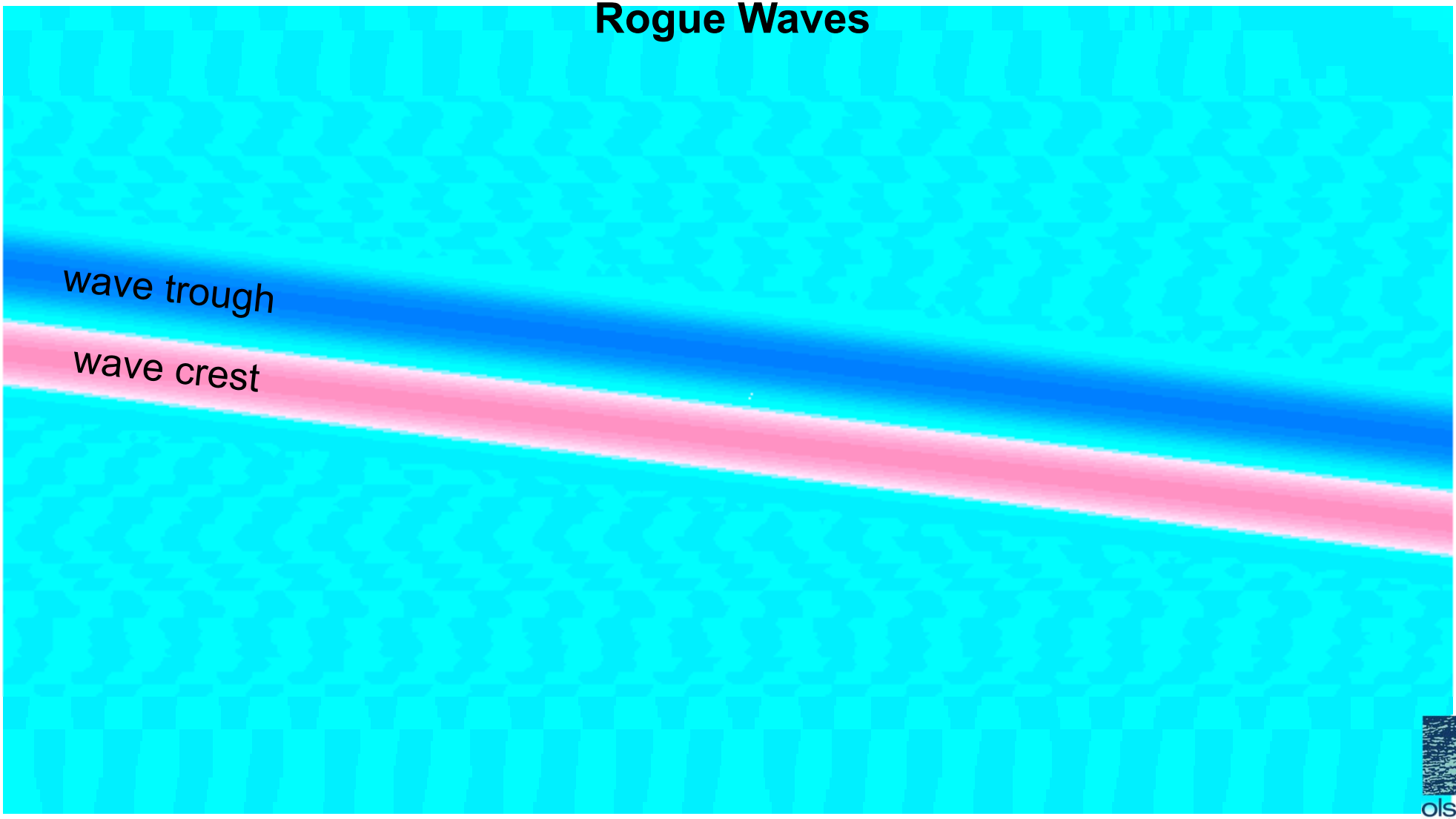
Rogue Waves



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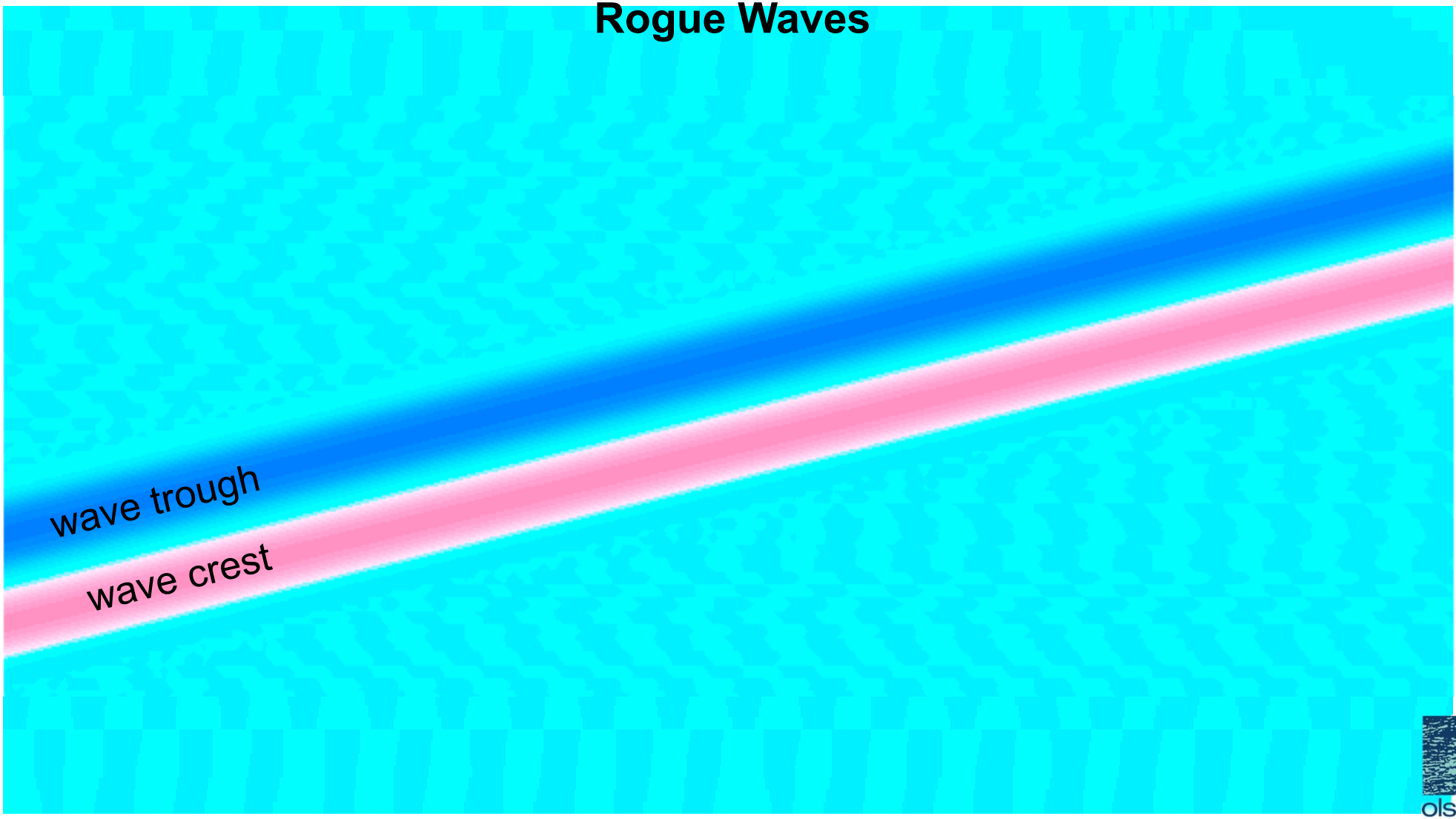
Rogue Waves



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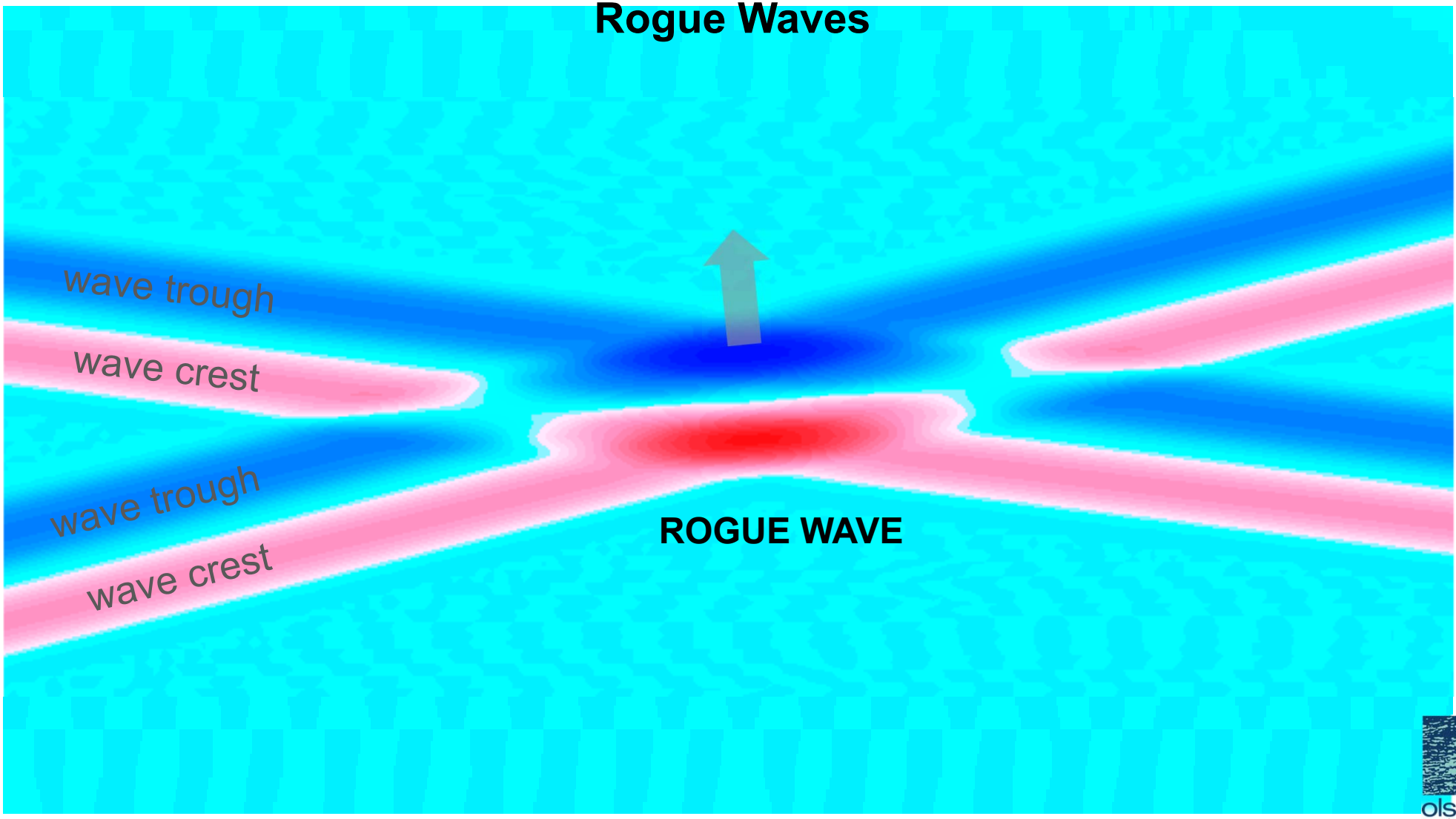
Rogue Waves



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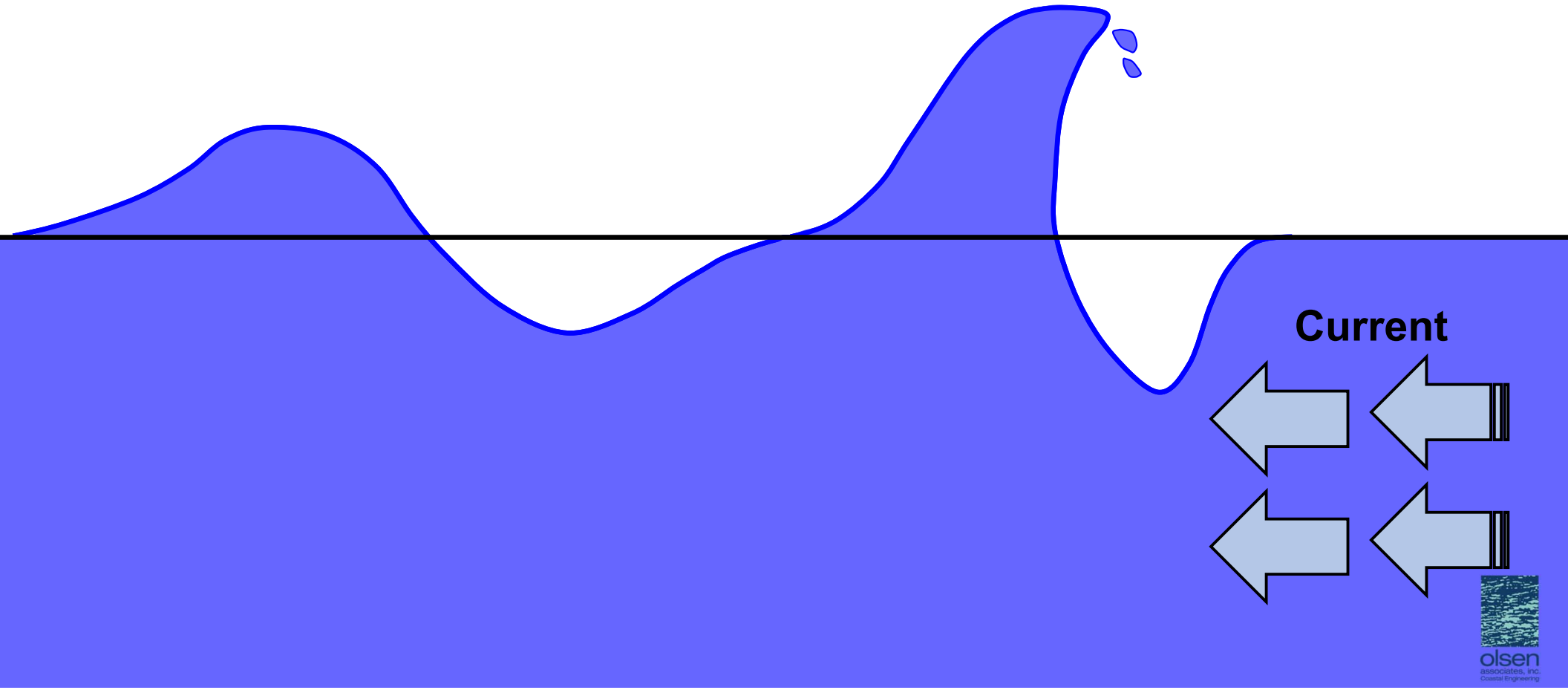
Rogue Waves



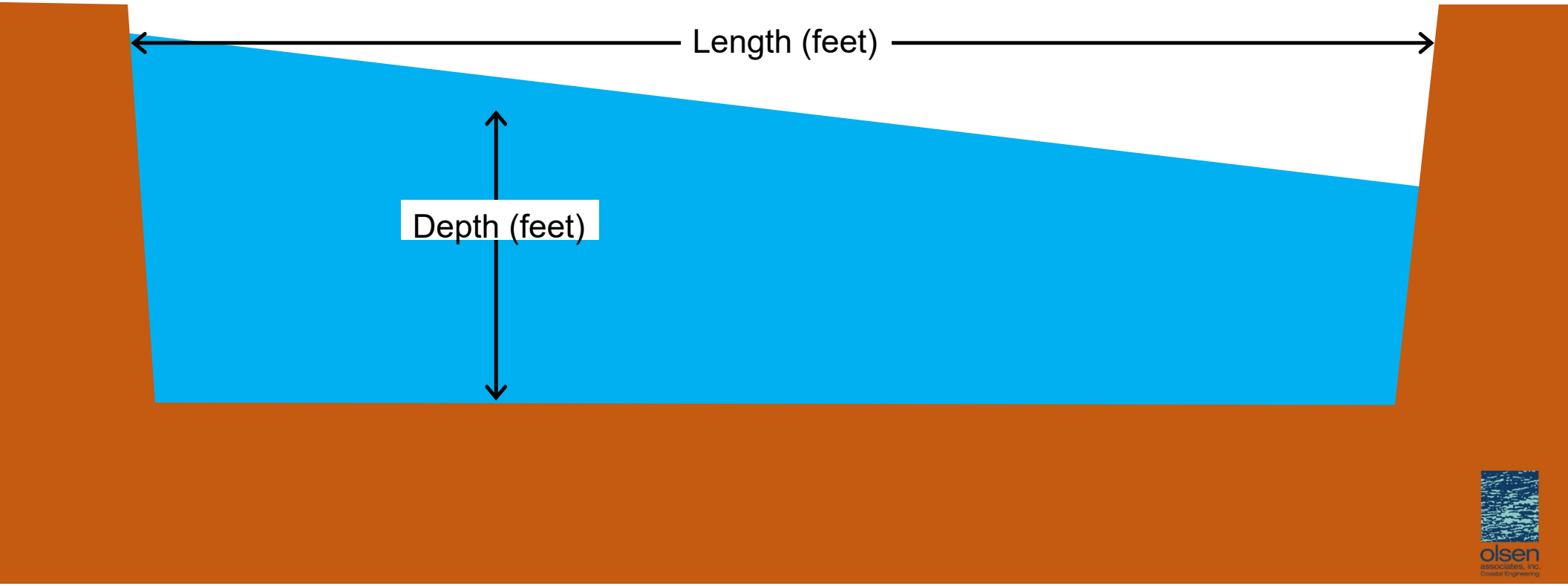
Seiche

$$\text{Period (secs)} = 0.35 \times \frac{\text{Length}}{\sqrt{\text{Depth}}}$$

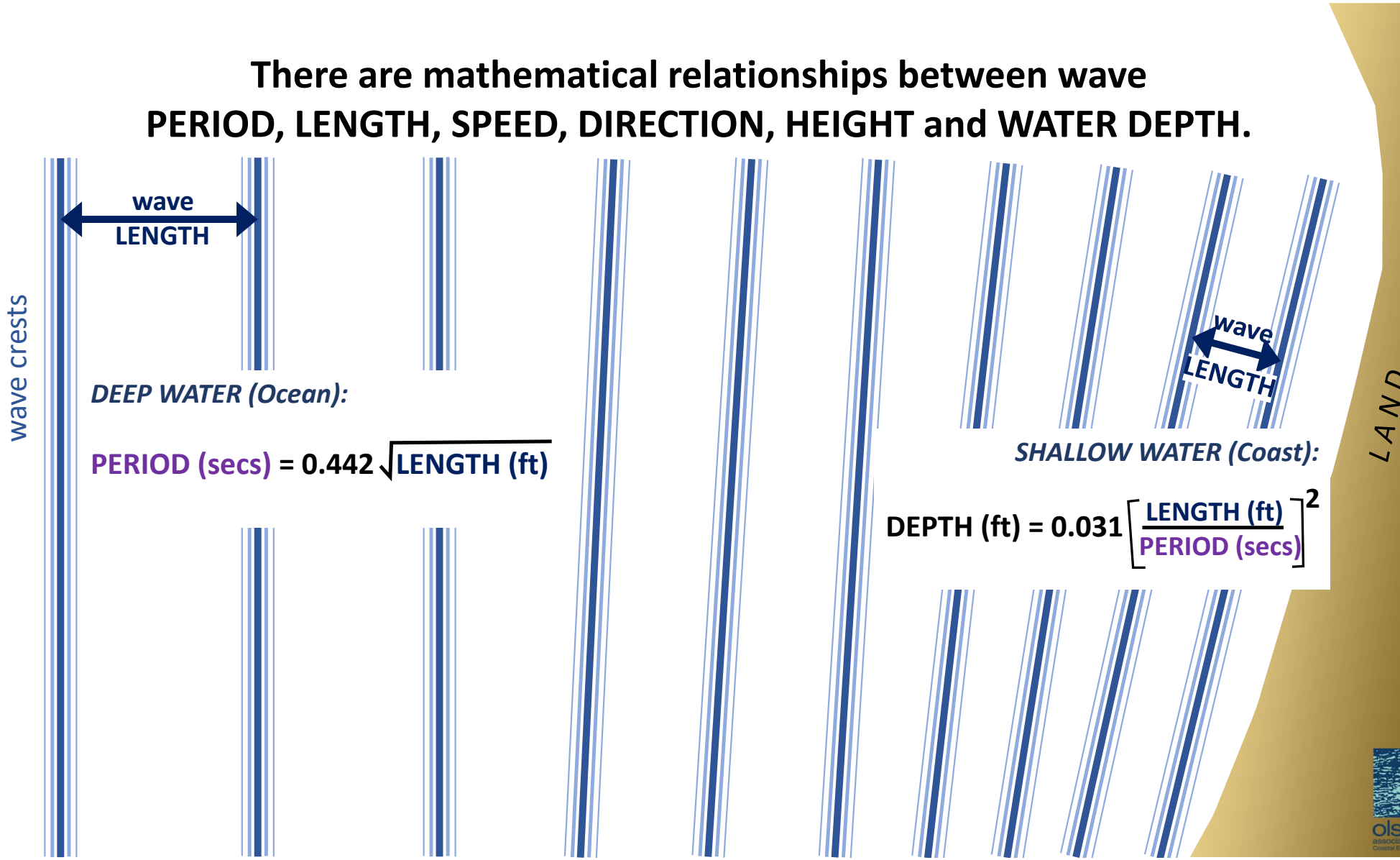
Example 1: Typical Marina.
Length = 1600 feet, Depth = 10 ft
Period = **3 minutes**

Example 2: Lake Okeechobee.
Length = 22.5 miles, Depth = 10 ft
Period = **3.7 hours**

Example 3: Gulf of Mexico.
Length = 865 miles, Depth = 5200 ft
Period = **6.2 hours**



There are mathematical relationships between wave PERIOD, LENGTH, SPEED, DIRECTION, HEIGHT and WATER DEPTH.



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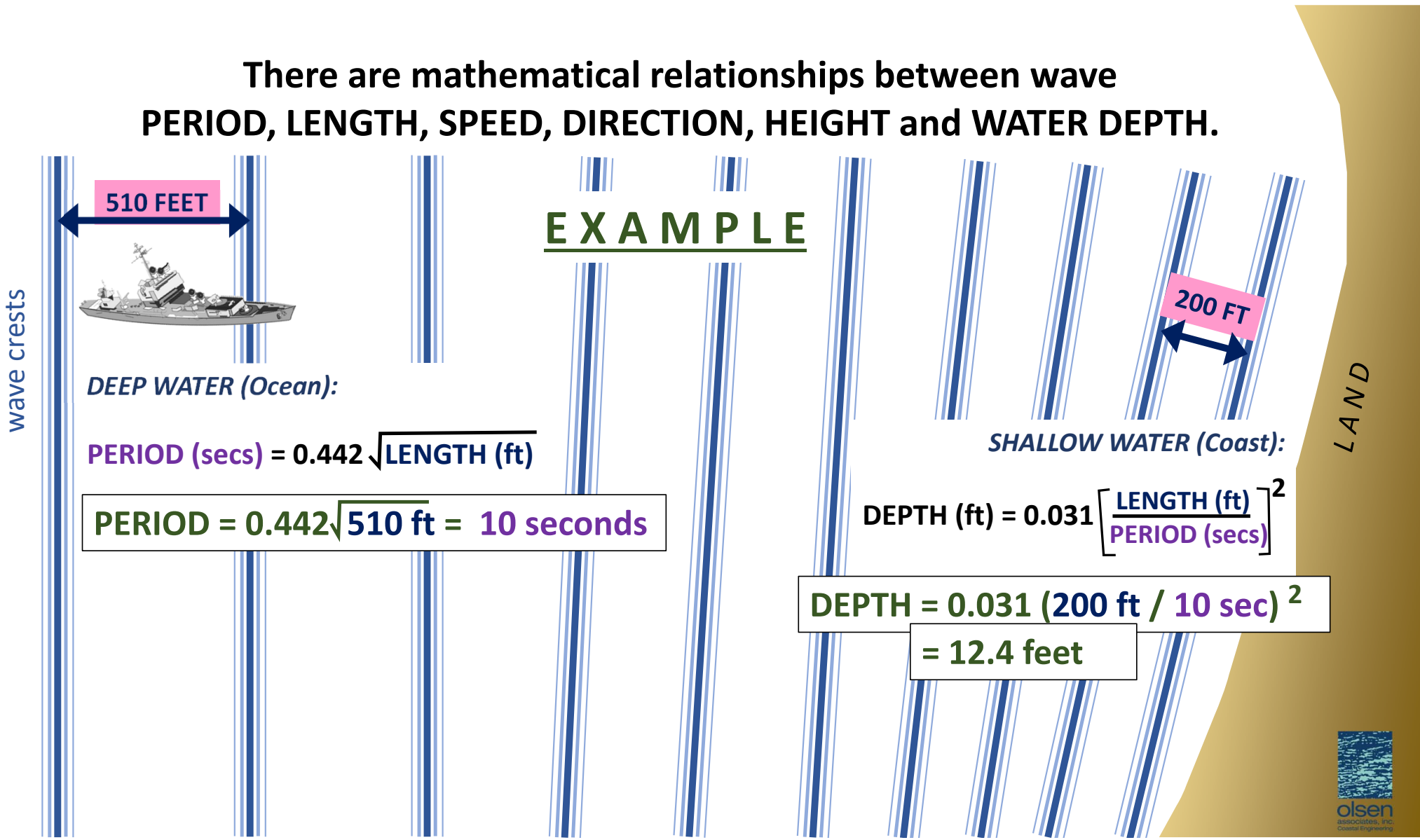
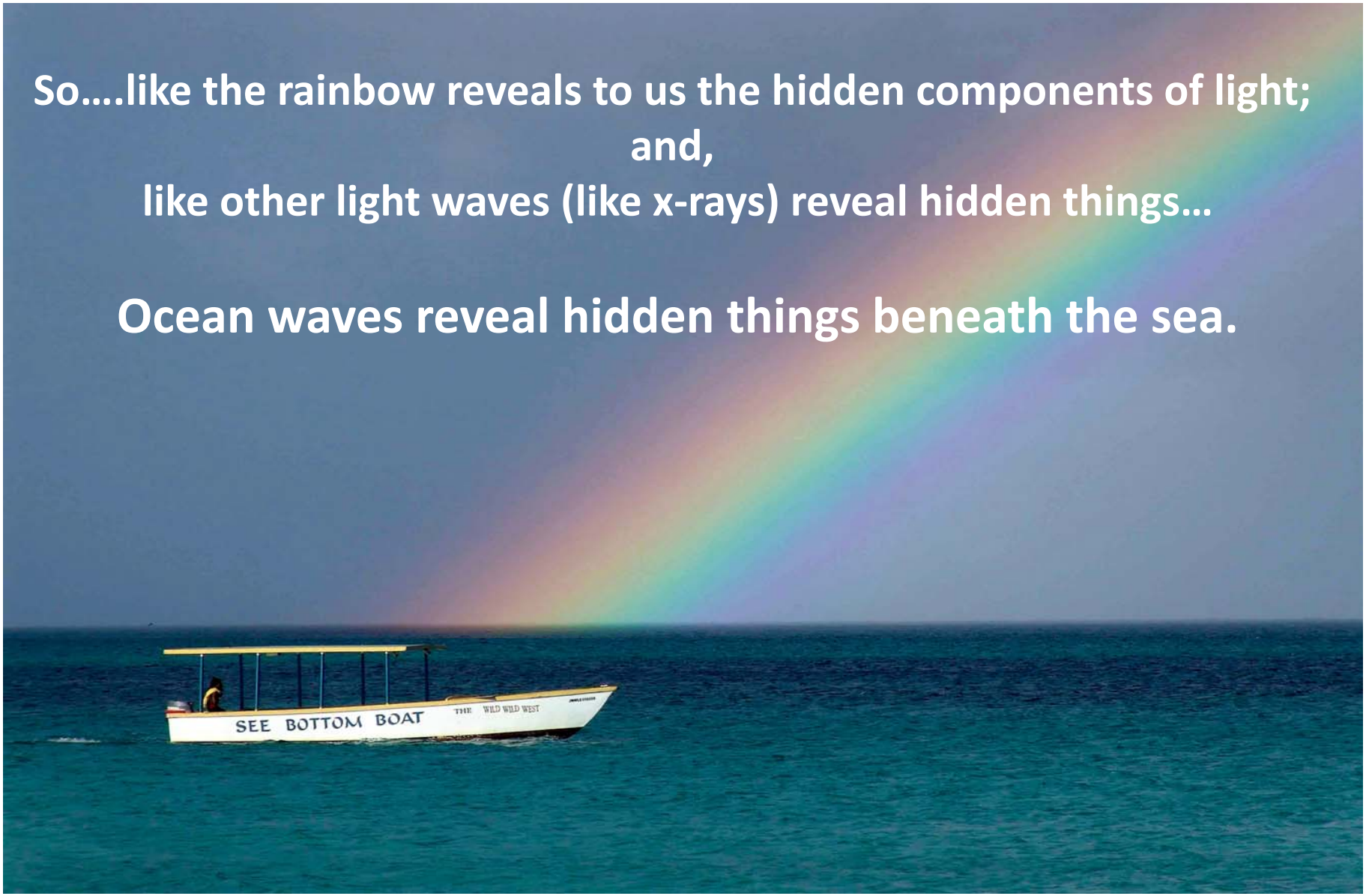


So….like the rainbow reveals to us the hidden components of light;
and,
like other light waves (like x-rays) reveal hidden things…

Ocean waves reveal hidden things beneath the sea.



Waves: The Rainbow in the Ocean.

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