Our Ocean Backyard—*Santa Cruz Sentinel* columns by Gary Griggs, Director, Institute of Marine Sciences, UC Santa Cruz.

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Why huge waves?

There are certain things in this world that both fascinate and also frighten many of us. Our individual lists may differ somewhat, but might include things like sharks, black widows, mountain lions, rattlesnakes, earthquakes, tsunamis, huge waves, and probably a whole lot of others.

There are a group of surfers that have no fear of big waves, however, and in fact they keep a close watch at the surf websites and actually search for the opportunity to surf the biggest waves out there. There now are a handful of places scattered around the planet that have been recognized as having the right bottom topography to create massive waves under the right set of oceanographic conditions.

Some of these places now have regular contests (Mavericks, Jaws, and Nelscott Reef, to name a few), which choose the contestants in advance and send them an invitation. The invites are then put on notice every year that the contest may open within a day or two and they need to be ready to show up and surf on virtually a few days notice. I have to say it's an interesting way to plan your yearly schedule.

Another surfing spot on the list of exceptionally large waves is Cape Nazaré, Portugal, which for now holds the record for the largest wave ever ridden. In November of 2017, Brazilian surfer Rodrigo Koxa successfully rode a wave that was determined by judges to be 80-feet high. This topped the existing record of a 78-foot high wave ridden by Garrett McNamara in 2011, also at Cape Nazaré.

A year ago, on January 18, 2018, 32 year old Maya Gabeira, also from Brazil and also at Cape Nazaré, Portugal, captured the world record for the largest wave ever ridden by a woman at 68-feet high. These are some amazing athletes and a look at any of the on-line videos will probably instantly give you the sense that this sport isn't for the fainthearted or for those with fear of heights.

We do have buoys out there that routinely measure waves, but for these world surfing records it's the determination made by human observers, who look at the videos and photographs and try to agree on a height. If you watch the on-line videos of any of these record-setting rides you will get some idea of how difficult this might be to agree on.

To generate waves 70 or 80 feet high requires a unique set of conditions that don't occur often or at many places. Ultimately, the size of the waves we see breaking along the coast is dependent on the amount of energy transmitted to the ocean by the wind during some distant storm.

It's the combination of the length of time the wind blows, the wind speed, and the distance over the ocean surface that it blows that determine the size of the resulting waves. In order to generate really big waves, we need to have high velocity wind (at least 40 to 50 mph) persisting for an extended period of time (36-48 hours) over vast stretches of ocean (500 to 1000 miles). While you can get very small waves by blowing into your coffee cup, modest size waves in a pond or a lake, it takes a big ocean, like the Pacific, to crank up really large waves.

There's actually something else besides the wind that affects wave size, however, which is why the same storm may produce 50-foot waves at Mavericks, 15-foot waves at Steamer Lane, and 6-foot waves at Cowells. Why the difference?

The bottom topography is the other big factor affecting how high those waves can get as they approach the coast. As a wave enters shallower water, the underwater portion of the wave begins to feel the drag of the seafloor. This starts to slow down the deeper portion of the wave but also begins to compress the wave form so that it increases in height as it enters shallower water. Where rock outcrops on the seafloor and the depth changes or gets shallow over a short distance, the waves will undergo a sudden increase in height.

This same rock outcrop may form an isolated mound on the seafloor such that the portion of the wave passing over this high area will increase in height and slow down, while the portion of the wave to either side will refract or bend around the rock outcrop or reef, thereby converging wave energy. Waves will thus wrap around these high areas on the seafloor, concentrating energy and producing higher waves at these locations. Mavericks is a unique location where the water gets shallow very quickly and the waves also wrap or bend around this steep rock outcrop, producing very huge waves under the right conditions.

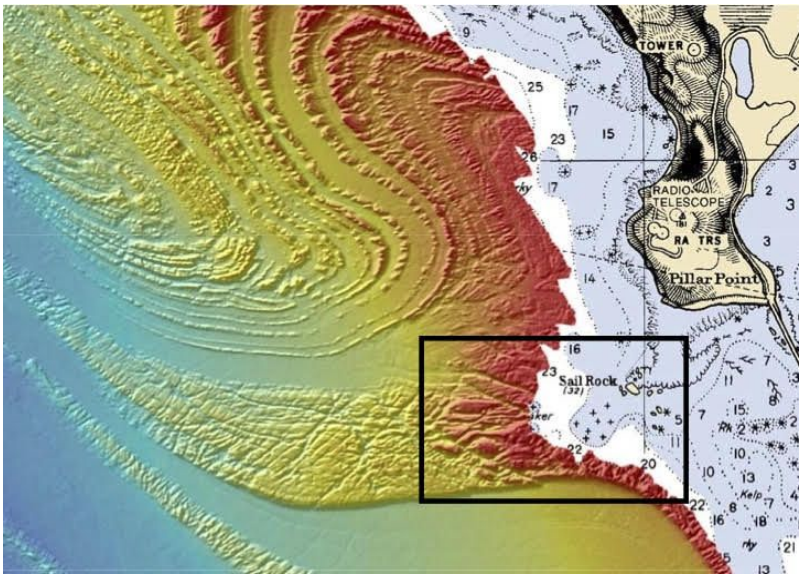

Photo credit: CSUMB Seafloor Mapping Lab