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Wave Theory – and Practice

Waves can be the most beautiful and the most fearsome aspect of the sea.

The 48-foot fishing vessel Sea Hunter is hidden in the trough of a 15 - 18 foot wave in the Gulf of Alaska. *Official Coast Guard photo courtesy of Coast Guard Cutter Hickory*.

Whether you float above them or dive beneath them, you had better understand them and most certainly respect them.

This column is about that.

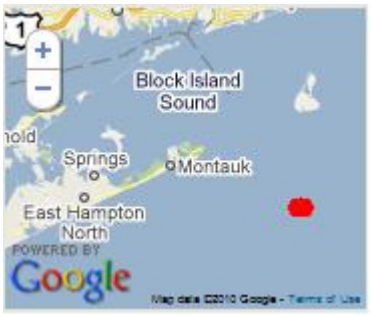
Winds Are Known From Whence They Blow, Currents By Where They Go
A northerly wind means a wind FROM the north, thus blowing you south. A northerly current means a current heading TO the north, setting you in the same direction – north. What does that have to do with waves? Largely, waves are the off-spring of the wind. Ignoring for the moment that wave action can be created by tidal forces sluicing through a narrow channel (Mastering the Inlet, *Atlantic Maritime*

Academy, 12/12/07), waves are created by the wind. When the water is fairly still, as you'll often see early in the morning, and the wind starts to pick up, those little over-lapping wavelets, called the Cat's Paws, will eventually build into something significant. The greater the distance that the wind has blown over the water unhindered by land (called its "Fetch"), the greater the size of the waves. If you ever wondered why mariners for centuries have feared Cape Horn at the bottom of South America, it is because the "fetch" there is essentially infinite. Wind can blow continuously, unimpeded by land, around the entire planet in the space between Cape Horn and Antarctica. Again. Again. And again. 100' waves are not uncommon…

Packing a Punch

The "sea state", which can be characterized as the sum of the height, frequency and direction of waves, is the key to understanding comfort – and safety – of any passage over the water, even more so than the strength and direction of the wind. Anyone that has ever been caught in 6' seas that are but 6 seconds apart in frequency would gladly trade them for 10' waves that are 30 seconds apart. The first is a kidney-busting beating; the latter is a sleigh ride. Of boats that sink at sea, slightly more than 1 in 20 of them sink because they break apart from the pounding of the waves upon the hull (We're Sinking!, *Atlantic Maritime Academy*, 12/13/06.) BTW, for very different reasons, four times as many boats sink at their dock than sink at sea (Where Boats Sink, *The Daily Boater*, 8/21/06.)

So, I'm Heading Out To Sea – How Are the Waves?



"buoy44017: 4.3 ft @ 5.9 sec - 10:00pm"
(typical text message to my cell phone)
Courtesy GoogleMaps.

One of the unsung heroes of our maritime services is NOAA (www.noaa.gov) and their National Ocean Service (http://oceanservice.noaa.gov). They, along with the Army Corps of Engineers, understand how important wave action is and maintain 70 wave-gauging stations placed around the coastline of the U.S. (including the Great Lakes) collecting data on wave height and direction in near-shore areas. Now you can get an hourly update from these stations, direct to your cell phone. I get Buoy #44017, which is 23 nautical miles southwest of Montauk. Go to http://www.buoyalarm.com/ to find the buoy or buoys you want to monitor. Oh, and it is your favorite price. Free.

"Surf Happens" – But How Do I Gauge It?

For the more scientifically inclined, the energy within a wave is proportional to the square of the wave's height. Like many things in nature, a 4' wave isn't four times as powerful as a 1' wave. Four-foot seas are 16 times as energetic as one-foot seas, all else being equal. How much energy is in one of those 100' "grey beards" passing by Cape Horn, compared to a 4' wave in Moriches Inlet? Do the math. Not 25 times more powerful (100' / 4') but 625 times more powerful! (100 squared / 4 squared)

But things are rarely equal. A long, slow, four-foot sea is one of life's great pleasures as sea. What matters is how close together and how steep those waves are. A good way to compare waves for steepness is the wave height divided by the square of the frequency period. This is essentially how fast your sleigh ride is going to be – or the beating you are going to take. Halving the frequency period (from, say, 10 seconds to 5 seconds) of a wave quadruples the acceleration of your sleigh ride, and more than likely multiplies the sea sickness aboard the boat (Mal de Mer - Oh! My Stomach!, *Atlantic Maritime Academy*, 2/21/07.)

Another way to gauge what awaits you at sea is a Severity measurement. This indicates the amount of energy carried by each bit of wave and is proportional to the energy of a wave (the square of its height) divided by its wavelength (how much distance the waves are apart, measured from peak to peak.) As you can probably do in your head, 6' waves that are 6' (distance, not time) apart are more severe than 6' waves that are 12' apart. We don't need the Cray computer for that one…

In a subsequent column, we'll get into different kinds of waves – tsunamis, deep, shallow, non-wind, etc – and the effect they have on mariners. But this column will hopefully get you thinking about safety before you leave the dock.

BTW, if you are interested in being part of USCG Forces, email me at JoinUSCGAux@aol.com or go direct to the D1SR Human Resources department, who are in charge of new members matters, at DSO-HR and we will help you "get in this thing…"