



Tides and Waves

What are Waves?

Most waves are born of the wind and driven by gravity. As wind passes over the water surface, friction prevents the water from flowing along with moving air; instead, water piles up into crests. The wind exerts even more force against the inclined surfaces of the crests and pushes them higher; simultaneously gravity acts to flatten them, resulting in an energy pattern that moves through the water. Individual particles of water move upward into the crests, forward and downward as the crest passes, then backward and upward almost to their original positions as the crest is replaced by a trough.

How does the ocean bottom affect a wave?

Waves begin to touch bottom while still miles from shore. Forward movement of waves is slowed waves bunch up and their crests become steeper. Movement into shallower water tends to align the waves; if a wave approaches the shore at an angle, its leading edge slows in the shallows while its farther reaches catch up, and the entire wave tends to bend until it approaches the shore head on. Thus, a long-term effect of wave action is to straighten a shoreline.

As water becomes shallower, circular movement of the wave becomes difficult. Meanwhile, gravity acts constantly to level the wave, and soon there is not enough returning water available to fill in the crest and maintain the symmetrical shape of the swell; the waves steepen and assume a peaked, rather than rounded, shape. The wave becomes so unstable that it breaks.

What is the white foam of waves?

The unsupported top of the wave crest falls forward, entrapping air bubbles to produce the white foam that is characteristic of breakers. The wave flattens and makes its last headlong rush up the surface, ultimately ending with a line of thin, foamy wash.

Winter and Summer Waves:

The strength of wind affects the shape of waves. A steep, plunging storm wave strips much sand from the beach as it returns to sea. The stronger winds and more frequent storms of winter produce waves that are generally higher and closer together.

Although winter waves are stronger than those of summer, only finer sand grains are carried into the sea. Often the backwash of the breaking waves carries sand seaward into the breaker zone, where sediment is deposited in the form of offshore bars; this slows the advance of waves.

Spring puts the erosion process into reverse; lower, slower waves ease sand from the offshore bars back onto the berm; as summer progresses, the bars move closer to shore, diminished and sometimes completely removed.

Although every winter storm brings apparent destruction of the shoreline, the seasonal variations are natural consequences of the dynamic equilibrium between the beach and sea.

What is the longshore current?

The longshore, or littoral, current is generated by waves that approach at an angle; they transport sand from one end of a beach to another. Sand is carried until the longshore current is slowed or deflected by inlets, bars, headlands, or man-made structures such as jetties. Then the sand begins to settle and accumulate.

How many waves strike the beach on an average day? 14,000.

What is a tide? Tides are the grandest waves of all.

Period of tide: 12 hours, 25 minutes.

Wavelength of tide: half the circumference of the earth.

High & low tide: crest and trough of the tide.

What causes tides?

Gravitational pull of the moon and sun causes tides. Gravity is an attraction between two masses. The moon, being closer, exerts greater force, pulling toward it the water on the nearer side of the earth.

Visualize an earth completely covered with water, spinning on its axis. As the moon orbits around the earth, the part of earth directly opposite the moon will be pulled by the moon's gravity, and the water will bulge away from the earth toward the moon.

The spinning motion of the earth-moon pair creates what is known as centrifugal force, which causes the water on the earth farthest away from the moon to also bulge out, away from the earth's surface. The gravitational pull of the moon and the centrifugal force modify one another, and a bulge of water will occur on the side of earth facing the moon and on the side farthest away from the moon.

How many tides are there each day?

Because the earth revolves completely around on its axis every 24 hours and 50 minutes, every spot on earth will experience both types of bulges within that 24-hour period. The bulges are called lunar tides; the peaks are the high tides, and the troughs are the low tides.

Where does the water go when the tide is out?

The water does not really go anywhere. The sea level rises and falls as the tidal wave passes through it, but the water itself does not move horizontally except where the sea is contained in narrow inlets, for only in such places are tidal currents produced. The sea ebbs and flows on the shore simply because its own level goes up or down, like the water in a bathtub when you get in or out, except that here it is the moon, and to a lesser extent, the sun that make the disturbance.

What is a spring tide?

The moon orbits the earth once every 27.5 days (a lunar month) and in the course of its orbit the moon is in a different position relative to the sun daily. At the time of the new moon and full moon, the sun, the earth, and moon are in a direct line with one another and the combined pull causes extra high and extra low tides; these are called spring tides.

What is a syzygy?

Twice a month the earth, moon and sun are aligned, causing a syzygy. The sun's gravitational pull adds to that of the moon; this causes a higher-than-usual high tide (spring tide) and a lower-than-usual low tide.

What is a neap tide?

When the moon, earth and sun form a 90-degree angle, the gravitational bulge produced by the sun occurs in the trough of the lunar tides, diminishing both the high and low tides by about 20%; this is a neap tide.

What is a perigee?

Because the moon's orbit around the earth is an ellipse, about once a month (every 27.55 days) the moon is at its closest point to earth and the ocean's lunar bulges are accordingly somewhat higher than normal.

What is a perigean spring tide?

Occurring at least once every 6 months, these are normally the highest tides of the year and often coincide with the most destructive storms (i.e., the Ash Wednesday storm of 1962)

How much does the tide vary?

There is considerable tidal variation on earth. The geographical position, shape of the ocean basin, and a host of other local, global, and planetary factors act to modify the tides.

By: Patsy D. King, 1987 Intern, N.C. Maritime Museum