

Waves forecasts for Paddlers

Understanding Lake and Ocean Waves with
Pictures

Greg Anderson

Northeastern Illinois University

2017

NOAA Forecasts and Hindcasts

3-meter foam
Buoy

Lake Superior
Buoy 45004
(2016)

Significant Wave
Height (H_s)

Statistical
Distribution of
Wave Heights

Lake Michigan
Buoy 45007
(2016)

Lake Superior
Buoy 45004
(2016)

Neah Bay Buoy
46087 (2016)

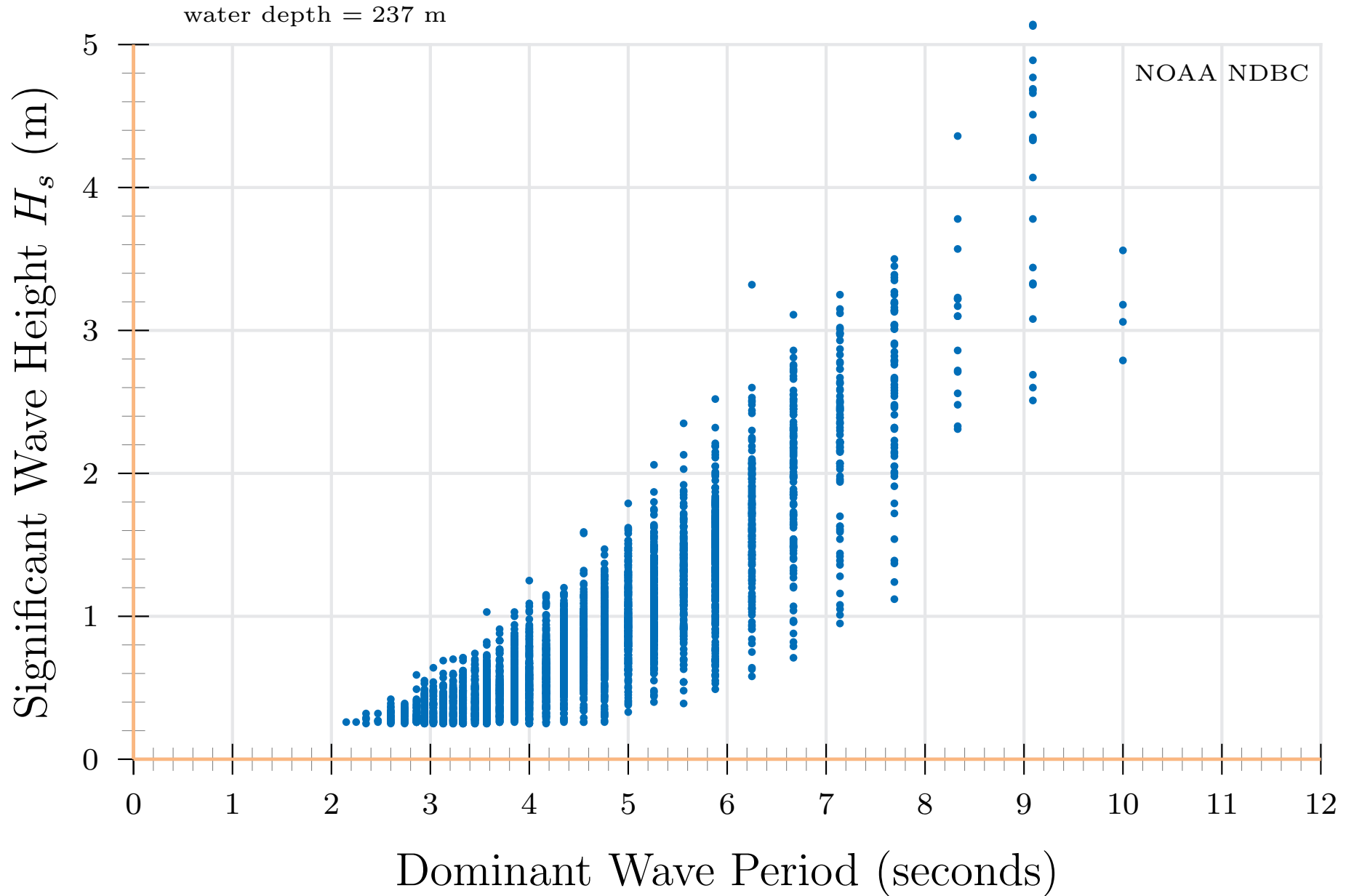
Shoaling and
Breaking

NOAA Forecasts and Hindcasts



3m foam buoy

Lake Superior Buoy 45004 (2016)



Significant Wave Height (H_s)

- What a “trained observer” would estimate.

Significant Wave Height (H_s)

- ~~What a “trained observer” would estimate.~~
- The average of the highest one-third of the waves, as measured from the trough to the crest of the waves.

Significant Wave Height (H_s)

- ~~The average of the highest one-third of the waves, as measured from the trough to the crest of the waves.~~
- Proportional to the square root of the variance

$$H_s \approx 4\sigma$$

Significant Wave Height (H_s)

- ~~Proportional to the square root of the variance~~
- FFT applied by processor onboard the buoy to generate spectral density $S(f)$

$$H_s \approx 4 \sum_{f_l}^{f_u} S(f) (\text{band width}(f))$$

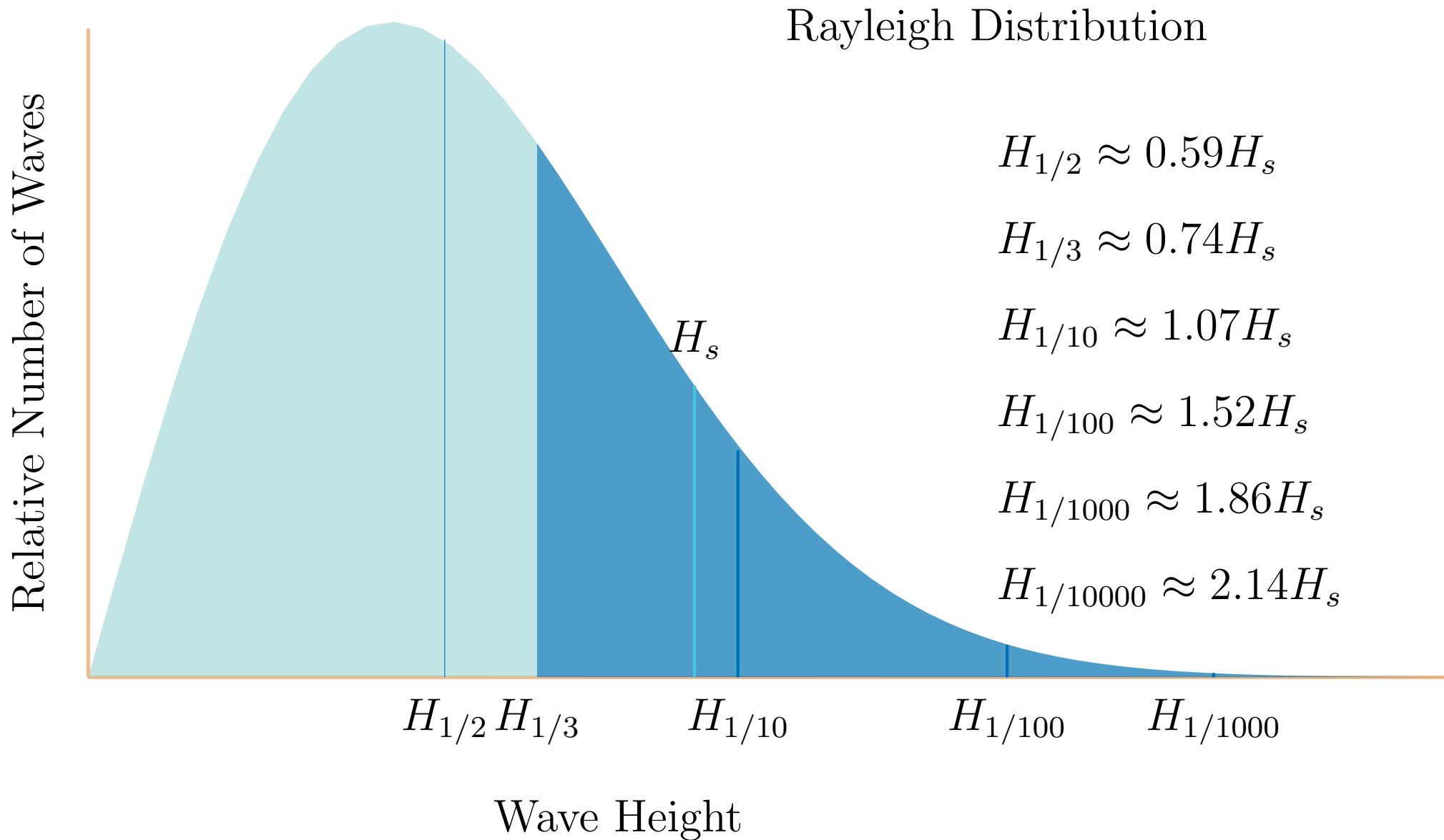
Significant Wave Height (H_s)

- FFT applied by processor onboard the buoy to generate spectral density $S(f)$

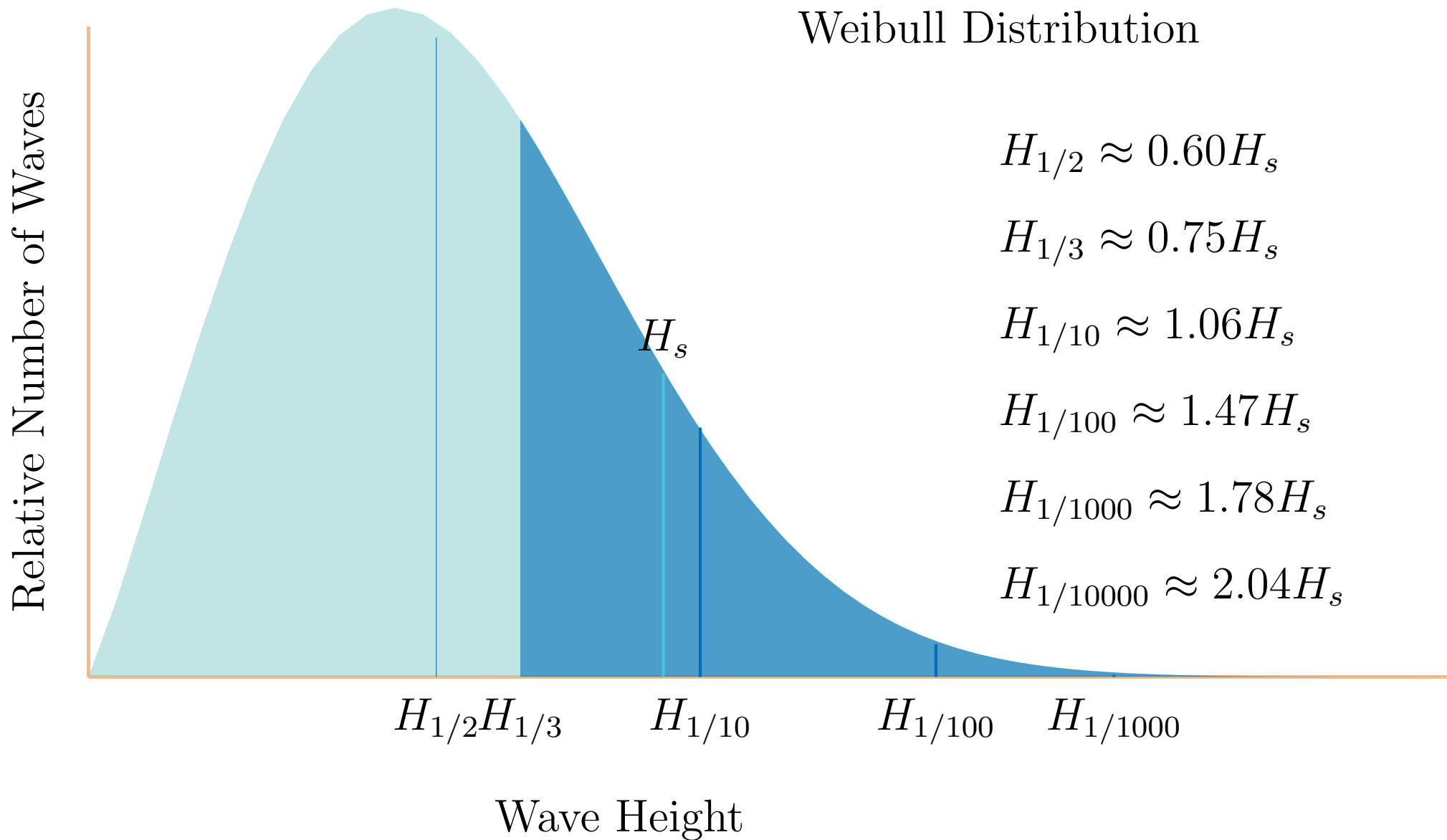
$$H_s \approx 4 \sum_{f_\ell}^{f_u} S(f) (\text{band width}(f))$$

- **What a “trained observer” would estimate.**

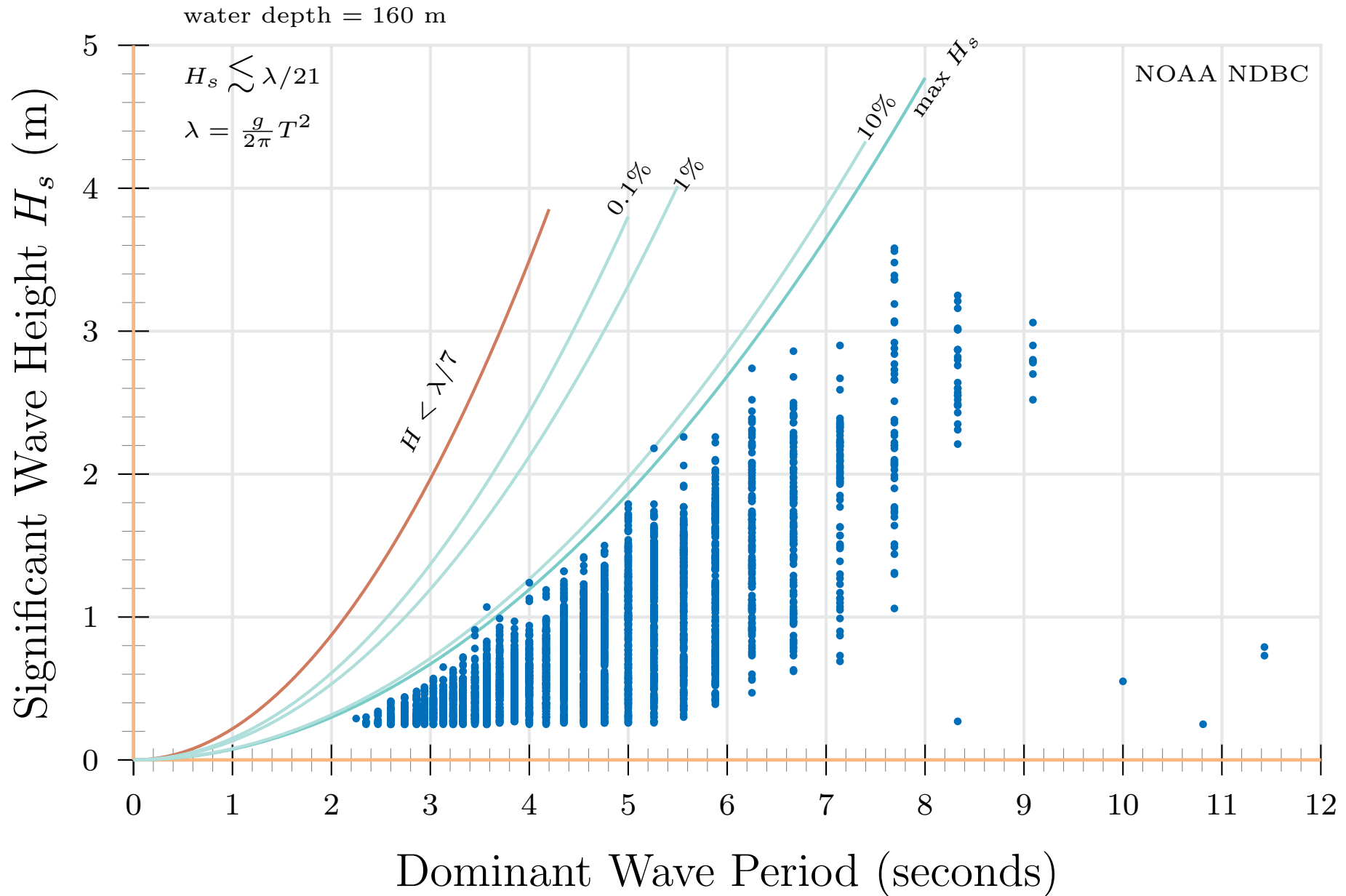
Statistical Distribution of Wave Heights



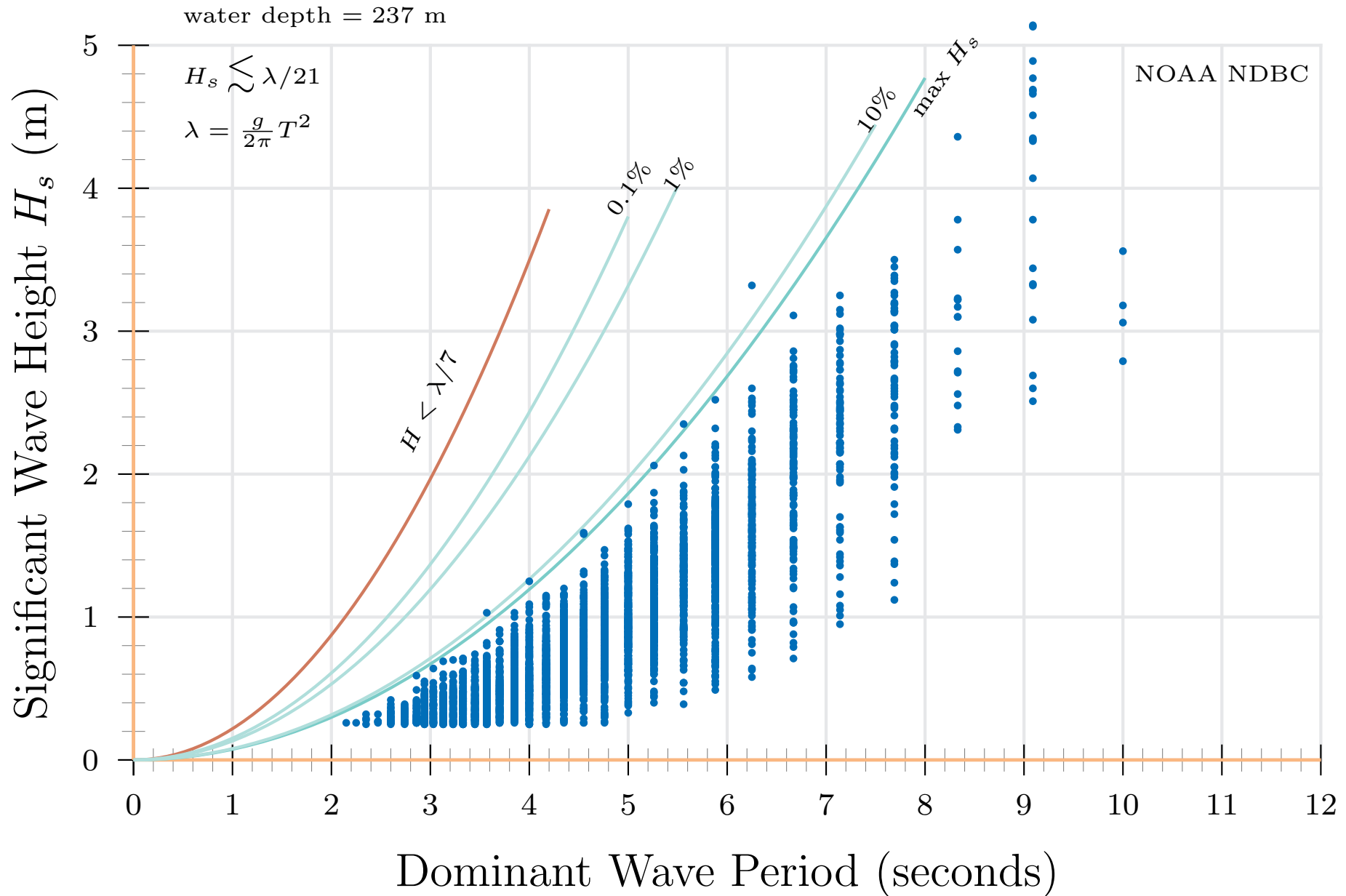
Statistical Distribution of Wave Heights



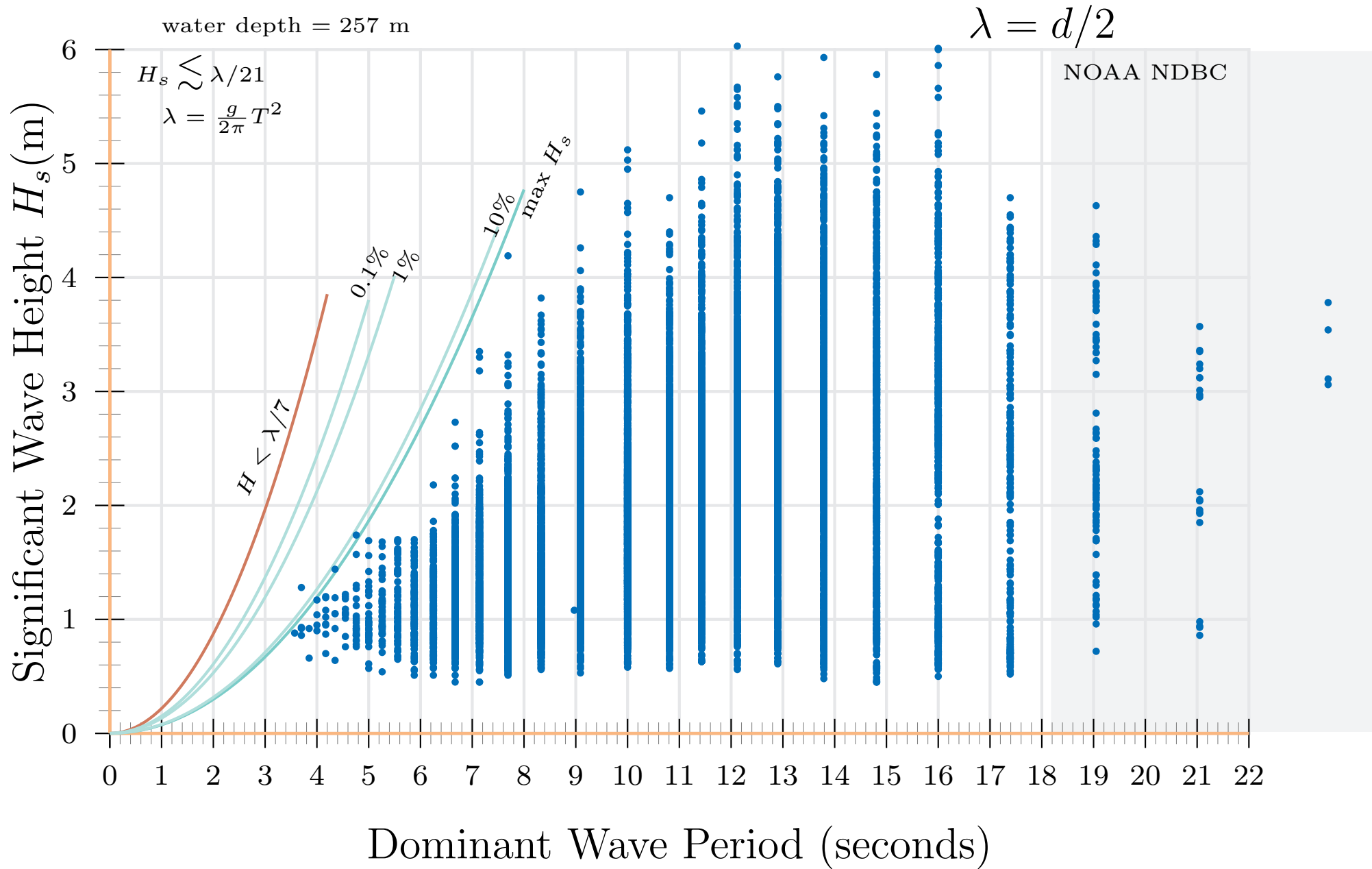
Lake Michigan Buoy 45007 (2016)



Lake Superior Buoy 45004 (2016)



Neah Bay Buoy 46087 (2016)



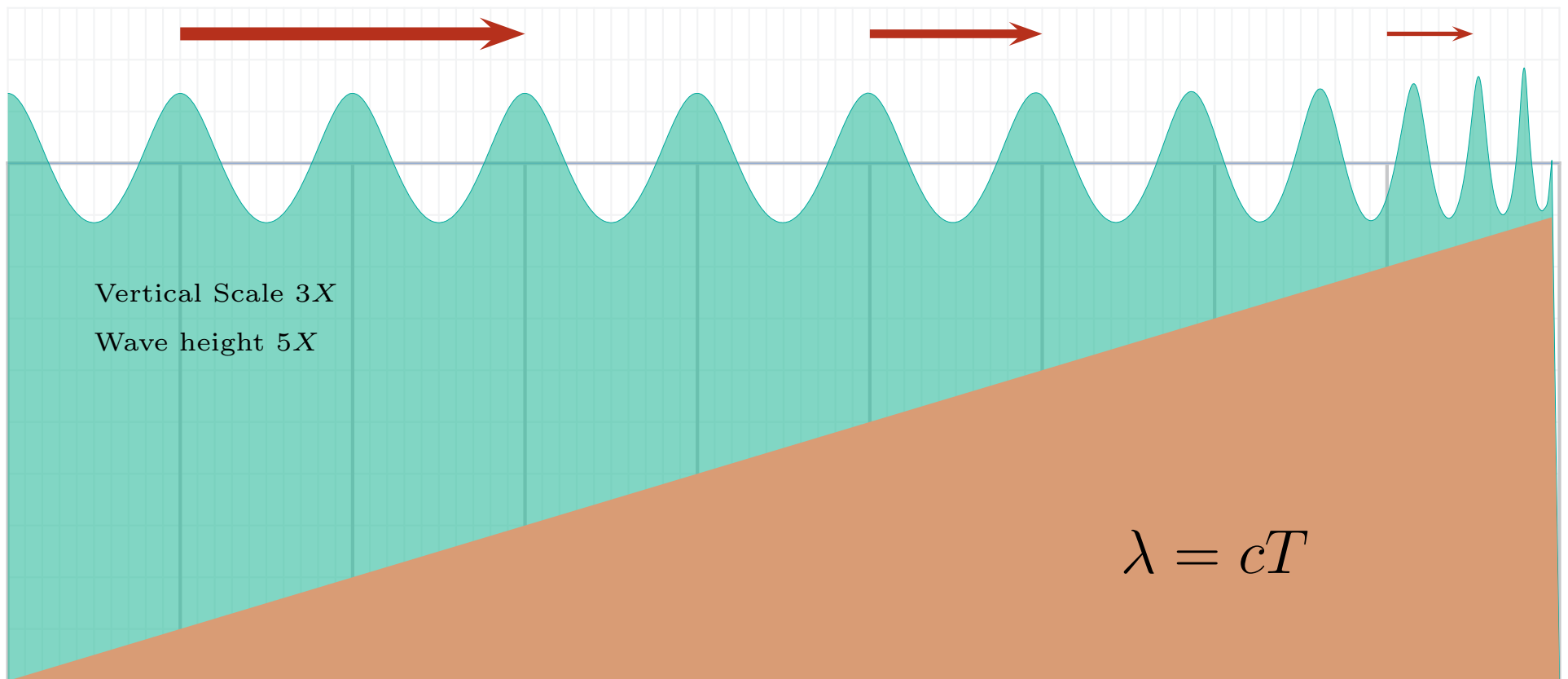
Shoaling and Breaking



Image Credit: Andrew Schmidt

Shoaling

Waves slow down, decrease in wavelength, and increase in height when entering shallow water.



Breaking Waves

As waves enter shallow water they slow down, bunch together, build in height, and break.

Breaking conditions:

- $H \approx \frac{1}{7}\lambda$ (deep water)
- $d \approx 1.8H$ (shallow water)



Image Credit: Scott Fairty

How a wave breaks depends on the wavelength and the steepness of the ocean or lake floor.

Regimes

